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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002766

February 2, 2010

Subject: AP1000 Response to Request for Additional Information (SRP 18)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 18. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP18-COLP-22 R1	RAI-SRP18-COLP-28 R1	RAI-SRP18-COLP-35 R1
RAI-SRP18-COLP-23 R1	RAI-SRP18-COLP-31 R1	RAI-SRP18-COLP-49 R1
RAI-SRP18-COLP-24 R1	RAI-SRP18-COLP-32 R1	RAI-SRP18-COLP-52 R1
RAI-SRP18-COLP-26 R1	RAI-SRP18-COLP-33 R1	

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

D.A. Lindgren /FOR

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Request for Additional Information on SRP Section 18

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 18

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-22
Revision: 1

Question:

The ISV Plan did not address all of the commitments for ISV made in the *Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan* (WCAP-15860, Rev 2) dated Oct 2003. In some cases the ISV Plan takes exceptions to these commitments. Some examples follow:

1. Technical Support Center (TSC): WCAP-15860 calls for the V&V scope to include the TSC, but it is out of scope per the ISV.

2. Risk Important Human Actions (RIHAs): WCAP-15860, Sec. 4.4 calls for ISV of risk-important tasks. The RIHAs and tasks are identified in TR-59/WCAP-16555. Section 3.2 identifies 22 post-accident RIHAs in Table 3.2-2. The ISV includes essentially all of these 22 RI HAs in scenarios. However, it is not clear why the HA #19 was excluded.

3. Risk Important Maintenance, Test, and Inspection Human Actions (RIMTIS Has): WCAP-15860, Section 4.5 calls for risk-important MTIS tasks. Section 3.3 of TR-59/WCAP-16555 is titled Risk Important Human Actions for MTIS and has two tables that identify many RI MTIS activities. However, the ISV Plan does not appear address these. It seems like they could all be addressed by one ISV scenario where the plant is at a normal full power operating status and the operators validate each of the RI MTIS interfaces while maintaining a normal operating status.

4. Validation of All EOPs: WCAP-15860, Sec. 4 states that the validation of EOPs is explicitly included in ISV. The ISV Plan does include many EOPs in the scenarios, but it states in Sec. 5.1.2 "Not all EOPs will be individually exercised in ISV scenarios." If that is the case, then how will these missing EOPs be validated?

5. Beyond Design Basis Scenarios: WCAP-15860, Sec. 4.4 states that ISV will include beyond design-basis-accident scenarios. At least one scenario that goes to core damage should be included, so that actions leading up to core damage to prevent core damage can be more fully evaluated. Additionally, the capability to support post-CD actions can be assessed.

6. Reactor Trip Scenario: WCAP-15860 indicates that a reactor trip transient (as opposed to an accident scenario) event will be included, but the ISV Plan does not appear to include one.

7. Validation of HRA Assumptions: WCAP-15860, Sec. 4.6 states that ISV will include validation of key HRA modeling assumptions for RIHAs. Section 30 of the PRA describes the modeling of RIHAs, which includes the 'time window' 'estimated actual

time' and 'slack time.' There is no discussion in the ISV about how HRA modeling assumptions are addressed. The ISV does appropriately verify that the RIHAs can be performed within the time window. However, documentation of actual times during the scenarios and then feeding that information back to the HRA to see that assumptions were correct and that recovery and HEPs were appropriately treated seems to be missing.

8. Participant Experience: WCAP-15860, Sec. 4.9, Subjects, states that "steps will be taken to identify and select test subjects from crews with less experience or unexceptional performance." This does not appear to be addressed in the ISV.

9. Adequacy of Staffing: WCAP-15860, Sec. 4.3 and 4.4 calls for evaluation of the adequacy of staffing. It is not clear from the ISV how this will be done.

10. Selection of Crews: Section 4 of the ISV Plan indicates that crews will come from at least three different utilities. The utilities will assign "typical crews" based on availability and that crews will not be selected based on individual characteristics. However, no information is provided to address how utilities will select crews or what instruction Westinghouse will provide to utilities to prevent sample bias.

Conformance to WCAP-15860 is part of COL item and ITAAC commitments. Please address the general issue of conformance to WCAP-15860, as well as the specific issues noted above.

Westinghouse Response:

WEC agrees that any discrepancies between the commitments stated in WCAP-15860 (Reference 1) and the ISV Plan need to be addressed. It should be noted that WCAP 15860 was issued in 2003, and since that time the OCS and HFE design has progressed. Therefore, some minor adjustments may be justifiable or inevitable, although it is confirmed that the AP1000 HFE V&V will conform to the intent of WCAP 15860, and any discrepancies will be resolved.

1. Technical Support Center (TSC): It is confirmed that WCAP-15860 identified the TSC as within V&V scope. However, the V&V associated with the TSC is part of the design verification scope (see WCAP-15860, Section 3, Reference 1, and APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan", Reference 2). Also, note that the extent of the HFE design verification will be limited to the design aspects of the TSC that are within the scope of Westinghouse.

2. Risk Important Human Actions (RIHAs): A scenario to address RIHA #19 (RHN-MAN04, Failure to recognize the need and failure to isolate the RNS system given rupture of the RNS piping when the plant is at hot/cold conditions) will be included in Revision C of the ISV Plan, to be issued by January 31, 2010.

3. Maintenance, Test, Inspection and Surveillance (MTIS) Tasks for Risk-important Structures, Systems and Components (SSCs): A subset of the "Representative MTIS Activities for Risk-Significant Components" (WCAP-16555, Section 3.3, Reference 3) will be included in a number of the scenarios in ISV. Other MTIS activities in Table 3.3-1 and Table 3.3-2 will be incorporated as scenario complications.

   Any MTIS activities in WCAP-16555, Section 3.3, which can not be reasonably incorporated into an ISV scenario will be subject to HFE analysis by another means. This may include assessment against HFE design guidelines, task walkthrough, maintenance trails utilizing manufactured equipment or part of the HFE design verification at plant startup (Reference 4), as appropriate.

   The MTIS activities that will be addressed in ISV will be identified during the detailed scenario description development being completed for Revision C of the ISV Plan (to be issued by January 31, 2010). Once this process is complete, WEC will determine the appropriate means to ensure that any remaining MTIS activities are adequately assessed to confirm human factors acceptability.

4. Validation of All EOPs: All EOPs are validated by the AP1000 Operations Procedures Group prior to issue for use as numeric revisions. The ISV scenarios are designed to ensure that a representative subset of the EOPs are exercised and validated in ISV.

   The ISV scenarios will ensure that all functional operator knowledge, skills and abilities addressed in the AP1000 EOPs are examined and validated in ISV. While the ISV scenarios may not explicitly cause the operators to enter each of functional recovery procedures, the demand to perform similar EOP steps will be represented in other scenarios. All major action categories identified in all AP1000 EOPs will be validated in ISV.

   Additionally, the AP1000 Operations Procedure group performs multiple walk-through validations of the AP1000 EOPs prior to ISV. These walk-throughs will exercise all major EOP action categories, validating the procedure steps and mitigation strategies. Insights and comments identified during these walk-throughs will be reflected in subsequent numeric revisions of the EOPs, and will be reviewed by Builder's Group operations personnel prior to ISV. These walk-throughs are ongoing and have been scheduled so that the applicable simulator models will be available to provide the fidelity and dynamic feedback necessary to evaluate the EOPs. This ensures that the findings from the walk-throughs are valid, and that the EOPs will be ready for use in ISV.

5. Beyond Design Basis Scenarios: It can be confirmed that a number of beyond design basis scenarios will be incorporated into ISV. However, it should be noted that the AP1000 passive safety features make core damage highly improbable in Modes 1

through 5; even assuming multiple equipment failures and operator errors. Also, the simulator will not model core damage.

Actions taken in response to core damage have a long time scale and are addressed by Severe Accident Management Guidelines. The traditional training approach to address such extreme situations is by walk-throughs and scripted role play. Therefore, such substitute measures will be used in ISV to assess the events leading to core damage (for example, violating safety limits or technical specifications) and the actions in response to core damage. The details of this scenario will be provided in Revision C of the ISV Plan, to be issued by January 31, 2010

6. Reactor Trip Scenario: A number of the ISV scenarios include a reactor trip. WEC will include an uncomplicated reactor trip in one of the scenarios in Revision C of the ISV Plan, to be issued by January 31, 2010.

7. Validation of HRA Assumptions: The validation of key HRA modeling assumptions for Risk Important Human Actions will be explicitly included in the ISV Plan. Exceeding the time window is deemed to be a trial failure, and will result in the generation of a Priority 1 Human Engineering Discrepancy (HED). The details of the time windows from Chapter 30 of the PRA (Reference 5) will be included in the scenario descriptions in Revision C of the ISV Plan, to be issued by January 31, 2010.

8. Participant Experience: A future revision of the ISV Plan (i.e., after Rev. C) will include further details on the selection and identification of subjects; including qualifications and experience. WEC confirms that the selection of subjects will be in accordance with the information provided in WCAP-15860, Section 4.9. However, please note that due to the ongoing development of the utility schedules for operator training (and hence the availability of utility crews), further details can not be provided at this time.

9. Adequacy of Staffing: WEC confirms that staffing levels and roles will be addressed as stated in WCAP-15860 Section 4.3 and 4.4. In particular, staffing aspects will be explicitly included in respect to the scenarios containing risk-important human actions. Guidance to address staffing issues will also be included in observer guides. Details will be included in Revision C of the ISV Plan, to be issued by January 31, 2010.

10. Selection of Crews: A future revision of the ISV Plan (i.e., after Rev. C) will include further details on the selection of crews. WEC confirms that the selection of subjects will be in accordance with the information provided in WCAP-15860. However, please note that due to the ongoing development of the utility schedules for operator training (and hence the availability of utility crews), further details can not be provided at this time.

