

ArevaEPRDCPEm Resource

From: Tesfaye, Getachew
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To: 'usepr@areva.com'
Cc: Mills, Daniel; Zhang, Deanna; Morton, Wendell; Spaulding, Deirdre; Mott, Kenneth; Truong, Tung; Zhao, Jack; Jackson, Terry; Jaffe, David; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 506 (5456), FSAR Ch. 14
Attachments: RAI_506_ICE1_5456.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 12, 2011, and discussed with your staff on August 25 and 29, 2011. Draft RAI Question 14.03.05-38 has been modified as a result of those discussions. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

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From: Tesfaye, Getachew

Created By: Getachew.Tesfaye@nrc.gov

Recipients:

"Mills, Daniel" <Daniel.Mills@nrc.gov>
Tracking Status: None
"Zhang, Deanna" <Deanna.Zhang@nrc.gov>
Tracking Status: None
"Morton, Wendell" <Wendell.Morton@nrc.gov>
Tracking Status: None
"Spaulding, Deirdre" <Deirdre.Spaulding@nrc.gov>
Tracking Status: None
"Mott, Kenneth" <Kenneth.Mott@nrc.gov>
Tracking Status: None
"Truong, Tung" <Tung.Truong@nrc.gov>
Tracking Status: None
"Zhao, Jack" <Jack.Zhao@nrc.gov>
Tracking Status: None
"Jackson, Terry" <Terry.Jackson@nrc.gov>
Tracking Status: None
"Jaffe, David" <David.Jaffe@nrc.gov>
Tracking Status: None
"Canova, Michael" <Michael.Canova@nrc.gov>
Tracking Status: None
"Colaccino, Joseph" <Joseph.Colaccino@nrc.gov>
Tracking Status: None
"ArevaEPRDCPEm Resource" <ArevaEPRDCPEm.Resource@nrc.gov>
Tracking Status: None
"usepr@areva.com" <usepr@areva.com>
Tracking Status: None

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U. S. EPR Standard Design Certification

AREVA NP Inc.

Docket No. 52-020

SRP Section: 14.03.05 - Instrumentation and Controls - Inspections, Tests, Analyses, and Acceptance Criteria

Application Section: 2.4

QUESTIONS for Instrumentation, Controls and Electrical Engineering 1 (AP1000/EPR Projects) (ICE1)

14.03.05-25

Provide ITAAC that verifies (1) the devices enforcing uni-directional communication are safety related and (2) only pre-defined messages are allowed during data communications between safety divisions and between safety and non-safety systems.

10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. SRP Section 14.3.5 states that specific areas of review for ITAACs include functional requirements of IEEE Std. 603-1991 and the General Design Criteria when implementing the safety system. IEEE Std. 603-1998, Clause 5.6, requires, in part, independence between safety and non-safety systems (the applicant proposed to use 1998 version of IEEE Std. 603 in lieu of the 1991 version). The staff requests the applicant to address the following ITAAC issues:

- a. Tier 2, Section 7.1.1.6.4, Interim Revision 3 mark-ups, states that communication is uni-directional from the Protection System /Safety Automation System to the Process Information and Control System and from the PS to the Qualified Display System. Tier 2, Figure 7.1-20, Interim Revision 3 mark-ups, shows the device enforcing uni-directional communication is safety-related as required by IEEE Std. 603-1998, Clause 5.6.3. ITAAC Item 4.17 in Table 2.4.1-7 and Item 4.9 in Table 2.4.4-6 of the U.S. EPR FSAR, Tier 1, Interim Revision 3 markups, did not state that the device enforcing uni-directional communication from the PS/SAS to non-safety system is Class 1E. The staff requests the applicant to clarify the design descriptions and ITAAC Item 4.17 in Tier 1, Table 2.4.1-7, and Item 4.9 in Tier 1, Table 2.4.4-6, to demonstrate that the device enforcing uni-directional communication is safety-related.
- b. The staff issued Digital Instrumentation and Controls Interim Staff Guidance 4 (D I&C ISG-04) to provide criteria for implementing interdivisional data communications. Criterion 7 in Section 1 of D I&C ISG-04 states that only predefined data sets should be used by the receiving system. The staff requests the applicant to provide an ITAAC to verify only pre-defined messages are allowed during data communications between safety divisions and between safety and non-safety systems to meet the requirements of 10 CFR 52.47(b)(1).

