Westinghouse

Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Direct tel: 412-374-6206
Direct fax: 724-940-8505
e-mail: sisk1rb@westinghouse.com

Your ref: Docket No. 52-006
Our ref: DCP_NRC_002883

May 21, 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 R2
RAI-SRP18-COLP-23 R2
RAI-SRP18-COLP-26 R2
RAI-SRP18-COLP-28 R2
RAI-SRP18-COLP-35 R2
RAI-SRP18-COLP-36 R1
RAI-SRP18-COLP-39 R1
RAI-SRP18-COLP-42 R1
RAI-SRP18-COLP-46 R1
RAI-SRP18-COLP-53 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,

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

/Enclosure

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

D063
NRO

cc:	D. Jaffe	-	U.S. NRC	1E
	E. McKenna	-	U.S. NRC	1E
	P. Donnelly	-	U.S. NRC	1E
	T. Spink	-	TVA	1E
	P. Hastings	-	Duke Power	1E
	R. Kitchen	-	Progress Energy	1E
	A. Monroe	-	SCANA	1E
	P. Jacobs	-	Florida Power & Light	1E
	C. Pierce	-	Southern Company	1E
	E. Schmiech	-	Westinghouse	1E
	G. Zinke	-	NuStart/Entergy	1E
	R. Grumbir	-	NuStart	1E
	B. Seelman	-	Westinghouse	1E

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: 2

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 Rev 1:

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.

Question Rev 2:

WEC response states the following: "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." This is an acceptable approach. The deviations will need to be documented by WEC and evaluated by NRC.

BNL has reviewed exceptions that were specifically noted in the ISV Plan (320) and found them acceptable. There still is not a general statement of compliance with the programmatic ISV Plan (WCAP-15860) and a listing of exceptions. We understand that WEC is considering putting that in DCD Chapter 18. That would be acceptable. It could also be in the ISV Plan itself. RAI-22 is Open pending documentation of conformance and a listing of the exceptions.

Westinghouse Response Rev 2:

Section 1.5 "List of Exceptions from WCAP-15860" has been included in the ISV Plan, Rev D. This new section provides a statement that ISV will be in conformance with WCAP-15860

(Reference 1), with two exceptions. The two exceptions are then described. In summary, these exceptions are (1) ISV will not be using currently qualified operating crews as the participants, and (2) not all of the EOPs will be exercised in ISV.

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: 2

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.

Question Rev 2:

Evaluation based on W response letter dated 2/2/10 – WEC states that closure of ITAAC #4 will be justified in DCD Rev. 17/18. This is an acceptable approach but the draft DCD markup did not fully address the wording of ITAAC #4. This should be done and further since exceptions are being taken, the DCD should reference where the exceptions are justified.

Westinghouse Response Rev 2:

The DCD Revision 18 will be updated to reference the five V&V documents as Tier 2* and to state that the V&V activities are in accordance with WCAP-15860 “Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan” (Reference 7). The DCD will also state that there are exceptions relating to ISV and these exceptions are described and justified in the ISV Plan.

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. The implementation of the verification and validation activities is detailed in the five documents References 3 to 7.

The verification and validation activities are in accordance with Reference 1. There are a number of exceptions in respect to Integrated System Validation. The details of these exceptions and the corresponding justifications are provided in Reference 5.

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.

RAI Response Number: RAI-SRP18-COLP-26
Revision: 2

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 Rev 1:

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.

Question Rev 2:

Evaluation based on W response letter dated 2/2/10: The response to the RAI and 320, Rev. C, Section 4.1.2, both define the min and max crew size. Validation scenarios will be run for both of these cases as specified in ISV documents 320 and 321. This is acceptable and this portion of the RAI is closed. The response also commits to updating TR-52 (and a related document) to make them consistent with these new values. This is acceptable and confirmatory.

Westinghouse Response Rev 2:

As discussed during the 4/16/10 telecon, the TR-52 (Reference 1) and the MCR staff roles and responsibilities document (APP-OCS-GJR-003, Reference 2) are largely replicate documents. TR-52 (Reference 1) was issued to support the revision of the DCD from Revision 16 to Revision 17. To avoid any future confusion, it was agreed only one document requires updating. Therefore, APP-OCS-GJR-003 (Reference 2) will be updated and the DCD will be modified to delete the reference to TR-52 (Reference 1) and replace it with Reference 2.

APP-OCS-GJR-003 (Reference 2) will be updated (from Revision 1 to Revision 2) to reflect the utilities minimum staffing levels of two Reactor Operators, one Senior Reactor Operator, with one Shift Technical Advisor.

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:

18.5.4.2 Main Control Room Position Scope and Responsibilities

The Combined License information requested in this subsection has been fully addressed in ~~APP-GW-GLR-010~~ APP-OCS-GJR-003 (Reference 15), and the applicable changes are incorporated into the DCD. 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 document the scope and responsibilities of each main control room position, considering the assumptions and results of the task analysis.

18.5.5 References

[*1. NUREG-0711, "Human Factors Engineering Program Review Model," U.S. NRC, July 1994.*]*

2. U.S. NRC Guidance, NUREG/CR-3371, "Task Analysis of Nuclear Power Plant Control Room Crews."

3. IEC-964, "Design for Control Rooms of Nuclear Power Plants."

4. Department of Defense Documents: DI-H-7055, "Critical Task Analysis Report," and MIL-STD-1478, "Task Performance Analysis."

5. NATO Document, "Applications of Human Performance Models to System Design," edited by McMillan, Beevis, Salas, Strub, Sutton, & van Breda, New York: Plenum Press, 1989.

6. Rasmussen, J., "Information Processing and Human-Machine Interaction, An Approach to Cognitive Engineering," New York: North-Holland, 1986.

7. Hollnagel, E. and Woods, D. D., "Cognitive Systems Engineering: New Wine in New Bottles," International Journal of Man-Machine Studies, Volume 18, 1983, pages 583-600.

8. Roth, E. and Mumaw, R., "Using Cognitive Task Analysis to Define Human Interface Requirements for First-of-a-Kind Systems," Proceedings of the Human Factors and Ergonomics Society 39th Annual Meeting, San Diego, Ca., 1995, pp. 520-524.

9. Vicente, K. J., "Task Analysis, Cognitive Task Analysis, Cognitive Work Analysis: What=s the Difference?" Proceedings of the Human Factors and Ergonomics Society 39th Annual Meeting, San Diego, Ca., 1995, pp. 534-537.

10. Drury, C. G., Paramour, B., Van Cott, H. P., Grey, S. N., and Corlett, E. N., "Task Analysis," Handbook of Human Factors, Salvendy, G. (ed.), New York: John Wiley & Sons, 1987.

11. Woods, D. D., "Application of Safety Parameter Display Evaluation Project to Design of Westinghouse SPDS," Appendix E to "Emergency Response Facilities Design and V & V Process," WCAP-10170, submitted to the U.S. Nuclear Regulatory Commission in support of their review of the Westinghouse Generic Safety Parameter Display System (Non-Proprietary) (Pittsburgh, PA, Westinghouse Electric Corp.), April 1982.

[*12. WCAP-14695, "Description of the Westinghouse Operator Decision Making Model and Function Based Task Analysis Methodology," Revision 0, July 1996.*]*

[13. *WCAP-14651, "Integration of Human Reliability Analysis and Human Factors Engineering Design Implementation Plan," Revision 2, May 1997.*]*

14. APP-GW-GLR-081, "Closure of COL Information Item 18.5-1, Task Analysis," Westinghouse Electric Company LLC.

15. ~~APP-GW-GLR-010~~ APP-OCS-GJR-003, "AP1000 Main Control Room Staff Roles and Responsibilities," Westinghouse Electric Company LLC.

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 will be marked as superseded by APP-OCS-GJR-003, "AP1000 Main Control Room Staff Roles and Responsibilities" (Reference 2)

RAI Response Number: RAI-SRP18-COLP-28
Revision: 2

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 Rev 1:

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

Question Rev 2:

Evaluation Based on W response in letter dated 1/2/2010 and APP-OCS-GEH-320, Rev. C (Feb 2010)

W's response in the letter indicates that if a scenario fails a P/F criterion, it will be rerun a minimum of three times with new crews. So will some of the failures on diagnostic measures based on the results of their HED analysis. Overall the approach looks pretty good.

Remaining follow-up questions:

1. For diagnostic measures, why is it necessary to see the same issue on multiple measures and multiple trails, especially if they are Priority 1 HEDs?

2. Treatment of HEDs is based on APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process." Rev. B seems limited to Priority 1 and Priority 2 HEDs identified during V&V. Where are the HEDs being tracked that are identified:

   - prior to V&V from other aspects of the HFE program
   - from the final Verification at Plant Startup (document 520)
   - as Priority 3 HEDs

Westinghouse Response Rev 2:

In response to the two follow-up questions:

1. For Priority 1 and Priority 2 HEDs identified from the diagnostic measures, if there are only a small number of HEDs, a fourth trial will be run using a different crew in order to assist in determining if a problem actually exists. The main purpose of this fourth run is to avoid making any unnecessary changes to the HSI design, procedures and/or training due to an outlier or rogue result obtained in the original three trial runs. If the results of the fourth trial run demonstrate that the problems does exist (i.e., the Priority 1 or Priority 2 HED reoccurs), then once the HED(s) have been resolved, the scenario will be re-run three times using crews that had not previously been exposed to the scenario. This clarification will be added to the ISV Plan, Rev D, Section 7.3.