Question Rev 1:

Technical Support Center (TSC): WEC notes that the extent of the HFE design verification will be limited to the design aspects of the TSC that are within the scope of Westinghouse. Please provide what those "design aspects" are or give a reference that contains that information.

Risk Important Maintenance, Test, and Inspection Human Actions:
WEC states that a subset of the "Representative MTIS Activities for Risk-Significant Components" (WCAP-16555, Section 3.3, Reference 3) will be included in a number of the scenarios in ISV. Other MTIS activities in Table 3.3-1 and Table 3.3-2 will be incorporated as scenario complications. Any MTIS activities in WCAP-16555, Section 3.3, which cannot be reasonably incorporated into an ISV scenario will be subject to HFE analysis by another means. This may include assessment against HFE design guidelines, task walkthrough, maintenance trails utilizing manufactured equipment or part of the HFE design verification at plant startup (Reference 4), as appropriate.

This is an acceptable approach. Please provide a Table that shows which of the MTIS items will be addressed by each of the noted V&V methods.

Validation of HRA Assumptions: The ISV does appropriately verify that the RIHAs can be performed within the time window. However, documentation of actual times during the scenarios and then feeding that information back to the HRA to see that assumptions were correct and that recovery and HEPs were appropriately treated seems to be missing.

Please specifically address how this feedback will be accomplished.

Westinghouse Response:

Technical Support Center (TSC):

The V&V activities associated with the TSC are part of the design verification scope (see WCAP-15860, Section 3, Reference 6, and APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan", Reference 2). The extent of the HFE design verification will be limited to the design aspects of the TSC that are within the scope of Westinghouse which comprises those tasks where the data and displays available in the MCR may be utilized in TSC. These functions are detailed in the document APP-OCS-GGR-110, "AP1000 Technical Support Center and Emergency Operations Facility Workshop" (Reference 6). The tasks are summarized as follows:

1. Classification of emergency events
2. Determination of the extent of any damage to the core
3. Provision of protective action recommendations
4. Provision of information to support dose assessments.

Risk Important Maintenance, Test, and Inspection Human Actions:

The following table lists all of the risk-important MTIS tasks identified in APP-GW-GL-011, "AP1000 Identification of Critical Human Actions and Risk-Important Tasks", Section 3.3 (Reference 3), and shows the corresponding methods used to assess them. If a task is addressed in ISV, the applicable scenario numbers are listed in the table.

Note that all risk-significant components and associated maintenance activities will be subject to a HFE maintainability assessment, such as assessment against HFE design guidelines, task walkthrough, maintenance trials utilizing manufactured equipment or HFE design verification at plant startup (Reference 4), as appropriate.

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
1. Component cooling water pumps	a. Switch normally operating pump	√	Scenario 11, 14	√
	b. Start second pump for plant shutdowns	√		√
2. Containment Vessel				√
3. Chemical and Volume Control System (CVS) letdown containment isolation valves	a. Monitor normal valve position (closed)			√
	b. Open valve to provide RCS letdown			√
	c. Exercise valve for IST, monitoring position			√
	d. Containment isolation valve leak test	√		√
4. WLS Sump Discharge Containment Isolation Valves	a. Monitor normal valve position (closed)			√
	b. Open valve to empty containment sump			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
	c. Exercise valve for IST, monitoring position			√
	d. Containment isolation valve leak test			√
5. Containment Purge Supply and Exhaust Containment Isolation Valves	a. Monitor normal valve position (closed)			√
	b. Open valve for containment atmosphere control			√
	c. Exercise valve for IST, monitoring position			√
	d. Containment isolation valve leak test			√
6. Hydrogen igniters	a. Operate to perform required surveillance	√	Scenario 12	√
7. Makeup pumps	a. Align one pump designated for automatic makeup control	√		√
8. Makeup Pump Suction and Discharge Check Valves				√
9. DAS automatic	a. Perform channel check	√	Scenario 10, 13, 15	√
10. DAS manual	a. Perform operational test			√
11. Rod drive motor generator (MG) set breakers	a. Open the MG set breakers and verify operation	√		√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
12. Non-Class 1E dc and UPS power to DAS				√
13. Reactor coolant pump (RCP) switchgear	a. Open RCP trip breakers and verify operation	√		√
14. Ancillary diesel generator				√
15. Medium voltage bus				√
16. Startup Feedwater Pumps	a. Start pumps for plant shutdown			√
17. Reactor trip instrumentation	a. Channel check	√		√
	b. Compare heat balance to nuclear instrumentation (NI) output	√	Scenario 10, 15	√
	c. Compare incore detectors to axial difference	√		√
	d. Calibrate excore channels	√		√
	e. Perform Trip Actuating Device Operational Test (TADOT) for manual reactor trip	√		√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
	f. Perform Reactor Trip Channel Operational Test (RTCOT)	√	Scenario 1	√
	g. Perform channel calibration	√		√
	h. Verify RTS response time	√		√
18. Engineered safety feature actuation system (ESFAS) instrumentation	a. Channel check			√
	b. Perform actuation logic test	√		√
	c. Perform TADOT			√
	d. Perform channel calibration			√
	e. Perform channel operational test	√		√
	f. Verify ESFAS response times	√		√
	g. Perform actuation device test	√		√
	h. Perform actuation test for squib valves	√		√
19. Class 1E batteries	a. Verify terminal voltage	√	Scenario 17	√
	b. Verify battery float current	√	Scenario 17	√
	c. Verify pilot cell voltage	√	Scenario 17	√
	d. Capacity test (8)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
20. Class 1E Battery Chargers				√
21. Class 1E Inverters				√
22. Class 1E ac and dc distribution				√
23. Recirculation Pumps	a. Start pump for normal circulation operation			√
24. PCCWST Drain Isolation Valves	a. Monitor normal valve position (closed)			√
	b. Exercise valve for IST, monitoring position			√
25. PCCWST Drain Series Isolation Valves	a. Monitor normal valve position (open)			√
	b. Close valve to allow IST of PCCWST discharge valve			√
	c. Close valve to block PCCWST operation during PCS and containment shell maintenance			√
26. PLS actuation hardware				√
27. Post Accident Monitoring Instrumentation	a. Channel check			√
	b. Perform channel calibration			√
28. Reactor trip breakers	a. Perform TADOT			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
29. IRWST Vents				√
30. IRWST Screens				√
31. Containment Recirculation Screens				√
32. CMT Inlet Isolation Valves	a. Monitor normal valve position (open)			√
	b. Close valve to allow IST of CMT discharge valves			√
	c. Close valve to block CMT operation during RCS drained maintenance or CMT maintenance			√
33. CMT discharge isolation valves	a. Monitor normal position (closed)	√		√
	b. Exercise valve for IST, monitoring position	√	Scenario 4, 12, 26	√
34. CMT Discharge Check Valves	a. Monitor normal valve position (open)			√
	b. Exercise valve for IST, monitoring position			√
35. CMT Discharge Manual Isolation Valve	a. Monitor normal valve position (open)			√
	b. Close valve to isolate CMT during RCS drained maintenance or CMT maintenance			√
36. Accumulator discharge	a. Monitor normal valve position (open)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
isolation valve	b. Monitor motor control center (MCC) power removed from valve operator	√		√
	c. Restore power, close, and remove power to isolate accumulators during plant shutdown and perform reverse procedure on plant startup	√		√
37. Accumulator Discharge Check Valves	a. Monitor normal valve position (closed)			√
	b. Exercise valve for IST, monitoring position			√
38. PRHR Inlet Isolation Valve	a. Monitor normal valve position (open)			√
	b. Monitor MCC power removed from valve operator			√
	c. Exercise valve for IST, monitoring position			√
	d. Close valve to allow IST of PRHR discharge valves			√
	e. Close valve to isolate PRHR during PRHR maintenance			√
39. PRHR Heat Exchanger	a. Monitor normal valve position (closed)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
Control Valves	b. Exercise valve for IST, monitoring position			√
40. PRHR Discharge Manual Isolation Valve	a. Monitor normal valve position (open)			√
	b. Close valve to isolate PRHR during PRHR or PRHR discharge isolation valve maintenance			√
41. Containment recirculation isolation valves	a. Monitor normal valve position (closed)			√
	b. Perform position indication IST	√		√
	c. Exercise valve controls with booster assembly removed and perform continuity check after new booster assembly installed	√		√
42. Containment Recirculation Block Valve	a. Monitor normal valve position (open)			√
	b. Exercise valve for IST, monitoring position			√
43. IRWST Injection Check Valves	a. Monitor normal valve position (closed)			√
	b. Exercise valve for IST, monitoring position			√
44. IRWST Injection	a. Monitor normal valve position (closed)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
Isolation Valves	b. Perform position indication IST			√
	c. Exercise valve controls with booster assembly removed and perform continuity check after new booster assembly installed			√
45. IRWST Line Isolation Valves	a. Monitor normal valve position (open)			√
	b. Monitor MCC power removed from valve operator			√
	c. Restore power, close, and remove power to isolate accumulators during plant shutdown and perform reverse procedure on plant startup			√
46. IRWST Gutter Bypass Isolation Valves	a. Monitor normal valve position (open)			√
	b. Exercise valve for IST, monitoring position			√
47. ADS Stage 1/2/3 Valves	a. Monitor normal valve position (closed)			√
	b. Exercise valve for IST, monitoring position			√
	c. Open valves to provide RCS venting during plant shutdown			√
	d. Monitor normal valve position (open)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
48. ADS Stage 4 Valves	a. Monitor normal valve position (closed)			√
	b. Perform position indication IST			√
	c. Exercise valve controls with booster assembly removed and perform continuity check after new booster assembly installed			√
49. ADS Stage 4 Isolation Valves	a. Monitor normal valve position (open)			√
	b. Perform position indication IST			√
	c. Close valve to isolate RCS during ADS-4 valve maintenance and ADS-4 firing circuit continuity testing			√
50. Pressurizer Safety Valves	a. Perform position indication IST			√
51. Reactor Vessel Insulation Water Inlet and Steam Vent Devices				√
52. Reactor Cavity Doorway Damper				√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
53. Fuel assemblies	a. Monitor power range excore NIs for axial flux difference (AFD) (delta-I, axial peaking) and quadrant power tilt ratio (QPTR) (radial peaking)	√	Scenario 10, 15	√
	b. Online Power Distribution Monitoring System (OPDMS) core power distribution monitoring (kw/ft, Fndh, Departure from Nucleate Boiling Ratio [DNBR])	√		√
	c. Core peaking factors (OPDMS inoperable, Fq[z], Fndh)	√		√
	d. Monitor rod group alignment	√		√
	e. Monitor reactor coolant chemistry and activity	√		√
54. Residual Heat Removal Pumps	a. Start pump for short-term availability control surveillance			√
	b. Start pumps for normal shutdown cooling			√
55. RNS Motor-Operated Valves	a. Monitor normal valve position (closed)			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
	b. Position valves for normal shutdown cooling			√
	c. Exercise valve for IST, monitoring position			√
	d. Containment isolation leak test			√
56. RNS Check Valves				√
57. RNS Check Valves				√
58. Spent Fuel Cooling Pumps	a. Switch normally operating pump			√
59. Main Steam Safety Valves	a. Perform valve position IST			√
60. Main steam and feedwater isolation valves	a. Monitor valve position (open)			√
	b. Exercise valve part closed for IST, monitoring position	√		√
61. Service Water Pumps and Cooling Tower Fans	a. Switch normally operating pump			√
	b. Start second pump for plant shutdowns			√
62. VBS MCR and I&C Rooms B/C Ancillary Fans	a. Start pump for STAC surveillance			√