14.03.05-26

Clarify the meaning of "a report exists and concludes" in Section 14.3 of the U.S. EPR Final Safety Analysis Report (FSAR), Tier 2.

10 CFR 52.47(b)(1) requires "inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations." Many of the ITAAC acceptance criteria used by the applicant in U.S. EPR FSAR, Tier 1, include language referring to "a report exists and concludes." In comparing the definition of "exists" between U.S. EPR FSAR, Tier 1, and SRP Section 14.3, Appendix A.IV.2.B, applicant does not have a complete definition. Specifically, the applicant should include the second sentence in the SRP definition of "exists," which links back to Tier 2. Specifically, the sentence is "Detailed supporting information on what should be present to conclude that an item "exists" and meets the design description is contained in the appropriate sections of the FSAR."

14.03.05-27

Provide a listing of the safety functions of the Safety Information and Control System (SICS) and clarify how the ITAAC map to those safety functions.

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. U.S. EPR FSAR, Tier 1, Section 2.4.2, includes ITAAC entries for all listed design description of the SICS but the actual "safety functions" are not listed. Item 4.10 for SICS refers to safety functions, but these functions are not detailed in the Tier 1 information for this system. Provide a listing of the safety functions of the SICS and clarify how the ITAAC map to those safety functions.

14.03.05-28

Provide an explanation on how the ITAAC address equipment qualification requirements for mild environments.

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. In RAI 78, Question 14.03.05-4, the staff requested additional detail on how the ITAAC in Section 2.4 addresses various aspects of safety systems. In response to this RAI, the applicant identified instances in which environmental qualification is verified for Class 1E equipment exposed to harsh environments, but stated that ITAAC are not required for Class 1E equipment exposed to mild environments. The applicant is correct that qualification required for harsh environments is different than that required for mild environments (e.g., 10 CFR 50.49(c)). However,

10 CFR 50.55(a)h sets forth the qualification requirements for mild environments (i.e., IEEE Std. 603-1991, Clause 5.4). The applicant is requested to provide an explanation of how the ITAAC address equipment qualification requirements for mild environments.

14.03.05-29

Provide editorial corrections to Tier 1, Tables 2.4.17-1, 2.4.19-1, and 2.4.26-3.

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. Should the headings of Tier 1, Table 2.4.17-1, Column 4, and Tier 1, Table 2.4.19-1, Column 4, "seismic class" be changed to "seismic category" to be consistent with other Tier 1 descriptions? Also, should Tier 1, Table 2.4.26-3, Item 1, read "temperature compensated RCCA positions" to maintain consistency within Tier 1?

14.03.05-30

Clarify how the ITAAC in Tier 1 Section 2.4.5 verify the listed safety functions of the Priority and Actuation Control System.

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. Tier 1, Section 2.4.5, includes ITAAC entries for all listed design description of the PACS, but it is unclear whether the actual safety functions are verified by ITAAC. Specifically, how does the ITAAC verify that the PACS prioritizes actuation requests from I&C systems, performs essential equipment protection, performs drive actuation, and performs drive monitoring? If other ITAAC, including those of mechanical systems, are used to verify PACS safety functions, demonstrate how those ITAAC verify the safety functions of PACS.

14.03.05-31

Clarify how the ITAAC in U.S. EPR FSAR, Tier 1, Section 2.4.13, map to the listed safety functions of the Control Rod Drive Control System (CRDCS).

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. Tier 1, Section 2.4.13, includes ITAAC entries for all listed design description of the CRDCS but it is unclear whether both the safety functions are verified by ITAAC. There does not appear to be an ITAAC corresponding to the second listed safety function "provides signals that report the status of the reactor trip contacts." The applicant is requested to clarify how the ITAAC map to the CRDCS safety functions.

14.03.05-32

Clarify how the ITAAC in Tier 1 Section 2.4.19 map to the listed safety functions of the Incore Instrumentation System (ICIS).

