18.0 HUMAN FACTORS ENGINEERING

18.2 Element 1: Human Factors Engineering Program Management

18.2.3 Results

18.2.3.1 Summary of Technical Information

The applicant added APP-OCS-GBH-001, Revision 0, "AP1000 Human Factors Engineering Program Plan," issued January 2008 (hereafter referred to as the AP1000 HFE Program Plan), as a reference in Section 18.2.6.1 of the design control document (DCD) to establish completion of Combined License (COL) Information Item 2-1. In Technical Report (TR)-90 (APP-GW-GLR-090, Revision 0, "Strategy for the Closure of the AP1000 Design Control Document, Chapter 18, 'Human Factors Engineering (HFE) COL Information Items,'" issued February 2007), the applicant stated that the HFE Program Plan captures the technical content discussed in DCD Section 18.2. TR-90, which provides additional details and describes implementation methods for incorporating HFE into the AP1000 design process, is designed to serve as an implementation manual for the engineering staff.

18.2.3.2 Staff Evaluation

The staff determined that this additional reference is consistent with Revision 15 of the AP1000 DCD. It describes the scope of the HFE program in terms of each of the elements identified in NUREG-0711, "Human Factors Engineering Program Review Model," issued February 2004. The reference also describes the processes used to incorporate HFE into the AP1000 design process.

18.2.3.3 Conclusion

The staff concludes that this change does not affect the conclusion in Section 18.2.4 of the AP1000 final safety evaluation report (FSER) (see NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," issued September 2004). The AP1000 HFE Program Plan continues to implement NUREG-0711 guidelines.

18.2.5 Evaluation of COL Information Item 18.2-1 (no comparable FSER section)

18.2.5.1 Summary of Technical Information

COL Information Item 18.2-1 states the following:

> The COL applicant referencing the AP1000 certified design is responsible for the execution of a Nuclear Regulatory Commission (NRC)-approved HFE Program.

In DCD Revision 17, the applicant stated:

> [The] AP1000 Human Factors Engineering Program Plan fully captures the information certified in Section 18.2 and provides execution guidance for the NRC-approved HFE Program. The ongoing confirmation that the AP1000 HFE Program Plan is being executed as required is demonstrated by fulfillment of the other COL Information Items in Chapter 18. The final confirmation that the HFE

Program Plan has been executed will be demonstrated by completion of the ITAAC [Inspections, Tests, Analyses and Acceptance Criteria] (Tier 1 Material, Table 3.2-1, Items 1 to 13).

18.2.5.2 Evaluation

From a program overview perspective, the applicant used Revision 17 to document changes in the status of a number of COL information items and ITAAC. TRs provided for staff review describe the supporting documentation. When the TRs indicate that partial progress has been made and additional work to address information items is ongoing, the staff evaluated redundancy between the COL information item and the ITAAC. If the staff identified redundancy, then the COL action item was closed. In all cases, the review ensured that final design product completion was appropriately tracked. The staff identified all documents used to conclude that the NUREG-0711 criteria were satisfactorily implemented, and Westinghouse docketed the documents.

With respect to COL Information Item 18.2-1, the staff determined that the information item is closed based on the following:

(1) The AP1000 HFE Program Plan is consistent with AP1000 DCD, Revision 15. It describes the scope of the HFE program in terms of each of the NUREG-0711 elements. It provides additional information on where and how the overall design process should use HFE guidance and, thus, provides reasonable assurance that the applicant will implement and undertake the required HFE activities for the AP1000 design at the most appropriate time in the project schedule. This program element requires no additional product development.

(2) COL information items in other sections and the ITAAC listed in Table 3.2-1 address specific HFE design products that require completion. Retaining this generic information item is redundant with the remaining open information items and ITAAC.

(3) ITAAC Table 3.2-1, Item 5, requires the applicant to perform the HFE verification and validation (V&V) program. This includes five specific tasks that validate and verify HFE program implementation and concludes with an evaluation of the implementation of the plant HFE/human-system interface (HSI) requirements as designed at the time of plant startup. This latter action will provide better verification of field implementation than the verification that would be accomplished under this COL information item.

18.2.5.3 Conclusion

The staff concludes that COL Information Item 18.2-1 is redundant to existing ITAAC included in Tier 1, Table 3.2-1. Consequently this COL information item is closed. ITAAC Item 5 will verify the execution of the NRC-approved HFE program.

18.2.6 Evaluation of COL Information Item 18.2-2 (no comparable FSER section)

18.2.6.1 Summary of Technical Information

COL Information Item 18.2-2 (Revision 17) states the following:

Specific information regarding the location of the emergency operations facility and emergency operations facility communications will be provided by the Combined Operating License applicant to address the Combined License information requested in this subsection.

18.2.6.2 Evaluation

The applicant stated in TR-134 (APP-GW-GLR-134, Revision 4, "AP1000 Standard COLA Technical Report," issued March 2008), that TR-136 (APP-GW-GLR-136, Revision 1, "AP1000 Human Factors Program Implementation for the Emergency Operations Facility and Technical Support Center," issued October 2007) partially addresses the information requested by this information item. In TR-136, the applicant described the method used to apply the AP1000 HFE Program Plan to technical support centers (TSCs) and emergency operations facilities (EOFs) used to support AP1000 plants and stated that the COL applicant has overall responsibility for the human factors adequacy of the TSC and EOF. In APP-OCS-GGR-110-P, Revision 1, "AP1000 Technical Support Center and Emergency Operations Facility Workshop," issued February 2008, the applicant described in detail how it derived the information in TR-136.

In TR-136 and subsequently in AP1000 DCD Amendment 17, the applicant made changes to this COL information item that deleted HFE design responsibilities that were included in the previously approved COL information item in Revision 15 of the DCD. In response to RAI-SRP18-COLP-21 (Westinghouse letter DCP/NRC 002577; July 31, 2009), the applicant removed EOF and TSC location requirements and added responsibilities for EOF and TSC human factors attributes.

Deletion of location requirements is acceptable because the HFE design is not dependent on location. The location of the EOF and TSC is subject to regulatory guidance. This is addressed in Chapter 13.3, "Emergency Planning," of this SER.

Addition of responsibility for defining EOF and TSC human factors attributes is consistent with the intent of the original, approved COL information item and ensures that HFE design outside the scope of the AP1000 DCD is addressed. Inclusion of the RAI response into Revision 18 of the DCD is tracked as **Confirmatory Item CI-SRP18-COLP-21.**

From the program description provided in TR-136 and APP-OCS-GGR-110-P, the NRC staff noted a well-structured and disciplined assessment of the HFE requirements applicable to the TSC and EOF. The following examples demonstrate how the applicant used the AP1000 HFE Program Plan and appropriate regulations to identify the HFE design requirements of the TSC/EOF:

- Westinghouse and utility personnel worked together to identify the functional requirements for the TSC/EOF. The diverse experience in this group supported a thorough evaluation.

- Westinghouse extracted specific requirements from the AP1000 DCD; the AP1000 HFE Program Plan; NUREG -0711, Revision 2; NUREG-0696, "Functional Criteria for Emergency Response Facilities," issued February 1981; and NUREG-0654, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," issued March 2002. These documents serve as the basis for identifying the TSC/EOF functional requirements. Identification of functional requirements is one of the basic steps required in the AP1000

HFE Program Plan and NUREG-0711. APP-OCS-GGR-110-P provides complete documentation of how Westinghouse identified applicable functions.

- Westinghouse and utility representatives conducted an operating experience review (OER). Application of lessons learned from operating experience is one of the basic steps required in the AP1000 HFE Program Plan and NUREG-0711.

- Westinghouse completed a task analysis incorporating OER results, observations from emergency plan drills at V.C. Summer and Harris nuclear sites, input from emergency procedures from four different utilities, and review comments from both Westinghouse and utility personnel. In TR-136, the applicant stated that it will capture the requirement for this task analysis in the Operational Sequence Analysis-2 (OSA-2) implementation plan. A task analysis is one of the basic steps required in the AP1000 HFE Program Plan and NUREG-0711, and OSA-2 incorporates accepted methods for performing task analyses.

- In accordance with TR-136, Section 2.4.4, Westinghouse has identified applicable HSI design guidelines from the AP1000 HSI design guidelines (APP-OCS-J1-002, Revision 0, "AP1000 Human System Interface Design Guidelines") to promote the human factors design adequacy of the TSC/EOF design. This ensures that standard HSI design requirements will be applied to the appropriate elements of HSI design.

- EOF/TSC HFE design elements outside the AP1000 scope are addressed via a COL information item. This provides reasonable assurance that a complete HFE design will be achieved for these emergency facilities.

Based on the activities outlined above, the applicant's use of a tailored approach in applying the AP1000 HFE program to the TSC/EOF is solidly based on NUREG-0711. However, the applicant has not finished documentation of the TSC and EOF task analysis results as described in the implementation plan. In addition, the staff has written RAI-SRP18-COLP-18, which asks the applicant to provide summary report results for the OSA-2 analysis of the EOF/TSC. The staff has created Open Item OI SRP18 COLP 18 to track the response from Westinghouse.

18.2.6.3 Conclusion

The applicant has developed a sufficient basis for applying a tailored HFE program to the TSC/EOF but has not finished documentation of the TSC and EOF task analysis results. (**OI-SRP18-COLP-18**) The revised COL Information Item 18.2-2 accurately communicates the COL applicant's responsibility for HFE design of the EOF and TSC. **Confirmatory Item CI-SRP18-COLP-21** tracks the revision of the DCD to reflect the revised COL information item.