2. Each of the bullet points are addressed as follows:

   - A formal HFE Tracking System is utilized to record and resolve any issues that are identified during the HFE design, review and evaluation process prior to V&V. This tracking system is a database application program and contains HFE issues that are one or more of the following

     - An assessment or analysis required to support a design decision.
     - An assessment that is required at a later stage in the lifecycle when the required level of design or operations detailed information becomes available.
     - An issue identified from a non-AP1000 project that is known or anticipated to be an issue for AP1000.
     - An HFE action item typically identified during the design review process that cannot be readily closed as part of the design review process.

This HFE Tracking System will be used for the HEDs identified during the V&V activities. Currently, the HFE issues in the Tracking System are categorized as 'issues'. The HEDs identified from the results of the V&V activities will be categorized as 'HEDs' and the Tracking System will denote the Priority.

Further details on the HFE Tracking System can be found in APP-OCS-GBH-001, "AP1000 Human Factors Engineering Program Plan" (Reference 5).

- HEDs identified during the HFE Verification at Plant Start-Up will not be entered into the tracking database. At the plant start-up stage of the project, this will be the responsibility of the utilities, and they may decide to use an alternative site-specific tracking system. This is in accordance with WCAP-15860 "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan" (Reference 6). However, it is noted that the results of the verification at plant start-up will be documented in APP-OCS-GER-520 "AP1000 Plant Startup HFE Design Verification Report" (Reference 7).
- APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process," (Reference 1) addresses the Priority 1, 2 and 3 HEDs from the Task Support Verification, Design Verification and ISV activities. Priority 3 HEDs are not required to be tracked via the formal HFE Open Items Tracking Database (i.e., it is the decision of the HFE design engineer) although it is noted that all Priority 3 HEDs will be documented in APP-OCS-GER-420 "Human Factors Engineering Resolution Verification Report" (Reference 3).

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

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

7. APP-OCS-GER-520, "AP1000 Plant Startup HFE Design Verification Report", Westinghouse Electric Company LLC. (Proprietary)

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-35
Revision: 2

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. Workload Rating Scales - 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. Questionnaires (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 Rev 1:

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.

Question Rev 2:

Evaluation Based on W response in letter dated 1/2/2010 and APP-OCS-GEH-320, Rev. C (Feb 2010).

W's response does not address all the measures. It provides measurement information for workload, SA, teamwork, goal achievement, and usability (**not** plant level measures, task performance measures).

The actual measurement characteristics are really not addressed. For example, after discussing that the SART measure will be used for workload, they simply state that: "SART is a good approach to measure SA in terms of construct validity, unintrusiveness, simplicity, sensitivity/scale, resolution, and diagnosticity." No explanation as to why it's good is identified. We are not sure the SART is a good measure of situation awareness. The SART questions do not pertain to any specific scenario details. Further, the measure is collected at the end of scenarios that, in many cases, are several hours long. Thus its sensitivity to changing SA across a scenario may not be too good. Please explain the use of the SART measure of SA.

The ISV plan does not include all the info in the RAI response. The logical organization of the ISV plan data section is unclear. The first measure discussed is workload (NASA TLX rating scales). This is followed by a discussion of questionnaires. That discussion includes situation awareness which is a rating scale like the TLX. This questionnaire discussion addresses many individual performance measures that are not individually discussed – a least not to the degree the TLX is discussed. The measurement characteristics of individual performance measures are really are not mentioned, except for workload and SA. A more detailed discussion of the SART measure that addresses construct validity appears later in the document with respect to diagnostic criteria.

Westinghouse Response Rev 2:

The ISV Plan, Rev C, Section 6.1 Methods will be revised/re-organized in the ISV Plan, Rev D, into Sections 6.1 Measures and Section 6.2 Methods. Section 6.1 Measures addresses performance measures, including plant performance measurements, personnel task measurements, situation awareness, workload, anthropometric and physiological factors, team performance, goal achievement and usability. Section 6.2 Methods addresses measuring approaches, including questionnaires, observer guides, debriefing, digital simulator recording, video and audio recording. Section 6.1 describes what is being measured and Section 6.2 describes how it is being measured and why this is an appropriate method (i.e. measurement characteristics). (Note, Section 6.3 Criteria is addressed in the response to RAI-SRP18-COLP-36, Rev 1)

The following are the new Section 6.1 Measures and Section 6.2 Methods, which will be included in the ISV Plan, Rev D. (Note, the references to Appendices refer to the Appendices in the ISV Plan, APP-OCS-GEH-320).

6.1 MEASURES

A set of performance measures are identified and selected to collect data on operator performance, as the follows:

- Plant Performance Measurement – Two types of plant performance measures representing functions, systems, components, and HSI use will be obtained: *discrete event recording* and *plant performance recording*. The successive discrete events that occur in the simulated plant will be recorded in each trial. This provides a time-stamped record of manual and automatic actions and other state changes to systems and components occurring over the course of the scenarios. Plant parameters showing the continuous evolution of plant conditions over time will be recorded in each trial. This provides a time-stamped record of plant behavior and operating performance over the course of the scenarios.

- Personnel Task Measurement – For each specific scenario, the tasks that personnel are required to perform will be identified and assessed. Two types of personnel tasks will be measured: primary and secondary. Primary tasks are those involved in performing the functional role of the operator to supervise the plant; i.e. monitoring, detection, situation assessment, response planning, and response implementation. Secondary tasks are those tasks that personnel must perform when interfacing with the plant, but which are not directed to the primary task, such as navigating and HSI configuration. The following measures are used to reflect the important aspects of the task with respect to system performance:

  - time
  - accuracy
  - frequency
  - errors (omission and commission)
  - amount achieved or accomplished
  - consumption or quantity used
  - subjective reports of participants

- Situation Awareness – Personnel situation awareness will be assessed to assure that the design supports the operators in terms of perception of the elements of the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future. Situation awareness is key for making decisions, especially during situations involving uncertainty.

- Workload – Personnel workload will be assessed to understand the cost of accomplishing task/scenario requirements for the human operator. Workload can have a great affect on task performance.

- Anthropometric and Physiological Factors – Anthropometric and physiological factors include such aspects as visibility of indications, accessibility of control devices, and ease of control device manipulation. Attention will be focused on aspects of the design that can only be addressed during testing of the integrated system, e.g. the ability of personnel to effectively use the various controls, displays, workstation, or consoles in an integrated manner.

- Team Performance – Team performance will be assessed to understand personnel communication and coordination within a team. It is a key indicator of the success of the overall system performance (i.e., the design, training, procedures, work organization, and staffing levels).

- Goal Achievement – Goal achievement will be assessed to examine how well participants achieved the trial goals/objectives overall, and how well each HSI feature assisted in achieving the goals.

- Usability – Usability will be evaluated to examine how well each HSI feature and all of the features as a whole accomplished their functions.

6.2 METHODS

Data collection will use a variety of paper-and-pencil techniques, structured discussions, and digital recording methods, as the follows:

- Questionnaires (Appendix A, B, C, and D) – Questionnaires are subjective paper-and-pencil tools which will be applied to subjects and observers to assess situation awareness, workload, anthropometric and physiological factors, team performance, goal achievement and usability. There are a total of four questionnaires, as follows:

    - Post-Trial Questionnaire for Subjects (Appendix A), including assessments of situation awareness, workload, team performance, goal achievement.
    - Final Questionnaire for Subjects (Appendix B), including assessments of anthropometric and physiological factors, and usability.
    - Post-Trial Questionnaire for Observers (Appendix C), including assessments of team performance and goal achievement.
    - Final Questionnaire for Observers (Appendix D), including assessments of anthropometric and physiological factors, and usability.

    Situation awareness is measured using the Situation Awareness Rating Technique (SART) (Reference 1 and 2). SART provides a validated and practical subjective rating tool for the measurement of situation awareness, based on personal construct dimensions associated with situation awareness. There are ten constructs which are clustered into three broad domains:

- Attentional Demand: instability of situation, variability of situation, and complexity of situation;
- Attentional Supply: arousal, spare mental capacity, concentration, and division of attention;
- Understanding: information quantity, information quality, and familiarity.

