ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Friday, December 17, 2010 1:28 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); WELLS Russell (AREVA); HALLINGER Pat (EXTERNAL AREVA); WILLIFORD Dennis (AREVA); PATTON Jeff (AREVA); RYAN Tom (AREVA); CONCKLIN John (AREVA); SHARPE Robert (AREVA); Miernicki, Michael; Carneal, Jason
Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 439, FSAR Ch. 14, questions 14.02-162 and 14.03.07-36
Attachments: RAI 439 Supplement 2 Response US EPR DC - DRAFT.pdf

Getachew,

Attached is a draft RAI response for questions 14.02-162 and 14.03.07-36 to support the final response date of February 21, 2011. Let me know if the staff has questions or if this response can be submitted as final.

Thanks,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Monday, November 22, 2010 5:37 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); LENTZ Tony (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 439, FSAR Ch. 14, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule on September 27, 2010 for technically correct and complete responses to the two questions in RAI 439. AREVA NP needs additional time to prepare the response and interact with the NRC.

The revised schedule for a technically correct and complete response to 2 of the 2 questions is provided below:

Question #	Response Date
RAI 439 — 14.02-162	February 21, 2011
RAI 439 — 14.03.07-36	February 21, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
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From: BRYAN Martin (External RS/NB)
Sent: Monday, September 27, 2010 1:48 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); LENTZ Tony (External RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 439, FSAR Ch. 14

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 439 Response US EPR DC.pdf," provides the schedule for technically correct and complete responses to these questions.

The following table indicates the respective pages in the response document, "RAI 439 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 439 — 14.02-162	2	5
RAI 439 — 14.03.07-36	6	8

A complete answer is not provided for 2 of the 2 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 439 — 14.02-162	December 14, 2010
RAI 439 — 14.03.07-36	November 23, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, August 26, 2010 5:08 PM
To: ZZ-DL-A-USEPR-DL
Cc: Reddy, Devender; Lee, Samuel; Segala, John; Miernicki, Michael; Hearn, Peter; Colaccino, Joseph; AreveaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 439 (4802,4803), FSAR Ch. 14

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 18, 2010, and on August 26, 2010, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. 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

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2456

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Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 439, FSAR Ch. 14, questions 14.02-162 and 14.03.07-36
Sent Date: 12/17/2010 1:27:41 PM
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From: BRYAN Martin (EXTERNAL AREVA)

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Files	**Size**	**Date & Time**
MESSAGE	4073	12/17/2010 1:29:22 PM
RAI 439 Supplement 2 Response US EPR DC - DRAFT.pdf	688773	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 439(4802, 4803), Supplement 2

8/26/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 14.02 - Initial Plant Test Program - Design Certification and New License Applicants
SRP Section: 14.03.07 - Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria

Application Sections: 14.2 & 14.3

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

Question 14.02-162:

SRP Section 14.2, Item 5 under SRP Acceptance Criteria, specifies that applicants should provide abstracts of planned tests to demonstrate and verify the performance capabilities of SSCs and design features that serve functions that are important to safety. The staff found the information in the FSAR to be insufficient in this regard. In particular, additional information is needed to address the following items:

1) Tier 2 Test 14.2.12.7.10 specifies testing for the steam turbine. The staff found that the test description is either incomplete or requires clarification with respect to the following items:

   a. The objectives under Item 1.4 indicate that a reactor trip and low condenser vacuum should each cause the turbine to trip. However, these trips are not listed in Tier 2 Section 10.2. Also, the trips that are listed in Tier 2 Section 10.2 are not included within the scope of the test objectives.

   b. The test needs to confirm that turbine overspeed protection is available and functioning properly; and that the manual turbine trip circuits in the control room and at the turbine are functioning properly and manned before proceeding with the rest of the test.

   c. Item 3.2 verifies the detection and annunciation of dangerous or undesirable conditions, and initiation of the appropriate control response. It is not clear what these conditions are and what the control response should be. The specific conditions of interest should be described in Tier 2 Section 10.2 of the DCD and referred to by the test procedure.

   d. Item 3.5 specifies observation of the response of power-operated valves upon a loss of motive power and refers to Tier 2 Section 10.3 for the anticipated response. The turbine control and stop valves are described in Tier 2 Section 10.2, and it isn't clear why Section 10.3 is being referenced and it isn't really clear what "power operated" valves are being referred to.

   e. Item 4 specifies data that is required, but the data that is called for doesn't seem to correlate very well with the actual testing that is being done. For example, Item 4.3 calls for the conditions under which the manual trips operate but the test does not specifically call for manual trip operation.

   f. Item 5 specifies the test acceptance criteria that must be satisfied, but they don't seem to encompass all of the items referred to under Items 3 and 4 of the test procedure. Also, Item 5.1 refers to Tier 2 Section 10.3 for the performance acceptance criteria for the steam turbine system and support systems but Tier 2 Section 10.2 describes turbine generator performance considerations; and not all of the considerations referred to in Item 5.1 are described in Section 10.2.

   g. Items 5.3 and 5.4 refer to Tier 2 Section 10.2 for information about turbine trip initiation in response to a reactor trip and a loss of condenser vacuum, but this information is not discussed in Section 10.2.

   h. The test needs to include provisions for addressing extraction steam non-return valve performance.

2) Tier 2 Test 14.2.12.11.11 specifies testing for the turbine generator instrumentation and control system. The staff found that the test description is incomplete or requires clarification with respect to the following items:

   a. The prerequisite listed under Item 2.7 specifies verification of proper operation of alarm, control, and indication functions. However, alarm, control, and indication functions need to be described in Tier 2 Section 10.2 and referred to by the test specification.

   b. The test method listed in the first sentence under Item 3.3 is a restatement of the test objective and is not really a test method.

   c. The trip logic referred to by Item 5.1 under the acceptance criteria needs to be discussed in Tier 2 Section 10.2 and referred to by the test specification.

   d. The “normal test functions” referred to under Item 5.5 of the acceptance criteria need to be described in Tier 2 Section 10.2 and referred to by the test specification.

   e. The test needs to include provisions to address the fail-safe response of the turbine generator control and overspeed protection systems.

   f. Provisions for addressing the turbine generator control and overspeed protection system diagnostic routines need to be included. The diagnostic routines also need to be described in Tier 2 Section 10.2 and referred to by the test specification.

3) Tier 2 Test 14.2.12.13.14 specifies pre-core turbine overspeed trip testing. The staff found that the test description is incomplete or requires clarification with respect to the following items:

   a. Provisions need to be included for testing the manual turbine overspeed trip devices located in the control room and at the turbine to confirm that they are fully functional and manned before proceeding with the test.

   b. Item 5.1 of the acceptance criteria specifies verification that the primary and secondary turbine trips occur within the design limits and refers to Tier 2 Section 10.2.2.9 for this information. However, the design limits that are referred to are not included in Tier 2 Section 10.2.2.9 and this information needs to be added to the FSAR accordingly.

   c. In addition to confirming that the turbine steam admission valves for the high pressure and intermediate pressure turbines are functioning properly in response to turbine trip signals, provisions need to be included for confirming proper operation of the extraction steam non-return valves that are credited for preventing turbine overspeed.

4) Tier 2 Test 14.2.12.16.5 specifies control systems checkout testing. Items 1.2 and 1.3 under the test objectives are to demonstrate that the automatic control systems operate satisfactorily during steady-state and transient conditions. These test objectives specify that the control systems shall control plant parameters in manner that minimizes oscillations of critical parameters, such as turbine load. However, provisions are not included for assessing automatic operation of the turbine control system and the test needs to be revised accordingly.