18.2.7 Evaluation of Tier 1 Information—Design Commitment 3, ITAAC Table 3.2-1 (DCD Revision 15)

18.2.7.1 Summary of Technical Information

ITAAC Design Commitment 3 reads as follows:

Design Commitment: The HSI design is performed for the operation and control system (OCS) in accordance with the HSI design implementation plan.

Inspection, Tests, and Analyses: An evaluation of the implementation of the HSI design.

Acceptance Criteria: A report exists and concludes that the HSI design for the OCS was conducted in conformance with the implementation plan and includes the following documents:

- Operation and Control Centers System Specification Document
- Functional requirements and design basis documents for the alarm system, plant information system, wall panel information system, controls (soft and dedicated), and the qualified data processing subsystems
- Design guideline documents (based on accepted HFE guidelines, standards, and principles) for the alarm system, displays, controls, and Anthropometrics
- Design specifications for the alarm system, plant information system, wall panel information system, controls (soft and dedicated), and the qualified data processing subsystems
- Engineering test report document summarizing outcomes of each man-in-the loop engineering test iteration performed to support HSI design

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.2.7.2 Evaluation

The staff did not find a one-to-one correlation between the list of completed documents in TR-82 (APP-GW-GLR-082, Revision 0, "Execution and Documentation of the Human System Interface Design Implementation Plan," issued May 2007) and the AP1000 DCD, Tier 1, ITAAC Table 3.2, Design Commitment 3, acceptance criteria. Design documents were not identified for the following areas:

- functional requirements and design-basis documents for the plant information system
- functional requirements and design-basis documents for controls (soft and dedicated)
- functional requirements and design-basis documents for the qualified data processing subsystems

RAI-SRP18-COLP-05 requested clarification of the discrepancy. The applicant's response (Westinghouse letter DCP/NRC2141 of May 28, 2008) indicated that terminology changes resulted in the inclusion of the areas listed above in the "Distributed Control and Information System" (APP-OCS-J1-010, "AP1000 Display System Functional Requirements"). The staff

found that this document contains the functional requirements and design-basis information for the systems listed above. The staff concluded that this change was limited to renaming and reorganizing information to improve clarity and did not affect the intent of the ITAAC.

The staff also found that the applicant had not completed all the design specifications listed in the ITAAC acceptance criteria. While there were completed specifications for systems not listed, the staff determined that, at a minimum, design specifications for systems listed in the ITAAC must be completed to close the ITAAC. The staff identified this as **Open Item OI-SRP18-COLP-01A**.

The staff reviewed the completed documents referenced in TR-82, along with the information provided in the RAI, and concluded that these documents appropriately implement the HSI design implementation plan, as described in AP1000 DCD, Revision 17. Clarity was consistently good across the procedural hierarchy, and the specificity of design requirements had increased in the transition from the functional design level to design specifications. These procedures provide reasonable assurance that the design process will effectively implement standardized HFE design requirements.

18.2.7.3 Conclusion

The staff concludes that the proposed change to delete Design Commitment 3 of the ITAAC is supported by the quality of the documents being written but is not ready for closure until all design specifications listed in the acceptance criteria have been completed as tracked by **OI-SRP18-COLP-01A**.

18.5 Element 4: Task Analysis

18.5.3 Evaluation of Operational Sequence Analysis-2 Implementation Plan and Results Summary

18.5.3.1 Summary of Technical information

In AP1000 DCD, Revision 17, the discussion of OSA-2 deleted the description of a specific theoretical model for evaluating operator workload measures, but still committed to conducting an evaluation of the effect of the HSI design and the task demands on operator workload. In TR-81 (APP-GW-GLR-081, Revision 1, "Closure of COL Information Item 18.5-1, Task Analysis," issued May 2007) and in the RAI-TR81-COLP-01 response dated January 29, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML080320212), Westinghouse indicated that APP-OCS-J1R-210, "AP1000 Operational Sequence Analysis (OSA-2) Implementation Plan," would identify the most appropriate task analysis methods to use.

18.5.3.2 Evaluation

The staff reviewed the OSA-2 implementation plan (APP-OCS-J1R-210), which describes the applicant's methods for analyzing the collected sequence information needed to satisfy the four issues addressed in the DCD: (1) completeness of available information, (2) time to perform tasks, (3) operator workload analysis, and (4) operational crew staffing. The staff concludes that it is acceptable to remove the prescriptive language from the DCD because the applicant provided a robust implementation plan containing detailed information describing how to

conduct an OSA analysis, the tasks that should be part of the analysis, and the expected results from the analysis.

The staff also reviewed APP-OCS-J1R-220, "AP1000 Operational Sequence Analysis (OSA-2) Summary Report," which describes the results of conducting the activities described in the implementation plan. Based on its review of the implementation plan and the summary report, the staff has determined that sufficient information exists to address the NUREG-0711 review criteria as described in the COL closure section below.

18.5.5 Evaluation of COL Information Item 18.5-1 (FSER Item 18.5.3-3)

18.5.5.1 Summary of Technical Information

COL Information Item 18.5-1 (FSER Item 18.5.3-3) states the following:

> The staff reviewed the applicant's task analysis at an implementation plan level of detail; finished products to complete the element were not available for review, but the methodology for conducting a complete task analysis was evaluated. The COL applicant will use this methodology to conduct a complete HFE task analysis after design certification.

The applicant submitted TR-81 as a basis for closing this information item. The report recommends a revision to Tier 1 of the DCD ITAAC to reflect completion of the AP1000 function-based task analysis and provides a basis for closure of COL Information Item 18.5-1. The applicant also provided the OSA-2 implementation plan, which describes the methodology used to conduct the second round of OSA.

18.5.5.2 Evaluation

The staff evaluated the information provided by the applicant in the OSA-2 implementation plan and the OSA-2 summary report against NUREG-0711, Revision 2.

NUREG-0711, Section 5.4(1), states Criterion 1 as the following:

> The scope of the task analysis should include the following:
>
> - selected representative and important tasks from the areas of operations, maintenance, test, inspection, and surveillance
> - a full range of plant operating modes, including startup, normal operations, abnormal and emergency operations, transient conditions, and low-power and shutdown conditions
> - Human Actions (HAs) that have been found to affect plant risk by means of PRA importance and sensitivity analyses should also be considered risk-important
> - where critical functions are automated, all human tasks, including monitoring of the automated system and execution of backup actions if the system fails

Evaluation of Criterion 1

[

]^{a,c} The inclusion of representative and important tasks from the areas of operations, maintenance, test, inspection, and surveillance during OSA-2 implementation satisfies the requirements in the first bullet of NUREG-0711 Criterion 1.

[

]^{a,c} The inclusion of these tasks within the scope of the task analysis implementation plan satisfies the requirements of the second bullet of NUREG-0711 Criterion 1.

As described in the AP1000 DCD, the applicant performed OSA-2 for a representative subset of tasks including risk-important human actions, risk-important tasks, and tasks that have human performance concerns. [

]^{a,c} The identification and inclusion of these risk-important tasks within the scope of the OSA-2 implementation plan satisfies the third bullet of NUREG-0711 Criterion 1.

[

]^{a,c}

The staff has determined that the scope of the task analysis is consistent with NUREG-0711 Criterion 1.

NUREG-0711, Section 5.4 (2), states Criterion 2 as the following:

> Tasks should be linked using a technique such as operational sequence diagrams. Task analyses should begin on a gross level and involve the development of detailed narrative descriptions of what personnel have to do. The analyses should define the nature of the input, process, and output needed by and of personnel.

Evaluation of Criterion 2

Consistent with the NUREG-0711 criterion, the applicant used the operational sequence diagram methodology to conduct two rounds of analysis. [

]^{a,c}

The staff reviewed the OSA-1 report titled "AP1000 Operational Sequence Analysis (OSA) Summary Report," Revision 0, and the implementation plan for OSA-2, APP-OCS-J1R-210. These reports describe the applicant's methods for analyzing the collected sequence information needed to satisfy the four issues identified in the DCD:

(1) Completeness of information: Establish the necessary information for successful task performance. The results of this analysis feed into the interface design process to ensure necessary information is available to the operator performing the task activities.

(2) Time to perform tasks: Establish that the operators will be able to complete tasks within the time available. This information is based on assumptions about the time required to access displays, select and actuate controls, etc. The OSA-2 summary report discusses that the generally acceptable range of "good" or appropriate operator workload is between 50 and 80 percent. A workload greater than 80 percent indicates a potential overload, while a workload less than 50 percent indicates a potential underload.

(3) Operator Workload: Establish the impact of task requirements and the HSI design on operator workload.

(4) Operational crew staffing: Establish staffing requirements. The results of the operator workload assessment and the identification of time constraints are used to review the adequacy of staffing assumptions, HSI design, task allocation and work organization.

Since the OSA-1 analysis was more general than the OSA-2 analysis, and the information from OSA-1 was used as input into OSA-2, the applicant's task analysis is consistent with NUREG-0711 Criterion 2 that the analysis should begin on a gross level (OSA-1) and become more detailed as the analysis proceeds.

Because of the overlap between Criteria 2 and 3, the staff presents its evaluation of the applicant's task analysis with regard to development of detailed narrative descriptions under Criterion 3 below and addresses the input, process, and output needed by and from personnel.

Based on its evaluation, the staff concludes that the applicant has satisfactorily met NUREG-0711 Criterion 2.

