**Response to**

**Request for Additional Information No. 16, Revision 0**

**7/3/2008**
**U. S. EPR Standard Design Certification**
**AREVA NP Inc.**
**Docket No. 52-020**
**SRP Section: 14.02 – Initial Plant Test Program**
**Application Section: 14.02**
**CQVP Branch**

**Question 14.02-01:**

Regulatory Guide 1.206 states that the COL applicant should describe the technical aspects of the initial test program in sufficient detail to show that (1) the test program adequately verifies the functional requirements of plant SSCs and (2) the sequence of testing is such that the safety of the plant does not depend on untested SSCs. In addition, the COL applicant should describe measures to ensure that (1) the initial test program is accomplished with adequate numbers of qualified personnel, (2) adequate administrative controls will be established to govern the initial test program, (3) the test program is used, to the extent practicable, to train and familiarize the plant's operating and technical staff in the operation of the facility, and (4) the adequacy of plant operating and emergency procedures is verified, to the extent practicable, during the period of the initial test program. Section 14.0 of the U.S. EPR does not state that the COL applicant is responsible for this description. The staff requests that AREVA provide additional information consistent with the COL responsibilities addressed in RG 1.206 C.I.14.

**Response to Question 14.02-01:**

Although the wording used in U.S. EPR FSAR, Tier 2, Section 14.2 to identify COL applicant responsibilities is different from the RG 1.206 wording, the information requested in the question is either addressed by the U.S. EPR FSAR or by COL information items 14.2-1 through 14.2-7:

- "the test program adequately verifies the functional requirements of plant SSCs" is addressed by the collection of test descriptions in the U.S. EPR FSAR Section 14.2.12 and COL information items 14.2-5 and 14.2-7.

- "the sequence of testing is such that the safety of the plant does not depend on untested SSCs" is addressed in the U.S. EPR FSAR, Tier 2, Section 14.2.11 that states "scheduling of individual tests or test sequences is established so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading." Also, the response to question 14.02-15 provides additional clarification on plant safety not being dependent on the performance of untested SSC during any phase of the startup test program.

- "the initial test program is accomplished with adequate numbers of qualified personnel" is addressed in the U.S. EPR FSAR, Tier 2, Section 14.2.2, which states that the COL applicant provides "information pertaining to the experience, qualification of supervisory personnel and other principal participants who are responsible for managing, developing, or conducting each test phase."

- "adequate administrative controls will be established to govern the initial test program" is addressed in the U.S. EPR FSAR, Tier 2, Section 14.2.4 and COL information item 14.2-4.

- "the test program is used, to the extent practicable, to train and familiarize the plant's operating and technical staff in the operation of the facility" is addressed in the U.S. EPR FSAR, Tier 2, Section 14.2.1.1.2 that states "To provide the permanent plant operating staff with the maximum opportunity to obtain practical experience in the operation and maintenance of equipment and systems and their associated procedures," and is also addressed in the U.S. EPR FSAR, Tier 2, Section 14.2.9 and COL information item 14.2-1.

- “the adequacy of plant operating and emergency procedures is verified, to the extent practicable, during the period of the initial test program” is addressed in the U.S. EPR FSAR Section 14.2.9 that states the “schedule for the development of the plant operating and emergency procedures shall allow sufficient time for trial use of these procedures during the initial test program as appropriate and to the extent possible.”

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 14.02-02:**

Section 14.2.II.1.B of the SRP provides general guidance criteria from RG 1.68 that DC applicants should address in its safety analysis report. RG 1.68.C.1.(b) states that suitable tests should be conducted for SSCs that will be used for shutdown and cooldown of the reactor under transient (infrequent or moderately frequent events) conditions and postulated accident conditions and for maintaining the reactor in a safe condition for an extended shutdown period following such condition. AREVA states in section 14.2.1.1 of the FSAR that testing is performed on SSCs that are used for safe shutdown of the reactor under infrequent or moderately frequent transient event, postulated accident conditions, and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions. However, the applicant does not clearly indicate that this testing of SSCs applies to both the shutdown and cooldown of the reactor plant. The NRC staff requests that AREVA provide clarifying information to this section to address whether the tests performed on these SSCs include both shutdown and cooldown.

**Response to Question 14.02-02:**

Startup testing of SSC applies to both shutdown and cooldown of the reactor plant. U.S. EPR FSAR, Tier 2, Section 14.2.1.1 will be revised to include cooldown.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-03:**

Section 14.2.II.1.A of the SRP states that the DC applicant should address the general guidance criteria from RG 1.68, including a description of each of the major phases of the test program. Appendix A of RG 1.68 states that the five phases of the ITP are (1) preoperational testing, (2) initial fuel loading and pre-criticality testing, (3) initial criticality testing, (4) low-power testing, and (5) power ascension testing. AREVA lists four phases of the startup test program in Section 14.2.1.1 of the FSAR which begin at the end of construction activities. Phase III of the startup test program include both initial criticality and low power physics testing. Appendix A of RG 1.68 lists these two phases as separate phases of the startup test program. The NRC staff requests that AREVA describe how these two phases of startup testing will be administratively controlled with respect to transitioning from one phase to the next since the FSAR Section 14.2.1.1 lists both phases as parts of Phase III to the startup test program.

**Response to Question 14.02-03:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.4 will be revised to address the transition from initial criticality to low power physics testing. The transition from initial criticality to low power physics testing is complete after verifying that the technical specification SR 3.1.2.1 requirement of 1000 pcm is met (item 6 listed in U.S. EPR FSAR, Tier 2, Section 14.2.1.1.4).

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.4 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-04:**

Section 14.2.II.1.A of the SRP states that the ITP should describe its objectives, including a description of the objectives for each of the major phases of the test program. Appendix A.1 of RG provides guidance on preliminary tests and inspections typically performed during construction. Appendix A states that the tests typically consist of activities such as initial instrument calibration, flushing, cleaning, wiring continuity and separation checks, hydrostatic pressure tests, and functional tests of components. AREVA provides a list of preliminary construction tests and inspections in Section 14.2.1.1.1 of the FSAR; however, this list does not include initial instrument calibration and functional test of components. The staff requests that AREVA revise Section 14.2.1.1.1 of the FSAR to include initial instrument calibration and functional test of components or justify their exclusion.