Subjects rate their level of experience for each construct on a scale. Each scale is a horizontal line divided into 20 equal intervals anchored by bipolar descriptors (e.g., Low/High). The 21 vertical tick marks on each scale divide the scale from 0 to 100 in increments of 5. A single value for situation awareness is created by using the algorithm:

Situation Awareness = Understanding – (Attentional Demand – Attentional Supply)

Understanding is the mean rating of the constructs within that domain. The same applies to Attentional Demand and Attentional Supply. The rating for situation awareness is -100 (minus 100) to 200, with 200 representing the best situation awareness. The average level of situation awareness is 50. This formula was derived from theoretical considerations of how the three domains interact. Interpretation of the situation awareness calculation results is determined in respect to the situation and scenario.

SART is a very commonly used method and an appropriate tool for measuring situation awareness when it is not appropriate to freeze a simulation. The ten constructs can be applied to almost any situation without needing to make the questions any more specific. The constructs are general in nature and therefore are applicable across domains. Decomposing situation awareness into the individual SART dimensions provides some diagnostic and predictable indicators for delineating the strengths and weakness associated with SA as measured by the scale. SART is very easy to administer and does not require costly and time consuming development of queries or implementation. The situation awareness rating questions will be given to the subjects at the completion of each trial as part of the Post-Trial Questionnaire for Subjects (Appendix A).

Workload is measured using the Task Load Index (TLX), developed by the National Aeronautics and Space Administration (NASA). TLX is a well-established, subjective paper-and-pencil method of workload assessment that is easily administered and processed. It provides a basis for comparisons between groups, and diagnostic insight on workload sources from its six component subscales, i.e. effort, performance, frustration level, temporal demand, mental demand and physical demand. The TLX ratings capture both high and low levels of workload. Each subscale is presented as a line divided into 20 equal intervals anchored by bipolar descriptors (i.e. Low/High). The 21 vertical tick marks on each subscale divide the scale from 0 to 100 in increments of 5. The overall rating for workload is the average of the six subscale ratings. Therefore the overall rating for workload is from 0 to 100, with 100 being the highest level of workload. The TLX questionnaire will be given to the subjects at the completion of each trial as part of the Post-Trial Questionnaire for Subjects (Appendix A).

Anthropometric and physiological factors are assessed utilizing a questionnaire to be completed by the subjects (Final Questionnaire for Subjects, Appendix B) and another questionnaire to be completed by observers (Final Questionnaire for Observers, Appendix D), after all scenarios have been completed. The questionnaires contain statements that address the anthropometric and physiological factors of the Main Control Room (MCR), i.e. control room layout, design of the workstations, climatic environment, visual environment, auditory environment. Participants record their level of agreement for each statement (e.g., strongly disagree to strongly agree), which provides an assessment of the anthropometric and physiological factors of the MCR. The statements are developed based on human factors requirements on control room design. The subjects and observers are also given opportunity to elaborate on the anthropometric and physiological factors of the MCR.

Team performance is assessed utilizing a questionnaire to be completed by both the subjects (Post-Trial Questionnaire for Subjects, Appendix A) and observers (Post-Trial Questionnaire for Observers, Appendix C), after each scenario is completed. Based on an extensive literature review, five dimensions (or aspects) of team performance are selected and evaluated individually. They are assertiveness, decision-making, situation assessment, leadership and communication. The subjects and observers are asked to rate the team by indicating the skill level (e.g., hardly any skill to complete skill) which most represents the skill presented by the team in each of the five dimensions. The rating for each team performance dimension is from 0 to 5, with 5 being the best rating for any dimension.

Goal achievement is assessed utilizing a questionnaire (Post-Trial Questionnaire for Subjects, Appendix A) to be completed by the subjects and another questionnaire (Post-Trial Questionnaire for Observers, Appendix C) to be completed by observers, after each scenario is completed. The questionnaires are developed based on expert judgment. The first four (for subjects) or three (for observers) questions in the questionnaires address overall performance in achieving the goal (e.g., poor to excellent) and the remaining questions address how counteractive or useful (e.g. very counteractive to very useful) 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 layout. In addition to an overall evaluation on the usefulness of individual HSI features, the subjects and observers are also given opportunity to elaborate on what and how specific design features were helpful or counteractive to achieving the goal. The rating for overall goal achievement and usefulness of each HSI feature is from 0 to 5, with 5 being the best rating.

Usability of the HSI features is assessed utilizing a questionnaire to be completed by the subjects (Final Questionnaire for Subjects, Appendix B) and another questionnaire to be completed by observers (Final Questionnaire for Observers, Appendix D); after all scenarios have been completed. The questionnaires contain statements that address the functionality of the individual HSI features and the HSI features as a whole. The subjects and observers give their level of agreement (e.g., strong disagree to strong agree) for each statement, which provides an assessment of the usability of the individual HSI features and the HSI features as a whole. The statements are developed based on usability requirements on HSI features. The subjects and observers are also given opportunity to elaborate on the usability of the HSI features.

Note that the design aspects are assessed via design verification prior to ISV (see APP-OCS - GEH-120, "AP1000 Human Factors Engineering Design Verification"). The design verification is static, does not require the use of the simulator, and will address adherence to HFE design guidelines. However, the ISV questionnaires request feedback on anthropometric and physiological factors, and usability, in a realistic operations environment.

- Observer Guides (APP-OCS-GEH-321, Appendix B) – These are paper-and-pencil tools that specify observable occurrences of task performance that are expected in the individual scenarios, based on the simulated events and applicable procedures. Key events and the corresponding expected operator responses are identified to provide observers with preview and context, and to support the identification of errors of omission.

  The observer guides do not include all of the individual actions identified in the procedures. The observer guides are designed to be easily implemented while not distracting from assessing crew performance. Each guide includes the following:

  - Title and brief description of the scenario 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 with understanding that some items will not be applicable.
  - Evaluation Items
    - HSI resources
    - Staffing levels
    - Risk-important tasks
    - Recognition and response to malfunctions (scenario malfunctions are listed)
    - Space for the observer to provide additional comments/notes.

  Each of the events and expected responses are not necessarily all of the items specified in the scenario descriptions as the pass/fail criteria; additional events are included. 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 in the scenario. It is noted that the observer guides are one of a number of measurement techniques to determine pass/fail. However, all of the risk-important tasks will be included in the sequence of the events, including start step and end step. Observers will be given space to record the time for start step and end step so that risk-important task completion time can be assessed against the PRA time window.

- Debriefing, Post-Trial and Final (Appendix F) – Debriefing promotes the open exchange between the participants on their test experience, perceptions and concerns to obtain feedback and clarifications that may be missed by the more structured data collection methods. Debriefing can provide confirmation or explanation regarding the information obtained from the completed questionnaires. The debriefing process is guided by a debriefing protocol (see Appendix F) and is recorded by video camera and audio recorder. An immediate debriefing of the participants will be performed after each scenario trial. A summary debriefing will be held at the end of each crews' participation in the ISV.

- Digital Simulator Recording – Plant performance measures, including discrete events and continuous plant parameters, will be recorded automatically by the simulator. The continuous plant parameter recordings are taken at fixed 1 second intervals. Digital simulator recording are utilized to support the evaluation of task performance and associated time margins and plant performance margins, where applicable. Digital simulator recording are not influenced by any subjective judgments of performance quality and therefore will provide objective confirmation of the results of the subjective observations.

- Video and Audio Recording – Operator behavior will be recorded locally at the individual MCR workstations. These recordings will capture the operators' primary and secondary task actions. General recordings of the MCR workspace and crew performance in each scenario will also be made. Video and audio recording will be reviewed and utilized to assess personnel task performance, where applicable. Video and audio recording are not influenced by any subjective judgments of performance quality and therefore will assist in providing objective conformation of the results of the subjective observations.

References:

1. Taylor, R. M., "Situational awareness rating technique (SART): The Development of a Tool for Aircrew Systems Design". In "Situational Awareness in Aerospace Operations (AGARD-CP-478)," Neuilly-sur-Seine, France: NATO-AGARD, 3/1-3/17, 1990.

2. Taylor, R. M., and S. J. Selcon, "Situation in Mind: Theory, Application and Measurement of Situational Awareness". In R. D. Gilson, D. J. Garland, & J. M. Koonce (Eds.), "Situational

Awareness in Complex Settings," Daytona Beach, FL: Embry-Riddle Aeronautical University Press, 69-78, 1994.

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-36
Revision: 1

Question:

Acceptance criteria for Pass/Fail measures are generally discussed in Section 6.2. Each scenario has "Scenario Criteria," but it is not clear which criteria are mandatory and would result in scenario failure if not satisfied. The criteria are applied on a trial-by-trial basis. The general acceptance criteria are (1) no violation of safety limits (e.g., Tech Specs) due to operator error, and (2) completion of all RIHAs within available time windows of PRA. The acceptance criteria for diagnostic measures determine whether an HED is defined. These criteria are only briefly discussed. For example, sustained unawareness of the situation leading to error and extreme workload leading to error are diagnostic criteria. How either is determined is not identified. Also, the necessity of linking these measures to error seems unnecessarily liberal. Sustained unawareness of the situation and extreme workload would seem to be worthy of HED assessment in their own right. The specific measures and acceptance criteria to be used for each scenario are not given. Please update the Plan to address these issues.