5) Tier 2 Test 14.2.12.18.1 specifies load swing testing. The staff found that the test description is incomplete or requires clarification with respect to the following items:

   a. Test prerequisites need to specify turbine generator controls are in automatic.

   b. The test method section needs to specify how load changes will be accomplished.

   c. Test method Items 3.2 and 3.3 specify conditions for acceptance and need to be relocated to the acceptance criteria section.

   d. The data requirement section needs to specify monitoring and recording of other plant data as necessary to confirm acceptable plant performance consistent with the test objectives.

   e. Item 5.1 of the acceptance criteria needs to make reference to Tier 2 Section 10.2 for secondary plant performance, and plant performance in this regard needs to be described in Section 10.2.

6) Tier 2 Test 14.2.12.18.13 specifies load follow testing. The test method indicates that plant behavior is monitored, and data collection focuses primarily on reactor performance. The acceptance criteria specify that the plant response should be in accordance with design, and refers to Tier 2 Section 10.2. However, Section 10.2 relates primarily to secondary plant performance. Provisions need to be included in the load follow test to address both primary and secondary plant performance, including turbine generator control system performance.

7) Tier 2 Test 14.2.12.21.4 specifies turbine generator load rejection testing. The staff found that the test description is incomplete or requires clarification with respect to the following items:

   a. The prerequisites need to specify that the turbine generator control and overspeed protection systems are fully functional and operating in automatic.

   b. The prerequisites need to include confirmation that manual turbine overspeed protection is available and functioning properly in the control room and locally at the turbine, and that these trip devices are manned before proceeding with the rest of the test.

   c. The Test Methods section needs to include provisions for evaluating secondary plant performance and response.

   d. Items 3.2 and 3.3 of the Test Methods Section are verification steps and are not test methods.

   e. The test needs to include parameters that must be monitored (or make reference to the appropriate Tier 2 FSAR sections where these parameters are discussed) in order to assess and confirm that the secondary plant response satisfies design specifications.

   f. The acceptance criteria need to include confirmation that the turbine does not trip as a consequence of load rejection.

   g. The acceptance criteria need to include provisions for confirming that the performance of plant systems and equipment, including turbine control and

overspeed protection systems and associated components, is consistent with design specifications and the description provided in Chapter 10 of the FSAR.

8) It isn't clear what combination of test procedures specified in Tier 2 Section 14.2 are intended to test the turbine generator control and overspeed protection systems in their entirety, including performance of all components, diagnostic routines, and failure modes. Additional information is needed to identify the specific test procedures that are credited in this regard.

Response to Question 14.02-162:

Item 1(a):

U.S. EPR FSAR Tier 2, Section 14.2, Test #068 simulates the turbine response to a reactor trip signal and simulated loss of condenser vacuum signal. The reactor trip listed in Test #068, Step 1.4.1 is the same as the "remote trip" listed in U.S. EPR FSAR Tier 2, Section 10.2.2.10. The loss of condenser vacuum listed in Test #068, Step 1.4.2 is the same as high condenser backpressure listed in U.S. EPR FSAR Tier 2, Section 10.2.2.10.

U.S. EPR FSAR Tier 2, Section 14.2, Test #134 performs testing of turbine-generator instrumentation and control (I&C) systems. The other turbine trips listed in Test #134, Step 5.9 are the same turbine trips as those described in U.S. EPR FSAR Tier 2, Section 10.2.2.10. AREVA NP will revise U.S. EPR FSAR Tier 2, Section 14.2, Test #134, acceptance criteria 5.9 to reference Section 10.2.2.10 instead of 10.2.2.9.

U.S. EPR FSAR Tier 2, Section 14.2, Test #174 verifies operation of the turbine overspeed function. The turbine overspeed listed in Test #174 is the same as the turbine overspeed listed in U.S. EPR FSAR Tier 2, Section 10.2.2.10.

Item 1(b):

The requirement to confirm that turbine overspeed protection is available and functioning properly; and that the manual turbine trip circuits in the control room and at the turbine are functioning properly and manned before proceeding with the rest of the test, will be added to the "Prerequisites" section of U.S. EPR FSAR Tier 2, Section 14.2, Tests #068 and #174.

Item 1(c):

U.S. EPR FSAR Tier 2, Section 14.2.12.7.10 (Test #068) item 3.2 will be revised to delete the term "dangerous" and clarify the term "undesirable operating conditions." It is not appropriate to add this information to U.S. EPR FSAR Tier 2, Section 10.2 since that information is not specified in SRP 10.2.

Item 1(d):

U.S. EPR FSAR Tier 2, Section 14.2, Test #068, Step 3.5 was revised to reference U.S. EPR FSAR Tier 2, Section 10.2 in RAI 144, Supplement 1, Question 14.02-72. U.S. EPR FSAR Tier 2, Section 14.2, Test #068 will be revised for clarification.

Item 1(e):

U.S. EPR FSAR Tier 2, Section 14.2, Test #068, Section 4.0 will be revised to add the requested testing requirement data.

Item 1(f):

U.S. EPR FSAR Tier 2, Section 14.2, Test #068, Section 5.0 will be revised to reflect the requested testing requirement data.

Item 1(g):

U.S. EPR FSAR Tier 2, Section 14.2, Test #068, Steps 5.3 and 5.4 will be revised to reference U.S. EPR FSAR Tier 2, Section 10.2.2.10 instead of referencing U.S. EPR FSAR Tier 2, Section 10.2.

Item 1(h):

The following steps from U.S. EPR FSAR Tier 2, Section 14.2, Test #068 describe pre-operational tests for extraction steam non-return valves:

- Step 3.5 addresses power-operated valves. Step 3.5 will be revised in response to Item 1(d).
- Step 3.9 verifies operation within design limits of the moisture separators, reheaters, and extraction steam systems. Step 3.9 will be revised to include actuation of the extraction steam non-return valves upon a turbine trip signal.
- Step 4.6 collects valve data. Step 4.6 will be revised in response to Item 1(e).

Item 2(a):

Information about proper operation of alarm, control, and indication functions is not described in U.S. EPR FSAR Tier 2, Section 10.2 since it is not specified in SRP 10.2. Alarm, control, and indication functions are specific to the site-specific turbine generator. U.S. EPR FSAR Tier 2, Section 14.2 contains the information recommended in RG 1.68.

Item 2(b):

U.S. EPR FSAR Tier 2, Chapter 14.2, Test #134, Section 3.0 will be revised to incorporate the "test method" wording convention.

Item 2(c):

Overspeed trip logic is discussed in U.S. EPR FSAR Tier 2, Section 10.2.2.9. There are some minimum requirements for the turbine protection system listed in U.S. EPR FSAR Tier 2, Section 10.2.2.5 and Section 10.2.2.10. Actual trip logic is specific to the site-specific turbine generator.

Item 2(d):

Section 10.2.2.12 discusses the normal test functions for the overspeed trip systems and the governor system. Most of the normal test functions (tests performed automatically on the control system) are specific to the site-specific turbine generator

Item 2(e):

U.S. EPR FSAR Tier 2, Section 14.2, Test #134, Section 5.0 will be revised to include information about the fail-safe response of the turbine generator control and overspeed protection systems.

Item 2(f):

Since the actual diagnostic routines are turbine vendor specific, AREVA NP does not have more specific information at this time. U.S. EPR FSAR Tier 2, Section 10.2.2.12 currently states: "The components of the electro-hydraulic governor system, as well as the primary and backup overspeed trip, are automatically tested when the turbine is in operation on a daily basis." The diagnostic routines may change according to the COL applicant turbine contract and operating experience. U.S. EPR FSAR Tier 2, Section 14.2, Test #134, Section 5.8 will be revised to state: "The primary and backup turbine overspeed trip devices are automatically tested and are operating properly." The actual trip function is done in test #174.

Item 3(a):

U.S. EPR FSAR Tier 2, Test #174, Section 2.0 will be revised to include information about testing the manual turbine overspeed trip devices located in the control room and at the turbine front standard to confirm that they are fully functional and manned before proceeding with the test.

Item 3(b):

U.S. EPR FSAR Tier 2, Section 10.2.2.9 states the primary overspeed system trips the turbine at about 110% of rated speed. It also states that the backup system trips the turbine at about 111% of rated speed, which meets the guidance of SRP 10.2.