**Response to Question 14.02-04:**

To provide the permanent plant operating staff with the maximum opportunity to obtain practical experience in the operation and maintenance of equipment and systems, the initial instrument calibrations and functional tests of components will occur during preoperational testing. U.S. EPR FSAR, Tier 2, Section 14.2.1.1.2 will be revised to include instrument calibrations and functional tests as objectives of preoperational testing.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.2 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-05:**

Standard Review Plan (SRP) Section 14.2, Revision 3, and Regulatory Guide (RG) 1.68, Revision 3, provide guidance and describe the general scope and depth that the NRC staff considers acceptable for initial test programs. Specifically, SRP Section 14.2 provides specific acceptance criteria for Design Certification (DC), Combined License (COL), and Operating License (OL) applicants. This guidance was provided based on previous experience with DC reviews conducted by the staff using an approach in which a lower level of detailed information was required in the DC application and a greater description of the administrative controls were required in the COL application. Based on recent experience with DC reviews, the NRC staff believes that the majority of the general administrative control provisions can be described in the DC application, therefore, allowing for greater standardization of COL initial test programs and efficient review of the COLs.

Section 14.2 of the AREVA's U.S. EPR DC application addresses administrative controls for the initial test program and provides test abstracts for each individual test conducted during the initial test program. Section 14.2 of AREVA's U.S. EPR DC application should establish the majority of the requirements to be used by all COL licensees for controlling the start of testing, for performing tests, for preparing and modifying approved testing procedures, for identifying and correcting test procedure exceptions, and for reviewing and approving initial test program results. This Section encompasses the overarching provisions governing how the initial test program is to be conducted. The staff expects that each COL holder will implement an initial test program by using Section 14.2 of the AREVA's U.S. EPR DC application as the basis to establish site-specific procedures or instructions for implementation.

In order to address, on a generic basis, the administrative controls that will be implemented during the execution of the initial test program, AREVA needs to fully describe the general methodology that will be implemented by applicants referencing the U.S. EPR DC in the following areas:

a. Initial test program objectives,
b. Organizational and staffing responsibilities,
c. A process for test procedure development, issuance, review, approval, distribution, control, and modifications,
d. Conduct of the initial test program (including plant modifications and pre-requisites),
e. Review, evaluation, and approval of test results (including methods and schedules for approval of test data for each major phase and methods used for reviews of individual parts of multiple tests),
f. Initial test program planning and scheduling,
g. Initial fuel loading, initial criticality, low-power testing, and power ascension tests,
h. Conformance with Regulatory Guides (RGs),
i. Utilization of reactor operating and testing experiences in test program development, and
j. Trial use of plant operating and emergency procedures.

Although AREVA can address the majority of the areas described above on a generic basis to a certain extent, the staff recognizes that there are certain areas that can only be addressed by the COL applicants in light of site-specific or licensee-specific details. In areas in which AREVA cannot provide detailed information because site-specific information or licensee-specific details are needed, a COL item will be identified. Specifically, Section 14.2 of the U.S. EPR DC application should identify the following areas as COL items:

a. The description of the site-specific organizational structure, including the identification of principal participants and the degree of participation of each organizational unit, based on the general requirements contained in Section 14.2 of the U.S. EPR DC application.

b. A site-specific schedule, relative to the fuel loading date, for conducting each major phase of the test program, based on the general provisions contained Section 14.2 of the U.S. EPR DC application.

c. The submittal of test specifications and test procedures for review by NRC onsite inspectors at least 60 days before their intended use.

The review and approval of a generic set of administrative controls described to the fullest extent possible provides an increased level of standardization in the design certification material that will be referenced by future COL applicants. Using this approach would allow the NRC staff to reduce the number of COL items in the U.S. EPR DC application and provide a clear description of the areas where COL applicants need to provide information to address site-specific activities. Except for initial test program-related license conditions that will be identified by COL applicants referencing the U.S. EPR DC, the staff anticipates that administrative controls in Chapter 14.2 of the U.S. EPR DC will be identified as Tier 2* information. Accordingly, the NRC requests that AREVA incorporate a greater level of detail into the administrative control sections of Chapter 14.2 of the U.S. EPR DC application consistent with the objectives outlined above.

**Response to Question 14.02-05:**

The information requested in the question is already addressed in the U.S. EPR FSAR or by COL information items 14.2-1 through 14.2-7, which provides standardization for future COL applicants. The items in the question above are restated below, and the FSAR areas or COL items that address the items are shown in the adjacent column:

| | |
|---|---|
| a. Initial test program objectives | U.S. EPR FSAR, Tier 2, Sections 14.2.1 and 14.2.9 |
| b. Organizational and staffing responsibilities | COL item 14.2-1 |
| c. A process for test procedure development, issuance, review, approval, distribution, control, and modifications | U.S. EPR FSAR, Tier 2, Sections 14.2.3 and 14.2.5, and COL item 14.2-3 |
| d. Conduct of the initial test program (including plant modifications and pre-requisites) | U.S. EPR FSAR, Tier 2, Sections 14.2.4 and 14.2.5 |

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| e. Review, evaluation, and approval of test results (including methods and schedules for approval of test data for each major phase and methods used for reviews of individual parts of multiple tests) | COL item 14.2-4 |
| f. Initial test program planning and scheduling | U.S. EPR FSAR, Tier 2, Sections 14.2.4 and 14.2.11, and COL item 14.2-2 |
| g. Initial fuel loading, initial criticality, low-power testing, and power ascension tests | U.S. EPR FSAR, Tier 2, Sections 14.2.1.1.3 - 14.2.1.1.5, 14.2.10.1, 14.2.10.2, 14.2.12 and COL items 14.2-5 and 14.2-7 |
| h. Conformance with Regulatory Guides (RGs) | U.S. EPR FSAR, Tier 2, Section 14.2.7 |
| i. Utilization of reactor operating and testing experiences in test program development | U.S. EPR FSAR, Tier 2, Section 14.2.8 and COL item 14.2-6 |
| j. Trial use of plant operating and emergency procedures | U.S. EPR FSAR, Tier 2, Section 14.2.9 |

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|---|---|
| a. The description of the site-specific organizational structure, including the identification of principal participants and the degree of participation of each organizational unit, based on the general requirements contained in Section 14.2 of the U.S. EPR DC application | U.S. EPR FSAR, Tier 2, Section 14.2.2 and COL item 14.2-1 |
| b. A site-specific schedule, relative to the fuel loading date, for conducting each major phase of the test program, based on the general provisions contained Section 14.2 of the U.S. EPR DC application | U.S. EPR FSAR, Tier 2, Section 14.2.11 and COL item 14.2-2 |
| c. The submittal of test specifications and test procedures for review by NRC onsite inspectors at least 60 days before their intended use | U.S. EPR FSAR, Tier 2, Section 14.2.11 and COL item 14.2-2 |

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 14.02-06:**

Section 14.2.II.1.A of the SRP states that DC applicants should describe the objectives and include a description of each of the objectives for each of the major phases of the test program. Appendix A.1 of RG 1.68 provides general guidance on the preoperational testing phase of the ITP and states that testing should include, as appropriate, manual operation, operation of systems and their components, automatic operation, operation in all alternate or secondary modes of control, and operation and verification tests to demonstrate expected operation following a loss of power sources and in degraded modes for which the systems are designed to remain operational. Accordingly, the NRC requests that AREVA provide the requisite information to ensure that Section 14.2.1.1.2 of the FSAR meets all of the preoperational testing objectives as described in Appendix A.1 of RG 1.68.