NUREG-0711, Section 5.4(3), states Criterion 3 as the following:

> The task analysis should be iterative and become progressively more detailed over the design cycle. It should be detailed enough to identify information and control requirements to enable specification of detailed requirements for alarms, displays, data processing, and controls for human task accomplishment.

Evaluation of Criterion 3

Westinghouse conducted OSA-1 and OSA-2 and described these analyses in APP-OCS-J1R-120, Revision 0, and APP-OCS-J1R-220, Revision A, respectively. [

]^{a,c} The staff determined that OSA-1 lays the foundation for and describes the tasks that were analyzed during OSA-2. These analyses meet the NUREG-0711 criterion that the task analysis should be iterative and become progressively more detailed over the design cycle, because the task analysis was repeated and OSA-2 is more detailed than OSA-1.

The staff reviewed the task analysis documents to determine whether the task analyses conducted were detailed enough to identify information and control requirements to enable specification of detailed requirements for alarms, displays, data processing, and controls for human task accomplishment. The staff's evaluation addressed the input, process, and output needed by and from personnel (part of Criterion 2 above). [

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Based on its evaluation, the staff concludes that the applicant has satisfactorily met NUREG-0711 Criterion 3.

NUREG-0711, Section 5.4(4), states Criterion 4 as the following:

> The task analysis should address issues such as:
>
> - the number of crew members
> - crew member skills
> - allocation of monitoring and control tasks to the (a) formation of a meaningful job, and (b) management of crew member's physical and cognitive workload.

Evaluation of Criterion 4

Section 2.3.3 of the task analysis implementation plan describes operator workload analysis as an evaluation of the effect of the HSI design and the demands on operator workload. [

]a,c

The staff has concluded that Westinghouse has conducted a thorough task analysis using both OSA-1 and OSA-2 and has described in detail the results from its analysis. The task analysis is considered complete once the remaining MTIS tasks have been analyzed as discussed in section 18.5.8.2 below. The OSA-2 analysis is being conducted in accordance with the implementation plan, which addresses issues such as the number of crew members, crew member skills, and allocation of monitoring and control tasks.

NUREG-0711, Section 5.4 (5), states Criterion 5 as the following:

> 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.

Evaluation of Criterion 5

[

]a,c This approach is consistent with the information described in Revisions 15–17 of the DCD and satisfies NUREG-0711 Criterion 5.

NUREG-0711, Section 5.4 (6), states the following as Criterion 6:

> The task analysis should provide input to the design of HSIs, procedures, and personnel training programs.

Evaluation of Criterion 6

The OSA-1 analysis identified inputs to the HSI design including display requirements, display design constraints, performance time constraints, inventory (alarms, controls, parameters), and display organization and navigation constraints. OSA-2 is performed as part of the design development process to understand the estimated operator workload, performance time estimates, staffing issues, and error potential associated with each task. The staff concludes that, as with OSA-1, the results of OSA-2 provide input to the design of HSIs by providing a set of requirements and constraints on operator task performance.

In Section 18.5.3 of the AP1000 FSER, the staff identified COL Information Item 18.5-1 (FSER Item 18.5.3-2), which states, “The COL applicant will use the information from the

AP1000-specific task analysis in the development of its procedures and training programs." In response to RAI-SRP18.5-COLP-01, the applicant referred to Sections 5.6 and 5.7 of the AP1000 HFE Program Plan (APP-OCS-GBH-001), which describes two documents: APP-OCS-GER-031, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Procedures," and APP-OCS-GER-041, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Training Program." According to Westinghouse's response to the RAI, the purpose of these documents is to [

]^{a,c} However, these documents are incomplete. The staff sent RAI-SRP18-COLP-17 to Westinghouse requesting they provide the necessary information in the documents listed above to close the COL information item.

The staff has determined that the task analysis completed by Westinghouse does provide input to the design of the HSI, but the information regarding input into procedures and training programs is incomplete. Therefore, NUREG-0711 Criterion 6 has not been fully satisfied. The staff is tracking completion of these documents under **Open Item OI-SRP18-COLP-17**.

NUREG-0711, Section 5.4 (7), states Criterion 7 as the following:

> Considerations should be addressed for plant modifications that are likely to affect HAs previously identified as risk-important, cause existing HAs to become risk-important, or create new actions that are risk-important.

Evaluation of Criterion 7

The applicant is not required to address the impact of plant modifications on risk-important HAs because Revision 17 of the AP1000 DCD applies to new plant construction.

18.5.3.3 Conclusion

In its evaluation of Revision 15 of the AP1000 DCD, the staff reviewed the function-based task analysis and OSA-1 results and concluded that the applicant had developed an acceptable task analysis implementation plan to satisfy the NUREG-0711 criteria for task analyses. The COL applicant was expected to use this methodology to conduct a complete task analysis after design certification. (Reference COL Action Item 18.5.3-3.) To close this action item, Revision 17 of the AP1000 DCD referenced additional task analysis documents, which describe an implementation plan for conducting a second operational sequence analysis (OSA-2) and provide a summary report of the OSA-2 results. The OSA-2 implementation plan and OSA-2 summary report focus on risk-important human actions, tasks with high human performance concerns, and on maintenance, testing, inspection, and surveillance activities. Based on its evaluation of Revision 17 of the DCD and the referenced reports, the staff concludes that the applicant has satisfactorily addressed all but Criterion 6 of NUREG-0711, Section 18.5. The staff is tracking completion of Criterion 6 under **Open Item OI-SRP18-COLP-17**.

18.5.6 Evaluation of COL Information Item 18.5-1 (FSER Item 18.5.3-2)

18.5.6.1 Summary of Technical Information

COL Information Item 18.5-1 (FSER Item 18.5.3-2) states the following:

> The COL applicant will use the information from the AP1000-specific task analysis in the development of its procedures and training programs.

In response to RAI-SRP18.5-COLP-01, the applicant referred to Sections 5.6 and 5.7 of the AP1000 HFE Program Plan, which describes two documents (APP-OCS-GER-031, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Procedures", and APP-OCS-GER-041, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Training Program").

18.5.6.2 Evaluation

[

]^{a,c} However, Westinghouse has not completed these documents. The staff requested this information in RAI-SRP18-COLP-17.

18.5.6.3 Conclusion

This COL information item cannot be closed because the documents related to training and procedure development have not been completed, and closure of the COL information item is contingent upon staff review of APP-OCS-GER-031, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Procedures," and APP-OCS-GER-041, "The Incorporation of Human Factors Engineering into the Development of the AP1000 Plant Training Program. The staff is tracking completion of this work under **Open Item OI-SRP18-COLP-17**.

18.5.7 Evaluation of COL Information Item 18.5-2 (FSER Item 18.5.3-1)

18.5.7.1 Summary of Technical Information

COL Information Item 18.5-2 (FSER Item 18.5.3-1) states the following:

> [A] COL applicant referencing the AP1000 certified design will document the scope and responsibilities of each Main Control Room position, considering the assumptions and results of the task analysis.

The applicant submitted TR-52 (APP-GW-GLR-010, Revision 2, "AP1000 Main Control Room Staff Roles and Responsibilities," issued June 2007) as a basis for closing COL Information Item 18.5-2 (FSER Item 18.5.3-1).

18.5.7.2 Evaluation

TR-52 states that the applicant has fully addressed the COL information item. Revision 17 of the DCD incorporates the applicable changes. As described in Section 4.5 of TR-52, the role of the shift technical advisor (STA) for the AP1000 design, including the role of assessing possible

significant plant abnormalities observed during normal operations, is consistent with the typical responsibilities of the STA as listed in NUREG-0737, "Clarification of TMI Action Plan Requirements," issued November 1980.

The staff issued RAI-TR52-COLP-12 asking Westinghouse to further clarify the duties and responsibilities in some key areas, including the RO and STA roles in communication and coordination. In response, Westinghouse submitted "AP1000 COL Responses to Requests for Additional Information," dated November 16, 2007 (ADAMS Accession Number ML073240107), which clarifies the roles and responsibilities of the RO and STA. [

]^{a,c} The OSA-2 implementation plan and the OSA-2 summary report also address MCR responsibilities. These responsibilities are consistent with the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54, "Conditions of Licenses."

18.5.7.3 Conclusion

The staff has determined that TR-52 describes adequate MCR staff roles. The applicant's response to RAI-TR52-COLP-12 addresses each section of the RAI not addressed in TR-52, including specifying how each STA responsibility matches with the list of 12 responsibilities in Appendix C to NUREG-0737. These documents in combination provide sufficient information to close COL Information Item 18.5-2 (FSER Item 18.5.3-1).

18.5.8 Evaluation of Tier 1 Information—Design Commitment 2, ITAAC Table 3.2-1 (DCD Revision 15)

18.5.8.1 Summary of Technical Information

ITAAC Design Commitment 2 reads as follows:

> Design Commitment: The applicant performs a task analysis in accordance with the task analysis implementation plan.
>
> Inspection, Tests, and Analyses: An evaluation of the implementation of the task analysis will be performed.
>
> Acceptance Criteria: A report exists and concludes that function-based task analyses were conducted in conformance with the task analysis implementation plan and include the following functions:
>
> – Control reactivity
> – Control reactor coolant system (RCS) boron concentration
> – Control fuel and cladding temperature
> – Control RCS coolant temperature, pressure, and inventory
> – Provide RCS flow
> – Control main steam pressure
> – Control steam generator inventory
> – Control containment pressure and temperature

– Provide control of main turbine

A report exists and concludes that operational sequence analyses (OSAs) were conducted in conformance with the task analysis implementation plan. OSAs performed include the following:

– Plant heatup and startup from post-refueling to 100% power
– Reactor trip, turbine trip, and safety injection
– Natural circulation cooldown (startup feedwater with steam generator)
– Loss of reactor or secondary coolant
– Post-loss-of-coolant accident (LOCA) cooldown and depressurization
– Loss of RCS inventory during shutdown
– Loss of the normal residual heat removal system (RNS) during shutdown
– Manual automatic depressurization system (ADS) actuation
– Manual reactor trip via PMS, via diverse actuation system (DAS)
– ADS valve testing during mode 1

In DCD Revision 17, the applicant deleted this ITAAC because it had completed the work described.