Item 3(c):

The confirmation that the extraction steam non-return valves are functioning was addressed in the Response to Item 1(d) and item 2(e). Verification that the extraction steam non-return valves are functioning correctly with the turbine generator synchronized to the grid will be confirmed in U.S. EPR FSAR Tier 2, Section 14.2, Test #134, Step 5.1.

Item 4:

U.S. EPR FSAR Tier 2, Section 14.2, Test #199 is not a turbine-specific test. Testing turbine control system operation is performed under Test #68 (U.S. EPR FSAR Tier 2, Section 14.2.12.7.10) and Test #134 (U.S. EPR FSAR Tier 2, Section 14.2.12.11.11). U.S. EPR FSAR Tier 2, Section 14.2.12.11.11 (Test #134), Steps 5.6 and 5.7 will be revised to state that control oscillations are self dampening, so operator intervention is not required.

Item 5(a):

U.S. EPR FSAR Tier 2, Section 14.2, Test #200, Section 2.0 will be revised to indicate that turbine-generator overspeed and load controls are in automatic.

Item 5(b):

U.S. EPR FSAR Tier 2, Section 14.2, Test #200, Section 3.0 will be revised to specify how load changes will be accomplished.

Item 5(c):

U.S. EPR FSAR Tier 2, Section 14.2, Test #200, Steps 3.2 and 3.3 will be revised as requested.

Item 5(d):

U.S. EPR FSAR Tier 2, Section 14.2, Test #200, Section 4.0 will be revised as requested. The list of required data is not all inclusive. It is common practice for this type of test to task each system engineer with reviewing plant data for their system, then to send the data collected to a common test director. Also, data from multiple systems can be shown on the same plot to better analyze system performance.

Item 5(e):

U.S. EPR FSAR Tier 2, Section 14.2, Test #200, Section 5.0 will be revised as requested. U.S. EPR FSAR Tier 2, Section 10.2 describes the turbine. Secondary plant systems are described in Sections 10.3 and 10.4.

Item 6:

U.S. EPR FSAR Tier 2, Section 14.2, Test #220 will be revised to indicate that the turbine ramp rates during the load follow testing are bounded by the turbine-generator ramp rates described in Section 10.2.2.5. The test is primarily focused on maintaining margin to protection trips and validating that secondary transients cause a minimum disturbance on the primary systems. System engineers should review plant parameters for their assigned systems, then send data trends to the test director. The test described in Test #220 is part of the actual activities that occur during this transient. The test review team will also interview operators involved with the test and plant transient data to determine if additional dynamic tuning or plant modifications are necessary.

Item 7(a):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 2.0 will be revised to include fully functional turbine overspeed and load controls.

Item 7(b):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 2.0, will be revised to include that manual trips are functioning properly and are manned.

Item 7(c):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 3.0, will be modified to include instructions for monitoring secondary parameters.

Item 7(d):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Items 3.2 and 3.3 will be revised to become test method steps. The acceptance criteria Section 5.0 for Test #221 will also be revised to include the information previously contained in U.S. EPR FSAR Tier 2, Section 14.2, Steps 3.2 and 3.3.

Item 7(e):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 4.0 will be revised to add secondary parameters to be monitored.

Item 7(f):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 5.0 will be revised as requested. The turbine generator is designed not to trip as the result of the partial trip and partial load rejection. Only house loads should remain.

Item 7(g):

U.S. EPR FSAR Tier 2, Section 14.2, Test #221, Section 5.0 will be revised as requested. A preliminary load rejection calculation indicates that turbine speed will increase to 107 percent rated speed, then stabilize at 104 percent rated speed.

Item 8:

The following test abstracts address test-specific turbine features:

- U.S. EPR FSAR Tier 2, Section 14.2, Test #068 simulates the turbine response to a reactor trip signal and simulated loss of condenser vacuum signal.
- U.S. EPR FSAR Tier 2, Section 14.2, Test #134 performs testing of turbine-generator I&C systems.
- U.S. EPR FSAR Tier 2, Section 14.2, Test #174 verifies operation of the turbine overspeed function.

There are several test abstracts that occur after core loading to test overall plant performance, including the turbine generator. Some of these test abstracts are as follows:

- U.S. EPR FSAR Tier 2, Section 14.2, Test #199 verifies control systems are not interacting in an unstable manner (diverging oscillations).
- U.S. EPR FSAR Tier 2, Section 14.2, Test #200 performs load swings on the plant, which includes the turbine generator.
- U.S. EPR FSAR Tier 2, Section 14.2, Test #217 tests response of the plant to loss of a feedwater pump, which could be a small perturbation on the turbine.

- U.S. EPR FSAR Tier 2, Section 14.2, Test #227 tests response of the plant to loss of the offsite grid, with the plant expected to transition to island mode.

U.S. EPR FSAR Tier 2, Section 14.2, Test #227 will be revised to provide clarifying information about performance of the components, diagnostic routines, and failure modes.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 14.2 will be revised as described in the response and indicated on the enclosed markup.

Question 14.03.07-36:

The review procedures in SRP Section 14.3.7 provide guidance for determining the acceptability of proposed inspections, tests, analyses, and acceptance criteria (ITAAC). The SRP guidance specifies in part that all Tier 1 information is consistent with Tier 2 information and that plant systems are clearly described in Tier 1, including (for example) key performance characteristics. Tier 1 Section 2.8.1 establishes ITAAC for the turbine-generator. However, the staff found the descriptive information and corresponding ITAAC in this section to be inadequate. In particular, additional information is needed to address the following items:

1) Paragraph 2.0 is duplicated and this editorial error needs to be corrected.

2) Paragraph 1.0 indicates that turbine overspeed protection is provided by a separate turbine overspeed protection system, in addition to the normal speed control function. However, this description is incorrect in that turbine overspeed protection is provided by a primary turbine overspeed protection system and a backup turbine overspeed protection system, in addition to the normal speed control function. Consequently, this information needs to be corrected.

3) Paragraph 1a indicates that turbine stop and control valves will be inservice tested and inspected at intervals in accordance with industry practice or as specified by the manufacturer to meet turbine missile generation probability requirements. This does not appear to be reflected in Tier 2 of the FSAR and in particular, the considerations specified in Tier 2 Section 10.2.2.12 have not been included. Also, tests and inspections that are necessary for the extraction steam non-return valves are not specified. Therefore, the FSAR needs to be revised accordingly.

4) The basic configuration of the turbine-generator system is shown in Tier 1 Figure 2.8.1-1. However, the figure is incomplete in that it does not show all major components that are important to ensure that the turbine does not exceed design overspeed conditions. In particular, the figure needs to be revised to not only show the high pressure turbine stop and control valves, but the intermediate pressure turbine reheat stop and intercept valves and the extraction steam non-return valves (i.e., those that are important for preventing turbine overspeed) also need to be shown. Similarly, Tier 1 Table 2.8.1-1 needs to be revised to include these additional components.

5) Paragraph 2.1 indicates that the turbine-generator is favorably oriented with respect to protection from turbine missiles. However, the description needs to be more clear and specify that the orientation is favorable with respect to protection of safety-related SSCs from turbine missiles. Also, based on the description in Tier 2 Section 3.5.1.3, safety-related SSCs are located within the low-trajectory turbine missile strike zone and these safety-related SSCs need to be identified and the Tier 1 information needs to be revised accordingly.

6) Paragraph 3 and Item 3.1 in Tier 1 Table 2.8.1-3 specify that controls exist in the main control room to trip the turbine generator. However, there is no recognition of the need to provide similar controls locally at the turbine-generator to enable

plant operators (who are in the immediate vicinity of the turbine) to trip the turbine if the turbine control and overspeed protection systems should fail. Consequently, Tier 1 and Tier 2 of the FSAR need to be revised to reflect this information.