**Response to Question 14.02-06:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.2 will be revised to include the preoperational testing objectives from Appendix A.1 of Regulatory Guide 1.68.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.2 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-07:**

Section 14.2.II.1.A of the SRP states that DC applicants should describe the ITP program objectives, including a description of the objectives for each of the major phases of the test program. Appendix A.3 and Appendix A.4 of RG 1.68 provides guidance on the objectives, precautions, prerequisites, and general tests to be performed during initial criticality and low-power physics testing. AREVA states in Section 14.2.1.1.4 of the FSAR, that a description of the procedures followed during the approach to initial criticality is discussed in section 14.2.1.1.4 of the FSAR. However, the applicant does not discuss the objectives of the initial criticality phase of the test program as stated in the guidance in Appendix A.3 of RG 1.68. Additionally, the applicant does not state the objectives of "Low-Power Testing" as stated in the Appendix A.4 RG 1.68. Accordingly, the NRC staff requests that AREVA provide additional information addressing the objectives of initial criticality and low-power physics testing in accordance with the guidance of Appendix A.3 and Appendix A.4 of RG 1.68.

**Response to Question 14.02-07:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.4 will be revised to provide the initial criticality testing objectives stated in Appendix A.3 of Regulatory Guide 1.68 and the low-power physics testing objectives stated in Appendix A.4 of Regulatory Guide 1.68.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.4 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-08:**

Section 14.2.II.1.A of the SRP states that DC applicants should describe the ITP objectives and include a description of the objectives for each of the major phases of the test program. Appendix A.5 of RG 1.68 provides guidance on the objectives, precautions, prerequisites, and general tests to be performed during power ascension testing. AREVA states in Section 14.2.1.1.5 of the FSAR, that a series of power ascension tests are conducted to bring the reactor to full power. However, the applicant does not describe the objectives of this phase of the test program as stated in Appendix A.5 of RG 1.68. Accordingly, the NRC staff requests that AREVA provide additional information addressing the objectives of power ascension testing in accordance with Appendix A.5 of RG 1.68.

**Response to Question 14.02-08:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.5 will be revised to provide the power ascension testing objectives stated in Appendix A.5 of Regulatory Guide 1.68

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.1.1.5 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-09:**

SRP Section 14.2.II.2.A states that the applicant should commit to the RGs listed in RG 1.68. If the regulatory guidance is not followed, the applicant should identify the exceptions and describe and justify specific alternative methods. Section 14.2.VI of the SRP states a reference list of regulatory guides (RGs) the applicant should include in the development of the initial test programs. AREVA provides a table in Section 1.9 of the U.S. EPR FSAR (Table 1.9-2) which assesses the applicability of the various RGs and their corresponding applicable section of the FSAR. Additionally, in Section 14.2.7 AREVA lists the RGs that the startup test program will conform to. The NRC staff noted the following exceptions to the RGs listed in the SRP and RG 1.68:

1. The applicant does not include RG 1.72 “Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin” in Section 14.2.7 of the FSAR. Table 1.9-2 of the FSAR states that this RG is “N/A-COL”.

2. The applicant does not include RG 1.78 “Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release” in Section 14.2.7 of the FSAR or Table 1.9-2.

3. The applicant does not include RG 1.118 “Periodic Testing of Electric Power and Protection Systems,” in Section 14.2.7 of the FSAR or reference the RG as applicable to FSAR section 14.2 in Table 1.9-2.

4. The applicant does not include RG 1.10 “Periodic Testing of Diesel Generation Units Used as Onsite Electric Power Systems at Nuclear Power Plants,” in Section 14.2.7 of the FSAR or Table 1.9-2.

The NRC staff requests that AREVA provide clarifying information about the applicability or the justification for exceptions to the RGs listed as in RG 1.68 and Section 14.2.VI of the SRP.

**Response to Question 14.02-09:**

1. The U.S. EPR standard design does not utilize spray pond piping made from fiberglass-reinforced thermosetting resin, so Regulatory Guide (RG) 1.72 is not applicable. U.S. EPR FSAR Tier 2 Section 14.2.7 will be revised to indicate RG 1.72 is not applicable.

2. The U.S. EPR conforms with RG 1.78, as indicated in Table 1.9-2 of U.S. EPR FSAR, Tier 2, Section 1.9. This table shows that the applicable FSAR sections are U.S. EPR FSAR, Tier 2, Sections 2.3.4, 6.4, and 9.4.1.1. The U.S. EPR standard design includes locations for toxic gas monitors as conceptual information, thus RG 1.78 is not applicable to U.S. EPR FSAR, Tier 2, Section 14.2. U.S. EPR FSAR, Tier 2, Section 14.2.7 will be revised to indicate RG 1.78 is not applicable to the U.S. EPR FSAR, Tier 2, Section 14.2.

3. U.S. EPR FSAR, Tier 2, Section 14.2.7 will be revised to include RG 1.118, and the Table 1.9-2 entry for RG 1.118 will be revised to include U.S. EPR FSAR, Tier 2, Section 14.2.

4. SRP Section 14.2.VI and U.S. EPR FSAR Tier 2 Section 14.2.7 do not list RG 1.10 because this RG has been withdrawn (46 FR 37579, 07/21/1981).

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Sections 1.9 and 14.2.7 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-10:**

Section 14.2.II.3.H.i of the SRP states that the applicant should incorporate, to the extent practicable, the plant operating, emergency, and surveillance procedures into the test program or otherwise verifies these procedures through use during the test program. Section 14.2.9 of the U.S. EPR FSAR states that the schedule for the development of the plant operating and emergency procedures shall allow sufficient time for trial use of these procedures during the initial test program as appropriate an to the extent possible. However, the applicant does not include surveillance procedures as plant procedures to be incorporated into the ITP. Accordingly, the NRC staff requests that surveillance procedures be included in Section 14.2.9 of the FSAR as plant procedures to be incorporated, to the extent practicable, into the initial test program. Otherwise, AREVA should justify their exclusion.