18.5.8.2 Evaluation

The task analysis consists of a function-based task analysis and two OSA analyses (OSA-1 and OSA-2). As documented in its safety evaluation of the AP1000 DCD Revision 15, the staff reviewed the function-based task analysis and OSA-1 results and concluded that these task analyses are complete. As part of the DCD Revision 17 review, the staff reviewed the OSA-2 implementation plan and OSA-2 summary report. The reports describe the detailed methodology the applicant used to conduct OSA-2, as well as the results and impact on the four issues described in the OSA-2 implementation plan: 1) completeness of available information, 2) time to perform tasks, 3) operator workload analysis, and 4) operational crew staffing. As described, the task analysis was used in establishing the basis for the HFE design.

The staff reviewed the OSA-2 summary report (APP-OCS-J1R-220), Revision A, which provides the results of OSA-2 for the AP1000 design in accordance with the implementation plan. [

]^{a,c}

The results summary report contains the following information:

(1) [

]^{a,c} This is acceptable because the detailed information contained in the summary report is sufficient such that if Westinghouse continues to use the same OSA-2 methodology to complete the analysis, then the staff has determined that the task analysis will be thorough. The staff will confirm this during its review of a later version of the summary report.

[

]^{a,c} This is consistent with the specification in Criterion 2 (in Section 5.4 of NUREG-0711) that the applicant use a process like OSA. Appendix C to the summary report presents the results of the MTIS analyses.

(2) [

]^{a,c} Appendix B to the summary report discusses the results of the analyses.

[

]^{a,c}

The staff has concluded that the task analysis for Revision 17 of the AP1000 DCD is incomplete because the task analysis has not been finished. Design Commitment 2 in ITAAC Table 3.2-1 cannot be closed. The staff is tracking completion of this work under **Open Item OI-SRP18-COLP-02A.**

18.5.8.3 Conclusion

The staff has reviewed the OSA-2 implementation plan, Revision 1, and the OSA-2 summary report, Revision A, and has determined that the applicant has adequately addressed the criteria found in Section 5 of NUREG-0711, with the exception of Criterion 6 which remains to be

satisfied by completion of documentation. In addition, the staff's review has determined that there is sufficient information to close COL Information Item 18.5-2 (FSER 18.5.3-1) and COL Information Item 18.5-1 (FSER Item 18.5.3-3). COL Information Item 18.5-1 (FSER Item 18.5.3-2) remains open, contingent upon Westinghouse's submittal of information related to procedures and training programs. Because the task analysis for the AP1000 design is incomplete, closing Design Commitment 2 in ITAAC Table 3.2-1 is not justified and will remain open. The completion of the task analysis is being tracked by **Open Item OI-SRP18-COLP-02A.**

18.7 Element 6: Human Reliability Analysis

The applicant made no substantive changes to this section. However, Westinghouse submitted TR-59 (APP-GW-GLR-011, Revision 0, "AP1000 Standard Combined License Technical Report, Execution and Documentation of the Human Reliability Analysis/Human Factors Engineering Integration") to close COL Information Item 18.7-1.

18.7.5 Evaluation of COL Information Item 18.7-1

18.7.5.1 Summary of Technical Information

COL Information Item 18.7-1 states the following:

> Combined license applicants referencing the AP1000 certified design will address the execution and documentation of the human reliability analysis/human factors engineering integration implementation plan that is presented in Section 18.7.

Westinghouse submitted TR-59 to close COL Information Item 18.7-1. This technical report summarizes the applicant's method for conducting the HRA/HFE evaluation for the AP1000 and unites the relevant HRA/HFE evaluation implementation plan with the results documentation.

The staff reviewed and approved Westinghouse Commercial Atomic Power (WCAP)-14651, Revision 2, "Integration of Human Reliability Analysis with Human Factors Engineering Design Implementation Plan," as a supporting document for DCD Revision 15. Sections 2 through 5 of WCAP-14651 describe the major aspects of the plan:

- Section 2 discusses the PRA/HRA identification of critical HAs and risk-important tasks.
- Section 3 describes the task analyses for critical HAs and risk-important tasks.
- Section 4 discusses the reexamination of critical HAs and risk-important tasks.
- Section 5 provides information on the validation of HRA performance assumptions.

The staff used this implementation plan (in addition to NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 18, "Human Factors Engineering," Revision 2, issued March 2007, and NUREG-0711, Revision 2) to review WCAP-16555, Revision 1, "AP1000 Identification of Critical Human Actions and Risk Important Tasks." In addition to TR-59, Westinghouse provided WCAP-16555 to the NRC to close COL Information Item 18.7-1. In WCAP-16555, the applicant provided the results of the evaluation of the AP1000 PRA/HRA that identifies the critical HAs and risk-important tasks for plant operation.

18.7.5.2 Evaluation

The staff determined that WCAP-16555 addresses Section 2 of the WCAP-14651 implementation plan. The applicant addressed Sections 3 through 5 of the implementation plan in Parts 1 and 2 of the OSA.

Section 2 of WCAP-14651 relates to Criterion 1 in Section 7.4 of NUREG-0711, which states the following:

> Risk-important human actions should be identified from the PRA/HRA and used as input to the HFE design effort.
>
> - These actions should be developed from the Level 1 (core damage) PRA and Level 2 (release from containment) PRA including both internal and external events. They should be developed using selected (more than one) importance measures and HRA sensitivity analyses to provide reasonable assurance that an important action is not overlooked because of the selection of the measure or the use of a particular assumption in the analysis.

Section 2 of WCAP-14651 discusses the PRA/HFE identification of critical HAs and risk-important tasks. Sections 2.1 and 2.2, respectively, describe the process used to identify critical HAs and risk-important tasks. Section 2.2 is divided into three subsections describing the process to identify the risk-important quantitative, qualitative, and qualitative MTIS criteria.

Evaluation Criterion 1—Critical Human Actions: Section 2.1 of WCAP-14651 states that the applicant will determine critical HAs using both deterministic and PRA criteria. In Section 3.1 of WCAP-16555, the applicant presented the results of the analyses, which determined that there were no critical actions for the AP1000. For the deterministic criterion, there were no Type A (as defined in Sections 7.5.2.1 and 7.5.3.1 of the DCD) postaccident instruments, and no HAs were required to mitigate any design-basis accident. For the PRA criteria, the analysis showed that no HA, when failed in the PRA, results in a core damage frequency (CDF) of $1x10^{-4}$ core damage events per reactor-year or greater. Further, no HA, when failed in the PRA, results in a large release frequency of $1x10^{-5}$ events per reactor-year. Thus, there are no critical actions for the AP1000 plant. This is in accordance with the design objectives of the AP1000.

Evaluation Criterion 2—Quantitative and Qualitative Risk-Importance Criteria: Section 2.2 of WCAP-14651 states that the applicant will use both quantitative and qualitative criteria to identify the risk-important tasks of the AP1000 design. The quantitative criteria are a risk achievement worth (RAW) of 3.0 and a risk reduction worth (RRW) of 1.1. The RAW is a value that examines the increase in risk that would result if a single HA were to fail. The RRW value examines the decrease in risk that would result if an HA were made perfectly reliable for a given process or parameter. The focused PRA reduced these values to an RAW of 2.0 and an RRW of 1.05.

Section 3.2 of WCAP-16555 and related tables provide the results of the evaluation using the RAW and RRW measures. The applicant performed evaluations for both the CDF and the large early release frequency and considered the internal events, flooding, fire, and shutdown PRAs. The applicant identified about 20 risk-important tasks, summarized in Table 3.2-2. The staff also compared the HAs in the dominant sequences with the top operator actions determined by the risk-importance measures. The dominant sequences and the operator actions were

consistent. The staff finds that the applicant's use of quantitative risk-importance criteria meets the objective of the implementation plan.

Section 2.2 of WCAP-14651 includes five qualitative criteria for identifying additional risk-important tasks in conjunction with an expert panel. The applicant used the criteria listed in WCAP-16555, Section 2.2.1, to identify the qualitative risk-important HAs. These criteria are consistent with those in the implementation plan. The applicant also provided the results of this evaluation in Sections 2.2.1 and 3.2.1 of WCAP-16555. The expert panel identified three HAs that were added to the list of risk-important tasks. This approach to identifying the qualitative risk-important HAs is consistent with that given in the implementation plan. The staff finds this to be acceptable.

Evaluation Criterion 3—MTIS Risk-Importance Qualitative Criteria: Section 2.2 of WCAP-14651 provides qualitative criteria for identifying risk-important MTISs.