Westinghouse Response:

Section 6.2 of the ISV Plan distinguishes between acceptance criteria and diagnostic criteria. Both types of criteria provide a basis for determining that if HED is required to be generated. However, diagnostic criteria do not necessarily define trial failure, and an assessment will be conducted to summarize the HED results and determine the overall conclusion as to whether the trial has indeed passed or failed.

In the ISV Plan, Rev B, Appendix E, the applicable subsections entitled "Scenario Criteria" in the individual scenario descriptions did not distinguish between the diagnostic criteria and acceptance criteria. Westinghouse will add this distinction for each scenario, and will provide scenario-specific acceptance criteria and diagnostic criteria as part of completing each detailed scenario description in the ISV Plan, Rev C, to be issued by 31st January 2010.

In addition, Westinghouse acknowledges that if workload is considered to be extreme relative to the situation, then a HED will be generated. Likewise, if crew situation awareness is determined to be poor, a HED will be generated. These HEDs will be created even if there is no actual operator error. Workload and situation awareness will be assessed by means of the Task Load Index (TLX) and the responses to the Likert-scaled questions that will be part of the post-test questionnaire completed by the scenario participants and scenario observers. Again, this additional information will be included in the ISV Plan, Rev C, to be issued by 31st January 2010.

Question Rev 1:

Evaluation Based on APP-OCS-GEH-320, Rev. C (Feb 2010) and 321
Follow-up questions:

1. With respect to P/F measures, how is failure to performance a RIHA on time per PRA assessed?

2. With respect to criteria for diagnostic measures, some are precisely defined while other are not. For example, a criterion stating "less that 75% expected operator responses per the observer guide" is a clearly stated criterion that identified how it's measured and precisely what is acceptable. This is not typically the case. In some cases the diagnostic measures are identified with reference to a criterion (e.g., extreme workload), while other diagnostic measures are not (e.g., SA). Please identify the criteria for each measure, the basis for the criterion (e.g., engineering analysis, expert judgment, etc.), and how will these measures will be used to trigger an HED?

3. Why are some diagnostic measure mentioned for specific scenarios while others are not, e.g., workload is not mentioned for any scenarios.

4. Additional specific questions:

- Error of Omission – how measured?
- Error of Commission – how measured?
- Extreme workload... leading to an operator error. Why does workload have to lead to an error to be a diagnostic criterion? The RAI response acknowledged error was not necessary – see RAI response to this RAI in the 11/02/09 letter - "In addition, Westinghouse acknowledges that if workload is considered to be extreme relative to the situation, then a HED will be generated.") How is extreme workload defined?
- Implementation error or substantial deficiency of the design of HSI, procedures and training - how assessed?
- Any other specific concern with a plausible negative impact on acceptable ops (how measured?)
- SA – a lot of detail is provided that would seem more appropriate for Section 6.1. But no criterion is provided.

Westinghouse Response Rev 1:

The response to each of the four questions is provided below:

1. One of the P/F criteria is "completion of all risk-important human actions within available time windows of the PRA". This will be assessed via the scenario specific observer guides, and the results will be verified using digital simulator recordings and video and audio recordings. For each risk-important human action, the starting step and the ending step according to the PRA is identified from the associated procedures and will be specified in the individual scenario

descriptions. When a scenario contains a risk-important human action, the observers are provided with clearly marked spaces in the associated observer guide to write down the time the crew entered the starting and completed the ending steps, from which the completion time for the risk-important human action can be obtained. The actual time to complete the risk-important task per the ISV results can then be compared against the available time window in the PRA. If the actual completion time surpasses the available time window, a failure in performing the risk-important human action is determined and the failure of the scenario is concluded.

2. ISV Plan, Rev C, Section 6.2.2 Diagnostic Criteria, has been rewritten (inserted below) to include more detailed information on the diagnostic criteria for each measure, the basis for the criteria and how these criteria will be used to trigger an HED. (Note that in the ISV Plan, Rev D, the section addressing criteria is now Section 6.3).

3. Diagnostic criteria will be specified for each measure for every scenario in the scenario descriptions (APP-OCS-GEH-321, Appendix A). (Note, scenario description for Scenario 1, 2, and 12 will be provided as examples in APP-OCS-GEH-321, Rev B, in the response to RAI-SRP18-COLP-34, Rev 1)

4. ISV Plan, Rev C, Section 6.2.2 Diagnostic Criteria, has been rewritten to address the questions (inserted below).

The following is the revised Section 6.3.Criteria to be included in the ISV Plan, Rev D.

6.3 CRITERIA

This subsection describes how the measurement results are applied to the determination of the success of the ISV trials in respect to the pass/fail criteria and the diagnostic criteria. A set of performance measures, as described in Section 6.1, will be used which includes measures of the performance of the plant and personnel.

6.3.1 Pass/Fail Criteria

The pass/fail criteria provide the lower limits on acceptable operation and are consistent with the AP1000 plant safety and risk analyses. The pass/fail criteria also ensure that a margin is maintained to unsafe conditions and unacceptable accident results.

Objective pass/fail criteria are specified for each scenario and are applied to the results of individual trials. For individual trials, all applicable pass/fail criteria must be met, or the trial is deemed to have failed. Failed trials result in the generation of Priority 1 HEDs for resolution according to APP-OCS-GEH-420, "AP1000 Human Engineering Discrepancy Resolution Process" (Reference 12). Once the associated HEDs have been dealt with, the scenario will be re-run three times with crews that

had not previously been exposed to the scenario. Three 'passes' are required for the scenario to be deemed to be successful according to the pass/fail criteria (see Section 7.3 for details).
The pass/fail criteria are listed in Table 6.3-1 in respect to relevant measures.

Table 6.3-1 Pass/Fail Criteria

Measures	Pass/Fail Criteria
Plant Performance Data	- No violation of safety limits as specified in Technical Specifications Section 2.0 due to operator error. - Applicable LCOs and surveillance requirements of the Technical Specifications are met, and required actions for the associated conditions are performed within the specified limits and time criteria.
Personnel Task Performance	- Completion of all risk-important human actions within available time windows of the PRA.

The AP1000 plant design does not have any associated critical human actions, as defined by either deterministic or PRA criteria; therefore, no pass/fail criteria are based on critical human actions.

Pass/Fail criteria will be assessed via the observer guides and the results will be verified using the digital simulator recordings and/or video and audio recordings.

For each risk-important human action, the starting step and the ending step according to the PRA is identified from the associated procedures and will be specified in the individual scenario descriptions. When a scenario contains risk-important human action, the observers are provided with clearly marked spaces in the associated observer guides to write down times the crew entered the starting and completed the ending steps, from which the completion time for the risk-important human action can be obtained. The actual time to complete the risk-important task per the ISV results can then be compared against the available time window in the PRA. If the actual completion time surpasses the available time window, a failure in performing the risk-important human action is determined and the failure of the scenario is concluded.

In a number of cases in the PRA, the estimated times and the required time windows for the risk-important human actions are relatively close. Therefore, the time to perform the risk-important human actions will be closely monitored. If a case occurs where the time available (i.e., the required time window) is potentially insufficient to ensure reliable operator performance, this will be identified as a Priority 1 HED. Insufficient time to complete a risk-important human action in ISV will suggest potential issues with staffing level, HSI resources, procedures, training, and/or the PRA assumptions. It is also noted that insufficient time to complete a risk-important human action in ISV may indicate that the human error probability (HEP) for that action in the PRA may have been underestimated as the time pressure is greater than originally expected. This information will be communicated to the group responsible for the PRA.

6.3.2 Diagnostic Criteria

In contrast to the pass/fail criteria, the diagnostic criteria provide a wider perspective on crew performance to better understand personnel performance and to facilitate the analysis of performance errors. This allows any concerns for acceptable performance to be identified and raised as an HED for resolution according to APP-OCS-GEH-420, "AP1000 Human Engineering Discrepancy Resolution Process" (Reference 12) (see Section 7.3 for details).

Diagnostic data include both objective and subjective data from subjects and observers about both plant and personnel performance. Table 6.3-2 lists diagnostic criteria in respect to all of the measures of performance (per Section 6.1, Measures). The diagnostic criteria are selected by an expert group consisting of HF specialists, operations, procedures, and training people.

If any one of these diagnostic criteria can not be met, an HED will be generated. Note that the ISV pilot testing phase will be used to further validate and define these criteria to ensure that they are adequate and appropriate.

Table 6.3-2 Diagnostic Criteria

Measures	Diagnostic Criteria
Plant Performance Data	- No plant level data, as specified in scenario description for each scenario, approaches a point which may challenge a system, structure or component (SSC) related to defense-in-depth, even if there is no violation of technical specifications.
Personnel Task Performance	- Expected operator responses/actions/tasks, as specified in the observer guides, shall be satisfactorily completed (i.e. error of omission or commission). - No error shall occur that puts the plant at greater risk or jeopardizes the health and safety of the public as evaluated by the observer guides (i.e. error of commission). - No error, irrespective of the consequence, remains unacknowledged and uncorrected, as evaluated by the observer guides and video and audio recording review.
Situation Awareness	- Average rating of situation awareness across subjects from questionnaire shall be > 50 (range -100 to 200). - Subjects should demonstrate behaviors, as specified in scenario description for each scenario, that they are aware of, understand, and respond to important events during the scenario. - No situation awareness issues are identified through questionnaire comments, debriefing, video and audio recording review.