**Response to Question 14.02-10:**

U.S. EPR FSAR, Tier 2, Section 14.2.9 will be revised to include surveillance procedures as plant procedures to be incorporated, to the extent practicable, into the initial test program.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.9 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-11:**

Section 14.2.II.4 of the SRP states that the applicant should include in the ITP a description of the general provisions and precautions for fuel loading, initial fuel loading, initial criticality, low-power testing, and power ascension phases. Precautions, prerequisites, and measures should be consistent with the guidelines and regulatory positions in RG 1.68. Additionally, Appendix A.2 of RG 1.68 states that the initial core loading should be directly supervised by a senior licensed operator having no other concurrent duties, and the loading operation should be conducted in strict accordance with detailed approved procedures. Section 14.2.10.1 of the U.S. EPR FSAR does not mention the requirement for a senior licensed operator to supervise the initial core load. The NRC staff requests that AREVA revise Section 14.2.10.1 of the FSAR to specify that the initial core loading should be directly supervised by a senior licensed operator having no other concurrent duties, consistent with SRP Section 14.2.II.4.

**Response to Question 14.02-11:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised to specify that the initial core loading will be directly supervised by a senior licensed operator having no other concurrent duties.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-12:**

Section 14.2.II.4 of the SRP states that the applicant should include in the ITP a description of the general provisions and precautions for fuel loading, initial fuel loading, initial criticality, low-power testing, and power ascension phases. Precautions, prerequisites, and measures should be consistent with the guidelines and regulatory positions in RG 1.68. Appendix C.2.a to RG 1.68 provides guidance on typical information and prerequisites for fuel loading. The U.S. EPR FSAR has included some of the prerequisites for fuel loading in Section 14.2.10.1 of the FSAR, but not all of them. Specifically, the applicant does not mention the following prerequisites:

a. Specify the composition, duties and emergency procedure responsibilities of the fuel handling crew.

b. Specify the status of all systems required for fuel loading.

c. Specify and establish the status of containment.

d. Specify the status of the reactor vessel. Components should be either in place or out of the vessel as specified, to make it ready to receive fuel.

e. Check the fuel handling equipment and perform dry runs.

f. Prescribe and verify the status of protection systems, interlocks, mode switch, alarms and radiation protection equipment.

The NRC staff requests AREVA revise Section 14.2.10.1 of the FSAR to include the prerequisites for fuel loading from RG 1.68, Appendix C.2.a as listed above.

**Response to Question 14.02-12:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised to include the prerequisites for fuel loading from Regulatory Guide 1.68, Appendix C.2.a.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-13:**

Section 14.2.II.4 of the SRP states that the applicant should include in the ITP a description of the general provisions and precautions for fuel loading, initial fuel loading, initial criticality, low-power testing, and power ascension phases. Precautions, prerequisites, and measures should be consistent with the guidelines and regulatory positions in RG 1.68. Appendix C.2.c of RG 1.68 provides guidance on the criteria for stopping fuel loading. Additionally, Appendix C.2.c provides guidance for establishing criteria for emergency boron injection, containment evacuation, actions to be followed in the event of fuel damage, and the actions to be followed before routine loading may resume after one of the fuel loading limitations have been reached or invoked. Section 14.2.10.1 of the U.S. EPR FSAR lists criteria for the safe loading of fuel and the requirements that stop the loading operations. However, AREVA does not provide information on the criteria for emergency boron injection, containment evacuation, actions in the event of fuel damage, and the procedures to be followed to resume after one of the fuel loading limitations have been reached or invoked. Accordingly, the NRC staff requests that AREVA provide additional information with respect to the safe fuel loading criteria of RG 1.68 Appendix C.2.c.

**Response to Question 14.02-13:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised to provide additional information on the safe fuel loading criteria of Regulatory Guide 1.68, Appendix C.2.c.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.1 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-14:**

Section 14.2.II.4 of the SRP states that the applicant should include in the ITP a description of the general provisions and precautions for fuel loading, initial fuel loading, initial criticality, low-power testing, and power ascension phases. Precautions, prerequisites, and measures should be consistent with the guidelines and regulatory positions in RG 1.68. Appendix C.3 of RG 1.68 lists criteria for initial criticality, including the required conditions and criteria for the deliberate and orderly approach to criticality. Appendix C.3 specifically states that Technical Specifications requirement must be met, a neutron count rate should register on startup channels before the startup begins, and the signal-to-noise ratio should be no greater than two. Section 14.2.10.2 of the U.S. EPR FSAR includes the criteria and conditions for providing a safe controlled approach to criticality; however, AREVA does not provide guidance about Technical Specifications, acceptable startup rate criteria, and signal-to-noise ratio on the startup channels. Accordingly, the NRC staff requests that AREVA include additional information in Section 14.2.10.2 of the U.S. EPR FSAR with respect to the initial criticality criteria in Appendix C.3 of RG 1.68.

**Response to Question 14.02-14:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.2 will be revised to provide additional information on the safe controlled approach to initial criticality per Regulatory Guide 1.68, Appendix C.3.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.10.2 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-15:**

Section 14.2.II.3.C.ii of the SRP states that the schedule for the ITP should establish that the safety of the plant will not depend on the performance of untested SSCs. Additionally, Section B of RG 1.68 states that the startup tests should be sequenced so that the plant safety is never dependent on the performance of untested SSCs. Section 14.2.11 of the U.S. EPR FSAR states that the scheduling of individual tests or test sequences is established so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel load. However, AREVA does not state that during any phase of the startup test program that plant safety will not be dependent on the performance of untested SSCs. Accordingly, the NRC staff requests that AREVA revise Section 14.2.11 of the U.S. EPR FSAR to clarify that plant safety will not be dependent on the performance of untested SSCs during any phase of the startup test program.

**Response to Question 14.02-15:**

U.S. EPR FSAR, Tier 2, Section 14.2.11 will be revised to clarify plant safety will not be dependent on the performance of untested SSCs during any phase of the startup test program.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.11 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-16:**

Section 14.2.II.3.C.iv of the SRP states that the sequential schedule for individual startup tests should establish that test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes. Section 14.2.11 of the U.S. EPR FSAR states that the sequential schedule for individual startup tests should establish, insofar as practicable, that test requirements should be completed prior to exceeding 25 percent power for SSC that are relied on to prevent, limit, or mitigate the consequences of postulated accidents. However, AREVA does not state that test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes. Accordingly, the NRC staff requests that AREVA revise Section 14.2.11 of the U.S. EPR FSAR to state that test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes.