Component	Operator Activity	OSA-2	ISV	HFE Maintainability Assessment
63. Air Cooled Chillers and Pumps	a. Switch normally operating pump and chiller			√
64. Diesel/generator package	a. Start diesel generator for short-term availability control	√	Scenario 10, 23	√
65. Engine room exhaust fans	a. Verify fans start upon diesel generator start	√		√

Validation of HRA Assumptions:

The ISV results report will include the actual completion times for risk-important tasks and any relevant information found during the performance of the risk-important tasks in ISV. The results recorded in the ISV report will be communicated to PRA Group to be incorporated into the PRA activities, as necessary.

References:

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

2. APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan", Westinghouse Electric Company LLC.

3. APP-GW-GL-011 (WCAP-16555), Rev. 0, "AP1000 Identification of Critical Human Actions and Risk Important Tasks," Westinghouse Electric Company LLC.

4. APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Design Verification Plan," Westinghouse Electric Company LLC.

5. APP-GW-GL-022, Chapter 30, Rev. 0, "AP1000 Probabilistic Risk Assessment," Westinghouse Electric Company LLC.

6. WCAP-15860, Rev. 2, "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan," Westinghouse Electric Company LLC.

7. APP-OCS-GGR-110, Rev A, "AP1000 Technical Support Center and Emergency Operations Facility Workshop," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-23
Revision: 1

Question:

DCD Tier I contains V&V ITAAC in Table 3.2-1, #4 and #5. ITAAC #4 states in part: "A report exists and concludes that the HFE V&V Implementation was developed in accordance with the programmatic level description ..." WCAP-16769-P provides the Westinghouse logic for closing ITAAC #4. WCAP-16769P does not state such conclusions, as specified in the ITAAC, although it seems as if that would be the appropriate place to do so. Please provide the report specified by the ITAAC.

Westinghouse Response:

WCAP-16769-P (Reference 1) described the basis for closing COL Information Item 18.11-1 via stating that the confirmation of completion of the HFE V&V implementation plans will be accomplished via ITAAC #4. WCAP-16769-P did not propose to address ITAAC #4. At this stage in the licensing process, it is not considered necessary to revise WCAP-16769-P or provide an additional report to describe the logic for closing ITAAC #4.

The wording provided in DCD Revision 15, Tier 1, Table 3.2-1 Item 4 (ITAAC item #4) Acceptance Criteria column is a based on a generic statement used to denote when documentation is required to fulfill the corresponding design commitment. This design commitment has been addressed by the submission of the following V&V implementation plans:

1. APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan," Westinghouse Electric Company LLC. (Reference 2).

2. APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan," Westinghouse Electric Company LLC. (Reference 3).

3. APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan," Westinghouse Electric Company LLC. (Reference 4)

4. APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Westinghouse Electric Company LLC. (Reference 5).

5. APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan," Westinghouse Electric Company LLC. (Reference 6).

It is WEC's understanding that the NRC intends to close DCD Revision 15 COL Information Item 18.11-1 as being redundant with ITAAC #4. Therefore, ITAAC #4 is not included in the DCD Revision 17, Tier 1, Table 3.2-1.

Question Rev 1:

The response states that there is no report to satisfy the requirements of ITAAC #4. However, Rev. 17 has removed ITAAC #4. This is not acceptable particularly since exceptions are being taken from the programmatic level description for V&V. Provide this report and ensure it explicitly states where exceptions are taken to the program plan. As discussed at the public meeting held 12/09/2009 this report can be integrated into the ITAAC closure documents as was done for other ITAACs or into the DCD.

Westinghouse Response Rev 1:

As discussed at the public meeting held 12/9/2009, Revision 18 of the DCD will include text to state that DAC Item #4 from Revision 15 of the DCD is closed via the issuance of the five V&V documents (References 2 to 6). These five V&V documents will be referenced as Tier 2* in Revision 18 of the DCD.

The total number of exceptions from WCAP-15860 "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan" (Reference 7) is small and applies only to the ISV Plan (Reference 3). Therefore, the exceptions will be clearly documented at the relevant points within the ISV Plan, and will not be integrated into the DCD.

References:

1. WCAP-16796-P (APP-GW-GLR-084), Rev. A, "AP1000 Human Factors Engineering Verification and Validation," Westinghouse Electric Company LLC.

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

3. APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan," Westinghouse Electric Company LLC. (Reference 2).

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

5. APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Westinghouse Electric Company LLC. (Reference 4).

6. APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan," Westinghouse Electric Company LLC. (Reference 5).

7. WCAP-15860, Rev. 2, "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

The DCD markup below is provided below to indicate the proposed changes in section 18.11. The markup is based on DCD Revision 17.

18.11 Human Factors Engineering Verification and Validation

A programmatic level description of the AP1000 human factors engineering verification and validation program is provided by Reference 1. Figure 18.11-1 shows the verification and validation activities conducted as part of AP1000 human factors engineering program. Using the programmatic level description, the development of an implementation plan for the AP1000 human factors engineering verification and validation is executed and documented as discussed in Reference 2. <u>The implementation of the verification and validation activities is detailed in the five documents References 3 to 7.</u>

18.11.1 Combined License Information

The Combined License information requested in this subsection has been fully addressed in Reference 2 (APP-GW-GLR-084). No additional work is required by the Combined License applicant to address the Combined License information requested in this subsection.

The following words represent the original Combined License Information Item commitment, which has been addressed as discussed above:

> 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.

18.11.2 References

[*1.* *WCAP-15860, "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan," Revision 2, October 2003.*]*

2. APP-GW-GLR-084, "AP1000 Human Factors Engineering Verification and Validation," Westinghouse Electric Company LLC.

[3. *APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan," Westinghouse Electric Company LLC.*]*

[4. *APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan," Westinghouse Electric Company LLC.*]*

[5. *APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan," Westinghouse Electric Company LLC.*]*

[6. *APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Westinghouse Electric Company LLC*]*

[7. *APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan," Westinghouse Electric Company LLC.*]*

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-24
Revision: 1

Question:

The ISV Plan does not address simulator verification beyond software testing identified in Section 2.3. Please add this information to the ISV Plan.

Westinghouse Response:

The objective of simulator testing in preparation for ISV is to demonstrate that the simulator responds in a manner similar to the reference unit while utilizing the operating procedures. The testing will be carried out in four phases and will take a total of 22 calendar weeks, with WEC personnel working double shifts. The details of the four phases of simulator testing are provided below. This information will be added to the ISV Plan Rev C to be issued by January 31, 2010. Note that the detailed list of simulator test is based on the current information regarding the ISV scenarios. This list may alter once the final detailed scenario descriptions are complete.

PHASE 1

In Phase 1, simulator stabilization and a series of 24 dedicated tests will be performed. Details of these tests can be found in the table at the end of this RAI Response. At the end of Phase 1, approximately 4 calendar weeks are allowed to fix any identified problems and retest as necessary.

PHASE 2

Phase 2 will comprise a repetition of the Phase 1 tests, but without the simulator stabilization process. The Phase 2 testing will take a total of 19.5 shifts, or 2 weeks in duration. At the end of Phase 2, approximately 2 calendar weeks are allowed to fix any identified problems and retest as necessary.

PHASE 3

Phase 3 will put into effect the ISV scenarios as described in the ISV Plan. Six of the scenarios will take 10 shifts to test, and the remaining twenty scenarios will each take half a shift. Therefore, the twenty-six scenarios will take a total of 20 shifts or 2 calendar weeks to test. At the end of Phase 3, approximately 4 calendar weeks are allowed to fix any identified problems and retest as necessary. Note, that if the total number of scenarios was to change, the amount of required testing will be adjusted accordingly.