Workload	- Average rating of workload across subjects from questionnaire shall be <85 (range 0 to 100). - Subjects demonstrate behavior, as specified in scenario description for each scenario, that their workload is within a reasonable range and there are no indications of stress caused by excessive workload. - No workload issues are identified through questionnaire comments, debriefing, video and audio recording review.
Anthropometric and Physiological Factors	- Average rating across subjects and observers from questionnaire shall be > 3 for any positive statement or < 3 for any negative statement (3 is the neutral position for a statement). - No anthropometric or physiological feature, as specified in scenario description for each scenario, inhibits subjects from successfully performing actions as required by the scenario. - No anthropometric and physiological issues are identified through questionnaire comments, debriefing, video and audio recording review.
Team Performance	- Averaged team performance rating across subjects and observers from questionnaire shall be > 3 (range 1 to 5; 3 is the adequate level of skills). - Subjects should demonstrate behavior, as specified in scenario description for each scenario, that they communicate and coordinate as a team. - No team performance issues are identified through questionnaire comments, debriefing, video and audio recording review.
Goal Achievement	- Average overall goal achievement rating across subjects and observers from questionnaire shall be > 2 (range 1 to 5; 2 is at the fair level). - Average rating for individual HSI features across subjects and observers shall be > 3 (range 1 to 5; 3 is neutral attitude as to being helpful or counteractive). - Performance milestones, as specified in scenario description for each scenario, shall be met. - No goal achievement issues are identified through questionnaire comments, debriefing, video and audio recording review.
Usability	- Average rating for any statement across subjects and observers from questionnaire shall be > 3. (3 is the neutral position for a statement) - No usability issue, as specified in scenario description for each scenario, inhibits subjects from successfully performing actions as required by the scenario. - No usability issues are identified through questionnaire comments, debriefing, video and audio recording review.

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-39
Revision: 1

Question:

<u>Crew Variability</u> - Section 4.1.2 of the ISV Plan states that a minimum of four crews will participate in the ISV. However, it is not completely clear that the design will account for human variability (per NUREG-0711, Section 11.4.3.2.3, Criterion 2) because of the way crews are assigned to scenarios, i.e., a scenario may be performed by only two crews. Further, little information is provided as to how the participating utilities will select crews (see RAI -22, Part 10). Finally, the ISV plan indicates that counterbalanced assignments will be used. However, the counterbalancing scheme is not presented. Please address these issues.

Westinghouse Response:

Westinghouse will perform three replications of each scenario (see RAI-SRP18-COLP-27). This requires at least three different crews, each to perform all of the ISV scenarios. A new test design will be provided to reflect these changes. In addition, an assignment scheme will be described that demonstrates a balanced trial order, so as to prevent test result bias due to the effects of trial order. This will take into account that some of the scenarios are a sequence of evolutions (e.g., startup and shutdown). These changes will be incorporated in Rev C of the ISV Plan, to be issued by 31st January 31 2010.

The ISV Plan, Rev C, will also include guidance for the utilities to address the selection of the participant personnel. It will be ensured that the participants are representative of the actual plant personnel who will ultimately be operating AP1000; and they will not be engineering personnel. The participants will be selected by the utilities, based on work experience, skills, qualifications and education. 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:

Evaluation Based on APP-OCS-GEH-320, Rev. C (Feb 2010)

A minimum of three crews will be user per scenario (see RAI 27). Section 3.1, Number of Trial Replications, states that each scenario will be run a minimum of three times. This is good.

Two follow-up questions remain:

1. W's response above stated that guidance for the utilities will be presented in ISV Plan C, but we cannot find it. Section 4.1.1 still states that "Guidance will be provided ...."

2. Counter balancing – Rev C provides little additional information than was available in the prior version of the plan. It states that the "trial assignment will provide a balance order, so as to prevent result bias due to the effects of trial order." But no actual order or sample of what this precisely means is presented.

Westinghouse Response Rev 1:

In response to the two follow-up questions:

1. Additional guidance for the utilities to address the selection of the participant personnel is included in the ISV Plan, Rev D, Section 4.1.1, Selection. The utilities are requested to select the ISV participants, and form the crews, such that they are as far as practicable representative of actual operating crews that ultimately will be operating the AP1000 plants. It is noted that at the time of ISV, the availability of appropriate personnel is limited and only a relatively small number will have completed the AP1000 SRO Instructor Certification Program. None of the participants will be experienced in actual AP1000 plant operations. However, each of the two utilities will be requested to provide three crews of four people, and each crew will comprises the following:

   - People that have successfully completed and passed the SRO Instructor Certification Program (26 week course), or it is indicated that they are performing well in their partial completion of the SRO Instructor Certification Program (18 week course).

   - Age – The crew should generally cover the age range of the available pool of participants.

   - Range of skills, abilities and attributes – Each crew should contain people who demonstrate a typical range of skills in terms of communication, team work, cooperation, organization, planning, computer skills and problem-solving skills.

   - Qualifications – Each crew should contain people with a variety of formal qualifications and educational background, as would typically be found on operating plants. Such qualifications may include a selection or combination of the following:

     - Navy Nuclear Power School
     - Bachelor of Science (BS) in engineering, engineering technology or a related physical science
     - Currently or previously licensed or certified operator.

   Note, all participants will have a High School Diploma or equivalent.

- Preferably contain at least one person with previous nuclear experience. This person(s) may be a previously or currently licensed operator or may have acquired their experience from the navy. As a guide, the person should have at least 2 years operating experience.

- Do not select personnel who participated in the previous AP1000 HFE Engineering Tests.

2. The ISV Plan has been revised. Sections 3.2 and 3.3 have been combined into a revised Section 3.2, Trial Assignments and Scheduling.

   This new Section 3.2 addresses all of the factors that need to be taken into consideration to determine the appropriate trial assignments and ordering per crew. The main factors are (1) the total number of scenarios, (2) the number of trial replications, (4) the number of crews, (5) the ordering of trials to facilitate the representation of realistic plant operations (where trial order does impact on scenario realism), (6) provide the ability to assess the effectiveness of the HSI design, procedures and training to support shift turnover (7) the randomization of trial order to counteract the effects of learning and experience, and (8) the practicalities of running ISV in terms of working hours, the duration of individual scenarios, how many crews are a available at a time and running ISV over 'shifts'. Each of these factors are discussed below, along with the basis for the ISV scheduling and a description of the means to determine the final schedule.

   The detailed trial assignments and trial order will be established during pilot testing using Westinghouse personnel with operations experience as 'ISV subjects'. Once pilot testing is underway, it will be possible to determine the approximate duration of each of the 24 scenarios. This duration will include an allowance for crew performance variability, and will be based on operations judgment of a credible 'worst case' crew in terms of the time to complete the individual scenarios. In addition to the actual scenario run time, the total time will also include pre-trial briefing, post-trial de-briefing, the completion of the post-trial questionnaires and breaks.

   Table 3.2-1 "Example of Crew Assignments to ISV Trials" has also been included in the ISV Plan in Section 3.2, and is shown at the end of this RAI Response. This table provides the basis for developing the detailed ISV crew assignments and scheduling. There are a number of key points, summarized as follows:

   - Scenarios 1 and 2 are plant shutdown and plant cooldown, respectively. Therefore, these scenarios will be run in order, transitioning from one crew to another. This will provide the opportunity to assess shift turnover. Scenarios 3 to 6 comprise plant heat-up and plant start-up operations. Therefore, again, these scenarios will be run in order and provide an opportunity to assess shift turnover activities. In each two week period, a minimum of two shift turnovers will be executed; providing a total of six.

- To account for any effects of learning, Crew A and Crew B will perform scenarios 1 to 6 at the start of their participation in ISV, and conversely, Crew C and Crew D will perform scenarios 1 to 6 at the end of their participation in ISV. Crews E and Crew F each have five accident scenarios to perform. These will be carried out at the beginning of their ISV participation, followed by scenarios 1 to 6, and this will be followed by running the fourth trials, as required and determined by the results from previous trials.

- Scenarios 7 to 24 represent accident scenarios, and as such, they are standalone scenarios and the trial order is not a factor. The information in Table 3.2-1 implies that, for example, Crew A and Crew B will carry out scenarios 7 to 17 in order, and therefore the results if ISV may potentially be influenced by the effects of learning and experience. However, this will not be the case. The order will be randomized simply by placing the scenario numbers in a pool and drawing the numbers 7 to 17 for Crew A, and then repeating the process for Crew B, and so on.