**Response to Question 14.02-16:**

U.S. EPR FSAR, Tier 2, Section 14.2.11 will be revised to address that test requirements will be completed in accordance with plant technical specification requirements for SSC operability before changing plant modes.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.11 will be revised as described in the response and indicated on the enclosed markup.

**Question 14.02-17:**

Section 14.2.II.3.C.i of the SRP states that the applicant should develop a schedule for conducting each major phase of the ITP. Further, RG 1.68, Regulatory Position C.5, "Schedule," includes provisions for developing the schedule for the preoperational and initial startup phases relative to the expected fuel loading date. In Section 14.2.11 of the U.S. EPR FSAR, AREVA states that the EPR startup schedule is as provided in Figure 14.2.11-1 - "U.S. EPR Commissioning Milestones." However, Figure 14.2.11-1 is inconsistent with the information provided in Section 14.2.11 of the FSAR. The staff requests that AREVA clarify the purpose of Figure 14.2.11-1 as it relates to the development of the actual schedule by prospective COL applicants.

Additionally, the table provided at the end of Chapter 14.2 of the U.S. EPR FSAR on page 14.2-257 is titled, “Figure 14.2-1 – U.S. EPR Commissioning Milestone,” where as the title in Section 14.2.11 is “Figure 14.2.11-1 - U.S. EPR Commissioning Milestones.”

**Response to Question 14.02-17:**

The startup testing schedule will be developed by the COL applicant as described in U.S. EPR FSAR, Tier 2, Section 14.2.11. To prevent possible conflicts of information between the U.S. EPR FSAR and COL holder’s testing schedule, Figure 14.2-1 and associated text in U.S. EPR FSAR, Tier 2, Section 14.2.11 will be deleted.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 14.2.11 and Figure 14.2-1 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

# 14.2 Initial Plant Test Program

## 14.2.1 Summary of Test Program and Objectives

### 14.2.1.1 Summary of the Startup Test Program

The startup test program includes testing activities that commence with the completion of construction and installation and end with the completion of the power ascension testing. Testing is performed on SSC that:

- Are used for safe shutdown and cooldown of the reactor under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period.

14.02-02

- Are used for the safe shutdown and cooldown of the reactor under infrequent or moderately frequent transient events, postulated accident conditions, and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions.
- Are used for establishing conformance with safety limits or limiting conditions for operation that shall be included in the Technical Specifications.
- Are classified as engineered safety features (ESF) or used to support or establish that the operations of ESF are within design limits.
- Are assumed to function or that are credited in the accident analysis as described throughout this FSAR.
- Are used to process, store, control, measure, or limit the release of radioactive materials.
- Are used in the special low-power testing program that is conducted at power levels no greater than five percent to provide meaningful technical information in addition to that obtained in the normal startup test program required for the resolution of Three Mile Island (TMI) action plan item 1.G.1.
- Are identified as a significant risk in the facility based on a specific probabilistic risk assessment.
- Are used to mitigate severe accidents that are beyond the U.S. EPR design basis.

This test program demonstrates that SSC operate and comply with design requirements and meet the requirements of 10 CFR 50, Appendix B, Criterion XI. The startup test program results confirm that performance levels meet the functional safety requirements and verify the adequacy of SSC design and the functionality of systems over their operating ranges. It also helps to establish baseline performance data and serves to verify that normal operating and emergency procedures achieve their intended purposes. The data collected during the performance of testing shall be

### 14.2.1.1.2 Phase I - Preoperational Testing

Upon the completion of construction and installation testing, preoperational tests are performed to demonstrate that SSC operate in accordance with design bases. Simulated signals or inputs are often used to demonstrate the full range of the system operation when it would be undesirable to create real system conditions. The general objectives of the preoperational test phase are: 14.02-06

14.02-06

- To demonstrate that appropriate acceptance criteria are met for SSC for safety-related SSC, including alarms and indications.
- To provide documentation of the performance and safety of equipment and systems in all operating modes, including degraded modes (e.g., stuck open miniflow valves, open cross connects) for which the systems are designed to remain operational.
- To demonstrate equipment performance throughout the full design operating range.
- To test, as appropriate, manual operation, operation of systems and their components, automatic operation, operation in alternate or secondary modes of control, and operation and verification tests to demonstrate expected operation following a loss of power sources.
- To test the proper functioning of instrumentation and controls, permissive and prohibit interlocks, and equipment protective devices, for which malfunction or premature actuation may shut down or defeat the operation of systems or equipment.
- To provide baseline test and operating data of equipment and subsystems for future reference.
- To operate ~~new~~ equipment for a sufficient period to demonstrate performance so that ~~any~~ design, manufacturing, or installation defects can be detected and corrected.

14.02-06

- To provide the permanent plant operating staff with the maximum opportunity to obtain practical experience in the operation and maintenance of equipment and systems and their associated procedures. Maintenance activities should include, but not be limited to, instrument calibrations, powered valve functional tests, and lubrication programs.
- To perform dynamic valve testing under maximum design differential pressure, if practical.

Phase I testing ends with hot functional testing (HFT) which is the initial opportunity to perform integrated tests at hot zero power (HZP) pressure and temperature conditions. The general objectives for HFT are:

- To make certain that plant systems operate together on an integrated basis to the extent possible prior to fuel load.
- To incorporate surveillance, normal, and emergency operating procedures into test program procedures to the extent practical. These procedures are verified to the extent practical and revised, if necessary, prior to fuel loading.
- To demonstrate that systems and safety equipment are operational and that it is possible to proceed to fuel loading and to the startup phase.
- The HFT preoperational tests shall clearly distinguish between the data that is used to verify that a design basis performance requirement is met and the test data is taken to record baseline information. The procedure shall clearly verify that data has clearly defined acceptance criteria, minimum acceptable value, and provide a method to document exceptions to the minimum acceptable value.

Abstracts for the preoperational tests are provided in Section 14.2.12.

#### 14.2.1.1.3 Phase II - Initial Fuel Loading and Precritical Testing

Initial fuel loading starts after completion of the preoperational testing. This phase of the initial test program provides a systematic process to safely accomplish and verify the initial fuel loadings. Fuel loading is detailed in Section 14.2.10.1.

Following the completion of initial fuel loading operations and prior to initial criticality, tests are performed to provide additional confirmation that plant systems necessary for normal plant operation function as expected and to obtain performance data on core-related systems and components. As often as is practical, normal plant operating procedures are used to bring the plant from cold shutdown conditions through hot shutdown conditions. Testing normally proceeds directly to initial criticality testing and the beginning of low power physics testing. Abstracts of tests conducted during this phase are provided in Section 14.2.12.