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. U.S. EPR FSAR, Tier 1, Section 2.4.19, includes ITAAC entries for all listed design description of the ICIS, but it is unclear how the safety functions are verified by ITAAC. The second listed safety function "provides a measurement of core outlet temperatures" does not appear to be verified by ITAAC. The applicant is requested to clarify how the ITAAC map to the ICIS safety functions.

14.03.05-33

Clarify how the ITAAC in U.S. EPR FSAR, Tier 1, Section 2.4.14, are sufficient to verify the listed safety functions of the Hydrogen Monitoring System (HMS).

10 CFR 52.47(b)(1) requires inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations.

Tier 1, Section 2.4.14, includes ITAAC entries for all listed design description of the HMS, but it is unclear whether the listed safety function is verified by ITAAC. Commitment 4.1 states "the HMS equipment classified as Class 1E in Table 2.4.14-1 can perform its safety function" under the given conditions. Does this necessarily ensure that the HMS system as a whole will perform its safety function? Is the equipment listed in Table 2.4.14-1 an exhaustive list of all HMS equipment? The applicant is requested to clarify how the ITAAC verify that the HMS will perform its safety function.

14.03.05-34

Clarify whether the Rod Position Measurement System (RPMS) processors have different operational modes that are controlled by the Central Processing Unit (CPU) state switch and provide Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC) to verify this feature to meet the requirements of 10 CFR 52.47(b)(1).

10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. Standard Review Plan (SRP) Section 14.3.5 provides acceptance criteria for ITAACs related to I&C systems. SRP Section 14.3.5 states that specific areas of review for ITAACs include functional requirements of IEEE Std. 603-1991 and the General Design Criteria when implementing the safety system.

The applicant proposed to use 1998 version of IEEE Std. 603 in lieu of the 1991 version. Clause 5.9 of IEEE Std. 603-1998 requires the safety system design to permit the administrative control of access to safety system equipment. These administrative controls shall be supported by provisions within the safety systems, by provisions in the generating station design, or by a combination thereof. Section 2.4.26 of the U.S. EPR FSAR, Tier 1, Interim Revision 3 markups, did not specify whether the TELEPERM XS (TXS) processors in the RPMS have different operational modes like the Protection System (PS)/Safety Automation System (SAS) processors and whether a CPU state switch controls the operational mode of the processor. The CPU state switch provides access control to prevent unauthorized changes to the operational mode of TXS function processors. The staff requests the applicant to clarify whether the RPMS processors have different operational modes that are controlled by the CPU state switch and to provide an ITAAC to verify this feature to meet the requirements of 10 CFR 52.47(b)(1).

14.03.05-35

Provide Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) to verify communications independence exists between Rod Position Measurement System and non-safety systems (i.e. Service Unit (SU)) to meet the requirements of 10 CFR 52.47(b)(1).

10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. SRP Section 14.3.5 provides acceptance criteria for ITAACs related to I&C systems. SRP Section 14.3.5 states that specific areas of review for ITAACs include functional requirements of IEEE Std. 603-1991 and the General Design Criteria when implementing the safety system. The applicant proposed to use 1998 version of IEEE Std. 603 in lieu of the 1991 version. IEEE Std. 603-1998, Clause 5.6, requires, in part, independence between redundant portions of safety systems and between safety and non-safety systems. The staff reviewed the ITAACs provided in Table 2.4.26-4 for the RPMS and could not identify an ITAAC to verify that communications independence exists between the RPMS and non-safety systems (i.e. SU). As such, the staff requests the applicant to provide an ITAAC to verify communications independence exists between RPMS and non-safety systems to meet the requirements of 10 CFR 52.47(b)(1).

14.03.05-36

Provide ITAAC that verifies electrical isolation exists between the Class 1E Rod Position Measurement System (RPMS) equipment and non-Class 1E equipment. Also, clarify the acceptance criteria in Tier 1, Table 2.4.2-2, ITAAC Item 4.2, regarding electrical isolation between the Class 1E divisions that power the controls and indications of the Safety Information and Control System (SICS).

10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. Standard Review Plan (SRP) Section 14.3.5

provides acceptance criteria for ITAACs related to I&C systems. SRP Section 14.3.5 states that specific areas of review for ITAACs include functional requirements of IEEE Std. 603-1991 and the General Design Criteria when implementing the safety system. The applicant proposed to use 1998 version of IEEE Std. 603 in lieu of the 1991 version. IEEE Std. 603-1998, Clause 5.6.1 requires, in part, electrical isolation between safety divisions.