- The crew assignments for scenarios 7 to 24 will ensure that each crew performs risk-important tasks, responds to transients and electrical faults, and undertakes tasks in multiple plant modes. It is considered to be unnecessary to randomize the assignment of scenarios 7 to 24 between the six crews. It is anticipated that there will be no overly 'good' or 'bad' crews, and guidance is given to the utilities on the selection of participants and the assignment of individuals to form the crews. Furthermore, although randomization is important, the limited exposure of the crews to scenarios (i.e., at most a total of fourteen) it is considered reasonable to assume that the results of ISV will be attributable to the scenario itself (e.g., demands on the operator, display design, procedures, etc) rather than the participants familiarity or a learning effect gained over the course of ISV.

- The order of the scenarios 7 to 24 will not be truly randomized within each crew. Firstly, as mentioned previously, the duration of the scenarios is currently unknown. It is judged that the duration of the scenarios (including setup, post-trial briefing and the time to complete the post-trial questionnaires) will be on average 4 hours. Therefore, the order of the trials will be adjusted to facilitate the trials fitting in an 8 hour working day. Secondly, the trials are not randomized across all six crews. Crews A and Crew B will undertake scenarios 7 to 17, and not 18 to 24. This assignment of scenarios to specific crews is to ensure that in the third two-week session, each scenario has one crew (i.e., Crew E and/or Crew F) that has not previously been exposed to that scenario, therefore a fourth trial can be run. The total number of scenarios for Crew E and Crew F is shown as "8", however, this number will increase depending on the requirements to run individual a scenarios a fourth time.

- Crews A, B, C and D will each be assigned a total of 14 scenarios. During a two week period and assuming that travel is carried out on working days, eight days are available for ISV. Running 14 scenarios over eight working days per a crew, provides some contingency if a trial takes significantly longer than estimated, or to allow for any potential problems with the simulator that may cause a delay to the start of a trial.

Table 3.2-1. Example of Crew Assignments to ISV Trials

Scenario Number	Crew A	Crew B	Crew C	Crew D	Crew E	Crew F
1	x		x		x	
2		x		x		x
3	x		x		x	
4		x		x		x
5	x		x		x	
6		x		x		x
7	x	x	x			
8	x	x	x			
9	x	x	x			
10	x	x	x			
11	x	x		x		
12	x	x		x		
13	x	x		x		
14	x	x		x		
15	x	x			x	
16	x	x			x	
17	x	x			x	
18			x	x	x	
19			x	x	x	
20			x	x		x
21			x	x		x
22			x	x		x
23			x	x		x
24			x	x		x
Total Scenarios per Crew	14	14	14	14	8	8

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-42
Revision: 1

Question:

<u>ISV test procedures</u> - NUREG-0711 criterion 11.4.3.2.6.2, Test Procedures, provides guidance on the details of ISV test procedures. The ISV Plan does not provide this detail for each scenario. Please address.

Westinghouse Response:

Issues included in NUREG-0711 11.4.3.2.6.2, Test Procedure, have been addressed in the following sections of ISV Plan:

- Section 3, Test Design (i.e. identification of which crews receive which scenarios and the order that the scenarios will be presented).
- Section 6, Data (i.e. instructions regarding when and how to collect and store data, procedures for documentation).
- Appendix E, Scenario Specifications (i.e. detailed criteria for the conduct of specific scenarios).

Westinghouse recognizes that some scenario-specific details concerning the test procedures will be added, as part of completing each detailed scenario description in the ISV Plan, Rev C, to be issued by 31st January 2010. This includes the following information:

- Instructions for briefing the participants.
- Scripted response for test personnel who will be acting as plant personnel during the test scenarios.
- Guidance on when and how to interact with participants if simulator or testing difficulties occur.

Please note that the any information on test procedure may be subject to change, depending on factors such as the actual number of crew available for the ISV.

Question Rev 1:

Evaluation Based on APP-OCS-GEH-320, Rev. C (Feb 2010)

This RAI asked for the information needed to evaluate the ISV plan with respect to NUREG-0711 11.4.3.2.6.2, Test Procedures. To be more specific, the aspects of these criteria that do not seem to be fully addressed are listed below.

Detailed, clear, and objective procedures should be available to govern the conduct of the tests. These procedures should include:

- The identification of which crews receive which scenarios and the order that the scenarios should be presented. **<This information is not currently presented, except via high-level description.>**
- Detailed and standardized instructions for briefing the participants. The type of instructions given to participants can affect their performance on a task. This source of bias can be minimized by developing standard instructions. **<The detailed instruction for briefing operators is not presented in the scenario descriptions>**
- Specific criteria for the conduct of specific scenarios, such as when to start and stop scenarios, when events such as faults are introduced, and other information discussed in Section 11.4.3.2.4, Scenario Definition. **<Most of this information is included – see subbullets from 11.4.3.2.4 below>.**

\- description of the scenario and any pertinent "prior history" necessary for personnel to understand the state of the plant upon scenario start-up **<This info is included>**
\- specific initial conditions (precise definition provided for plant functions, processes, systems, component conditions and performance parameters, e.g., similar to plant shift turnover) **<This info is included>**
\- events (e.g., failures) to occur and their initiating conditions, e.g., time, parameter values, or events This info is included
\- precise definition of workplace factors, such as environmental conditions <see RAI 49 – now closed>
\- task support needs (e.g., procedures and technical specifications) **<This info is included>**
\- staffing objectives **<This info is included>**
\- communication requirements with remote personnel (e.g., load dispatcher via telephone) **<This info is included>**
\- the precise specification of what, when and how data are to be collected and stored (including videotaping requirements, questionnaire and rating scale administrations) **<This info is included>**
\- specific criteria for terminating the scenario.> **<This info is included>**
\- Scenarios should have appropriate task fidelity so that realistic task performance will be observed in the tests and so that test results can be generalized to actual operation of the real plant. **<The scenarios as describes should provide appropriate task fidelity>**
\- When evaluating performance associated with operations remote from the main control room, the effects on crew performance due to potentially harsh environments (i.e., high radiation) should be realistically simulated (i.e., additional time to don protective clothing and access radiologically controlled areas). **<This info is included>**

• Scripted responses for test personnel who will be acting as plant personnel during test scenarios. To the greatest extent possible, responses to communications from operator participants to test personnel (serving as surrogate for personnel outside the control room personnel) should be prepared. There are limits to the ability to preplan communications since personnel may ask questions or make requests that were not anticipated. However, efforts should be made to detail what information personnel outside the control room can provide, and script the responses to likely questions. **<This info is not presented, although 320 does commit to providing that info "ISV staff will fulfill the AO's responsibilities by scripted role play">**

• Guidance on when and how to interact with participants when simulator or testing difficulties occur. Even when a high-fidelity simulator is used, the participants may encounter artifacts of the test environment that detract from the performance for tasks that are the focus of the evaluation. Guidance should be available to the test conductors to help resolve such conditions. **<This info is not addressed>**

• Instructions regarding when and how to collect and store data. These instructions should identify which data are to be recorded by:

- simulation computers
- special purpose data collection devices (such as situation awareness data collection, workload measurement, or physiological measures)
- video recorders (locations and views)
- test personnel (such as observation checklists)
- subjective rating scales and questionnaires.

<This info is presented in that the same info is used for all scenarios and instructions for collecting the data are provided>

• Procedures for documentation, i.e., identifying and maintaining test record files including crew and scenario details, data collected, and test conductor logs. These instructions should detail the types of information that should be logged (e.g., when tests were performed, deviations from test procedures, and any unusual events that may be of importance to understanding how a test was run or interpreting test results) and when it should be recorded. **<This info is not addressed>**

In summary, many of the individual items in the review criterion are not addressed. Therefore this is open and a follow up is needed.

Westinghouse Response Rev 1:

The RAI question concerns areas in NUREG-0711 Section 11.4.3.2.6.2 'Test Procedures' that were not fully addressed in either the previous RAI Response, APP-OCS-GEH-320, Rev C, nor APP-OCS-GEH-321, Rev A. NUREG Section 11.4.3.2.6.2 contains seven major areas, each represented by a bullet point. For clarity and completeness, the RAI Response below includes all of the seven bullet points, and provides the additional information as requested.

- The identification of which crews receive which scenarios and the order that the scenarios should be presented. **<This information is not currently presented, except via high-level description.>**

  This information was provided in RAI-SRP18-COLP-39, Rev 1, and has been included in ISV Plan, Rev D, Section 4.1.1, Selection.

- Detailed and standardized instructions for briefing the participants. The type of instructions given to participants can affect their performance on a task. This source of bias can be minimized by developing standard instructions. **<The detailed instruction for briefing operators is not presented in the scenario descriptions>**

  Detailed instructions for briefing participants will be included in the scenario descriptions for Scenarios 1, 2 and 12 in APP-OCS-GEH-321, Rev B.

  To facilitate the standardization of the briefing information, guidance has been included in the ISV Plan, Rev D, Section 5.2, ISV Procedures. This guidance states that a formal brief will be developed for each scenario. The briefing primarily states the initial conditions at the start of the scenario, such as a major piece of equipment is unavailable or a pre-existing malfunction exists. It also provides the direction for plant operation, such as maintaining the plant at 100% power.