7) Paragraph 3.1 indicates that turbine-generator overspeed protection systems are listed in Tier 1 Table 2.8.1-2. However, the intent of this table is to list the equipment instrumentation and controls, and electrical design as reflected by the title of the table, "Turbine-Generator System Equipment I&C and Electrical Design." Consequently, this table needs to be revised to list the major I&C and electrical design components that make up each of the turbine-generator overspeed protection systems.

8) Paragraph 4.0, specifies that the turbine stop and control valves fail closed on a loss of power. Likewise, the intermediate pressure turbine reheat stop and intercept valves, and the extraction steam non-return valves are important for preventing turbine overspeed conditions and failure modes for these valves also need to be specified.

9) The information provided for Item 2.2 in Tier 1 Table 2.8.1-3 does not provide sufficient specificity to enable inspectors to complete this ITAAC. In particular, this item needs to be revised to address the following considerations:

   a. The first and third columns indicate that the orientation of the turbine generator is favorable with respect to protection from turbine missiles. To be clear, these columns need to be revised to indicate that the orientation of the turbine generator is favorable with respect to protection of safety-related SSCs from turbine missiles. Also, safety-related SSCs that are located in the low-trajectory turbine missile strike zone as allowed by the design certification need to be identified. For example, the following statement (or similar) could be used: "Safety-related SSCs that are located in the low-trajectory turbine missile strike zone are limited to [list those that apply]."

   b. For clarity, the second column needs to be revised to state that an inspection will be performed of the orientation of the turbine-generator with respect to the location of safety-related SSCs.

   c. The third column needs to specify what constitutes "favorable orientation" such as by referring to the figure in Regulatory Guide 1.115.

10) The information provided for Item 2.3 in Tier 1 Table 2.8.1-3 does not provide sufficient specificity to enable inspectors to complete this ITAAC. In particular, this item needs to be revised to identify the turbine-generator system equipment that is subject to inspection, such as by listing this information in Tier 1 tables and by making reference to these tables in the ITAAC.

11) The information provided for Item 3.1 in Tier 1 Table 2.8.1-3 does not provide sufficient specificity to enable inspectors to complete this ITAAC. In particular, the information in the second column needs to be revised to specify that

inspections and tests will be performed to confirm that (a) a manual trip device for tripping the turbine-generator is provided in the MCR; and (b) when actuated, the manual trip device generates control signals that will cause the valves listed in Tier 1 Table 2.8.1-1 to go closed. Also, a similar item needs to be established for the manual trip device that is located at the turbine.

12) The information provided for Item 3.2 in Tier 1 Table 2.8.1-3 does not provide sufficient specificity to enable inspectors to complete this ITAAC. In particular, the information in the second column needs to be revised to specify that tests will be performed to determine the trip setpoints for the primary and backup overspeed protection systems. The information in the third column needs to specify what the allowable trip setpoints are for the primary and backup turbine overspeed protection systems.

Response to Question 14.03.07-36:

Item 1:

The duplication was corrected in U.S. EPR FSAR, Revision 2.

Item 2:

The third paragraph of U.S. EPR FSAR Tier 1, Section 2.8.1 will be revised to read:

> Turbine overspeed control is provided by two separate turbine overspeed protection systems, in addition to the normal speed control function. The primary and backup overspeed protection systems are included to minimize the possibility of turbine rotor failure and turbine missile generation.

Item 3:

Discussions of turbine overspeed system inservice inspection requirements will be deleted from U.S. EPR FSAR Tier 1, Section 2.8.1, Description, on the basis that items covered by programs and that apply during operation (not construction or startup) are not the subject of ITAAC as noted in SRP Section 14.3, page 14.3-14:

> In developing the ITAAC, the staff recognized that other programs ensure the continued safe operation of a facility after fuel load. For example, the continued operability of a facility after the ITAAC are satisfied is ensured through the Technical Specifications, Startup and Power Ascension Test Programs, as well as various programs such as the maintenance program, quality assurance program, and the in-service inspection and in-service testing program. Also, the operator ensures the facility is operated as designed, through the use of appropriate plant operating and emergency procedures.

Item 4:

Certain aspects of the design that are discussed in U.S. EPR FSAR Tier 2 do not have ITAAC or do not need to be addressed in U.S. EPR FSAR Tier 1. Compliance with U.S. EPR FSAR Tier 2 information is required and inspection of the Tier 2 features that do not have ITAAC is addressed in NRC Inspection Manual Procedure, IMC 2504, Non-ITAAC Inspections.

References to specific examples of this type of information in SRP Section 14.3 are provided below.

- SRP Section 14.3 Appendix A, page 14.3-16.
- SRP Section 14.3 Appendix A, page 14.3-17.
- SRP Section 14.3 Appendix C, II.B, page 14.3-31.
- SRP Section 14.3 Appendix C, vi Alarms, Displays and Controls, page 14.3-26.
- SRP Section 14.3 1D, page 14.3-9.
- SRP Section 14.3 Appendix C, page 14.3-25.
- SRP Section 14.3 Appendix C, page 14.3-27.
- SRP Section 14.3 Appendix C, page 14.3-28.
- SRP Section 14.3.3 Piping Systems and Components, page 14.3.3-7.

Some statements included in this question are not aligned with the guidance provided in SRP Section 14.3 regarding Tier 1 versus Tier 2 and to the NRC Inspection Manual associated with inspections. This relationship is documented numerous times in the SRP and the NRC Inspection Manual as noted below:

1. SRP Section 14.3 Appendix A page 14.3-18:

   Tier 2 contains detailed supporting information for various inspections, tests, and analyses that can, and should be, used to verify the Tier 1 design information and satisfy the acceptance criteria. If questions on interpretation should arise, the material in Tier 2 provides the background material and context for Tier 1 information. Tier 2 contains information reviewed by the staff which is the basis for the staff's safety determination for the design. Therefore the information in tier 2 provides an acceptable means, but not the only means, of satisfying an ITAAC.

2. IMC 2503 CIP: ITAAC Related Work

   03.18 Tier 2 Material. Tier 2 refers to the portion of the design related information contained in the design control document that is approved but not certified by the NRC. Tier 2 information includes: Information required by 10 CFR52.47 with the exception of technical specifications and conceptual design information; Information required for a final safety analysis report under 10 CFR 50.34; supporting information on ITAAC that will be performed to demonstrate that the acceptance criteria have been met; and Combined License (COL) information items which identify certain matters that are addressed by a COL applicant that references a certified design. Tier 1 material is derived from Tier 2 material. Compliance with Tier 2 is required and demonstrates a sufficient but not the only method for complying with Tier 1.

3. IP 65001 Inspections of ITAAC Related Work

   03.01 Plan the inspection.

Guidance:

Comprehensive inspection planning should include the following:

- Reviewing the applicable IP and the related ITAAC for the particular site design.
- Reviewing the site design control document (DCD) and final safety analysis report (FSAR).

4. Precedence

A review of other design certification applications determined that there is no precedent for the level of detail requested to be placed in U.S. EPR FSAR Tier 1. This is supported by the following SRP sections:

SRP Section 14.3 page 14.3-5, Item 3:

> If applicable, review the DCD for a certified design similar to the design for which certification is sought, specifically the Tier 1 information, for the purpose of using a similar approach, format, and language and for familiarity with the treatment of SSCs, the appropriate level of design detail, and other certification issues.

SRP Section 14.3, Appendix A, page 14.3-9:

> The purpose of this appendix is to describe how previous design certification applications have implemented the requirements of Subpart B of 10 CFR Part 52, so that this information can be used as guidance for review of new design certification applications.

Item 5:

U.S. EPR FSAR Tier 1, Section 2.8.1 will be revised by changing the commitment and wording as outlined below, which is consistent with U.S. EPR FSAR Tier 2, Section 3.5.1.3.