PHASE 4

Phase 4 will repeat the tests of Phase 3, and therefore will take 2 calendar weeks. At the end of Phase 4, approximately 2 calendar weeks are allowed to fix any identified problems and retest as necessary.

Table of Phase 1 Tests

TEST PROCEDURE TITLE	TIME REQUIRED
Simulator Stabilization	160 hours
AP1000 Simulator 100% Power Steady-State Accuracy Test Procedure	8 hours
AP1000 Simulator Normal Operations Test Procedures: • Normal Operation at 100% Power General Operating Test Procedure • Plant Shutdown from Mode 1 to Mode 3 Test Procedure • Plant Cooldown From Mode 3 to Cold Shutdown Test Procedure • Plant Cooldown From Mode 5 to Refueling Mode Test Procedure • Plant Heatup from Refueling Configuration to Mode 5 Test Procedure • Plant Heatup from Mode 5 to Mode 4 • Plant Heatup from Mode 4 to Mode 3 Test Procedure • Plant Startup from Mode 3 to 2% Power Test Procedure • Plant Power Escalation From 2% to 100% Power Test Procedure	80 hours
AP1000 PXS06 - IRWST to Containment Leak Malfunction Test Procedure	3 hours
AP1000 Simulator Component Failure Test Procedure	24 hours
AP1000 Simulator Loss of all Feedwater w/ATWS Scenario Test Procedure	8 hours
AP1000 Simulator SGS03 - Steamline Break Downstream of MSIVs Malfunction Test Procedure	3 hours
AP1000 Simulator RCS07 - Cold Leg LOCA Malfunction Test Procedure	3 hours
AP1000 Simulator RXS01 - Core Fuel Leak Malfunction Test Procedure	3 hours
AP1000 Simulator RCS17 - Steam Generator Tube Leak/Rupture High in Tube Bundle Malfunction Test Procedure	3 hours
AP1000 Simulator WLS02 – Effluent Holdup Tank Leak Malfunction Test Procedure	3 hours
AP1000 Simulator ECS01 - Station Blackout Malfunction Test Procedure	3 hours
AP1000 Simulator CCS06 - Aux Building Header Leaks Malfunction Test Procedure	3 hours
AP1000 Simulator SGS01 - Steamline Break Inside Containment Malfunction Test Procedure	3 hours

TEST PROCEDURE TITLE	TIME REQUIRED
AP1000 Simulator CAS01 - CAS Instrument Air Line Break D/S MT01A/B Malfunction Test Procedure	3 hours
AP1000 Simulator RCS03 - Reactor Coolant Pump Shaft Break Malfunction Test Procedure	3 hours
AP1000 Simulator SWS02 - SWS Discharge Line Break Malfunction Test Procedure	3 hours
TOTAL HOURS	316 hours
TOTAL SHIFTS	39.5 shifts
Calendar Weeks	4 weeks

Question Rev 1:

The response discusses 4 Phases of simulator testing. Please clarify the purposes of Phases 3 and 4. Are either of these the ISV itself or are they preliminary to the ISV? Also, the ISV Plan indicates that "the simulator will satisfy general requirements of Sections 3 and 4 of ANSI/ANS-3.5-1998." Please describe how the simulator will meet the requirements of ANSI/ANS 3.5, Section 4.2.1, Physical Fidelity and Human Factors.

Westinghouse Response:

It can be confirmed that the phases of simulator testing are not part of ISV. This testing is carried out by the Simulator Group prior to ISV and refers to the terminology utilized during the simulator development process.

The simulator and the ISV facility will meet the requirements of ANSI/ANS 3.5, Section 4.2.1, Physical Fidelity and Human Factors. The only exception is in Section 4.2.1.3, Control Room Environment. The ISV will be undertaken at the Engineering Development Simulator (EDS) located at the Westinghouse Cranberry Facility in Pittsburgh. The room dimensions and floor plan will be identical to the final MCR design. However, due to the constraints of the building, the ceiling height and ceiling design is different (i.e., the EDS ceiling height is approximately 2 feet lower and does not include the passive cooling fins; instead there is a conventional office building tiled ceiling). This does result in the lighting system to be different, although still representative of the final lighting system design. In addition, the heating and ventilation is provided by a conventional office building system, and will therefore not be representative of the final as-built MCR. The acoustic properties can not be completely replicated although they will be similar (i.e., painted walls, 'hard' ceiling tiles).

In summary, the design of the EDS has made every attempt to be as representative as possible of the final MCR design so that the final design can be at least partially assessed. It is considered that any differences will have minimal or no impact on ISV crew performance.

References:

None.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-26
Revision: 1

Question:

WCAP-15860, Sec. 4.9, Subjects, states that "validation crews will consist of currently qualified operating crews, as adjusted in number to man the AP1000 control room for conditions of minimum and maximum staffing." TR-52, AP1000 MCR Staff Roles and Responsibilities, defines the minimal and maximum crews, but the crew size in the ISV does not fully agree with that of TR-52. TR-52 states the minimal crew size will be 1 RO, 2 SROs, and 2 AOs. Also it notes that the STA role will be filled by one of the available SROs, not by a dedicated individual. TR-52 also defines two other staffing levels, one with an added unit supervisor and a maximum staff level. Most of the ISV scenarios (1 to 19) will be done with a staff of 2 ROs, 1 SRO, and 1 STA, while other scenarios (20 to 29) will be done with 2 ROs and 1 SRO. The ISV does not address at all the maximum crew as defined in TR-52. Please address the apparent conflicts in staffing levels between the various Westinghouse documents.

Westinghouse Response:

It is noted that most ISV scenarios are performed with a MCR staffing complement that is representative of utilities' expected minimum complements. This comprises two Reactor Operators, one Senior Reactor Operator, with one Shift Technical Advisor (for selected scenarios). It is also assumed that there are two Auxiliary Operators elsewhere in the plant. The number of Auxiliary Operator on shift does not impact the MCR design; therefore test staff (rather than test subjects) will fulfill the Auxiliary Operators' responsibilities in ISV by scripted role play. It is recognized that this expected minimum MCR staffing complement differs from the information provided in Reference 1, Section 4.1.2. However it was considered to be appropriate (and more realistic) to implement ISV with the crew size that the utilities are planning to adopt than use an alternative minimum crew size.

Reference 1 Section 5.3 specifies the operating staff for a large complement of staff and visitors in the MCR. This equates to the maximum capacity of the emergency habitability system for the MCR, and comprises the following:

In the access controlled area within the MCA section of the MCR:

One MCA RO (licensed RO)
One MCR Supervisor (licensed SRO)
First additional licensed RO (normally non-designated elsewhere in the MCR)
Second additional licensed RO (normally elsewhere in the plant)
One Unit Supervisor (licensed SRO)
One STA

Elsewhere in the MCA section of the MCR
One Shift Manager (licensed SRO)
One Communicator (for communications external to the MCR)
One NRC Observer
One Plant Management Observer
One additional member of the operations staff

WEC confirms that ISV will address the maximum staffing levels in the MCR. This will be addressed by means of scripted complications in one or more scenarios. The completed detailed scenario descriptions will be included in Revision C of the ISV Plan to be issued by January 31, 2010. Due to the ongoing development of the detailed scenario descriptions, further information can not be provided at this time. WEC would welcome a discussion with the NRC to address any concerns.

Question Rev 1:

In the response WEC states that it was considered to be appropriate (and more realistic) to implement ISV with the crew size that the utilities are planning to adopt than use an alternative minimum crew size. WEC also provides an approach to validate the maximum crew size. These seem to be reasonable approaches, but do not agree with the staffing specified in TR-52.

Please clearly define the max and min crew sizes and update TR-52 to reflect these revised values.

Westinghouse Response:

The minimum and maximum crew sizes will be clearly specified in the ISV Plan, Rev C. The minimum crew size comprises two Reactor Operators, one Senior Reactor Operator, with one Shift Technical Advisor. The maximum crew size (and maximum number of people in the MCR) is the 11 people listed above. The detailed scenario descriptions will state the staffing per individual scenario.

TR-52 (Reference 1) and the supporting APP-OCS-GJR-003 "AP1000 Main Control Room Staff Roles and Responsibilities" (Reference 2) will be updated to reflected the utilities minimum staffing levels of two Reactor Operators, one Senior Reactor Operator, with one Shift Technical Advisor. Note, the maximum crew size remains unchanged.

References:

1. APP-GW-GLR-010, Rev. 2, "AP1000 Main Control Room Staff Roles and Responsibilities," Westinghouse Electric Company LLC.

2. APP-OCS-GJR-003, Rev 1, "AP1000 Main Control Room Staff Roles and Responsibilities," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

APP-GW-GLR-010, Rev. 2, "AP1000 Main Control Room Staff Roles and Responsibilities," Westinghouse Electric Company LLC.

RAI Response Number: RAI-SRP18-COLP-28
Revision: 1

Question:

According to the ISV plan, if a failure on Pass/Fail criteria is encountered on one (of the two) replications, then another (a 3rd) trial is run "to avoid an ambiguous result." If the added scenario trial is successful, the final outcome is not clearly specified in the plan. Is the design considered validated for that scenario? If so, the design may be validated with two out of three successful trials, e.g., if a risk-important human action can be accomplished two out of three times, it's acceptable. This is an unacceptably weak standard of acceptance. Please clarify actions when a scenario fails and how that scenario is eventually validated as successful.

Westinghouse Response:

WEC has reviewed the required number of repetitions per scenario, and has determined that each scenario will be run three times. This will be revised in the ISV Plan Rev C to be issued by January 31, 2010.

If a trial fails, then a Human Engineering Discrepancy (HED) will be generated. The HED resolution process will prioritize the failures based on the potential consequences, cause, the extent of the failure and the likelihood of recurrence. The HEDs that are assessed as being significant, important or related to safety, will receive the highest priority. The HED prioritization and evaluation process will consider several aspects, including possible commonalities with other HEDs across scenarios.