In Section 3.3 of WCAP-16555, the applicant gives the methodology used to identify the MTIS activities for the risk-important structures, systems, and components (SSCs). A group of engineers representing various disciplines and backgrounds, including HFE, HRA, and PRA, reviewed the results produced by this methodology. The applicant also provided Tables 3.3-1 and 3.3-2, which present the results of the MTIS evaluation. Table 3.3-1 includes the initial list of SSCs considered for MTIS activities, along with any other components that may be risk-important and have interfaces with the control room but may not have been included in the initial list. Lastly, Table 3.3-2 lists the representative MTIS activities that will receive the HFE review. In cases where the same MTIS activity was repeated for different SSCs, one of those MTIS activities from that list was chosen to represent (or selected as a "representative" of) that group.

The staff requested clarification in RAI TR59-11 about the activities outside of the control room and whether they were included in the set of MTIS tasks identified through the expert panel. The staff noted that the Davis-Besse reactor vessel incident is an example of the need for proper MTIS task identification. The reactor vessel is a risk-important SSC, and inspection of the vessel exterior would be an MTIS activity that seems worthy of appropriate planning at the design stage to address human factors issues associated with this activity. Thus, by including activities outside of the control room, accessibility can be assured and procedures and training provided to avoid the kinds of problems that occurred with reactor vessel leakage and corrosion. In their response dated July 27, 2007, Westinghouse provided information clarifying that operator actions outside of the control room were considered and noted that two of the actions considered were outside of the control room. Further, the passive nature of the plant design limits the use of manual control valves, and the manual control valves that are risk-important have main control room position indication.

The staff finds that the applicant has acceptably implemented the process specified in WCAP-14651 to identify the MTIS risk-important tasks.

Criterion 2 in Section 7.4 of NUREG-0711 states the following:

> Risk-important HAs and their associated tasks and scenarios should be specifically addressed during function allocation analyses, task analyses, HSI design, procedure development, and training. This will help verify that these tasks are well supported by the design and within acceptable human performance capabilities (e.g., within time and workload requirements).

Criterion 2 Evaluation

WCAP-14651, Section 3, describes the process for including the HRA risk-important activities in the task analysis. Westinghouse's OSA documents (for OSA-1 and OSA-2) summarize how the applicant input the HRA risk-important tasks into the task analysis. The OSA-1 summary report, Table 3-1, specifically addresses the risk-important tasks. The OSA also detailed task sequences and performance requirements. The applicant gave details of its methodology for task identification with regard to emergency operating procedures, system operating procedures, and general operating procedures. Section 4.2.4 of the OSA-1 summary report presents recommendations for the risk-important actions. Finally, in Section 1 of the OSA-1 summary report, Westinghouse stated that the results of the OSA are a set of requirements and constraints on operator task performance and that these are fed into the HSI design. The staff finds that the applicant has acceptably implemented the process described in the implementation plan.

Criterion 3 in Section 7.4 of NUREG-0711 states the following:

> The use of PRA/HRA results by the HFE design team should be specifically addressed; that is, how are risk-important HAs addressed (through HSI design, procedural development, and training) under the HFE program to minimize the likelihood of operator error and provide for error detection and recovery capability.

The applicant submitted the implementation methodology for OSA-2 to address part of Sections 3 and 4 in WCAP-14651. The applicant also provided the OSA-2 summary report for review. These documents meet the objectives of Sections 3 and 4 of WCAP-14651, by assigning focus areas for operators, by including MTIS activities in OSA-2, and by using operating procedures during the process. The staff finds that the applicant acceptably implemented the process described in the implementation plan.

Criterion 4 in Section 7.4 of NUREG-0711 states the following:

> HRA assumptions such as decision making and diagnosis strategies for dominant sequences should be validated by walkthrough analyses with personnel with operational experience using a plant-specific control room mockup or simulator. Reviews should be conducted before the final quantification stage of the PRA.

WCAP-14651 describes the process for the validation of the HRA performance assumptions. The applicant is implementing this process as part of its integrated system validation for the AP1000. Section 10.0 of this report details the review of the process used to integrate the HRA risk-important HAs.

18.7.5.3 Conclusion

The staff concludes that TR-59 (APP-GW-GLR-011), WCAP-16555, and the related RAI response (RAI TR59-11) describe an acceptable approach to implementing WCAP-14651 and to meeting the criteria in Section A.6 of NUREG-0800 and Section 7.4 of NUREG-0711.

18.7.6 Evaluation of Tier 1 Information—Design Commitment 1, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15)

18.7.6.1 Summary of Technical Information

ITAAC Design Commitment 2 reads as follows:

> Design Commitment 1: The integration of HRA with HFE design is performed in accordance with the implementation plan.
>
> Inspection, Tests, and Analyses: The applicant will perform an evaluation of the implementation for the integration of HRA with HFE design.
>
> Acceptance Criteria: A report exists and concludes that critical human actions (if any) and risk important tasks were identified and examined by task analysis, and used as input to the HSI design, procedure development, staffing, and training.

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.7.6.2 Evaluation

This ITAAC was deleted in Revision 16 of the AP1000 DCD (but the number was kept as a place holder), then subsequently removed entirely from Revision 17. For Revision 17 to the DCD, the applicant has provided the methodology and summary reports that show the risk-important tasks were examined and would have input into the other HFE elements listed in the acceptance criteria. Also, the work products provided by the applicant demonstrate the following:

- There are no "critical human actions" because of the AP1000 passive design.
- "Risk-important actions" as well as "significant" actions are recognized.
- The OSA-1 task analysis included all identified actions from the HRA. OSA-2 is a reiterative analysis (see Section 18.5 of this report) that also includes input from the HRA.

18.7.6.3 Conclusion

The staff concludes that this ITAAC (and the COL information item) can be closed because risk-important HAs have been identified in accordance with the implementation plan and these HAs have been appropriately implemented in the HFE design via the task analysis in OSA-2.

18.8 Element 7: Human-System Interface Design

18.8.3 Summary of Technical Information

In DCD Section 18.8.1.8, the applicant deleted reference to the use of computer-based models of cognitive response to control room events as an analytic method supporting workload analysis. The applicant substituted the term "task analysis": the sentence now reads, "Analytic methods include the use of task analysis."

18.8.3.1 Evaluation

FSER Section 18.8.1.3 discusses task analysis only from a generic perspective as one of the NUREG-0711 elements. FSER Section 18.8 does not include specific methods for evaluating workload. In both cases, the change described above does not affect the evaluation or conclusions from this section of the safety evaluation. Section 18.5, "Task Analysis," provides an evaluation of the impact of the change on task analysis.

18.8.3.2 Conclusion

The staff concludes that this change does not affect the evaluation or results documented in FSER Section 18.8.1.3.

18.8.5 Evaluation of COL Information Item 18.8-1

18.8.5.1 Summary of Technical Information

COL Information Item 18.8-1 states the following:

> The COL applicant referencing the AP1000 certified design is responsible for the execution and documentation of the HSI design implementation plan.

The applicant issued TR-82 to address this COL information item. In this document, the applicant stated that the COL item has been fully addressed and no additional work is required by the COL applicant.

18.8.5.2 Evaluation

The applicant has satisfactorily completed documentation of the HSI design implementation plan. The staff reviewed the completed documents referenced in TR-82 and concluded that they appropriately execute the HSI design implementation plan, as described in the AP1000 DCD, Revision 15. The specificity of design requirements clearly increased in the transition from the functional design level to design specifications. The documents were consistently clear across this procedural hierarchy. The scope of and specificity in the design documents provide reasonable assurance that the design process will effectively produce the design document needed to support procurement, construction and inspection activities.

This COL information item is redundant to Design Commitment 3 from ITAAC Table 3.2-1, which states that the HSI design is performed for the OCS [Operation and Control System] in accordance with the HSI design implementation plan. Based on this redundancy, the COL information item is closed.

18.8.5.3 Conclusion

The applicant is completing design documents in accordance with the HSI design implementation plan. While the applicant has not completed execution of the HSI design implementation plan, the COL information item is being closed because it is redundant to an existing ITAAC.

18.8.6 Review of Human Factors Evaluation Style Guide (APP-OCS-J1-002) against NUREG-0711 Criteria

18.8.6.1 Summary of Technical Information

The applicant submitted AP1000 HSI Design Guidelines (APP-OCS-J1-002, Revision 0). This document implements several NUREG-0711 criteria that have not been previously reviewed at the implementation plan level. The evaluation below verifies that the AP1000 HSI Design Guidelines effectively address applicable NUREG-0711 criteria.

18.8.6.2 Evaluation

Criterion 1—Style Guide

NUREG-0711, Section 8.4.5, "HSI Detailed Design and Integration Criteria," Criterion 1 states the following:

> Design-specific HFE design guidance (style guide) should be developed. The design of the HSI features, layout, and environment should incorporate HFE guidelines.

In APP-OCS-J1-002, the applicant provided a detailed set of HFE requirements for all HSIs similar to the level of detail in NUREG-0700, Revision 2, "Human-System Interface Design Review Guidelines," issued May 2002. The goal of the document is to ensure that the AP1000 designs comply with applicable HFE design principles.

The staff concludes that this document meets this criterion for design-specific HFE guidance.

Subcriterion—Style Guide Content

NUREG-0711, Section 8.4.5, Criterion 1, states the following:

> The content of the style guide should be derived from (1) the application of generic HFE guidance to the specific application, and (2) the development of the applicant's own guidelines based upon design-related analyses and experience. The applicant may justify guidelines that are not derived from generic HFE guidelines based on an analysis of recent literature, analysis of current industry practices and operational experience, tradeoff studies and analyses, and the results of design engineering experiments and evaluations. The guidance should reflect the applicant's design decisions that address the specific goals and needs of the HSI design.