	Commitment Wording	ITA	AC
2.2	The axis of the turbine rotor shafts is positioned such that safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, are located outside the turbine low-trajectory hazard zone.	An inspection of the location of the axis of the turbine rotor shafts to verify that safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, are located outside the turbine low-trajectory hazard zone will be performed.	The location of the of the axis of the turbine rotor shafts is favorable with respect to protection of safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, from turbine missiles outside the turbine low-trajectory hazard zone.

As with Tier 1 material and ITAAC, the details for the commitment meanings and ITAAC are addressed in the Tier 2 discussion of the related subject. This is supported by SRP Section 14.3 Appendix A page 14.3-18:

> Tier 2 contains detailed supporting information for various inspections, tests, and analyses that can, and should be, used to verify the Tier 1 design information and satisfy the acceptance criteria. If questions on interpretation should arise, the material in Tier 2 provides the background material and context for Tier 1 information. Tier 2 contains information reviewed by the staff which is the basis for the staff's safety determination for the design. Therefore the information in tier 2 provides an acceptable means, but not the only means, of satisfying an ITAAC.

Item 6:

Certain aspects of the design that are discussed in U.S. EPR FSAR Tier 2 do not have ITAAC or do not need to be addressed in U.S. EPR FSAR Tier 1, as discussed in SRP Section 14.3 and outlined in Item 4 of this Response. More detail on the turbine overspeed protection system will be provided in the Response to RAI 430.

Item 7:

As discussed in Item 4 of this Response, U.S. EPR FSAR Tier 1 information is derived from U.S. EPR FSAR Tier 2. Per SRP 14.3, Appendix A, item IV.4.A only the most safety-significant features require ITAAC. By having an ITAAC about the existence of the controls, the following criteria are satisfied:

SRP Section 14.3 page 14.3-5 item # 3:

> If applicable, review the DCD for a certified design similar to the design for which certification is sought, specifically the Tier 1 information, for the purpose of using a similar approach, format, and language and for familiarity with the treatment of SSCs, the appropriate level of design detail, and other certification issues.

SRP Section 14.3, Appendix A page 14.3-9

> The purpose of this appendix is to describe how previous design certification applications have implemented the requirements of Subpart B of 10 CFR Part 52, so that this information can be used as guidance for review of new design certification applications.

SRP Section 14.3 Appendix A page 14.3-18:

> Tier 2 contains detailed supporting information for various inspections, tests, and analyses that can, and should be, used to verify the Tier 1 design information and satisfy the acceptance criteria. If questions on interpretation should arise, the material in Tier 2 provides the background material and context for Tier 1 information. Tier 2 contains information reviewed by the staff which is the basis for the staff's safety determination for the design. Therefore the information in tier 2 provides an acceptable means, but not the only means, of satisfying an ITAAC.

Item 8:

See the Response to Item 4.

Item 9(a):

See the Response to Item 5.

Item 9(b):

See the Response to Item 5.

Item 9(c):

See the Response to Item 5. Also, in accordance with the following SRP Section 14.3 guidance, neither regulations nor Tier 2 should be referenced in Tier 1 material:

SRP Section 14.3 Appendix A page 14.3-17

> The use of codes and standards in Tier 1 should be minimized, with exceptions granted on a case-by-case basis. Instead, the applicable requirements from the regulations, codes, or standards should be stated in Tier 1, rather than reference them.

Items 10, 11 and 12:

The purpose of U.S. EPR FSAR Tier 1 is not to provide details at the level required to perform inspections. As discussed in the Response to Item 4, these details are in U.S. EPR FSAR Tier 2 and the need for the inspectors to look at Tier 2 material for the details is repeated in the NRC Inspection Manuals as well as throughout SRP Section 14.3.

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.8.1 will be revised as discussed in the response and as provided in the attached markups.

U.S. EPR Final Safety Analysis Report Markups

2.8 Steam and Power Conversion Systems

2.8.1 Turbine-Generator System

1.0 Description

The turbine-generator system is a non-safety-related system that converts the energy of the steam produced in the steam generators into mechanical shaft power and then into electrical energy.

The flow of steam is directed from the steam generators to the turbine through the main steam system, turbine stop valves, and turbine control valves. After expanding through the turbine, which drives the main generator, exhaust steam is transported to the main condenser.

Turbine overspeed control is provided by two~~a~~ separate turbine overspeed protection systems, in addition to the normal speed control function~~.~~ . ~~and is~~The primary and backup overspeed protection systems are included to minimize the possibility of turbine rotor failure and turbine missile generation.

~~Turbine rotor components and turbine stop and control valves will be inservice tested and inspected at intervals in accordance with industry practice or as specified by the manufacturer to meet turbine missile generation probability requirements.~~

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2.0 Arrangement

2.1 The basic configuration of the turbine-generator system is shown in Figure 2.8.1-1—Turbine-Generator System Basic Configuration.

2.2 ~~The orientation of the turbine-generator is favorable with respect to protection from turbine missiles.~~ The axis of the turbine rotor shafts is positioned such that safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, are located outside the turbine low-trajectory hazard zone.

2.3 The location of the turbine-generator system equipment is listed in Table 2.8.1-1—Turbine-generator System Equipment Mechanical Design.

2.4 Turbine rotor integrity is provided through the combined use of selected materials with suitable toughness, analyses, testing, and inspections.

2.5 The probability of turbine material and overspeed-related failures resulting in external turbine missiles is less than $1x10^{-4}$ per turbine year.

3.0 Instrumentation and Controls (I&C) Design Features, Displays, and Controls

3.1 Controls exist in the main control room (MCR) to trip the turbine-generator.

3.2 The turbine generator has overspeed protection.

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Table 2.8.1-3—Turbine-Generator System ITAAC (2 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
2.1	The basic configuration of the turbine-generator system is shown on Figure 2.8.1-1.	Inspections of the as-built system as shown on Figure 2.8.1-1 will be conducted.	The as-built turbine-generator system conforms with the basic configuration as shown in Figure 2.8.1-1.
2.2	The axis of the turbine rotor shafts is positioned such that safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, are located outside the turbine low-trajectory hazard zone. ~~The orientation of the turbine-generator is favorable with respect to protection from turbine missiles.~~	An inspection of the location of the axis of the turbine rotor shafts to verify that safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, are located outside the turbine low-trajectory hazard zone will be performed. ~~An inspection will be performed of the orientation of the turbine-generator.~~	The location of the of the axis of the turbine rotor shafts is favorable with respect to protection of safety-related structures, except for two of the four Essential Service Water Buildings and two of the four Emergency Power Generating Buildings, from turbine missiles outside the turbine low-trajectory hazard zone. ~~The turbine-generator orientation is favorable relative to turbine missile protection.~~
2.3	The location of the turbine-generator system equipment is listed in Table 2.8.1-1.	An inspection will be performed of the location of the equipment.	The turbine-generator system equipment is located as listed in Table 2.8.1-1.
2.4	Turbine disk integrity is provided through the combined use of selected materials with suitable toughness, analyses, design, testing, and inspections.	An analysis of turbine rotor material property data, turbine rotor and blade design, and pre-service inspection and testing requirements will be conducted. This information will be available for review greater than one year before loading the fuel.	An analysis exists and concludes that the turbine disk integrity meets the requirements of the manufacturer's turbine missile probability analysis: (1) turbine material property data, rotor and blade design analyses (including loading combinations, assumptions and warm-up time) demonstrating safety margin to withstand loadings from overspeed events, and (2) the requirements for pre-service testing and inspection information.

14.2.12.7.10 Steam Turbine (Test #068)

1.0 OBJECTIVE

1.1 To demonstrate functional performance of the steam turbine controls.

1.2 To demonstrate functional performance of the steam turbine support system.

1.3 To perform initial operation of the steam turbine system (HFT and power ascension tests).

1.4 To verify the steam turbine generator trips in response to the following:

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1.4.1 Simulated reactor trip signal.