The basis for the HED prioritization (as detailed in APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process", Reference 1) is as follows:

- Priority 1 – These HEDs have direct or indirect safety consequences. The HEDs with direct safety consequences are those that affect personnel performance where the consequences of human error could reduce the margin of plant safety below an acceptable level. The acceptable level is determined via indications such as violations of technical specification safety limits, operation limits or limiting conditions for operations. Priority 1 HEDs include discrepancies associated with safety-related HSI resources or critical human tasks (if any were to exist). The HEDs with indirect safety consequences are those that prevent normal plant operation (i.e., prevent the execution of tasks as required by the plant's operating procedures). They include (but are not limited to) discrepancies associated with defense-in-depth systems and risk-important tasks.

- Priority 2 – These HEDs substantially affect the plant's desired performance and efficiency, or other factors affecting overall plant operability. These may include discrepancies associated with the mandatory HFE guidelines (see APP-OCS-GEH-120, "AP1000 HFE Design Verification Plan", Reference 2), the availability of non-safety related HSI resources, or other human performance issues that effect plant maintenance or productivity.

- Priority 3 – These HEDs are all other discrepancies.

WEC will determine the appropriate evaluation process for any changes resulting from the resolution of HEDs generated from the ISV on a case-by-case basis. A graded approach will be adopted, based on the complexity and impact of the changes. Independent verifiers will perform the evaluation of the HED resolution, and this may involve a retest, if necessary. The evaluation processes and associated results will be documented in APP-OCS-GER-420, "AP1000 Human Factors Engineering Resolution Verification Report" (Reference 3).

For HEDs that cannot be resolved until the plant is built and equipment is installed, the HFE verification at plant startup includes a mechanism to check and resolve any outstanding issues (Reference 4). All Priority 1 and Priority 2 HEDs are required to be resolved prior to plant startup.

Question Rev 1:

Are there any high level criteria that can be stated as requiring a retest, such as those listed in Section 6.2.1 of the ISV Plan? The response indicates that each scenario will be run three times. If a trial fails, the HED resolution process is conducted and design changes may be implemented. Independent verifiers will determine if retesting is necessary. It remains unclear what the actual criteria are for determining that the design passes for a given scenario. And it seems as if there may be no retest even if the high-level acceptance criteria from Section 6.2.1 of the ISV Plan are not met. For example, suppose a scenario has one pass and two failures. Each of the two failures results in design changes to resolve the HEDs identified. If the independent verifiers determine that no additional testing is necessary, is the design considered validated for that scenario even though two out of three scenarios were failures? Please clarify how you determine that testing of a particular scenario is successfully completed. Also please address actions when the acceptance criteria in Section 6.2.1 are not met for a given scenario.

Lastly, please define "defense-in-depth systems" as used in the discussion of Priority 1 HEDs.

Westinghouse Response:

It can be confirmed that is a scenario 'fails' according to the pass/fail criteria, then the problem and resultant HED resolutions will be assessed via a full re-test. The scenario will be re-run three times using crews that had not previously been exposed to this particular scenario.

For problems identified based on the diagnostic criteria, the requirement for running a fourth scenario, re-testing and concluding that a scenario is successfully complete will be determined on a case-by-case basis. The means to determine the re-test requirements is as follows:

1. There are multiple Priority 1 HEDs derived from the diagnostic criteria. These were identified by more than one run (i.e., more than one crew) and the problem was confirmed based on more than one of the measurement techniques. This indicates that an important problem undoubtedly exists. Therefore, once the HEDs have been resolved, the scenario will be re-run three times using crews that had not previously been exposed to this particular scenario.

2. There are a small number of Priority 1 HEDs derived from the diagnostic criteria, the problem only arose in one run (i.e., only identified by one crew) and is not confirmed by multiple measures. In this case, the scenario will be re-run utilizing a crew that had not previously encountered this scenario in order to determine if a problem exists (i.e., a fourth replication carried out prior to the resolution of the HED). If the re-run confirms that a Priority 1 HED problem does exist, once the HED(s) have been resolved, the scenario will be re-run three times using crews that had not previously been exposed to this particular scenario.

3. There are multiple Priority 2 HEDs derived from the diagnostic criteria (and no Priority 1 HEDs). These were identified by more than one run (i.e., more than one crew) and the problem was confirmed based on more than one of the measurement techniques. This indicates that a problem exists. Therefore, once the HEDs have been resolved, the scenario will be re-run three times using crews that had not previously been exposed to this particular scenario.

4. There are a small number of Priority 2 HEDs derived from the diagnostic criteria (and no Priority 1 HEDs), the problem only arose in one run (i.e., only identified by one crew) and is not confirmed by multiple measures. In this case, the scenario will be re-run utilizing a crew that had not previously encountered this scenario in order to determine if a problem exists (i.e., a fourth replication carried out prior to the resolution of the HED). If the re-run confirms that a Priority 2 HED problem does exist, once the HED(s) have been resolved, the scenario will be re-run three times using crews that had not previously been exposed to this particular scenario.

5. There are multiple Priority 3 HEDs derived from the diagnostic criteria (and no Priority 1 or 2 HEDs). The scenario will not be run a fourth time and will not be re-run once the HEDs have been addressed.

The strategy/process described above will be fully described in the ISV Plan, Rev C. This will include a flow diagram to illustrate the process.

The term “defense-in-depth systems” as used in the discussion of Priority 1 HEDs, refers to the multiple barriers that prevent the release of radioactive materials. These barriers are non-safety and comprise a variety of measures including the provision and design of structures, systems and components (SSCs), quality assurance, administrative controls and the human operator (or maintainer). In respect to ISV, a Priority 1 HED related to a defense-in-depth system will be human errors or discrepancies associated with equipment designated as Class D. The DCD Chapter 3, Section 3.2.2.6, provides a description of the Class D categorization criteria and outlines the additional requirements on procurement, inspection and monitoring.

As examples from the DCD, Class D is assigned to SSCs that provide the following functions:

- Provide core or containment cooling which prevents challenges to the passive core cooling system and the passive containment cooling system
- Process, extract, encase, store or reuse radioactive fluid or waste
- Verify that plant operating conditions are within technical specification limits
- Provide permanent shielding for post accident access to Class A, B or C SSCs or of offsite personnel
- Handle spent fuel, the failure of which could result in fuel damage such that limited quantities of radioactive material could be released from the fuel (for example, fuel handling machine, spent fuel handling tool, new and spent fuel racks)
- Protect Class B or C SSCs necessary to attain or maintain safe shutdown following a fire
- Indicate the status of protection system bypasses that are not automatically removed as a part of the protection system operation
- Aid in determining the cause or consequences of an event for post-accident investigation
- Prevent interaction that could result in preventing Class A, B or C SSCs from performing required safety-related functions
- Limit the buildup of hydrogen in the containment atmosphere to acceptable values

References:

1. APP-OCS-GEH-420, Rev. B, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Westinghouse Electric Company LLC.

2. APP-OCS-GEH-120, "AP1000 HFE Design Verification Plan," Westinghouse Electric Company LLC.

3. APP-OCS-GER-420, "AP1000 Human Factors Engineering Resolution Verification Report", Westinghouse Electric Company LLC.

4. APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan", Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-31
Revision: 1

Question:

The ISV Plan contains considerable detail in some areas, but not others. As noted in the ISV Plan itself, Section 3.4 indicates that detailed procedure development and scenario development must be completed before validation testing can begin. Such detail also must be completed before the staff can conduct a complete Implementation Plan Review. Additional examples of areas where additional detail is needed are given in the other RAIs in this Table. Please provide the added detail.

Westinghouse Response:

The detailed scenario descriptions will be completed in Revision C of the ISV Plan, to be issued by 31st January 2010. This will include the scenario-specific descriptions, initial conditions, sequence of events, participants, termination criteria, plant performance and personnel performance measures and criteria. The observer guides for each of the scenarios will be completed in later revisions of the ISV Plan (i.e., after Rev C), following the completion of corresponding ISV detailed scenario descriptions and operating procedures.

Numerical revisions of all EOPs are currently available for NRC review at any time. Walk-through validations being conducted by the AP1000 Operations Procedure group will continue to improve the fidelity and accuracy of these procedures.

The process for the development, review and approval of AP1000 Operations Procedures is included in the Writer's Guidelines, APP-GW-GJP-100 and APP-GW-GJP-200 (References 1 and 2, respectively). These documents have been placed on the docket with the NRC for the AP1000, and this process is additionally defined in APP-GW-GLR-040 (Reference 3), which has been submitted to the NRC for review and approval. This process incorporates proven techniques and operational experience to ensure that the AP1000 Operations Procedures are developed in accordance with regulatory guidelines and industry standards.

It is noted that the actual implementation of ISV is not scheduled to take place for some time. Between now and ISV implementation, Westinghouse will continue to progress the preparations for ISV taking into account further detailed and final information on the OCS and HSI designs, the simulator, procedures and training programs. To assist the preparation activities, there will be further interim revisions of the ISV Plan (i.e., after Rev C) to support preparation activities. Prior to ISV, the ISV Plan will be issued as Revision 0 and placed under formal configuration control. Revision 0 will contain the final approved details of the scenarios, including all the aspects mentioned in the first paragraph of this RAI Response. It is recognized that the NRC needs detailed information in order to complete the implementation plan review process. Therefore, Westinghouse will provide detailed information in ISV Plan, Rev C, (by 31st January

2010) to facilitate the review process with the aim of demonstrating that the detailed scenario-specific information will meet the NRC's expectations. Some of the detailed information may be subject to change as the design finalization program continues; although this should not impact the outcome of the NRC's review.