In APP-OCS-J1-002, the applicant included a list of technical references used to develop specific HFE guidance for the AP1000 design. The applicant used NUREG-0700 as a major source. The following references also support the AP1000 HFE design guidance:

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The staff concludes that these technical references represent a diverse and thorough set of inputs for the AP1000 guidance. The AP1000 design guidance contains design principles and specific design criteria for all of the AP1000 HSIs.

Subcriterion—Scope and Level of Detail

NUREG-0711, Section 8.4.5, Criterion 1, states the following:

> The topics in the style guide should address the scope of HSIs included in the design and address the form, function, and operation of the HSIs, as well as environmental characteristics relevant to human performance.

In APP-OCS-J1-002, Section 3, the applicant described the scope of the design guidelines. This includes the MCR, remote shutdown station, and TSC. Specific HSI interfaces include the plant information system, alarm system, computerized procedures, safety systems, soft controls, dedicated controls, diverse actuation system, and large screen displays. The scope addresses all areas described by the previously reviewed program-level documents. APP-OCS-J1-002, Section 26, contains environment-related criteria.

The staff concludes that the design guideline addresses the HSI scope satisfactorily. The level of detail is consistent with that found in NUREG-0700, an accepted program for HFE design criteria.

Subcriterion—Guideline Specificity

NUREG-0711, Section 8.4.5, Criterion 1, states the following:

> The individual guidelines should be expressed in concrete, easily observable terms. In general, generic HFE guidelines should not be used in their abstract form. Such generic guidance should be translated into more specific design guidelines that can, as much as possible, provide unambiguous guidance to designers and evaluators. They should be detailed enough to permit their use by design personnel to achieve a consistent and verifiable design that meets the applicant's guideline.

The level of detail provided in individual guidelines is consistent with the specificity in NUREG-0700. [

]a,c

The staff concludes that the direction provided in the design guidance document is of sufficient detail that design personnel will be able to achieve a consistent and verifiable design.

Subcriterion—Style Guide Ease of Use

NUREG-0711, Section 8.4.5, Criterion 1, states the following:

> The style guide should provide procedures for determining where and how HFE guidance is to be used in the overall design process. The style guide should be written so that designers can readily understand it. The style guide should support the interpretation and comprehension of design guidance by supplementing text with graphical examples, figures, and tables.

APP-OCS-J1-002 provides generic direction stating that the design guidance will be used during the design process and to facilitate design verification. [

]a,c

The staff concludes that the design guidance in APP-OCS-J1-002 is presented in a manner likely to facilitate its use by designers and evaluators. The applicant has provided sufficient cross-referencing in procedures to ensure their appropriate use.

Subcriterion—Usability

NUREG-0711, Section 8.4.5, Criterion 1, states the following:

> The guidance should be maintained in a form that is readily accessible and usable by designers and that facilitates modification when the contents require updating as the design matures. Each guideline included in the guidance documentation should include a reference to the source upon which it is based.

The applicant maintains APP-OCS-J1-002 on its electronic document tracking system as a controlled document. This ensures document accessibility and facilitates usability by virtue of word search capability. [

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18.8.6.3 Conclusion

The staff concludes that APP-OCS-J1-002 provides specific HFE design guidance that satisfactorily implements NUREG-0711 criteria. The document provides sufficient detail to ensure that the process is consistently followed and provides reasonable assurance that design requirements are properly factored into the HSIs.

18.9 Element 8: Procedure Development

The applicant made no substantive changes to this section. However, Westinghouse submitted TR-70 (APP-GW-GLR-040, Revision 1, "Plant Operations, Surveillance, and Maintenance Procedures") to close COL Information Item 18.9-1.

18.9.5 Evaluation of COL Information Item 18.9-1

18.9.5.1 Summary of Technical Information

COL Information Item 18.9. This COL action item is divided into two parts. The COL action item states the following:

> With regard to procedure development, the COL applicant will (1) address the procedure development considerations in NUREG-0711, and (2) identify the minimum documentation that the COL applicant will provide to the staff to complete its review.

Westinghouse submitted TR-70 for staff review. This report documents the methodology, criteria, and schedules for procedure development. The document addresses the information needed to close COL Information Item 18.9-1. The applicant made the TR-70 supporting documents available to the staff for the purpose of closing COL Information Item 18.9-1. Two of these documents were the writer's guides for normal operating procedures and two-column operating procedures (APP-GW-GJP-100, Revision G, "AP1000 Normal Operating Procedures (NOPs) Writer's Guideline," and APP-GW-GJP-200, Revision D, "Writer's Guideline for Two Column Procedures," respectively). The writer's guidelines explain the programmatic process that controls the preparation of the normal operating procedures and two column procedures.

The goal of the staff's review was to address each part of the action item. Consequently, the evaluation is described in two parts. Part 1 details how the applicant addressed the procedure development considerations in NUREG-0711. Part 2 describes the documents that were submitted to the staff so that it could complete the review.

18.9.5.2 Part 1—Evaluation

The staff reviewed TR-70 in combination with the writer's guides. The staff verified that the applicant had implemented the guidelines specified in WCAP-14690, "Designer's Input to Procedure Development for the AP600." WCAP-14690 is the staff-approved document that describes the methodology the COL applicant should use to develop procedures. In NUREG-1793 (the AP1000 FSER), the staff approved the use of this document as a guide for procedures development and an acceptable guideline for creation of an implementation plan for the AP1000. In its review, the staff found that the writer's guides meet the criteria in NUREG-0711, Section 9.4, for the basis, development, and content of the AP1000 two column and normal operating procedures. The staff found that the information in TR-70 is consistent with the guidelines in WCAP-14690. Section 2.0 of WCAP-14690 details the general criteria that an applicant should implement to develop procedures. TR-70 addresses all of the guidance criteria in Section 2.0 of WCAP-14690. Section 4.0 of WCAP-14690 provides guidance on the process that should be used to write the plant-specific emergency operating procedures. Sections 3.0 and 5.0 of the WCAP describe the guidance for creation of the implementation plan with regard to computer-based procedures (CBPs). The following section documents the CBP evaluation as a subpart to addressing Part 1 of COL Information Item 18.9-1.

NUREG-1793: Human Factors Engineering Aspects of Computer-Based Procedures

The applicant did not address the impact of computerized procedures and accessibility in the original design certification application. In the staff's evaluation of the AP1000 DCD, the FSER states the following:

> Evaluation of the applicant's computerized procedure system was not included in the design certification for the AP1000. WCAP-14690, Revision 1, provides information on the computer-based procedure system which will serve as the interface to the plant procedures.

NUREG-0700, Section 8, Interim Staff Guidance (ISG)-05 ("Task Working Group #5: Highly-Integrated Control Room—Human Factors Issues"), and NUREG-0711, Section 9.4, Criteria 7 and 9, are used to evaluate the methodology used to design the CBP system and the interaction between the operator and that system. ISG-05 is used as complementary review guidance for Criterion 9.

Criterion 7 states the following:

> An analysis should be conducted to determine the impact of providing CBPs and to specify where such an approach would improve procedure utilization and reduce operating crew errors related to procedure use. The justifiable use of CBPs over paper procedures should be documented. An analysis of alternatives in the event of loss of CBPs should be performed and documented.

In TR-70 or in the supporting referenced documentation, the applicant addressed the impact and utilization of CBPs not addressed in the original design certification application. In Section 2.7 of TR-70, Revision 1, the applicant stated that comments from operations personnel involved in the human factors testing of the AP1000 control room design, and specifically the computerized procedure system, have been generally favorable. The applicant also documented the results of the analysis of the impact of providing CBPs in the referenced report

WCAP-14645-NP, Revision 3, "Human Factors Engineering Operating Experience Review Report for the AP1000 Nuclear Power Plant." The staff reviewed WCAP-14645-NP, Revision 3. The applicant identified multiple human performance issues with the CBPs and then noted the solution, or proposed solution, for each issue.

The staff issued RAI-SRP18-COLP-14 to the applicant requesting the analysis of alternatives to CBPs, in the event that a loss of CBPs occurs. In the RAI-SRP18-COLP-14 response dated August 4, 2008 (ADAMS Accession Number ML082200546), Westinghouse stated that it would conduct this analysis as part of the second OSA, described in Section 2.1 of APP-OCS-J1R-210.

Subsequent to this RAI, the staff reviewed APP-OCS-J1R-210, Revision 0. [

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In RAI-SRP18-COLP-19, the staff requested clarification of Task 24, and Scenario 16. The staff is tracking this RAI as **Open Item OI-SRP18-COLP-19.**

Criterion 9 states the following:

> The physical means by which operators access and use procedures, especially during operational events, should be evaluated as part of the HFE design process. This criterion generally applies to both hard-copy and computer-based procedures, although the nature of the issues differs somewhat depending on the implementation.

The staff used ISG-05 as the complementing review guidance for NUREG-0711, Section 9.4, Criterion 9. ISG-05 provides review criteria for how the user will interface with the CBP system. The applicant provided the documentation to satisfy the ISG-05 criteria in APP-OCS-J1-020, Revision A, "Computerized Procedures System Functional Requirements." APP-OCS-J1-020 documents how the operator physically interfaces with the computer procedure system. The technical information in APP-OCS-J1-020 is consistent in addressing the criteria in ISG-05. The staff submitted RAI-SRP18-COLP-11 to Westinghouse requesting clarification of the CBP automation and whether the AP1000 computer procedure system would be computer-paced or user-paced. In the RAI-SRP18-COLP-11 response dated August 4, 2008 (ADAMS Accession Number ML082200546), Westinghouse stated that this issue would not be of any consequence because the computer-paced function would be removed. The staff found this response acceptable.