#### 14.2.1.1.4 Phase III - Initial Criticality and Low Power Physics Testing

The initial criticality phase of the startup test program confirms that criticality is achieved in a safe and controlled manner:

14.02-07

- Neutron flux levels are continuously monitored and periodically evaluated. A neutron count rate at least ½ count per second is registered on the startup channels before startup begins, and the signal-to-noise ratio is greater than two.
- Systems required for startup or protection of the plant, including the reactor protection system and emergency shutdown system, are operable and in a state of readiness.
- The control rod or poison removal sequence is accomplished using detailed procedures approved by personnel or groups designated by the COL holder. The

14.02-07

reactor achieves initial criticality by boron dilution and control rods are withdrawn before dilution begins. The control rod insertion limits defined in the Technical Specifications are observed and complied with. The reactivity addition sequence is prescribed, and the procedure will require a cautious approach in achieving criticality to prevent passing through criticality in a period shorter than approximately 30 seconds (<1 decade per minute).

14.02-07

A description of the procedures followed during the approach to initial criticality is included in Section 14.2.10.2. Following initial criticality, a series of low-power physics tests are performed to verify selected core design parameters. These tests serve to substantiate the safety analysis assumptions and Technical Specifications. They also demonstrate that core characteristics are within the expected limits and provide data for benchmarking the design methodology used for predicting core characteristics later in life. The initial criticality and low-power physics tests (LPPT) follow the guidelines described in ANSI 19.6.1 and as a minimum consist of the following sequence:

1. Withdrawal of the shutdown bank RCCAs.
2. Withdrawal of the control bank RCCAs in sequence and overlap until the final control bank is inserted approximately 50 to 100 pcm.
3. Reduction of the reactor coolant boron concentration (dilution) in a gradual manner until the reactor is just critical or with source range counts increasing gradually.
4. Increasing source range counts slowly to the point of adding heat (POAH) and then reducing the intermediate range indication by one-half to one decade.
5. Determination of adequate overlap of source and intermediate-range neutron instrumentation, and verification that proper operation of associated protective functions and alarms provide plant protection in the low-power range.
6. Verification that the Technical Specification SR 3.1.2.1 requirement of 1000 pcm is met.
7. Establish the LPPT band and reduce flux until the reactor is approximately at the lower end of the flux band.
8. Measurement of the all rods out boron concentration (boron endpoint) to verify calculational models and accident analysis assumptions.
9. Measurement of the isothermal coefficient which infers the boron and moderator temperature reactivity coefficients over the temperature and boron concentration ranges in which the reactor may initially be taken critical.
10. Measurements of control rod and control rod bank reactivity worths to (1) confirm that they are in accordance with design predictions and (2) confirm by analysis that the rod insertion limits will be adequate to confirm a shutdown margin

14.02-07 consistent with accident analysis assumptions throughout core life, with the greatest worth control rod stuck out of the core.

–Abstracts of tests performed during this phase are provided in Section 14.2.12.

#### 14.2.1.1.5 Phase IV - Power Ascension Testing

14.02-08

A series of power ascension tests is conducted to bring the reactor to full power. Testing is performed at various power levels and is intended to demonstrate that the facility operates in accordance with its design bases during steady state conditions and, to the extent practicable, during anticipated transients. To check the analytical models used to predict plant responses to anticipated transients and postulated accidents are bounding, the measured responses are compared to the predicted responses. The predicted responses should be developed using real or expected values of such attributes as beginning-of-life core reactivity coefficients, flowrates, pressures, temperatures, pump coastdown characteristics, and response times of equipment, as well as the status of the plant.

The following items illustrate some of the types of performance demonstrations, measurements, and tests that are included in the power ascension test phase.

1. Determine power coefficients and steady state core performance are within design limits (Test Numbers 190, 191, 192, 206, and 207).

2. Check rod drop times against plant data (Test Number 222).

3. Demonstrate capability and sensitivity to detect a control rod misalignment equal to or less than the Technical Specification limits (Test Number 213).

4. Verify that plant performance is as expected for runback and following a partial trip (Test Number 221).

5. Verify the capability of plant monitoring systems (Test Numbers 193, 197, 204, and 205).

6. Demonstrate the adequacy of design by comparing design values to performance data (Test Numbers 194, 199, 203, 210, 212, 215, and 216).

7. Demonstrate the ability of the plant to withstand transient conditions (Test Numbers 196, 198, 200, 211, 214, 217, 219, and 220).

–Abstracts of tests performed during power ascension are provided in Section 14.2.12.

### 14.2.2 Organization and Staffing

It is the responsibility of the COL applicant to organize and staff phases of the test program. A COL applicant that references the U.S. EPR certified design will provide site-specific information that describes the organizational units that manage,

### 14.2.6 Test Records

According to applicable regulatory requirements, initial test program results are compiled and maintained in compliance with administrative procedures. Retention periods for test records are based on considerations of their usefulness in documenting plant performance characteristics, and are retained in accordance with RG 1.28, Quality Assurance Program Requirements – Design and Construction, as described in Section 17. Startup test reports will be prepared in accordance with RG 1.16, Reporting of Operating Information – Appendix A Technical Specifications.

### 14.2.7 Conformance of Test Programs with Regulatory Guides

The primary regulatory guide for the startup test program is RG 1.68, Initial Test Program for Water Cooled Nuclear Power Plants, Revision 3, March 2007. The startup test program will conform to the relevant testing guidance in applicable regulatory guides. The RGs which provide specific guidance related to testing and testing programs are:

- RG 1.9 - Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants, Revision 4, March 2007.
- RG 1.20 - Comprehensive Vibration Assessment Program for Reactor Internals During Preoperation and Initial Startup Testing, Revision 3, March 2007.
- RG 1.30 - Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment, Revision 0, August 1972.
- RG 1.37 - Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants, Revision 1, March 2007.
- RG 1.41 - Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments, Revision 0, March1973.
- RG 1.52 - Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants, Revision 3, June 2001.
- RG 1.68.2 - Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants, Revision 1 July 1978.
- RG 1.68.3 - Preoperational Testing of Instrument and Control Air Systems, Revision 0, April 1982.

14.02-09

- RG 1.72 - Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin, Revision 2, November 1978. This RG is not applicable because the U.S. EPR does not use this type of spray pond piping.

14.02-09

- RG 1.78 - Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release, Revision 1, December 2001. This RG is not applicable to the initial plant test program for the U.S. EPR.
- RG 1.79 - Preoperational Testing of Emergency Core Cooling Systems for Pressurized-Water Reactors, Revision 1, September 1975.