  The operating crew will be given a turnover briefing sheet which outlines the current plant status and the current weather conditions and forecast. The Westinghouse ISV Coordinator will verbally brief the operating crew with initial plant conditions. An example extracted from Scenario 12 is as follows:

  > *The plant is operating at 100 percent power near the end of core life. It is a weekday, dayshift and the weather is partly cloudy with temperature near 78 degrees Fahrenheit. Wind is relatively calm at 2.3 miles per hour from the west (at compass point: 272 degrees). Thunderstorms are expected to develop later in the day. All plant equipment is operational with no major maintenance activities in progress. The surveillance schedule requires the performance of PXS-801, CMT Valve Surveillance and IST Testing, Section 5.2, in order to comply with Technical Specification SR 3.5.2.6. PXS-801, Initial Conditions 4.1 and 4.4 are signed off as complete and 4.2 and 4.3 are not applicable (N/A). Remote position verification is not required for this quarter. Maintain the plant in a safe condition and at 100% power in accordance with Technical Specifications.*

  Following the briefing, the crew is allowed time to familiarize themselves with the plant conditions. This will be limited to ten minutes, at which time the crew should assume their respective stations and the simulator scenario is set in operation (running mode).

The briefing material will be tested during pilot testing using Westinghouse employees as the ISV participants. This will provide the opportunity to ensure that the briefing material is clear and comprehensive. Any modifications will be made prior to the start of ISV.

- Specific criteria for the conduct of specific scenarios, such as when to start and stop scenarios, when events such as faults are introduced, and other information discussed in Section 11.4.3.2.4, Scenario Definition. **<Most of this information is included>**

  The details of when to start and stop scenarios and introduce faults or events are clearly stated in the scenario descriptions for Scenarios 1, 2 and 12 in APP-OCS-GEH-321, Rev B.

- Scripted responses for test personnel who will be acting as plant personnel during test scenarios. To the greatest extent possible, responses to communications from operator participants to test personnel (serving as surrogate for personnel outside the control room personnel) should be prepared. There are limits to the ability to preplan communications since personnel may ask questions or make requests that were not anticipated. However, efforts should be made to detail what information personnel outside the control room can provide, and script the responses to likely questions. **<This info is not presented, although 320 does commit to providing that info "ISV staff will fulfill the AO's responsibilities by scripted role play">**

  The scenario descriptions for Scenarios 1 and 2 in APP-OCS-GEH-321, Rev B, will include the scripted responses for the ISV personnel who will be acting as plant personnel (e.g., local operators, chemistry) where communication is required outside of the Main Control Room (MCR). To facilitate standardization across trial runs, the content of the responses will be clear, simple and not contain any unnecessary or superfluous information. (Note, there is no requirement for communication outside of the MCR in Scenario 12, therefore, scripted responses are not included in the scenario description).

  Each scenario will have a pre-prepared 'scenario package' that is maintained under the control of the ISV Coordinator. The scripted responses are provided by numbered hardcopies that will be signed out for use and then returned to the ISV Coordinator. The scripted responses will be tested during pilot testing using Westinghouse employees as the ISV participants. This will provide the opportunity to ensure that the scripted responses are clear and comprehensive. Any modifications will be made prior to the start of ISV.

  At this stage, without the ability to run the scenarios on the simulator, it is not feasible to anticipate all questions from the ISV participants. The aim is to minimize the need for the ISV participants to ask questions. Pilot testing will be used to assist in avoiding questions. For example, it will be ensured that the briefing material is clear, concise and adequate – thereby reducing the likelihood of the participants from needing to ask supplemental questions. Testing the scripted responses for the local plant operators will also provide the opportunity for ensuring that the responses are clear and complete.

Obviously it is not possible to eliminate questions entirely. Therefore, the Westinghouse personnel acting as plant personnel will be instructed to provide clear, simple and short answers and to not include any information that is not directly related to the question being asked. All of the communication will be captured via video and audio recording for future reference. In addition, this information will be included in the 'scenario package', therefore, if the same question is raised by more than one crew, the same response will be provided. Again, this will facilitate standardization across the crews and help avoid confounding the ISV results.

The guidance for the development of scripted responses will be included in the ISV Plan, Rev D, Section 5.2, ISV Procedures.

- Guidance on when and how to interact with participants when simulator or testing difficulties occur. Even when a high-fidelity simulator is used, the participants may encounter artifacts of the test environment that detract from the performance for tasks that are the focus of the evaluation. Guidance should be available to the test conductors to help resolve such conditions. **<This info is not addressed>**

The aim is to minimize the occurrence of testing difficulties. The simulator/pilot testing process was described in RAI-SRP18-COLP-24 and APP-OCS-GEH-321, Rev A, Appendix C. In summary, the testing will be undertaken in four phases and will take approximately 22 weeks to complete. The tests comprise simulator stabilization tests and running the ISV scenarios. There are formal testing procedures and the estimated duration of each phase includes an allowance for the time that may be required to fix any identified problems. Therefore, the successful completion of this testing should ensure that any software bugs will be dealt with and not reveal themselves during ISV implementation.

The Engineering Development Simulator (EDS) room environment will not be subject to any distractions or other factors that may detract from the running the ISV scenarios and or impact the performance of the participants. The EDS is a dedicated purpose built room. Access is controlled via a security pass, and a sign will be placed on the doors to inform people that entry is not permitted (e.g., "Do Not Disturb – ISV Testing In Progress"). However, some interruptions are outside of our control, such as a fire drill or an actual fire event. In this case, everyone will be instructed to follow the building evacuation procedures. On returning to the building, a decision will be made by the Westinghouse ISV team regarding the continuation of the scenario. If the affected scenario was only in the early stages and no significant events or faults had been introduced, then the scenario will be re-started from the beginning with the same crew. If the scenario was at the point where events were in-progress, the scenario will be re-run with a different crew that had not previously seen this scenario.

In respect to unanticipated problems with the simulator model or software, a similar strategy will apply. A simulator technician will be present in the Instructors Booth; therefore any simulator problem will be promptly detected and the ISV Coordinator informed. The technician will also be able to detect any problems regarding the digital, video and audio recording of data. If the problem can be fixed in a short time period (within 15 minutes), the ISV Coordinator will inform the crew that a simulator problem has occurred, instruct the crew to stop interacting with the Human System Interfaces (HSI) in the EDS, and to remain in the EDS while the problem is fixed. The crew will be instructed to not interact with other non-crew personnel that may be in the EDS (e.g., simulator technicians), and the observers will be requested to not interact with the crew.

Depending on the timing of the problem, the scenario will either be restarted from the point of the simulator problem (so it will appear as though the simulator model has be 'unfrozen') or the scenario will be restarted from the beginning. However, if the problem occurs once the scenario is well underway, the disruption to the scenario will adversely impact the realism of the scenario. Therefore, once the problem is fixed, the scenario will be re-run from the beginning with a different crew. The ISV Coordinator will keep the crew informed of the estimated time to fix the problem, although general discussions between the ISV Coordinator and the crew will not be permitted (e.g., chatting, discussing the scenario, HSI design)

If the time to correct the problem is estimated to be relatively long, then the trial will be terminated and the crew dismissed. If the problem occurred early in the scenario before plant faults were introduced, the scenario will be re-run from the beginning with the same crew. If the problem occurred when the scenario was well underway, then the scenario will be re-run from the beginning with a different crew.

This general guidance on how to deal with ISV problems will be added to the ISV Plan, Rev D, Section 5.2, ISV Procedures.

- Instructions regarding when and how to collect and store data. These instructions should identify which data are to be recorded by:
  - simulation computers
  - special purpose data collection devices (such as situation awareness data collection, workload measurement, or physiological measures)
  - video recorders (locations and views)
  - test personnel (such as observation checklists)
  - subjective rating scales and questionnaires.

  <This info is presented in that the same info is used for all scenarios and instructions for collecting the data are provided>

Further information regarding the collection and storage of ISV results data will be added to the ISV Plan, Rev D, Section 5.2, ISV Procedures.

The ISV Coordinator will be responsible for distributing and collecting the completed Observer Guides for each scenario. The Observer Guides are hardcopy, and will include the date, time and crew identification. At the end of each scenario, the ISV Coordinator will distribute and collect the completed post-trial questionnaires for the subjects, and at the end of the crews and observers participation in ISV, the ISV Coordinator will distribute and collect the final questionnaires for the subjects and observers. All of this information is hardcopy, and will be clearly marked and stored in a secure location.

The simulator will record discrete plant events and plant parameter histories. In addition, the operator actions will be recorded using the Morae recording software. This software tool was successfully used in the Engineering Tests, where it was the principle tool for the real-time data recording of operator behavior and actions. Morae creates a time-stamped record from several channels of separate data, and provides playback, search and analysis tools. The data includes keyboard inputs, mouse clicks and all display activity on both monitors of each recorded workstation. It also has a video channel to record operator movements and expressions via a webcam mounted on the top of the VDU monitors, plus an audio channel to record the operator's communications.