Question Rev 1:

NRC requests at least 3 scenarios be fully complete including the observer guides. Does the revision schedule mean that the ISV plan will not be Tier 2*? WEC should also clarify how revisions to the ISV plan (made after the NRC review is completed for design certification of Rev. 17 of the DCD) will be made available to NRC for their review.

Westinghouse Response:

As discussed at the public meeting held 12/9/2009, the ISV Plan, Rev B, will be divided into two documents, as follows:

APP-OCS-GEH-320, Rev. C, "AP1000 Human Factors Engineering Integrated System Validation Implementation Plan"

APP-OCS-GEH-321, Rev. A, "AP1000 Human Factors Engineering Integrated System Validation Scenario Information"

The APP-OCS-GEH-321, Rev A, document will contain three example observe guides.

In order to facilitate subsequent referencing, updating and the NRC's review of the ISV documentation, APP-OCS-GEH-320 will be designated as Tier 2* in the DCD Revision 18. This is the main governing document and it is anticipated that this document will not require further revision. If any updates are required, they should be relatively minor.

The APP-OCS-GEH-321 document will contain the detailed scenario descriptions and the observer guides. It is anticipated that the details in this document will need to be updated as the AP1000 design progresses and the preparations for ISV are further developed. This document will not be Tier 2*.

References:

1. APP-GW-GJP-100, Rev. H, "Writer's Guideline for Normal Operating Procedures," Westinghouse Electric Company LLC.

2. APP-GW-GJP-200, Rev. E, "Writer's Guideline for Two Column Procedures," Westinghouse Electric Company LLC.

3. APP-GW-GLR-040, Rev. 1, "Plant Operations, Surveillance, and Maintenance Procedures," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

RAI Response Number: RAI-SRP18-COLP-32
Revision: 1

Question:

The plan distinguished between measures used for pass/fail (P/F) criteria and those used for diagnostic purposes. P/F measures are measures reflecting tech spec performance and risk-important human actions (RIHAs) as defined in the PRA. This seems to provide a limited perspective on overall crew performance. Section 4.4 of the WCAP discusses "Risk important tasks" as including potential task identified in the OSA and EOPs as well as those identified in the PRA. The EOP tasks are likely captured in the scenarios. Are there any added important tasks from the task analysis?

Westinghouse Response:

The P/F criteria provide the lower limits on acceptable operation and are consistent with the AP1000 plant safety and risk analyses. However, the P/F criteria are not the only means to assess successful trial performance. The P/F criteria also ensure that a margin is maintained to unsafe conditions and unacceptable accident results.

In contrast to the P/F criteria, diagnostic criteria allow a wider perspective on crew performance, including scenario-specific measures. This allows any concerns for acceptable performance to be identified and raised as an HED. The conclusion as to whether performance is acceptable also takes into account the integrated evaluation of all the validation results.

It can be confirmed that the risk-important tasks (and outlined in WCAP-15860 Section 4.4, Reference 1) are included in the ISV scenarios. Also, the following tasks from the OSA-2 task analysis (APP-OCS-J1R-220, Reference 2) are included:

- OSA-2 Task 22, "Failure to Close Equipment Hatch and Personnel Airlocks" – This task will be incorporated as a complication to one of the lower operating mode scenarios.

- OSA-2 Task 23, "Data Display and Processing System (DDS) Failure" – The ISV scenario Plant Shutdown from PMS based on the loss of the DCIS is representative of a DDS failure task.

- OSA-2 Task 24, "Loss of Computerized Procedure System" – Anticipated Transient Without SCRAM (Steamline Break) will include the loss of the computerized procedure system as a scenario complication.

- OSA-2 Task 25, "Technical Specification Monitoring" – This activity is implicit across a number of the ISV scenarios. The evaluation criteria in each scenario will specify a representative sample of Technical Specification monitoring tasks, and will incorporate maintenance, test, inspection and surveillance tasks.

- OSA-2 Task 26, “Control Room Evacuation” – Plant Shutdown and Cooldown from the Remote Shutdown Panel based on a fire in the MCR. This scenario will address the transfer of control and operation from the MCR to the Remote Shutdown Room, establish plant control and utilize the Remote Shutdown Workstation to conduct plant cooldown.

The tasks derived from the OSA-2 analysis results which were not previously included in the ISV Plan, Rev B, will be added to the ISV Plan, Rev C, to be issued by 31st January 2010. The ISV Plan will clearly identify the source of the selection. Therefore, it can be confirmed that the risk-important tasks and the additional important tasks identified in the OSA-2 analysis will be incorporated in ISV.

Question Rev 1:

The response identifies five tasks derived from OSA-2 task analyses that will be included in the ISV. However, additional information is needed to close this RAI:
A. how were the tasks selected (what criteria were used to determine their inclusion in ISV)
B. does the addition of these tasks require additional scenarios
C. is the performance of these tasks part of the P/F measures or the diagnostic measures?
Please provide this information.

Westinghouse Response:

The response to the three questions above is as follows:

A. OSA-2 Task 22, “Failure to Close Equipment Hatch and Personnel Airlocks”. This task will be incorporated as a complication in one of the lower operating mode scenarios (Scenario 19). This task is identified as a risk-important task in APP-GW-GL-011, “AP1000 Identification of Critical Human Actions and Risk Important Tasks” (Reference 3). This task was omitted from the ISV Plan, Rev B.

   The remaining four tasks (OSA-2 Tasks 23, 24, 25 and 25) were identified as tasks that may have human performance concerns such as high workloads or potential high error rates (see APP-OCS-J1R-220, Reference 2). OSA-2 Task 23 will be addressed in scenarios 9, 14, 19 and 22, OSA-2 Task 24 will be addressed in scenarios 9 and 19, OSA-2 Task 25 is addressed in all of the scenarios and OSA-2 Task 26 is addressed in scenario 7.

B. The additional tasks have been integrated into existing scenarios as additional tasks or complications, with the exception of OSA-2 Task 26 “Control Room Evacuation”, which has a dedicated scenario.

C. All of the additional five tasks are incorporated into the detailed scenario descriptions, which includes the identification of the associated general safety limits and key technical specifications. Therefore, while each of the tasks is not assessed in isolation from the rest of the scenario, performance against the relevant pass/fail criteria will be determined. Task performance will also be assessed utilizing the diagnostic criteria identified for each of the scenarios. In addition, OSA-2 Task 26, “Control Room Evacuation” (which has its own scenario) does have general safety limits and key technical specifications specifically related to this task.

References:

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

2. APP-OCS-J1R-220, Rev. B, “Operational Sequence Analysis (OSA-2) Summary Report,” Westinghouse Electric Company LLC.

3. APP-GW-GL-011, Rev. 0, “AP1000 Identification of Critical Human Actions and Risk Important Tasks,” (WCAP-16555), Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-33
Revision: 1

Question:

The ISV Plan indicates that risk-important actions will be measured. In addition, operator task performance will also be measured using observer guides for each scenario. An example is provided in Appendix F. However, the ISV plan does not address how these behaviors are selected for assessment. Please discuss.

In addition, Appendix F provides an example only. The task behaviors to be assessed for each scenario are needed for the implementation plan review. Please provide.

Westinghouse Response:

Observer guides will be provided for each individual scenario, and will be based on the associated procedures, job and task analysis information. The operator behaviors (actions or tasks) selected for assessment are the actions identified by the procedures to address the conditions of the scenario. The observer guides are in part a subset of the applicable procedures, formatted to facilitate the identification of the expected course of events, the operator behaviors and the applicable criteria for those behaviors. Where applicable, the observer guides will also incorporate the task identification, task breakdown and job analysis information developed as part of the operator training program and training materials.

Westinghouse will provide the scenario-specific observer guides in later revisions of the ISV Plan (i.e., after Rev C). The observer guides cannot be completed until the detailed ISV scenario descriptions are finished (which will be incorporated into the ISV Plan, Rev C, to be issued by 31st January 2010). However, to assist the implementation plan review process, the ISV Plan, Rev C, will contain an example of a detailed observer guide for at least one of the ISV scenarios.

Question Rev 1:

The response indicates that the RIHA behaviors to be measured are "the actions identified by the procedures to address the conditions of the scenario." What does this statement mean? Will all actions specified by the procedure be measured? Will each of the behaviors be categorized as P/F criteria? Please provide these clarifications.

The response also indicates that Rev C of the plan will contain an example of a detailed observer guide for at least one ISV scenario. The staff does not consider a single guide is sufficient to provide reasonable assurance that RIHA's are being properly assessed.

Westinghouse Response:

It can be confirmed that three example observer guides will be completed to support the NRC's review.

The observer guides will not include all of the individual actions identified in the procedures. This was considered to be an ineffective method to identify the adequacy of the operators' performance. From past experience obtained in the Human Factors Engineering Tests, it was apparent that the observers were focused on completing the observer guides and this hindered their assessment of the overall task performance and crew behaviors. Conversely, the observers did not complete the observer guides; and instead they focused on assessing overall crew performance.

Therefore, the observe guides will be relatively less detailed and are designed to be easily implemented while not distracting from assessing crew performance. Each observer guide includes the following:

- Scenario title and brief description of the initial conditions.
- Table with the following columns:
    - Sequence of events. This comprises the major events only.
    - Expected response. This is provided to inform the observer on successful task performance
    - Satisfactory/Unsatisfactory. This column is blank for the observer to provide their notes.
- Evaluation Items
    - HSI resources
    - Staffing levels
    - Recognition and response to malfunctions (scenario malfunctions are listed)
    - Space for the observer to provide comments/notes.

Each of the events and expected responses are not necessarily the items specified in the scenario descriptions as the pass/fail criteria. In order to provide a logical observer guide and aid the observer in following the progress of the scenario, the events may simply represent key progress points/steps through the scenario. It is noted that the observer guides are one of a number of measurement techniques to determine if the scenario had passed or failed. However, the risk-important tasks will be included in the events.