1.4.2 ~~Simulated loss of condenser vacuum signal~~

1.4.3 Manual trip from the main control room.

2.0 PREREQUISITES

2.1 Construction activities on the steam turbine system are complete.

2.2 Steam turbine system instrumentation has been calibrated and is functional for the performance of the following test.

2.3 Appropriate test equipment is available and has been calibrated.

2.4 Fluid levels throughout the system meet design limits. Personnel safety shall limit proximity to lubricating and hydraulic oils.

2.5 Schedule visual inspection of the steam turbine following testing.

2.6 Appropriate AC and DC power sources are available and functional.

2.7 Support systems required for the steam turbine system are complete and functional.

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2.8 MSS is available.

2.9 Main condenser is available.

2.10 Turbine overspeed protection systems are available and functioning properly.

2.11 Manual trip circuits in the main control room and at the turbine are functioning properly and are manned during test evolutions.

3.0 TEST METHODS

3.1 Demonstrate the electro hydraulic control (EHC) system performs the following:

3.1.1 That turbine turning gear engages and disengages as designed.

3.1.2 That automatic control of turbine speed and acceleration functions through the entire speed range.

3.1.3 That automatic control of load and loading rate from auxiliary to full load, with continuous load adjustment and discrete loading rates.

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3.1.4 Standby manual control of speed and load is functional when it becomes necessary to take the primary automatic control out of service.

3.1.5 Limiting of load in response to preset limits on operating parameters.

3.2 Verify that detection of ~~dangerous or~~ undesirable operating conditions (e.g., resonance frequencies, maximum exhaust hood temperature, condenser vacuum limits, turbine vibration limits), annunciation of detected conditions, and initiation of control response to such conditions meets design requirements, as follows:

3.2.1 Monitoring the status of the control systems including the power supplies and redundant control circuits as designed and described in Section 10.2.

3.2.2 Testing of valves and controls including response to a simulated reactor trip signal and simulated loss of condenser vacuum signal and manual trip.

- Verify response time from initiation of a turbine trip signal to closure of the ~~turbine~~main steam stop valve.
- Verify response time from initiation of a turbine trip signal to closure of the ~~turbine~~reheat steam intercept valve.
- Verify response time from initiation of a turbine trip signal to closure of the ~~turbine~~main steam control valve.
- Verify response time from initiation of a turbine trip signal to closure of the reheat steam stop valve.
- Verify response time from initiation of a turbine trip signal to closure of the extraction steam non-return valve.

3.2.3 Pre-warming of valve chest and turbine rotor.

3.2.4 Monitoring the status of the turbine auxiliary systems as designed and described in Section 10.2.

3.3 Perform steam turbine performance test per latest edition of ASME PTC-6 (Reference 3).

3.4 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Observe response of the following power-operated valves upon loss of motive power (refer to Section 10.2 for anticipated response).

3.5.1 Main steam stop.

3.5.2 Reheat steam intercept.

3.5.3 Main steam control.

3.5.4 Reheat steam stop.

3.5.5 Extraction steam non-return.

3.6 Demonstrate turbine lube oil system operation.

3.7 Demonstrate hydrogen oil-sealed cooling system for rotor cooling operation.

3.8 Demonstrate stator water cooling system operation.

3.9 Demonstrate moisture separators, reheaters, and extraction steam systems operation, including actuation of the extraction steam non-return valves upon a turbine trip signal.

4.0 DATA REQUIRED

4.1 Setpoint at which alarms and interlocks occur.

4.2 ~~Setpoints of~~ Plant Data for time period corresponding to automatic trip~~s~~, if applicable.

4.3 ~~Conditions under which~~Plant Data during time period corresponding to manual trip~~s operate~~.

4.4 ~~Verification of~~Turbine control logic ~~combinations~~checklist (functions verified during preoperational test).

4.5 ~~Valve logic verification of~~ EHC ~~system~~operation of each component in normal and trip mode.

4.6 Valve performance data, where required:~~.~~

4.6.1 Stroke Time (full open to fully closed upon receipt of turbine trip signal).

4.6.2 Stroke Time (full closed to fully open using control signal).

4.6.3 Stroke Time (full open to fully closed using control signal).

4.7 Valve position indication.

4.8 Position response of valves to loss of motive power.

4.9 Operating data and function verification of associated turbine support systems.

5.0 ACCEPTANCE CRITERIA

5.1 The steam turbine system and support systems perform as designed (refer to Section 10.2):

5.1.1 Turbine turning gear engages and disengages as designed.

5.1.2 Turbine alarms, interlocks, protective devices, and controls (manual and automatic) meet design requirements.

5.1.3 Turbine valves (e.g., stroke speed, failure mode upon loss of motive power, ability to control turbine speed) meet design requirements.

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5.1.4 Turbine performance meets design requirements.

- Turbine speed and acceleration function through the entire range.
- Automatic loading and loading rate.
- Manual turbine controls.
- Response to preset limits.

5.1.5 Turbine lube oil system operates as designed.

5.1.6 Turbine cooling systems operate as designed.

- Hydrogen oil-sealed rotor cooling.
- Stator water cooling.

5.1.7 Moisture separators, reheaters, and extraction steam systems.

5.2 Steam turbine performance is as required by vendor ratings.

5.3 Steam turbine generator trip signal is generated in response to a simulated reactor trip signal as designed (refer to ~~Section 10.2~~Section 10.2.2.10).

5.4 Steam turbine generator trip is generated in response to a simulated loss of condenser vacuum signal as designed (refer to ~~Section 10.2~~Section 10.2.2.10).

5.5 Steam turbine-generator trip is generated in response to a manual trip from the main control room.

14.2.12.7.11 Circulating Water Supply System (Test #069)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the circulating water supply system. The following is a typical COLA test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate the ability of the circulating water supply system (CWS) to provide a continuous supply of cooling water to the main condensers and return the water to the cooling tower for heat dissipation.

2.0 PREREQUISITES

2.1 Construction activities on the CWS have been completed.

2.2 The CWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the CWS are complete and functional.

2.4 Intake structure at the required level and water quality within limits.

14.2.12.11.11 Turbine–Generator Instrumentation and Control System (Test #134)

1.0 OBJECTIVE

1.1 To verify the proper installation and operation of the non-safety-related turbine-generator instrumentation and control system.

2.0 PREREQUISITES

2.1 Construction activities on the turbine-generator instrumentation and control system are essentially complete and the applicable systems and components are ready for testing.

2.2 Applicable operating manuals are available for developing detailed procedures.

2.3 Turbine-generator instrumentation and control software is installed and instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Test equipment and instrumentation is available and calibrated and is operating satisfactorily prior to performing the following test.

2.5 Plant systems required to support testing are functional to the extent necessary to perform the testing or suitable simulations are used.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify input data and control paths from systems associated with the turbine-generator instrumentation and control system.

3.2 Simulate inputs and verify system responses and demand settings.

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3.3 ~~Verify the functions of the turbine-generator instrumentation and control system. Using simulated signals, v~~Verify that the operator interface allows turbine control~~, as designed~~ to the following simulated signals as designed.

3.3.1 Manual operation.

3.3.2 Increasing load.

3.3.3 Decreasing load.

3.3.4 Latching turbine turning gear.

3.3.5 Unlatching turbine turning gear.

3.4 Verify that turbine-generator instrumentation responds as designed to the following simulated signals:

3.4.1 Turbine rpm.

3.4.2 Reactor trip.

3.4.3 Turbine trip.

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3.4.4 Turbine alarms.

