## ArevaEPRDCPEm Resource

**From:** DUNCAN Leslie E (AREVA NP INC) [Leslie.Duncan@areva.com]
**Sent:** Friday, December 05, 2008 10:20 AM
**To:** Getachew Tesfaye
**Cc:** John Rycyna; Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 68, Supp. 1, FSAR Ch 14
**Attachments:** RAI 68 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 11 of the 12 questions of RAI No. 68 on October 24, 2008. The attached file, "RAI 68 Supplement 1 Response US EPR DC.pdf" provides a technically correct and complete responses to the remaining question, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 68 Question 14.02-23.

The following table indicates the respective pages in the response document, "RAI 68 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 68 — 14.02-23 | 2 | 3 |

This concludes the formal AREVA NP response to RAI 68, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

(Les Duncan on behalf of)
*Ronda Pederson*
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
**AREVA NP, Inc.**
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
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**From:** Pederson Ronda M (AREVA NP INC)
**Sent:** Friday, October 24, 2008 3:34 PM
**To:** 'Getachew Tesfaye'
**Cc:** DUNCAN Leslie E (AREVA NP INC); WELLS Russell D (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 68 (987,1008),FSAR Ch 14

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 68 Response US EPR DC.pdf" provides technically correct and complete responses to 11 of the 12 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 68 Questions 14.02-19, 14.02-20, 14.02-21, 14.02-22, 14.02-24, 14.02-25, 14.02-26, 14.02-27, 14.02-29, and 14.02-30.

The following table indicates the respective pages in the response document that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 68 — 14.02-19 | 2 | 2 |
| RAI 68 — 14.02-20 | 3 | 3 |
| RAI 68 — 14.02-21 | 4 | 4 |
| RAI 68 — 14.02-22 | 5 | 5 |
| RAI 68 — 14.02-23 | 6 | 6 |
| RAI 68 — 14.02-24 | 7 | 7 |
| RAI 68 — 14.02-25 | 8 | 8 |
| RAI 68 — 14.02-26 | 9 | 9 |
| RAI 68 — 14.02-27 | 10 | 10 |
| RAI 68 — 14.02-28 | 11 | 11 |
| RAI 68 — 14.02-29 | 12 | 12 |
| RAI 68 — 14.02-30 | 13 | 13 |

A complete answer is not provided for 1 of the 12 questions. The schedule for a technically correct and complete response to this question is provided below.

| Question # | Response Date |
|---|---|
| RAI 68 — 14.02-23 | December 5, 2008 |

Sincerely,

*Ronda Pederson*

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**From:** Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
**Sent:** Wednesday, September 24, 2008 1:03 PM
**To:** ZZ-DL-A-USEPR-DL
**Cc:** Dori Votolato; Juan Peralta; Michael Miernicki; Joseph Colaccino; John Rycyna
**Subject:** U.S. EPR Design Certification Application RAI No. 68 (987,1008),FSAR Ch 14

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 4, 2008, and discussed with your staff on September 16, 2008. No change was made to the draft RAI as a result of that discussion. 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:** 3

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**Subject:** Response to U.S. EPR Design Certification Application RAI No. 68, Supp. 1, FSAR Ch 14
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**From:** DUNCAN Leslie E (AREVA NP INC)

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**Response to**

**Request for Additional Information No. 68 Supplement 1 (987, 1008), Revision 0**

**9/24/2008**

**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**
**Application Section: 14.2**
**CQVP Branch**

**Question 14.02-23:**

In RAI 14.02-14, the NRC staff requested that AREVA include additional information in Section 14.2.10.2, "Initial Criticality," of the U.S. EPR FSAR with respect to the initial criticality criteria in Appendix C.3 of RG 1.68. AREVA's response provided information on the conditions for the safe controlled approach to initial criticality, including: a minimum count rate of two counts per second is met, and a statistical reliability test on each operable source range instrument is performed. RG 1.68 Appendix C.3 states that a neutron count rate of at least 1/2 count per second should be used. The NRC staff requests additional information to justify the use of two counts per second versus the 1/2 counts per second recommended by the regulatory guide. In addition, the NRC staff requests clarification on the process used to perform a statistical reliability test on each operable source range instrument.

**Response to Question 14.02-23:**

The neutron count rate in U.S. EPR FSAR Tier 2, Section 14.2.10.2 will be revised to a minimum ½ counts per second to conform to Regulatory Guide 1.68, Appendix C.3.