The staff reviewed ITAAC Item 4.2 in Tier 1, Table 2.4.2-2, Interim Revision 3 mark-ups, and find that additional information is required to demonstrate that the acceptance criterion in this ITAAC is sufficient to verify that electrical isolation exists (e.g., qualified Class 1E isolation device) between the Class 1E divisions that power the controls and indications of the SICS. Specifically, the staff finds ITAAC Item 4.2 in Tier 1, Table 2.4.2-2, Interim Revision 3 mark-ups, is inadequate since the acceptance criterion to verify this commitment does not describe what is acceptable electrical isolation. The staff requests the applicant to clarify how the acceptance criterion in Item 4.3 in Tier 1, Table 2.4.2-2, Interim Revision 3 mark-ups, will verify that electrical isolation exists (e.g., qualified Class 1E isolation device) between the Class 1E divisions that power the controls and indications of the SICS.

In addition, the staff reviewed ITAAC Table 2.4.26-4 of the U.S. EPR, FSAR, Tier 1, Interim Revision 3 mark-ups, and could not identify an ITAAC to verify that electrical isolation exists between the RPMS and non-Class 1E equipment. Provide an ITAAC that will verify that electrical isolation exists between the Class 1E RPMS equipment and non-Class 1E equipment to meet the requirements of 10 CFR 52.47(b)(1).

14.03.05-37

Provide ITAAC that verifies features that support control of access to cabinets of the Safety Information and Control System (SICS), Signal Conditioning and Distribution System (SCDS), and Rod Position Measurement System (RPMS) to meet the requirements of 10 CFR 52.47(b)(1).

10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. SRP Section 14.3.5 provides acceptance criteria for ITAACs related to I&C systems. SRP Section 14.3.5 states that specific areas of review for ITAACs include functional requirements of IEEE Std. 603-1991 and the General Design Criteria when implementing the safety system. The applicant proposed to use 1998 version of IEEE Std. 603 in lieu of the 1991 version. Clause 5.9 of IEEE Std. 603-1998 requires the safety system design to permit the administrative control of access to safety system equipment. These administrative controls shall be supported by provisions within the safety systems, by provisions in the generating station design, or by a combination thereof. The staff reviewed the ITAACs provided in U.S. EPR FSAR, Tier 1, Interim Revision 3 mark-ups, and could not identify ITAACs to verify that features that support control of access to cabinets of the SICS, SCDS, and RPMS. The staff requests the applicant to provide ITAACs to verify these features exist for these systems to meet the requirements of 10 CFR 52.47(b)(1).

14.03.05-38

Provide an ITAAC Item that verifies ESF design functionality available on the Remote Shutdown Station (RSS).

Appendix A to Part 50, General Design Criteria 19 requires, in part, that equipment outside the control room shall be provided, 1) With a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and 2) With a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

U.S. EPR FSAR, Tier 1, Section 2.4.1, states that the PS provides for the manual initiation of ESF functions, listed on Tier 1, Table 2.4.1-4. ITAAC Item 4.11 in Tier 1, Table 2.4.1-7, provides the applicant's commitment for verifying system-level manual activation of ESF functions in the main control room. ITAAC Item 4.15 addresses manual reactor trip from the RSS; but no ITAAC was identified to verify system-level manual actuation of ESF functions from the RSS. According to Interim Revision 3 mark-ups of Tier 2, Section 7.4.1.1, the SICS inventory in the RSS comprises ESF system reset functionality. The staff requests the applicant provide an ITAAC Item on Tier 2, Table 2.4.1-7, that verifies ESF manual controls on the RSS.

14.03.05-39

Discuss the basis for not including ITAAC to verify single failure protection for all safety-related systems.