4.0 DATA REQUIRED

4.1 Input signals from associated systems.

4.2 Turbine-generator instrumentation and control system demand outputs in response to inputs.

4.3 Alarm and trip values.

5.0 ACCEPTANCE CRITERIA

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5.1 The turbine-generator instrumentation and control system trip logic operates properly. Verify that the following valves respond as designed:

5.1.1 Main steam stop.

5.1.2 Reheat steam intercept.

5.1.3 Main steam control.

5.1.4 Reheat steam stop.

5.1.5 Extraction steam non-return.

5.2 The turbine-generator I&C system provides grid synchronization capability.

5.3 The turbine-generator I&C system startup and shutdown controls operate properly.

5.4 The controls for startup and shutdown of the turbine-generator auxiliaries operate properly.

5.5 The automatic and manual controls to preheat the turbines, to close the main output breaker and load the generator, to adjust generator load, to perform all normal test functions, and to unload the generator are operating properly.

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The turbine-generator speed control is operating properly and control oscillations are self dampening.

5.7 The turbine-generator load control is operating properly and control oscillations are self dampening.

5.8 The primary and backup turbine overspeed trip devices are automatically tested and are operating properly. ~~The primary and backup turbine-generator overspeed trip devices are operating properly.~~

5.9 The turbine-generator I&C system provides monitoring of thermal, hydraulic, and electrical parameters associated with the turbine generator and initiates a turbine trip for the conditions listed in ~~Section 10.2.2.9~~Section 10.2.2.10.

5.10 The turbine-generator I&C system functions as described in Section 10.2.

5.0 ACCEPTANCE CRITERIA

5.1 The CVCS meets design requirements (refer to Section 9.3.4).

14.2.12.13.14 Pre-Core Turbine Overspeed (Test #174)

1.0 OBJECTIVE

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1.1 ~~(Deleted)~~Verify that the manual overspeed trip is functional.

1.2 To demonstrate that the primary and secondary overspeed trip systems protect the turbine as designed.

1.3 To demonstrate electrical independence and redundancy of non-safety-related power supplies.

2.0 PREREQUISITES

2.1 Associated instrumentation has been checked, calibrated, and is functioning satisfactorily prior to performing the test.

2.2 Verify that manual and automatic (electronic) trip functions have been successfully tested (Test #134) with simulated signals.

2.3 RCS at HZP (temperature and pressure) conditions with the corresponding RCS pressure and temperature conditions.

2.4 Turbine overspeed protection is available and functioning properly.

2.5 Manual turbine trip circuits in the control room and at the turbine are functioning properly and are manned throughout the preoperational test.

2.6 Turbine is operating at normal speed but not synchronized to the grid.

3.0 TEST METHOD

3.1 Verify that the primary overspeed trip is functional, not bypassed.

3.2 Make the secondary overspeed trip not functional and verify that the primary overspeed trip remains functional.

3.3 Slowly increase turbine speed until the primary overspeed occurs.

3.4 Verify that when the turbine trip occurs the turbine returns to turning gear.

3.5 Restore to functional the secondary overspeed trip that was previously not functional and make the primary overspeed trip that was previously tested, not functional.

3.6 Verify that the secondary overspeed trip remains functional.

3.7 Slowly increase turbine speed until the secondary electronic overspeed occurs.

3.8 Verify that when the turbine trip occurs the turbine returns to turning gear.

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2.3.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.3.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.3.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.3.5 Turbine-Generator overspeed and load controls are in automatic.

3.0 TEST METHOD

3.1 Load increases and decreases (i.e., steps and ramps) shall be performed within the established test band.

3.1.1 Step load increases and decreases should be performed by using the normal plant turbine controls.

3.1.2 Step load changes should be as close to instantaneous as possible.

3.1.3 Ramp load increases should be performed by using the normal plant controls.

3.1.4 Ramp load increases should be as challenging as possible without exceeding commercial limits on the fuel and turbine limits described in Section 10.2.2.5.

3.2 ~~Verify that~~ Monitor margin to Protection setpoints during designed load increases and decreases ~~can~~and terminate the load step or load ramp if the margin to Protection setpoint is unacceptable~~be performed without challenging the protection setpoints~~.

3.3 Monitor main steam and feedwater systems and terminate the load step or load ramp if the margin to system limits is unacceptable~~meet design requirements~~.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 Pressurizer level and pressure.

4.1.2 VCT parameters.

4.1.3 RCS temperatures.

4.1.4 RCCA position.

4.1.5 Power level and demand.

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4.1.6 SG levels and pressures.

4.1.7 Feedwater and steam flow.

4.1.8 Feedwater temperature.

4.1.9 Turbine operating data.

4.1.10 Feedwater heater levels.

4.1.11 Condenser hotwell and deaerator levels.

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4.1.12 Reactor power level.

5.0 ACCEPTANCE CRITERIA

5.1 The step and ramp transients demonstrate that the plant performs load changes allowed by the AREVA Fuel Preconditioning Guidelines and data has been taken that shall demonstrate the plant's ability to meet unit load swing design transients as designed (refer to Sections 3.9.1.1, 4.4.3.4, and 7.7.1.1).

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5.2 That no audible noise or significant vibration is observed in the SG or in the rest of the feedwater and EFWS due to water hammer.

5.3 Verify that designed load increases and decreases can be performed without challenging the protection setpoints.

5.4 Main steam, feedwater, and other secondary systems meet design requirements as described in Section 10.2, Section 10.3, and Section 10.4.

5.5 Secondary parameters for the turbine-generator, condenser hotwell, feedwater heater trains, and other secondary systems are tuned to provide rapid response to system transients without being unstable,

14.2.12.18.2 Secondary Calorimetric Power (Test #201)

1.0 OBJECTIVE

1.1 To verify that various indications of core power have been calibrated to the calculated calorimetric power produced by the secondary systems.

1.2 The secondary calorimetric power and associated calibrations shall be performed prior to determining the core power distributions using incore instrumentation. This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power.

2.2 The data required for calculating secondary calorimetric power is available.

3.0 TEST METHOD

3.1 Maintain reactor power, T_{avg}, and pressurizer level constant during data collection.

5.3 Steam valve isolation occurs within the times described in the accident analyses, with margin, or as specified in regulatory documents.

5.4 The following feedwater system is capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

5.4.1 Emergency feedwater.

14.2.12.18.13 Load Follow (Test #220)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds as designed to a requested change to reduce power, stabilize power at lower power level, and return to original power level.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The following systems are in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

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2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}, feedwater temperature).

2.1.5 Reactor reactivity controls (i.e., control rods, boration and dilution).

3.0 TEST METHOD

3.1 Plant power is reduced 10 percent from the original power level to a new power level over a one hour duration without operator intervention.

3.2 Plant power is stabilized at the new power level for two hours without operator intervention.

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3.3 Plant power is increased ten percent from the reduced power level to the original power level over one and half hour duration without operator intervention.

3.4 Turbine ramp rates during the load follow testing are bounded by the turbine-generator ramp rates described in Section 10.2.2.5.

3.5 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

4.0 DATA REQUIRED

4.1 Plant condition prior to transient.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Pressurizer parameters (i.e., pressure and level).

4.2.2 RCS temperatures (i.e., T_{cold}, T_{hot} and T_{avg}).

4.2.3 SG parameters (i.e., flow, pressure, temperature and level).

4.2.4 RCS parameters (i.e., flow, pressure, temperature and pressurizer level).

4.2.5 RCCA position.

4.2.6 RCS boron concentration.

4.3 Additional key plant parameters shall be monitored for baseline data.

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5.0 ACCEPTANCE CRITERIA

5.1 The plant responds as designed (refer to Sections 10.2, 10.3, and 10.4).

14.2.12.19 Power Ascension Plateau, 50 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.19.1 Biological Shield Survey (Test #212)

1.0 OBJECTIVE

1.1 To measure the radiation levels in accessible locations of the plant outside of the biological shield.

1.2 To determine permissible stay times for these areas during power operation.

1.3 To perform radiation surveys to determine shielding effectiveness. This procedure shall be repeated at the following plateaus:

1.3.1 50 percent in accordance with RG 1.68.

1.3.2 ≥98 percent in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Radiation survey instruments have been calibrated and are functional for performance of the following test.