A statistical reliability test on each operable source range instrument is listed in U.S. EPR FSAR Tier 2, Section 14.2.10.2, which provides additional confidence in instrumentation during the approach to initial criticality. Generating a reliable instrumentation signal during the approach to criticality is difficult because the neutron count rate in a subcritical reactor is low and resembles a random event. That is, there are frequent bursts of neutrons occurring between periods of little or no activity. Utilizing Poisson statistics allows a prediction of the neutron count rate in nuclear reactors and a determination that the observed neutron count rate is following the predicted distribution.

The source range instrumentation used to detect neutron counts in a subcritical reactor generates a pulse in response to each neutron reaching the detector. These pulses are counted over recurring periods of time to generate a neutron count rate. However, the amplitude of the pulses generated by these sensors is not high compared to the considerable noise that can generate from different sources. Because the signal level is low, electronic noise from circuit components in the measuring system can be a factor. Also, gamma rays can trigger pulses in some sensors. The electronic noise and gamma ray noise tend to be lower in amplitude than the pulses produced in the sensor by neutrons. Discriminating circuits can be used to remove gamma noise. Other types of noise induced by outside events, such as the operation of motors or other electrical equipment, can also result in large amplitude spikes in the neutron detection channels.

The following statistical reliability test is a typical test performed on each source range channel that uses Poisson distribution methods to alert personnel using the source range detectors to conditions where the counts are not following the expected statistical distribution:

1. Set the counting interval (Δt) to a value that will result in an integral count of at least 1000.
2. Obtain a minimum of ten separate values of integral counts (Ni) per Δt.
3. Calculate the average value of counts ( $\bar{N}$ ) and Chi-square ( $\chi^2$ ) per the following:

$$\bar{N} = \frac{\sum_{i=1}^{I} N_i}{I}, \qquad \chi^2 = \frac{\sum_{i=1}^{I}\left(N_i - \bar{N}\right)^2}{\bar{N}}$$

where $N_i$ is the number of counts in interval $i$, and $\bar{N}$ is the average number of counts for I intervals.

(Note: Due to the probabilistic nature of statistical tests, some test failures can be expected even with properly operating equipment. Data which shows less than a reasonable amount of scatter is inherently more likely at lower values of integral counts by the definition of Chi-square. A low value of Chi-square may be indicative of a constant source of counts (such as that produced by a test oscillator used to check the equipment) superimposed on the actual detector output. Data which shows more than a reasonable amount of scatter is generally indicative of random electrical interference caused by arc welders, elevator operation, or other intermittent electrical equipment. This type of interference should be obvious as spikes in count rate.)

1. Plot the value of $\chi^2$ for each source range division on a Chi-squared acceptance graph.
2. If the plotted point for a division falls between the acceptance curves on the Chi-squared acceptance graph, then the division is acceptable.
3. If the plotted point for a channel falls outside the Chi-squared acceptance curves, then the division should be considered suspect and action should be taken to correct the problem. If there is no reason to suspect malfunction of the counting equipment or external sources of interference, the following alternatives are recommended to restore confidence in the questionable division:

   A. Repeat the previous steps with the same counting interval (Δt) and repeat the $\chi^2$ calculation on the basis of the increased number of counting intervals. For example, obtain an additional five or ten counting intervals and perform the $\chi^2$ calculation on the basis of 15 or 20 intervals.

   B. Lengthen the counting interval to obtain larger values of integral counts per counting interval and repeat the previous steps.

**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.

# U.S. EPR Final Safety Analysis Report Markups

use the rod withdrawal sequence and dilution to criticality in subsequent plant startups that require LPPT. For U.S. EPR startups not requiring LPPT, the plan is to dilute to a concentration that corresponds to an estimated critical condition with Control Bank D near the core mid-plane. The same withdrawal sequence and pattern is used with criticality being achieved during Control Bank D withdrawal.

During reactor startup, the~~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:

- ~~That h~~High flux trip setpoints ~~be~~are reduced to a value consistent with performance of the next test plateau.
- Rod drop time tests have been performed to provide reasonable assurance that the control rods will trip within the required time under plant conditions that bound those under which the control rods might be required to function to achieve plant shutdown (rod drop testing should demonstrate control rod drop times at both hot zero power and cold temperature conditions, and with all RCPs operating and no-RCPs operating conditions).
- Technical Specifications required for entry into MODE 2 are met.
- 14.02-23 A minimum count rate of ~~two~~1/2 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