References:

None.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

RAI Response Number: RAI-SRP18-COLP-35
Revision: 1

Question:

The ISV Plan does not address measurement characteristics. It is recognized that most of the measurement characteristics identified in Review Criterion 1 in NUREG-0711, Section 11.4.3.2.5.1 will not be applicable to many of the measures, but the plan should at least address the characteristics identified in Section 11.4.3.2.5.1 that are applicable. For example, the plan can explain how the questionnaire in Appendix D measures those variables listed on page 6-1 (workload, situation awareness, teamwork, usability, and goal achievement) and why their approach to measuring these variable in this way is a good one. The plan also indicates that the questionnaire will be filled out by both participating operators and observers. But, it is not clear how observers can answer many of the questions presented, e.g., "Was there anything about the PMS, PDSP, or SDSP surprising, misleading, or unclear?" Please update the Plan to address these issues.

Westinghouse Response:

The measurement characteristics used in the ISV are described in Section 6.1 of the ISV Plan, Rev B. These are described below along with the corresponding measurement characteristics identified in Section 11.4.3.2.5.1 of NUREG-0711, which are noted at the applicable points in italics:

1. <u>Workload Rating Scales</u> - The Task Load Index (TLX) is a widely used measure of subjective mental workload and has been subject to many years of research and application by NASA (*construct validity*). After each scenario is completed, the TLX is administered to the test subjects (*unintrusiveness*), and the data is relatively straightforward to process (*simplicity*). The TLX ratings capture both high and low levels of workload (*sensitivity/scale*), although whether the workload levels are acceptable or appropriate is determined in respect to the situation and scenario. In addition, separate TLX subscales for different components of subjective workload (*resolution*) will provide useful information as to the sources of workload (*diagnosticity*).

2. <u>Questionnaires</u> (Appendix D) – Likert scale ratings are general tools of subjective measurement. In ISV, a post-test questionnaire will be given to the operators and observers in order to investigate specific areas of interest and to assess workload, situation awareness, team work, and goal achievement (*construct validity*). The questionnaires will administered to the test participants after the trail is completed (*unintrusiveness*) and the data is straightforward to process (*simplicity*). Likert scales are developed to give a full and uniform rating range for each answer (*sensitivity*), reflecting

both good and bad results (*impartiality*). In addition, multiple questions for each of the areas of interest (*resolution*) will provide an insight into observed operator performance (*diagnosticity*).

The questionnaire (Appendix D) will be modified to take into account that certain questions cannot be readily answered by both the operators and the observers alike. Two versions of the questionnaire will be provided – one for operators and one for observers.

3. Observer Checklists (Appendix F) – These checklists will assist observers in focusing on and identifying the key instances of task performance that correspond to successful operator performance, as planned for each scenario (*objectivity*). The observer checklists use the operating procedures as a basis, and therefore, the checklists are highly valid in terms of content (*construct validity*). The use of the observer checklists does not interfere with the test performance by the subjects/operators. The results obtained from the checklists are straightforward to process (*simplicity*).

   It is noted that the observer checklist entries are most helpful when the events and behavior follow the anticipated course of the scenario (*sensitivity*), as they are prepared in terms of 'good' performance (*impartiality*). Also, note that the level of detail is relatively less than contained in the actual procedures, due to the real-time needs and limitations of observation (*resolution*). The repeatability of the checklist results is anticipated to be relatively high, because there is redundancy across observers; plus the results can be subsequently confirmed by the event and plant performance recordings (*reliability*).

4. Debriefing (Appendix G) – Debriefing supports the clarification of the other more structured results (*diagnosticity*), and allows for both good and bad results to be reported (*impartiality*). The debriefing process consisting of a guided but open discussion on the participants' test experiences, perceptions and concerns (*simplicity*). While individual and group dynamics may affect the course and results of any discussion, the repeatability of the process and results will be supported by provision of a debriefing protocol and the use of meeting recorders (*reliability*).

5. Discrete Event Recording – Computer-generated records of time-stamped actions, status changes of equipment, and other discrete events are used to evaluate time margins and will assist in confirming the results of the subjective observations (*objectivity*). The event records provide a factual history, the event recording does not interfere with test performance by the subjects (*unintrusiveness*), and because the event records are generated in computer form, these results will be relatively easy to process (*simplicity*). Furthermore, the event records are not influenced by any subjective judgments of performance quality (*impartiality*). The level of detail is defined intrinsically by the events themselves and the I&C database structure (*resolution*). Finally, the event

records are particularly useful for understanding the overall course of events and operator responses (diagnosticity) and provide a repeatable measure (*reliability*).

6. Plant Performance Recording – The continuous recording of plant parameter values over time has much in common with discrete event recording as previously described in terms of measurement characteristics (*objectivity, construct validity, unintrusiveness, simplicity, impartiality, resolution* and *diagnosticity*). A major difference is that the sampling intervals for plant performance recordings are taken at fixed 1 second intervals. This interval is imposed to help make the relatively large amount of data more manageable. However, it is sufficient for the identification and subsequent assessment of operator actions and the plant response (*sensitivity*). As a result of the fixed sampling intervals, the repeatability of plant performance recording is high *(reliability)*.

7. Video and Audio Recording - The use of video and audio recording supports the capturing of events and will assist in the use of the other measurement characteristics described above (*diagnosticity*). This data will record both good and bad results (*impartiality*). Also, it is relatively straightforward, consisting of the application of familiar equipment and technologies (*simplicity*).

Westinghouse will include the information described above, and the modified Appendix D (Post-Test Questionnaire), in the ISV Plan, Rev C, to be issued by 31st January 2010.

Question Rev 1:

The response clarified the last part of the RAI concerning use of the same questionnaires for both operators and observers by indicating that the questionnaire will contain only those questions appropriate to the person filling it out. The response did not completely address the staff's question about measurement characteristics. The response mixes measuring approaches, such as questionnaires and debriefing, and the performance measures themselves: such as workload. For example, how does the statement: "In ISV, a post-test questionnaire will be given to the operators and observers in order to investigate specific areas of interest and to assess workload, situation awareness, team work, and goal achievement" constitute construct validity for any of the performance measures listed? The staff expects the discussion of measurement characteristics to focus on the aspects of performance being measured: e.g., plant performance, task performance, situation awareness, etc. We recognize that the means of collecting data on the performance measures, such as by way of a questionnaire, is applicable to some of the specific characteristics, such as intrusiveness.

Please provide information pertaining to applicable measurement characteristics for the aspect of performance being measured.

Westinghouse Response:

The following lists the performance measures and explains the approaches that will be used to measure them and why these approaches are appropriate in terms of assessing the corresponding measurements characteristics.

1. Workload – Workload will be measured by the Task Load Index (TLX) in the format of a questionnaire to be completed by test subjects (i.e. operators). TLX is a widely used measure of subjective mental workload and has been subject to many years of research and application by NASA. After each scenario is completed, the TLX is administered to the test subjects. The data is relatively straightforward to process. The TLX ratings capture both high and low levels of workload, although whether the workload levels are acceptable or appropriate is determined in respect to the situation and scenario. In addition, separate TLX subscales for different components of subjective workload will provide useful information as to the sources of workload. In summary, TLX is a well established good approach to measure workload in terms of construct validity, unintrusiveness, simplicity, sensitivity/scale, resolution and diagnosticity.

2. Situation Awareness – Situation awareness (SA) will be measured by the Situation Awareness Rating Technique (SART) in the format of a questionnaire to be completed by the test subjects. SART is a widely used subjective measure of SA which directly assesses SA by asking individuals to rate their own SA. After each scenario is completed, the SART is administered to the test subjects. The SART evaluates the SA using ten subscales for ten factors or constructs of SA. Operators are asked to indicate on each scale (low to high) what most accurately reflects the level of their experience for that factor. This data is relatively straightfoward to process. SART is a good approach to measure SA in terms of construct validity, unintrusiveness, simplicity, sensitivity/scale, resolution, and diagnosticity. Further details on SART will be included in the ISV Plan, Rev C.

3. Team Work – Team work will be assessed utilizing a questionnaire to be completed by both test subjects and observers. Based on an extensive literature review, five dimensions (or aspects) of team performance are selected and evaluated individually. After each scenario is completed, the team performance questionnaire is administered to the test subjects and observers. The test subjects and observers are asked to rate the team by indicating the skill level (hardly any skill to complete skill) which most represents the skill presented by the team in each of the five dimensions. The data is relatively straightfward to process. The approach to measure the team performance is good in terms of construct validity, impartiality, unintrusiveness, simplicity, sensitivity/scale, resolution, and diagnosticity.

4. Goal Achievement – Goal achievement will be assessed in the format of a questionnaire to be completed by both test subjects and observers. The first three questions in the

questionnaire address overall performance in achieving the goal (e.g., poor to excellent) and the remaining questions address how useful or counteractive the individual HSI features are to achieving the goal, i.e. Wall Panel Information System (WPIS), Alarm Presentation System (APS), Computerized Procedure System (CPS), Distributed Control and Information System (DCIS), Protection and Monitoring System (PMS), soft controls, Primary Dedicated Safety Panels (PDSP), Secondary Dedicated Safety Panels (SDSP), Diverse Actuation System (DAS) and the control room. In addition to an overall evaluation on usefulness of individual HSI features (very counteractive to very helpful), test subjects and observers are also given opportunity to elaborate what and how specific design features were helpful or counteractive to achieving the goal. The approach to measure the goal achievement is good in terms of construct validity, impartiality, unintrusiveness, simplicity, sensitivity/scale, resolution, and diagnosticity.