18.9.5.3 Part 1—Conclusion

The staff determined that TR-70 and the writer's guides for normal and two column procedures together constitute an acceptable implementation plan for procedure development. This is because (1) the documents address the criteria in the staff-approved WCAP-14690, which explains the process the procedure writer should take to develop an implementation plan, and (2) the documents also address the applicable criterion in the procedures development chapter in NUREG-0711.

However, the staff had concerns about the results of the analysis for a loss of CBPs. The staff believes that COL Information Item 18.9-1 should remain open pending further clarification. **Open Item OI-SRP18-COLP-19** tracks this clarification**.**

18.9.5.4 Part 2—Evaluation

To address the second part of COL Information Item 18.9-1, in addition to submitting TR-70, the applicant stated in Revision 17 of the AP1000 DCD that the COL applicant will be responsible for addressing the operational and programmatic issues and training to complete the AP1000 COL licensing process. Westinghouse would be responsible for managing the development, review, and approval of the AP1000 normal operating, abnormal operating, emergency operating, refueling and outage planning, alarm response, administrative, and MTIS procedures, as well as the procedures that address the operation of post-72-hour equipment.

18.9.5.5 Part 2—Conclusion

The staff finds the applicant's position acceptable because the quality of the development of the procedures writer's guides and the procedures in general will be better controlled having been created by the reactor designer. This response by Westinghouse satisfies Part 2 of COL Information Item 18.9-1 (FSER Item 18.9.3-1).

The staff concludes that the applicant's procedure development program will likely result in procedures that support and guide human interaction with plant systems, as well as control plant-related events and activities. Human engineering principles and criteria are applied, along with all of the other design requirements, to develop procedures that are technically accurate, comprehensive, explicit, easy to use, validated, and in conformance with 10 CFR 50.34(f)(2)(ii).

The staff evaluated the applicant's CBP design in accordance with NUREG-0711 guidance. The staff found that, to have confidence that a reasonable assurance of safety exists, a detailed human factors review of the CBP design will be necessary. The existing COL information item does not include this action. The staff created **Open Item OI-SRP18-COLP-19** to track completion of this review.

COL Information Item 18.9-1 will remain open until the applicant addresses the staff's concerns regarding the results of the analysis for a loss of CBPs.

COL Item 13.5-1 addresses the completion of the procedures development review.

18.11 Element 10: Human Factors Verification and Validation

The applicant made no substantive changes to this section.

Westinghouse submitted procedures to address COL Information Item 18.11-1 and ITAAC Design Commitment 4, Tier 1, Table 3.2-1 (DCD Revision 15) as described below:

- APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan," Revision A

- APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan," Revision A

- APP-OCS-GEH-320, “AP1000 Human Factors Engineering Integrated System Validation Plan,” Revision B

- APP-OCS-GEH-420, “Human Factors Engineering Discrepancy Resolution Process,” Revision B

- APP-OCS-GEH-520, “AP1000 Plant Startup HFE Design Verification Plan,” Revision A

18.11.5 Evaluation of COL Information Item 18.11-1

18.11.5.1 Summary of Technical Information

COL Information Item 18.11-1 states the following:

> Combined License applicants referencing the AP1000 certified design will address the development, execution and documentation of an implementation plan for the verification and validation of the AP1000 Human Factors Engineering Program. The programmatic level description of the AP1000 verification and validation program presented and referenced by Section 18.11 will be used by the Combined License applicant to develop the implementation plan.

18.11.5.2 Evaluation

COL Information Item 18.11-1 contains two distinct activities related to the AP1000 HFE program V&V. The first activity addresses development of an implementation plan. Design Commitment 4, Tier 1, Chapter 3, ITAAC Table 3.2-1, of the AP1000 DCD, Revision 16, also addresses this commitment. The second activity is to execute the implementation plan. Design Commitment 5, Tier 1, Chapter 3, ITAAC Table 3.2-1, of the AP1000 DCD, Revision 16, addresses this commitment.

18.11.5.3 Conclusion

The NRC staff determined that COL Information Item 18.11-1 is redundant to existing Design Commitments 4 and 5, ITAAC Table 3.2-1. COL Information Item 18.11-1 is no longer needed because Westinghouse has assumed responsibility for the V&V implementation plan as part of the DCD Revision 17 changes. The work is being completed under the DCD ITAAC, which is evaluated below.

18.11.6 Evaluation of Tier 1 Information—Design Commitment 4, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15), Part 1, HSI Task Support Verification

18.11.6.1 Summary of Technical Information

ITAAC Design Commitment 4 reads as follows:

> Design Commitment: An HFE program verification and validation implementation plan is develop[ed] in accordance with the programmatic level description of the AP1000 human factors verification and validation plan.

Inspection, Test, and Analysis: An inspection of the HFE verification and validation implementation plan will be performed.

Acceptance criteria (part 1): A report exists and concludes that the HFE verification and validation implementation plan was developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan and includes the following activities:

– HSI task support verification

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.11.6.2 Evaluation

NUREG-0711, Section 11.4.2.2, Criterion 1, states the following:

The criteria for task support verification come from task analyses of HSI requirements for performance of personnel tasks.

Evaluation of Criterion 1

In APP-OCS-GEH-220, Revision A, the applicant provided a specific verification plan for each of the task analysis inputs as outlined below:

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The staff concludes that APP-OCS-GEH-220 provides clear, specific direction on how the results of each specific task analysis are verified. Acceptance criteria are stated within the procedure and, when combined with the use of an independent verifier, provide reasonable assurance that the HSI requirements properly incorporate the task analysis results.

NUREG-0711, Section 11.4.2.2, Criterion 2, "General Methodology," states the following:

> The HSIs and their characteristics (as defined in the HSI inventory and characterization) should be compared to the personnel task requirements identified in the task analysis.

Evaluation of Criterion 2

The implementation plan for task support verification, as outlined above, provides clear direction that the final HFE design is to be compared to personnel task requirements. Direction is provided to document and justify or resolve all deviations. The direction is structured so that each task analysis is specifically addressed. This supports a clear communication of source documents and acceptance criteria to be used in the verification.

The staff concludes that APP-OCS-GEH-220 provides sufficient implementation plan details to satisfactorily demonstrate implementation of this NUREG criterion for the general methodology of task verification.

NUREG-0711, Section 11.4.2.2, Criterion 3, states the following:

> Human engineering discrepancies (HEDs) should be identified when an HSI needed for task performance is not available or when HSI characteristics do not match personnel task requirements.

Evaluation of Criterion 3

In APP-OCS-GEH-220, the applicant stated that any time an HSI resource or an appropriate display is not available, a discrepancy worksheet is filled out. The procedure specifically states the following verification points:

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The staff concludes that APP-OCS-GEH-220 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for identifying task requirement deficiencies during task verification.

NUREG-0711, Section 11.4.2.2, Criterion 4, states the following:

> An HED should be identified for HSIs that are available in the HSI, but are not needed for any task.…

Evaluation of Criterion 4

In APP-OCS-GEH-220, Sections 2.3.2 (OSA-1) and 2.4.2 (OSA-2), the applicant stated that the independent verifier will check each display for information and/or controls that are not associated with task requirements. Deviations must be documented on a discrepancy worksheet.

The staff concludes that APP-OCS-GEH-220 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for identifying unnecessary HSI components during task verification.

18.11.6.3 Conclusion

The staff concludes that APP-OCS-GEH-220 provides an implementation plan that satisfactorily implements the guidance contained in NUREG-0711 relative to task support verification. The level of detail provided and the use of an independent verifier provides reasonable assurance that the HSI requirements properly incorporate the results from all task analyses performed. As described in Section 18.11.8, ITAAC Design Commitment 4 will remain open pending the satisfactory review of APP-OCS-GEH-320. COL Information Item 18.11-1 can be closed because it is redundant to the ITAAC.

18.11.7 Evaluation of Tier 1 Information—Design Commitment 4, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15), Part 2, HFE Design Verification

18.11.7.1 Summary of Technical Information

ITAAC Design Commitment 4 reads as follows:

> Design Commitment: An HFE program verification and validation implementation plan is develop[ed] in accordance with the programmatic level description of the AP1000 human factors verification and validation plan.
>
> Inspection, Test, and Analysis: An inspection of the HFE verification and validation implementation plan will be performed.

Acceptance criteria (part 2): A report exists and concludes that the HFE verification and validation implementation plan was developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan and includes the following activities:

- HFE Design Verification

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.11.7.2 Evaluation

NUREG-0711, Section 11.4.2.3, Criterion 1, states the following:

> The HFE guidelines serve as review criteria. Selection of specific guidelines depends on the characteristics of the HSI components included in the scope of review and whether the applicant has developed a design-specific guideline document. NUREG-0700 may be used for HFE design verification.

Evaluation of Criterion 1

In APP-OCS-GEH-120, the applicant stated that HSI resources and operation and control centers are verified against APP-OCS-J1-002. APP-OCS-J1-002 satisfactorily implements NUREG-0711, Section 8.4.5(1), as described in Section 18.8. [

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The staff concludes that APP-OCS-GEH-120 provides sufficient direction to ensure that the HFE guidelines serve as review criteria and have an appropriate level of detail. The report is also consistent with the program description.