14.2.12.21.3 (Deleted)

14.2.12.21.4 Turbine-Generator Load Rejection (Test #221)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a turbine-generator load rejection.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

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2.0 PREREQUISITES

2.1 The following systems are in fully functional and in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

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2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.1.5 RCSL control of RCCAs.

2.1.6 Turbine-Generator overspeed and load controls.

2.2 Manual turbine overspeed protection is available and functioning properly in the control room and locally at the turbine, and that these trip devices are manned.

3.0 TEST METHOD

3.1 The turbine-generator is removed from the grid by opening the output breakers in the switchyard.

3.2 ~~Verify that~~Monitor the following RCP~~s~~ parameters:~~continue to operate with power supplied from the offsite grid.~~

3.2.1 Voltage.

3.2.2 Current.

3.2.3 Speed.

3.3 ~~Verify that a partial rod trip occurs but the reactor remains critical~~Monitor the following RCCA positions:

3.3.1 Control Bank A.

3.3.2 Control Bank B.

3.3.3 Control Bank C.

3.3.4 Control Bank D.

3.4 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

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3.5 Monitor secondary systems, including the turbine-generator to determine system performance. At a minimum, collect the following plant data during the evolution:

- 3.5.1 Feedwater flow.
- 3.5.2 Reactor power.
- 3.5.3 Feedwater heater levels.
- 3.5.4 Condenser hotwell level.
- 3.5.5 Deaerator level.
- 3.5.6 Steam generator level.
- 3.5.7 Turbine-Generator control valve position.
- 3.5.8 Turbine-Generator electrical output.
- 3.5.9 Turbine-Generator speed.

4.0 DATA REQUIRED

4.1 Plant condition prior to turbine-generator load rejection.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

- 4.2.1 Pressurizer parameters (i.e., pressure and level).
- 4.2.2 RCS temperatures (i.e., T_{cold}, T_{hot} and T_{avg}).

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- 4.2.3 SG parameters (i.e., flow, pressure, temperature and level).
- 4.2.4 RCS parameters (i.e., flow, pressure, temperature and pressurizer level).
- 4.2.5 RCCA position as a function of time.
- 4.2.6 Secondary performance parameters (i.e., feedwater flow, feedwater heater levels, deaerator level, condenser hotwell level).

4.3 Additional key plant parameters shall be monitored for baseline data.

- 4.3.1 Turbine speed and generator frequency.
- 4.3.2 Generator voltage.
- 4.3.3 Generator excitation.

5.0 ACCEPTANCE CRITERIA

5.1 RCSL and turbine controls remain within analyzed limits and reactor power is stabilized at the lower power for at least 30 minutes following the test initiation without unanticipated operator action.

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5.2 RCCAs are restored to proper sequence and overlap with Technical Specification LCO limits.

5.3 RCPs continue to operate with power supplied from the off site grid.

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5.4 Partial rod trip occurs but the reactor remains critical.

5.5 Turbine-Generator output breakers open.

5.6 Turbine-Generator performance remains within design limits and as described in Section 10.2.

5.7 Secondary performance remains within design limits as described in Sections 10.2, 10.3, and 10.4.

14.2.12.21.5 Actual Rod Drop Times (Test #222)

1.0 OBJECTIVE

1.1 To determine the actual RCCA drop times from actual reactor trips.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Determine reactor trip times for reactor trips since fuel load.

3.0 TEST METHOD

3.1 Collect rod drop times for each reactor trip.

4.0 DATA REQUIRED

4.1 Rod drop times for each reactor trip.

5.0 ACCEPTANCE CRITERIA

5.1 Verify that actual rod drop data meets Technical Specification requirements and there are no adverse data trends.

14.2.12.21.6 Cooling Tower Acceptance (Test #223)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the cooling tower. The following is a typical COLA test; if a site specific test will be used the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To verify the cooling tower is capable of rejecting the design heat load.

2.0 PREREQUISITES

2.1 Construction activities are complete.

2.2 Circulating water system flow balance has been performed.

2.3 Permanently installed instrumentation is functional and calibrated.

2.4 Test instrumentation is calibrated and available.

3.0 TEST METHOD

3.1 Perform a measurement of the cooling tower performance using Cooling Tower Institute (CTI) standards.

4.0 DATA REQUIRED

4.1 Cooling water temperature and flows.

5.0 ACCEPTANCE CRITERIA

5.1 The cooling tower performance meets manufacturers design (refer to Section 10.4.5.1).

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14.2.12.2.17 Loss of Offsite Power with Plant Auxiliary Loads Supplied in Island Mode (Test #227)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a loss of offsite grid. Turbine-generator output breakers are expected to remain closed, and the turbine-generator supply house loads in the island mode.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 A transient load flow analysis has been performed that demonstrates the electrical transient (voltage and frequency) from the test will not exceed safety-related equipment capabilities and protection system setpoints.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.2.5 RCSL control of RCCAs.

2.2.6 Turbine-Generator overspeed and load controls.

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2.3 Manual turbine overspeed protection is available and functioning properly in the control room and locally at the turbine, and that these trip devices are manned.

3.0 TEST METHOD

3.1 Offsite power is removed from the plant by tripping transmission line breakers in the switchyard.

3.2 Verify that RCPs continue to operate with power supplied from the main generator.

3.3 Verify that a partial rod trip occurs but the reactor remains critical.

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3.4 Verify that the turbine-generator continues to provide auxiliary loads.

3.5 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

3.6 Monitor the following RCCA positions:

3.6.1 Control Bank A.

3.6.2 Control Bank B.

3.6.3 Control Bank C.

3.6.4 Control Bank D.

3.7 Monitor RCP parameters:

3.7.1 Voltage.

3.7.2 Current.

3.7.3 Speed.

3.8 Monitor the following turbine-generator parameters:

3.8.1 Speed.

3.8.2 First stage pressure.

3.9 Monitor secondary systems, including the turbine-generator, to determine system performance. At a minimum, collect the following plant data during the evolution:

3.9.1 Feedwater flow.

3.9.2 Reactor power.

3.9.3 Feedwater heater levels.

3.9.4 Condenser hotwell level.

3.9.5 Deaerator level.

3.9.6 Steam generator level.

3.9.7 Turbine-Generator control valve position.

3.9.8 Turbine-Generator electrical output.

4.0 DATA REQUIRED

4.1 Plant condition prior to trip.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Electrical distribution system voltage and frequency.

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4.2.2 Pressurizer parameters (i.e., pressure and level).

4.2.3 RCS temperatures (i.e., T_{cold}, T_{hot}, and T_{avg}).

4.2.4 SG parameters (i.e., flow, pressure, temperature, and level).

4.2.5 RCS parameters (i.e., flow, pressure, temperature, and pressurizer level).

4.2.6 RCCA position as a function of time.

- Control Bank A.
- Control Bank B.
- Control Bank C.
- Control Bank D.

4.2.7 RCP parameters:

- Voltage.
- Current.
- Speed.

4.3 Additional key plant parameters shall be monitored for baseline data.

4.3.1 Turbine speed and generator frequency.

4.3.2 Generator voltage.

4.3.3 Generator excitation.

5.0 ACCEPTANCE CRITERIA

5.1 RCSL and turbine controls remain within analyzed limits and reactor power is stabilized at the lower power for at least 30 minutes following the test initiation without unanticipated operator action.

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5.2 Electrical distribution system voltage and frequency measurements can be correlated with the transient load flow analysis.

5.3 RCPs continue to operate with power supplied from the turbine-generator.

5.4 Partial rod trip occurs but the reactor remains critical.

5.5 Turbine-Generator output breakers remain closed.

5.6 Turbine-Generator performance remains within design limits and as described in Section 10.2.

5.7 Secondary performance remains within design limits as described in Sections 10.2, 10.3, and 10.4.

14.2.13 References

1. ASME Boiler and Pressure Vessel Code, Section III, “Rules for Construction of Nuclear Facility Components,” The American Society of Mechanical Engineers, 2004 (No Addenda).