5. Usability – Usability will be assessed in the format of questionnaires by both test subjects and observers both after each scenario is completed and after the whole test is completed. The test subjects and observers are asked to indicate their level of agreement (strongly disagree to strongly agree) on statements about the control room and HSI features. The questions are based on usability and human factors requirements on control room design and HSI features. Test subjects and observers are also given the opportunity to provide additional comments on every HSI feature and the overall control room design in terms of usability. The approach to measure goal achievement is a good one in terms of construct validity, impartiality, unintrusiveness, simplicity, sensitivity/scale, resolution, and diagnosticity.

Note that the questionnaires described above will be provided in the ISV Plan, Rev C.

Also note that while the questionnaires can directly and systematically measure the above performance characteristics, other approaches will also be used to gain information on these performance measures. The other approaches include observer checklists, debriefing, discrete event recording, plant performance recording, audio and video recording. For example, the observer checklists and debriefing can provide confirmation or detailed information regarding the information obtained from the completed questionnaires. Also, discrete event recording, plant performance recording, video and audio recording are not influenced by any subjective judgments of performance quality and therefore will provide objective confirmation of the results of the subjective observations.

References:

None.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-49
Revision: 1

Question:

Selection of Scenarios - Scenarios selected for validation generally appear to comply with the criteria in WCAP-15860 and NUREG-0711. A few areas appeared to either be missing or the staff could not identify the specific scenario that addressed the below areas:

- OER-identified difficult tasks
- use of administrative procedures
- communication between MCR and offsite (e. g., plant management, EOF or NRC)
- situational factors in NUREG-0711 section 11.4.1.2.1 (3)

Westinghouse Response:

The AP1000 human factors engineering program incorporates the results from the Operating Experience Review (Reference 1) during the design phase. However, there are relatively few cases where specific tasks suitable for scenario-based assessment in ISV are identified. Nevertheless, there are two specific cases identified from the Operating Experience Review that will be incorporated into the ISV. These are as follows:

- Low-power feedwater control (Item 122, Reference 1) – The resolution of difficult low-power feedwater control and the transition to main feedwater control will be exercised in the scenario for plant startup from Mode 2 to Mode 1 (Scenario 6 in the ISV Plan, Rev B). In addition, a number of other scenarios will make routine but limited use of startup feedwater.

- Remote valve stroke testing (Item 152, Reference 1) – Remote stroke testing, for example, of the CMT discharge valves, will be performed in the scenario for large break LOCA with inadequate core cooling (Scenario 12 in the ISV Plan, Rev B).

Many of the ISV scenarios will address the situational factors identified in Section 11.4.1.2.1(3) of NUREG-0711. In addition, complications are utilized to introduce or emphasize particular aspects of operator performance, as follows:

- Operationally difficult tasks, high-workload conditions, and varying-workload situations – These are addressed in a majority of the ISV scenarios to varying degrees. All emergency events, and particularly those with risk-important human actions, include beyond design basis failures and other complications. Normal operating scenarios include similar complications and will span the full range of operations from Modes 1 to 5. Tasks of notable concern, such as the drain-down to midloop plant conditions in Mode 5, will be identified as an operator task of particular importance within the individual scenario specifications.

- Error-forcing contexts – Although the AP1000 design strives to preclude error-forcing contexts, they will be incorporated in scenarios where plausible opportunities to do so are identified. For example, the unrecognized existence of a protective system block, or a common mode alignment error of certain level instruments, may invite the operators to overlook and consequently omit the timely manual actuation of a protective function.

- Fatigue and circadian factors (e.g., due to shift rotation or sleep deprivation) – These are uncontrolled conditions of the test subjects across scenarios, and are not addressed in the scenarios. However, some self-report data (e.g., on schedule history) will be collected in order to characterize the subjects at the time of testing.

- Environmental factors – The degradation of the environmental conditions in the main control room (MCR) will be addressed by isolation of the MCR and a station blackout.

The use of administrative procedures will be incorporated in a number of the scenarios (as appropriate) and as added complications. The occurrence of communications between the personnel located in the MCR and offsite personnel will be incorporated in a number of accident scenarios.

Westinghouse will provide the information described above in the detailed scenario descriptions in the ISV Plan, Rev C, to be issued by 31st January 2010.

Question Rev 1:

The WEC response satisfactorily addressed incorporation of tasks related to OER, the use of administrative procedures, and offsite communications. Situational factors were addressed in the response, but there are two follow-up areas associated with these.

1. Please clarify the discussion of how environmental factors are addressed.
2. Please clarify why fatigue/circadian factors are not addressed. For example, isn't it possible to run some scenarios during the "graveyard" shift?

Westinghouse Response:

The response to these questions is as follows:

1. The ISV will be undertaken at the Engineering Development Simulator (EDS) located at the Westinghouse Cranberry Facility in Pittsburgh. This room has been designed to be as representative as possible of the final as-built MCR. As the Cranberry facility is a new building, it was possible to build the EDS so that the room dimensions and floor plan will be identical to the final MCR design. However, due to the constraints of the building, the ceiling height and design is different (i.e., the EDS ceiling height is approximately 2 feet

lower and does not include the passive cooling fins; instead there is a conventional office building tiled ceiling). This does result in the lighting system to be different, although still representative of the final lighting system design. Also, the heating and ventilation is provided by a conventional office building system, and will therefore not be representative of the final as-built MCR. In addition, the acoustic properties can not be completely replicated although they will be similar (i.e., painted walls, 'hard' ceiling tiles). However, it is considered that any differences will have minimal or no impact on ISV crew performance.

The final questionnaire for the ISV subjects and observers includes questions to solicit feedback on the environmental conditions. The purpose of this is to gain useful insights into the environmental conditions for the final as-built MCR. The questions cover the temperature, air quality, lighting levels, glare, plus the auditory environment in terms of communications, background noise and the audibility of alarms. The responses to these questions will require interpretation in respect to the differences between the EDS and the final plant design. Also, it is noted that the environmental conditions will be fully assessed in APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan".

2. ISV does not address fatigue and circadian factors. It is considered to be impractical to attempt to mimic the conditions that are typical on an operating site and therefore any endeavor to do this will have very limited or no value. The only form of fatigue that is assessed is visual fatigue, and this is addressed via the questionnaires.

References:

1. APP-OCS-GJR-001, Rev. 0, "Human Factors Engineering Operating Experience Review Report for the AP1000 Nuclear Power Plant," Westinghouse Electric Company LLC.

2. APP-OCS-GEH-520, "AP1000 Plant Startup Human Factors Engineering Verification Plan," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP18-COLP-52
Revision: 1

Question:

Simulation of RSW - There is a scenario (E.7) for remote shutdown after a fire in the MCR. However it is not clear what will be the testbed simulation for the remote shutdown workstation (RSW). The descriptions of the simulated RSW in the ISV Sections 1.3, 2.1 and E.7 are not fully descriptive or consistent. Please clarify.

Westinghouse Response:

The ISV Plan, Rev C (to be issued by 31st January 2010), will include a clear description of the simulated Remote Shutdown Workstation (RSW) facility and the means to represent the evacuation of the MCR and the relocation of the operators to the Remote Shutdown Room. In the ISV Plan, Rev B, the associated scenario description states that, "A fire will be simulated in the MCR, which will require the evacuation of the MCR. The operators expected to trip the reactor and transfer control to the remote shutdown panel. A plant shutdown and cooldown will then be performed using the remote shutdown panel [i.e., workstation]."

To the extent practical, the RSW capabilities will be represented and validated utilizing the Facility. The MCR includes all features and capabilities of the RSW, and the RSW will be represented by using the subset of MCR resources that comprise the RSW resources. This will be achieved by utilizing a section of the RO console comprising two non-safety dual-headed monitor workstations, a mock-up of the RSW panel switches and representative communication facilities.

The Wall Panel Information System, safety displays, access to the switches that are not provided at the RSW, and the DAS panel will not be available. The ISV facility equipment in excess of the RSW complement will be made clearly unavailable during remote shutdown activities, for example, by deenergizing display monitors, and by physically covering panels and switches. The changeover to this temporary configuration will be performed while the crew is 'evacuating' the MCR, transferring control to the RSW, and 'relocating' to the Remote Shutdown Room. The transfer-of-control switches outside the simulated MCR will be represented by a static mockup.

Question Rev 1:

One aspect of the ISV of the RSW is that it will include a "mock-up of the RSW panel switches." DCD section 7.4.3.1.1 states that the RSW includes dedicated non-safety controls that provide the minimum inventory of controls listed in Table 18.12.2-1. These would appear to be the same dedicated controls that are in the MCR and hence in the simulator. Why are these simulator controls not used for this scenario rather than an additional mock-up that may not be functional?

Westinghouse Response:

The statement that the RSW controls are the same as the dedicated controls in the MCR provided via the Primary Dedicated Safety Panel (PDSP) and hence in the simulator is largely correct in terms of control functionality. However, there are two differences; the main one being that the RSW possesses a single switch for each control function that needs to be actuated (in conjunction with a soft control action via the DCIS or a local plant control action), whereas the PDSP possesses two switches for each control function that need to be actuated simultaneously. Another difference is that the PDSP possesses some control functions that are not applicable during an evacuation of the MCR to the Remote Shutdown Room. For example, the 'DAS Enable' and 'MCR Isolation' control functions are not required at the RSW. This results in the RSW having fewer switches and it is a smaller panel.

The design of the RSW is compatible with the PDSP in terms of labeling conventions, switch type and general arrangement. However, it is considered necessary to provide a mock-up of the RSW. The alternative would be to use the PDSP with the switches that are not included on the RSW 'blanked off' in some manner. It is considered that this would be insufficient in terms of assessing the human factors adequacy of the RSW design.

References:

None.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.