14.02-09

- RG 1.116 - Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems, Revision 0-R, May 1977.
- RG 1.118 - Periodic Testing of Electric Power and Protection Systems, Revision 3, April 1995.
- RG 1.128 - Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants, Revision 2, February 2007.
- RG 1.139 - Guidance for Residual Heat Removal. Revision 0, May 1978.
- RG 1.140 - Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants, Revision 2, June 2001.

## 14.2.8 Utilization of Reactor Operating and Testing Experience in Development of Initial Test Program

The design of the U.S. EPR is an evolutionary design. As such, the experience gained from previous successful startups is factored into the initial test program. This information reflects both AREVA NP operating and test experience and industry wide experience concerning pressurized water reactors. A summary will be developed to provide conclusions from this review and the effects on the test program.

The plant operations staff reviews reactor operating and testing experiences at other facilities that are similar in design and capacity prior to the unit starting up. This review is carried out by circulating the following information to startup and operations personnel so that pertinent information can be utilized in the startup program:

- Licensee event reports or summaries.
- NRC I&E bulletins.
- NRC circulars.
- NRC information notices.
- INPO items.

**Table 1.9-2—U.S. EPR Conformance with Regulatory Guides**
**Sheet 9 of 19**

| RG / Rev | Description | U.S. EPR Assessment | FSAR Section(s) |
|---|---|---|---|
| 1.106, R1 | Thermal Overload Protection for Electric Motors on Motor-Operated Valves | Y | 8.3.1.1 |
| 1.107, R1 | Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures | Y | 3.8.1 |
| 1.109, R1 | Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I | Y | 11.2 |
| | | | 11.3 |
| 1.110, 03/ 1976 | Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors | Y | 11.2 |
| | | | 11.3 |
| 1.111, R1 | Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors | N/A-COL | 2.3.5 |
| 1.112, R1 | Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors | Y | 11.1 |
| | | | 12.2 |
| 1.113, R1 | Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I | N/A-COL | N/A |
| 1.114, R2 | Guidance to Operators at the Controls and to Senior Operators in the Control Room of a Nuclear Power Unit | N/A-COL | N/A |
| 1.115, R1 | Protection Against Low-Trajectory Turbine Missiles | Y | 3.5 |
| | | | 3.8.4 |
| | | | 9.1.2 |
| | | | 10.3 |
| 1.116, R0-R | Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems | Y | 14.2 |
| 1.117, R1 | Tornado Design Classification | Y | 3.5 |
| | | | 10.3 |
| 1.118, R3 | Periodic Testing of Electric Power and Protection Systems | Y | 7.1 |
| | | | 8.1 |
| | | | 8.3 |
| | | | 14.2 |

14.02-09

### 14.2.8.1 First-of-a-Kind Testing

First-of-a-kind (FOAK) design features are those identified as new, unique, or special in one or more aspects of their plant application that warrant extended or more detailed testing to verify their functional performance.

From a design standpoint, the U.S. EPR is not a FOAK plant. Specific features that may be novel in the U.S., such as the control rod drive systems or the incore neutron measurement system, have been successfully implemented in previous AREVA designs. In addition, for new EPR-specific features, the U.S. EPR will be preceded by European units, which are scheduled to enter commercial operation prior to any U.S. unit. Hence, extensive testing and operational data will be available prior to the first U.S. EPR beginning its Initial Plant Test Program.

Examples of features that may be novel in the U.S., but which are in service at AREVA plants in Europe include:

- Control rod drive mechanisms (CRDM).
- Control rod position indication.
- Fixed and moveable incore neutron measurement systems.

Examples of features that may be novel in the U.S., but which are expected to have been demonstrated in other EPR units prior to operation of any U.S. EPR include:

- Reactor internals (vibration measurement).
- Natural circulation of the reactor coolant system (RCS).
- Reactor coolant pump (RCP) stand-still seal.
- Pressurizer surge line (thermal stratification).

The first COL applicant that references the U.S. EPR certified design will commit to review results from European predecessors concerning the new, unique, or novel EPR features such as those previously noted and propose supplemental testing if necessary.

### 14.2.9 Trial Use of Plant Operating and Emergency Procedures

14.02-10

The test program schedule is addressed in Section 14.2.11. The schedule for the development of the plant operating and emergency procedures shall allow sufficient time for trial use of these procedures during the initial test program as appropriate and to the extent possible. For example, the Plant Operations staff should take every available opportunity to use the plant procedures as follows:

14.02-10

- Normal operations procedures should be used to perform basic valve alignments for preoperational tests.
- Hot Functional testing should be performed with as many normal operations procedures as practical.
- Emergency operating procedures that require special plant conditions, such as the reactor head removed and the refueling cavity available to receive water, should be performed when those conditions have been created for preoperational testing.
- Technical specification surveillance tests should be performed and surveillance test problems corrected prior to fuel loading.

–In addition, the COL applicant should identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in the following reports:

NUREG-0660 - NRC Action Plans Developed as a Result of the TMI-2 Accident, Revision 1, August 1980.

NUREG-0694 - TMI-Related Requirements for New Operating Licenses, June 1980.

NUREG-0737 - Clarification of TMI Action Plan Requirements.

To accomplish these requirements, the emergency procedures will be performed on the plant simulator for procedure validation and operator training.

## 14.2.10 Initial Fuel Loading and Initial Criticality

Initial fuel loading and initial criticality are performed in a controlled manner during the startup test program. These activities are performed in a controlled and safe manner using the test procedures addressed in Section 14.2.12. Technical Specification requirements are applicable and must be satisfied prior to these operations.

### 14.2.10.1 Initial Fuel Loading

Minimum initial conditions for core load:

- ~~All ITAAC have been closed.~~
- The fuel loading evolution is controlled by the use of approved plant procedures, which establish plant conditions, control access, establish security, control maintenance activities, and provide instructions that pertain to the use of fuel handling equipment.
- The boron concentration and isotopic content in the coolant is verified to be equal to or greater than that required for refueling. It is not anticipated that the

refueling cavity will be completely filled. However, the water level in the reactor vessel shall remain above the installed fuel assemblies at times.

- The residual heat removal system (RHRS) provides coolant circulation that verifies adequate boron mixing and a means of controlling water temperature. The in-containment refueling water storage tank (IRWST) is in service and contains borated water at a volume and concentration that complies with the requirements. Applicable administrative controls shall be used to prevent unauthorized alteration of system lineups or change to the boron concentration in the RCS.