The camera system in the EDS will comprise five cameras. There will be a fixed camera mounted to the ceiling in each corner of the room, with a fifth camera mounted on the ceiling above the safety console. This fifth camera will have pan/tilt/zoom capability, plus a preset positioning function. The cameras will be controlled from the Instructors Booth via software and there will be a dedicated monitor with split screen capability for displaying the camera images. The audio system consists of four ceiling mounted microphones in the EDS – two over the operator console, one over the SRO console, and one over the meeting/conference table. Speakers will be provided in the Instructors Booth and the Observation Room. All of this data will be recorded digitally and backed-up on discs.

Finally, there will be an intercom system with a microphone in the Instructors Booth and a speaker in the MCR.

- Procedures for documentation, i.e., identifying and maintaining test record files including crew and scenario details, data collected, and test conductor logs. These instructions should detail the types of information that should be logged (e.g., when tests were performed, deviations from test procedures, and any unusual events that may be of importance to understanding how a test was run or interpreting test results) and when it should be recorded. **<This info is not addressed>**

Further details will be added to the ISV Plan, Rev D, Section 5.2 ISV Procedures, on the documentation of the ISV results.

The ISV Coordinator will be responsible for the ISV documentation. In addition to maintaining and controlling the 'scenario packages', the ISV Coordinator will collect the ISV results data and will be in charge of ensuring that this data is not 'lost'.

The discrete event data and plant parameter data from the simulator will be stored on a server and burnt onto discs. The file names for this data will identify the scenario number, the crew, and will be date and time-stamped.

The data from the recordings at the individual 'drops' (i.e., individual workstations) from the Morae software will likewise be stored on a server and on discs, plus the scenario, crew, date, time and workstation will also be recorded. The video and audio recordings will be stored in the same manner. These recordings will encompass the scenario runs plus the scenario de-briefings.

The ISV Coordinator will produce a trial log for each trial. This log will identify the scenario number, the crew, date and the starting time and ending time of the scenario. This log will record any notable events regarding the actual running of the scenario. This may include, for example, any problems or signs of potential problems with the simulator or data collection methods. The log will include a record of any unanticipated questions asked by the crew, and the responses. This information will be available for future runs of the same scenario so that the same response can be supplied if the question was to be asked again.

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-46
Revision: 1

Question:

Margin for error - NUREG-0711 Section 11.4.3.2.7 (5) recommends that there be some allowance for margin of error in validation. In some cases the time criteria for RIHAs do not appear to provide sufficient margin. For example,

- ADN-MAN03 (3 min. estimated time versus 5 min. required time window)
- ATW-MAN03 (0.5 min. estimated time versus 1 min. required time window)
- RHN-MAN04 (6 min. estimated time versus 10 min. required time window).

Please discuss and justify.

Westinghouse Response:

It is recognized that in a number of cases the estimated time and the required time windows for the Risk-Important Human Actions (RIHA) are relatively close. The time information was derived from the PRA, and therefore it can not be altered (in the ISV Plan). The detailed AP1000 design has been demonstrated to have a very low likelihood of violating critical limits. For example, design requirements, safety analysis, the PRA and Technical Specifications each incorporate conservative assumptions and explicit margins to provide this assurance. In addition, the ISV includes a number of general conservatisms to provide added confidence in the results. Some of the scenarios are demanding, and coupled with the relative inexperience of the test subjects, actual crew performance in an operating plant is highly likely to be better than that demonstrated in ISV.

The time to perform RIHAs will be closely monitored. If a case is occurs where the time available (i.e., the required time window) is potentially insufficient to ensure reliable operator performance, this will be identified as an HED. Subsequently, the cause of the problem and an appropriate resolution (e.g., added training, revised procedures, change to the HSI design, etc.) will be determined. Resolution of the corresponding HED will seek to mitigate any actual problem in the design. It is also noted that insufficient time to complete a RIHA in ISV will suggest that the human error probability (HEP) for that action in the PRA may have been underestimated. This information will be communicated to the group responsible for the PRA.

Question Rev 1:

Evaluation based on review of 320 Rev. C, and 321: The wording of the response was acceptably added to 320 Rev. C, Section 6.2.1. Review of 321, including the observer guide for Scenario 12, noted that for RIHAs, the document is not completely clear on how the actual times to complete a RIHA would be measured/determined. Also there didn't seem to be a specified place for recording this information. The observer guide only has a SAT/UNSAT column. WEC needs to clearly specify the events that start and stop the time clock. This didn't seem consistent between the scenario description (Table A12-1) and the observer guide. The Scenario 12 guide seems to start on red path announcement rather than a physical parameter such as CET ≥1200 °F. Please clarify and update documents as necessary. Open

Westinghouse Response Rev 1:

For all scenarios containing a Risk-Important Human Action, the scenario descriptions in APP-OCS-GEH-321 (Appendix A) state the Risk-Important Human Actions. This information comprises a table denoting the basic event identification, event description, time window trigger, procedures and the corresponding time windows. Three of the scenario descriptions have been updated in APP-OCS-GEH-321, Rev B. One of these scenarios (Scenario 12) contains two Risk-Important Human Actions, and the information in the aforementioned table will be expanded to include the starting and ending steps. In future revisions of APP-OCS-GEH-321, all of the other applicable scenario descriptions will be updated to include the starting and ending step information.

The Observer Guides will be modified to ensure that the starting and ending time for the Risk-Important Human Actions are recorded. The Sequence of Events column will include the starting step and a designated space for the observer to record the time. Likewise, the ending step will be included in the Sequence of Events column, and the observer will be provided with a clearly marked space to enter the end time. From the starting and ending times, it will be straightforward to calculate the total task time for the Risk-Important Human Action and compare it against the 'available time window' as per the PRA. In APP-OCS-GEH-321, Rev B, the Observer Guide for Scenario 12 will be modified accordingly. The Observer Guides for the other scenarios containing a Risk-Important Human Action(s) will be updated to include this information in a future revision

It is recognized that it may not be 'easy' for the observers to accurately identify the time of the start and ending step. For example, the observers' attention may be elsewhere and they could be inaccuracies in their time recording. However, there will be multiple observers, plus there will be discrete event recording (providing a time-stamped record of manual actions, automatic actions and component state changes), plant performance recording (providing a time-stamped record of plant behavior and operating performance) and video and audio recording. This data will be utilized to confirm the results obtained via the Observer Guides and support the evaluation of the time taken to complete the Risk-Important Human Actions.

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-53
Revision: 1

Question:

Simulation of local actions - Section 1.3, Scope, of the ISV states in part that "The use of local control stations may be represented in ISV scenarios, but local control stations are outside the scope of the ISV." Reasons for this are given in the proprietary portion of Section 1.3. However, the staff notes that the list of AP1000 RI HAs in Table 3.2-2 of APP-GW-GL-011, WCAP-16555 (NP) includes a local action to close the equipment hatch and personnel airlocks during shutdown. Please address.

Westinghouse Response:

The risk-important task involving the local control action to close the equipment hatch and personnel airlocks during shutdown (as detailed in APP-GW-GL-011, Reference 1) will be included in the ISV Plan, Rev C, to be issued by 31st January 2010. (Note, this was also included in the Response to RAI-SRP18-COLP-32).

The activities associated with closing the containment involve closing the equipment hatch, personnel hatches and any temporary penetrations. The time required to physically close the hatches under optimal conditions is perhaps five minutes, versus a time window of 30 minutes. The uncertainty in such situations includes the extent to which temporary penetrations and work practices and procedures will add to the time to complete these activities. With respect to the ISV scenario, the time required to physically close local containment hatches and temporary penetrations can not be validated utilizing the ISV facility. However, the assurance of prompt local containment closure will be addressed via an assessment of the local plant design against relevant HFE guidelines, a review of the applicable administrative procedures and controls, the performance of task walkthroughs on installed equipment, and as part of the HFE design verification at plant startup (Reference 2). This information will be added in Revision C of the ISV Plan, to be issued by 31st January 2010.

Question Rev 1:

Evaluation based on review of 320 Rev. C and 321: The RIHA to close the hatches is addressed in Scenario 19 of 321. The actual verification of acceptability of planned local actions associated with the hatches will need to be deferred until the plant is built. Therefore the RAI response proposes adding this to the HFE Design Verification at Plant Startup, APP-OCS-GEH-520. This is acceptable and this RAI is confirmatory until that change is made.

Westinghouse Response Rev 1:

The local action to close containment involving closing the equipment hatch, personnel hatches and any temporary penetrations following core damage during a shutdown event, has been added to APP-OCS-GEH-520 "AP1000 Plant Startup Human Factors Engineering Design Verification Plan", Section 1.2.2 "List of Design Features Requiring Verification" (Reference 2).

The local plant action to close the containment is also included in the in the human factors assessment of local plant operations and plant maintainability (in progress).

References:

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

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

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.