IEEE Std. 603-1991, Clause 5.1, requires that any single failure within the safety system shall not prevent proper protective action at the system level when required. Guidance in the application of the single-failure criterion is provided in Regulatory Guide 1.53, "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems," which endorses IEEE Std. 379-1988, "Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems." The applicant provided ITAACs to verify design commitment regarding single-failure protection for safety-related systems such as Protection System (U.S. EPR FSAR, Tier 1, Table 2.4.1-7, Item 4.18), SICS (Tier 1, Table 2.4.2-2, Item 4.10), and SAS (Tier 1, Table 2.4.4-6, Item 4.10). Staff requests applicant to explain why such single-failure protection ITAACs were left out for the other safety-related systems such as Incore Instrumentation System, Excore Instrumentation System, Boron Concentration Measurement System, Radiation Monitoring System, Hydrogen Monitoring System, Signal Conditioning and Distribution System, and Rod Position Measurement System.

14.03.05-40

Provide an ITAAC that verifies the Radiation Monitoring System (RMS) performs its safety functions under all environmental conditions enumerated in the design basis.

10 CFR 52.47(b)(1) requires, in part, ITAAC that are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. SRP Section 14.3.5 provides guidance to meet the requirements of 10 CFR 52.47(b)(1). Tier 1, Section 2.4, states that the various safety-related instrumentation and control systems can perform their respective safety functions

when subjected to electromagnetic interference, radio-frequency interference, electrostatic discharges and power surges. However, Section 2.4 does not state this information for RMS. The ITAAC provided in Section 2.4 provides for verification of these environmental factors for all previously mentioned safety systems in this section with the exception of RMS. The staff requests that the applicant clarify in Section 2.4 that the RMS can perform its safety function under the specified environmental conditions and to provide an ITAAC test to verify this design aspect.

14.03.05-41

Provide a design description and ITAAC testing item in U.S. EPR FSAR, Tier 1, to address self-test functionality for the Safety Automation System (SAS).

IEEE Std. 603-1998, Clause 5.7 requires, in part, that the capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. 10 CFR 52.47(b)(1) requires, in part, that ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations. SRP Section 14.3.5 provides guidance to meet the requirements of 10 CFR 52.47(b)(1).

U.S. EPR FSAR, Tier 1, Section 2.4.4, contains the design description of SAS. The design description does not include details concerning self-test functionality for SAS similar to that of the PS stated in Section 2.4.1, ITAAC Item 4.26. There is no ITAAC item for testing SAS self-testing functionality shown on Tier 1, Table 2.4.4-6, Interim Revision 3 mark-ups. Technical Report ANP-10315, Section 2.2.6, states that the TXS inherent and engineered monitoring features, also collectively referred to as "self-testing features", applies to both the PS and SAS. In addition, IEEE Std. 603-1998, Clause 5.7, applies to SAS as well, therefore requiring a verification of design functionality of SAS self-testing features considering the applicant is taking credit for self-testing features of the SAS to meet the requirements of Clause 5.7. The staff requests the applicant add self-testing features to the design description of Tier 1, Section 2.4.4, and an ITAAC item in Tier 1, Section 2.4.4, for SAS.

14.03.05-42

Clarify Tier 1 ITAAC information regarding verification of system-level manual controls.

Clause 6.2 of IEEE Std. 603 requires, in part, that means be provided to manually initiate protective system actuation at the division level with minimal number of discrete operator manipulations. The staff used SRP Appendix 7.1-C as guidance for this area of the evaluation, which references RG 1.62 as an acceptable means of addressing compliance with Clause 6.2. U.S. EPR FSAR, Tier 1, Table 2.4.1-7, ITAAC Item 4.11, provides for the verification of manual system-level controls. The acceptance criteria for ITAAC Item 4.11 do not present the level detail similar to that of ITAAC Item 4.2, which addresses Clause 5.2 (Completion of Protective Action) for automatic actuations. It is not clear that ITAAC Item 4.11 verifies that the manual actuation sequence goes on to

completion before reset. The staff requests the applicant revise the acceptance criteria of ITAAC Item 4.11 to improve the level detail commensurate with the acceptance criteria of ITAAC Item 4.2. Also, according to Tier 2, Table 7.1-4, Interim Revision 3 mark-ups, the SICS on the RSS does provide limited ESF reset functionality. Tier 1, Table 2.4.1-7, Interim Revision 3 mark-ups, does not provide an ITAAC item to verify this functionality. The staff requests that the applicant add an ITAAC item to verify this design aspect.