14.02-11, 14.02-12, 14.02-13

- The initial core loading is directly supervised by a senior licensed operator having no other concurrent duties.
- The composition, duties, and emergency procedure responsibilities of the fuel handling crew are specified.
- The status of all systems required for fuel loading is specified.
- The status of containment is specified.
- The status of the reactor vessel is specified.
- The fuel handling equipment has been verified to be operating correctly by performing preoperational tests prior to handling fuel.
- The status of protection systems, interlocks, alarms, and radiation protection equipment has been verified.
- A minimum of two permanent or temporary neutron detectors are located so that core reactivity changes can be detected and recorded. The neutron detectors shall be calibrated and operable prior to fuel movement.
- Response checks of neutron detectors are required prior to the commencement of fuel loading.
- Continuous area radiation monitoring shall be provided during fuel handling and fuel loading operations. Permanently installed radiation monitors display radiation levels in the main control room (MCR) and shall be monitored by licensed operators.

Fuel assemblies, together with inserted components, are placed in the reactor vessel, one at a time, according to previously established and approved sequences. The initial fuel loading procedure shall include detailed instructions, which prescribe successive movements of each fuel assembly. The procedures allow each fuel assembly movement to be verified prior to proceeding with the next assembly. Multiple checks are made for fuel assembly and inserted component serial numbers to guard against possible inadvertent exchanges or substitutions.

At least two fuel assemblies that contain primary neutron sources shall be placed into the core at appropriate specified points in the initial fuel loading procedure. This will ~~ensure~~provide a neutron population large enough for adequate monitoring of the core. As each fuel assembly is loaded, at least two separate inverse count-rate plots shall be maintained to verify that the extrapolated inverse count-rate ratio (ICRR) behaves as expected. In addition, nuclear instrumentation shall be monitored to verify that each just-loaded fuel assembly does not excessively increase the count-rate. The results of each loading step shall be reviewed and evaluated before the next sequence fuel assembly is grappled by the manipulator crane.

Criteria for the safe loading of fuel require that loading operations stop immediately if:

- The neutron count-rate from either temporary nuclear channel unexpectedly doubles during any single loading step, excluding anticipated change due to detector or source movement, or spatial effects such as a fuel assembly coupling source with a detector.

14.02-11, 14.02-12, 14.02-13

- The neutron count-rate on any individual nuclear channel increases by a pre-established maximum multiplication factor during any single loading step, excluding anticipated changes due to detector or source movement, or spatial effects such as a fuel assembly coupling source with a detector.
- There is a loss of communications between the control room and the senior licensed operator or fuel handling personnel.
- There is less than the required minimum number of operable source-range detectors.
- The extra borating system is inoperable.

A fuel assembly shall not be un-grappled from the refueling machine until stable count-rates have been obtained. In the event that an unexplained increase in count-rate is observed on any nuclear channel, the last fuel assembly loaded shall be withdrawn. Before proceeding, the procedure and loading operation shall be reviewed and evaluated to verify the safe loading of fuel.

14.02-11, 14.02-12, 14.02-13

Plant procedures shall establish criteria for the following:

- Emergency boron injection.
- Containment evacuation.
- Actions to be followed in the event of fuel damage.
- Actions to be followed or approvals to be obtained before routine loading may resume after one of the above limitations has been reached or invoked.

### 14.2.10.2 Initial Criticality

Initial criticality is controlled by the use of approved plant procedures which establish required plant conditions and successful completion of prerequisite tests described in Section 14.2.12. Initial criticality is obtained by a specified, controlled and orderly combination of a rod cluster control assembly (RCCA) withdrawal, and a boron concentration reduction. The approach to criticality requires that RCCA groups be withdrawn in sequence with overlap, except for the last regulating group, which shall remain far enough into the core to provide effective control when criticality is achieved. The RCS boron concentration is then reduced to achieve criticality, at which time the regulating group shall be used to maintain criticality.

Core response during RCCA group withdrawal and RCS boric acid concentration reduction shall be monitored in the MCR by observing the change in neutron count-rate as indicated by the permanent nuclear instrumentation.

The neutron count-rate is plotted as a function of RCCA group position and RCS boron concentration during the approach to criticality. The approach to criticality shall be controlled and specific hold points shall be specified in the procedure. The results of the inverse count-rate monitoring and the indications on installed instrumentation shall be reviewed and evaluated before proceeding to the next prescribed hold point.

The criteria for providing a safe and controlled approach to criticality require that the following conditions are met:

14.02-14

- ~~That h~~High flux trip setpoints ~~be~~are reduced to a value consistent with performance of the next test plateau.
- Technical Specifications required for entry into MODE 2 are met.
- A minimum count rate of two counts per second (cps) is met.
- A signal-to-noise ratio greater than two is met.
- A statistical reliability test on each operable source range instrument is performed.
- A sustained startup rate of one decade per minute is not exceeded.
- ~~That a sustained startup rate of one decade per minute not be exceeded.~~
- ~~That~~ RCCA withdrawal or boron dilution is suspended if unexplainable changes in neutron count-rates are observed.
- ~~That a~~ A minimum of one decade of overlap ~~be~~is observed between the source and intermediate channels of the excore nuclear instruments.

## 14.2.11 Test Program Schedule

The scheduling of individual tests or test sequences is established so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading. Tests that require a substantial core power level for proper performance are performed at the lowest power level commensurate with obtaining acceptable test data.

A COL applicant that references the U.S. EPR certified design will develop a test program that considers the following ~~five~~seven guidance components:

14.02-15, 14.02-16

- The applicant should allow at least nine months to conduct preoperational testing.
- The applicant should allow at least three months to conduct startup testing, including fuel loading, low-power tests, and power-ascension tests.
- Plant safety will not be dependent on the performance of untested SSCs during any phase of the startup test program.
- Surveillance test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes.
- Overlapping test program schedules (for multiunit sites) should not result in significant divisions of responsibilities or dilutions of the staff provided to implement the test program.
- The sequential schedule for individual startup tests should establish, insofar as practicable, that test requirements should be completed prior to exceeding 25 percent power for SSC that are relied on to prevent, limit, or mitigate the consequences of postulated accidents.
- Approved test procedures should be in a form suitable for review by regulatory inspectors at least 60 days prior to their intended use or at least 60 days prior to fuel loading for fuel loading and startup test procedures.

14.02-17

~~The EPR startup schedule is as provided in Figure 14.2-1—U.S. EPR Commissioning Milestones.~~

## 14.2.12 Individual Test Descriptions

The individual preoperational test abstracts identified in this section contain test descriptions that form one part of the bases for defining the minimum testing requirements.

In these abstracts:

Figure deleted per 14.02-17

**Figure 14.2-1—~~U.S. EPR Commissioning Milestones~~**