NUREG-0711, Section 11.4.2.3, Criterion 2, states the following:

> The applicant should compare the characteristics of the HSI components with the HFE guidelines to determine whether the HSI is acceptable or discrepant (i.e., an HED).
>
> The applicant should evaluate discrepancies as potential indicators of additional issues.

Evaluation of Criterion 2

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The staff concludes that the implementation plan provides a disciplined process for verifying that the HSI design effectively implements design acceptance criteria. Discrepancies are documented and subjected to a corrective action process that evaluates the potential for additional issues. The staff concludes that APP-OCS-GEH-120 provides sufficient implementation plan detail to satisfactorily demonstrate implementation of this NUREG criterion for design verification methodology.

NUREG-0711, Section 11.4.2.3, Criterion 3, states the following:

> The applicant should document HEDs in terms of the HSI component involved and explain how the characteristics depart from a particular guideline.

The evaluation of this criterion is contained in the evaluation of Criterion 2, directly above.

18.11.7.3 Conclusion

The staff concludes that APP-OCS-GEH-120 provides an implementation plan that satisfactorily implements NUREG-0711 criteria associated with design verification. The document provides sufficient detail to ensure that the process is consistently followed and provides reasonable assurance that the HSIs properly factor in the results from design requirements. As described in Section 18.11.8, ITAAC Design Commitment 4 will remain open pending satisfactory review of APP-OCS-GEH-320 (Integrated System Validation Plan). COL Information Item 18.11-1 can be closed because it is redundant to the ITAAC.

18.11.8 Evaluation of Tier 1 Information—Design Commitment 4, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15), Part 3, Integrated System Validation

18.11.8.1 Summary of Technical Information

ITAAC Design Commitment 4 reads as follows:

> Design Commitment: An HFE program verification and validation implementation plan is develop[ed] in accordance with the programmatic level description of the AP1000 human factors verification and validation plan.
>
> Inspection, Test, and Analysis: An inspection of the HFE verification and validation implementation plan will be performed.
>
> Acceptance criteria (part 3): A report exists and concludes that the HFE verification and validation implementation plan was developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan and includes the following activities:
>
> – Integrated System Validation

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.11.8.2 Evaluation

The NRC staff received APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan," Revision B in late June, and the plan is in the review process. **Open Item OI-SRP18-COLP-03A** tracks completion of this work.

18.11.8.3 Conclusion

ITAAC Design Commitment 4 tracks completion of the V&V implementation plans. ITAAC Design Commitment 4 remains open pending the receipt and satisfactory review of APP-OCS-GEH-320.

18.11.9 Evaluation of Tier 1 Information—Design Commitment 4, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15), Part 4, Issue Resolution Verification

18.11.9.1 Summary of Technical Information

ITAAC Design Commitment 4 reads as follows:

> Design Commitment: An HFE program verification and validation implementation plan is develop[ed] in accordance with the programmatic level description of the AP1000 human factors verification and validation plan.
>
> Inspection, Test, and Analysis: An inspection of the HFE verification and validation implementation plan will be performed.
>
> Acceptance criteria (part 4): A report exists and concludes that the HFE verification and validation implementation plan was developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan and includes the following activities:
>
> – Issue Resolution Verification

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.11.9.2 Evaluation

NUREG-0711, Section 11.4.4.2, Criterion 1, states the following:

> Discrepancies could be acceptable within the context of the fully integrated design. If sufficient justification exists, a deviation from the guidelines may not constitute an HED. The technical basis for such a determination could include an analysis of recent literature or current practices, tradeoff studies, or design engineering evaluations and data. The applicant should identify unjustified discrepancies as HEDs to be addressed by the HED resolution.

Evaluation of Criterion 1

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]a,c The staff concludes that procedures referenced in this section provide sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for HED justification.

NUREG-0711, Section 11.4.4.2, Criterion 2, states the following:

> The HED analysis should include the following:
>
> - Plant system—The potential effects of all HEDs relevant to a single-plant system should be evaluated. The potential effects of these HEDs on plant safety and personnel performance should be determined, in part, by the safety significance of the plant system, their effect on the accident analyses summarized in the safety analysis report, and their relationship to risk-significant sequences in the plant PRA.
>
> - HED scope—The scope of the HED should consider the following:
>
> - Global features HEDs—These HEDs relate to configurational and environmental aspects of the design, such as lighting, ventilation, and traffic flow. They relate to general human performance issues.
>
> - Standardized features HEDs—These HEDs relate to design features that are governed by the applicant's design guidelines used across various controls and displays of the HSI (e.g., display screen organization and conventions for format, coding, and labeling). Because a single guideline may be used across many aspects of the design, a single HED could be applicable to many personnel tasks and plant systems.
>
> - Detailed features HEDs—These HEDs relate to design features that are not standardized, thus their generality has to be assessed.
>
> - Other—This subcategory specifically pertains to HEDs identified from integrated system validation that cannot be easily assigned to any of the three preceding categories.
>
> - Individual HSI or procedure—HEDs should be analyzed with respect to individual HSIs and procedures. The potential effects of these HEDs on plant safety and personnel performance are determined, in part, by the safety significance of the plant system that is related to the particular component.
>
> - Personnel function—HEDs should be analyzed with respect to individual personnel functions. The potential effects of these HEDs is determined, in part, by the importance of the personnel function to plant safety (e.g.,

consequences of failure) and the cumulative effect on personnel performance (e.g., degree of impairment and types of potential errors).

The applicant should also analyze HEDs with respect to the cumulative effects of multiple HEDs on plant safety and personnel performance.

In addition to addressing the specific HEDs, the analysis should treat the HEDs as indications of potentially broader problems.

Evaluation of Criterion 2

In APP-OCS-GEH-420, Section 2.2, the applicant stated that the HFE group performs a safety
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The staff concludes that APP-OCS-GEH-420 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for HED analysis.

NUREG-0711, Section 11.4.4.2, Criterion 3, states the following:

> The applicant should use a systematic evaluation to identify HEDs for correction. Priority 1 HEDs are those with direct, indirect, or potential safety consequences. Priority 2 HEDs are those that do not have significant safety consequences, but do have potential consequences to plant performance/operability, non-safety-related personnel performance/efficiency, or other factors affecting overall plant operability. The remaining HEDs are those that do not satisfy the criteria associated with the first and second priorities. Resolution of these HEDs is not an NRC safety concern but may be resolved at the discretion of the applicant.

Evaluation of Criterion 3

This criterion is addressed in the previous section.

NUREG-0711, Section 11.4.4.2, Criterion 4, states the following:

> The applicant should fully document each HED, including assessment category (priority for correction), associated plant system, associated personnel function, and associated HSI or procedure. The documentation should clearly show whether the HED was dismissed or identified as needing design modification, and the basis for this determination in terms of consequence to plant safety or operation should be clearly described.

Evaluation of Criterion 4

Section 2 of APP-OCS-GEH-420 includes documentation requirements. [

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The staff concludes that APP-OCS-GEH-420 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for HED evaluation documentation.

NUREG-0711, Section 11.4.4.2, Criterion 5, states the following:

> The applicant should identify design solutions to correct HEDs. The design solutions should be consistent with system and personnel requirements identified in the preparatory analysis (i.e., operating experience review, function and task analysis, and HSI characterization).

Evaluation of Criterion 5

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The staff concludes that APP-OCS-GEH-420 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for development of HED design solutions.

NUREG-0711, Section 11.4.4.2, Criterion 6, states the following:

> The applicant should evaluate designs by repeating the appropriate V&V analyses. When the problems identified by an HED cannot be fully corrected, the applicant should provide appropriate justification.

Evaluation of Criterion 6

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The staff concludes that APP-OCS-GEH-420 provides sufficient details of the implementation plan to satisfactorily demonstrate implementation of this NUREG criterion for design solution evaluation.

18.11.9.3 Conclusion

The staff concludes that APP-OCS-GEH-420 provides an implementation plan that satisfactorily addresses the NUREG-0711 criteria associated with tracking and resolving HEDs. The level of detail is sufficient to address all of the applicable NUREG-0711 criteria.

18.11.10 Evaluation of Tier 1 Information—Design Commitment 4, ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15), Part 5, Plant HFE/HSI (as Designed at the Time of Plant Startup) Verification

18.11.10.1 Summary of Technical Information

ITAAC Design Commitment 4 reads as follows:

Design Commitment: An HFE program verification and validation implementation plan is develop[ed] in accordance with the programmatic level description of the AP1000 human factors verification and validation plan.

Inspection, Test, and Analysis: An inspection of the HFE verification and validation implementation plan will be performed.

Acceptance criteria (part 5): A report exists and concludes that the HFE verification and validation implementation plan was developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan and includes the following activities:

- Plant HFE/HSI (as designed at the time of plant startup) verification

In DCD Revision 17, the applicant deleted this ITAAC based on completion of the work it described.

18.11.10.2 Evaluation

The applicant submitted APP-OCS-GEH-520, Revision A, to address this part of ITAAC 4. The staff has reviewed the procedure but not yet documented the results. The staff is tracking completion of this work through **Open Item OI-SRP18-COLP-04A.**

18.11.10.3 Conclusion

The review of APP-OCS-GEH-520 is ongoing. The staff has opened **OI-SRP18-COLP-04A** to track this review in response to the removal of ITTAC Design Commitment 4 from ITAAC Table 3.2-1, Tier 1, Section 3.2 (DCD Revision 15).