ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Friday, October 01, 2010 3:54 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); NOXON David (AREVA); WILLIFORD Dennis (AREVA); HALLINGER Pat (EXTERNAL AREVA); RYAN Tom (AREVA); GARDNER Darrell (AREVA)
Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 436, FSAR Ch. 11, OPEN ITEM
Attachments: RAI 436 Supplement 1 Response US EPR DC - Draft.pdf

Getachew,

Attached is a draft response for RAI 436 questions 11.05-26 and 11.05-27 in support of a final response date of November 1, 2010. Let me know if the staff has questions or if this response can be sent as final.

Thanks,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
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From: BRYAN Martin (External RS/NB)
Sent: Monday, September 27, 2010 2:33 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); NOXON David (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 436, FSAR Ch. 11, OPEN ITEM

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 436 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 436 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 436 — 11.02-26	2	3
RAI 436 — 11.05-26	4	4
RAI 436 — 11.05-27	5	5

The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 436 — 11.02-26	November 22, 2010
RAI 436 — 11.05-26	November 1, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, August 27, 2010 5:47 PM
To: ZZ-DL-A-USEPR-DL
Cc: Dehmel, Jean-Claude; Roach, Edward; Patel, Jay; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 436 (4849, 4968),FSAR Ch. 11, OPEN ITEM

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 17, 2010, and on August 27, 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: 2078

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Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 436, FSAR Ch. 11, OPEN ITEM
Sent Date: 10/1/2010 3:53:56 PM
Received Date: 10/1/2010 3:54:52 PM
From: BRYAN Martin (EXTERNAL AREVA)

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Response to

Request for Additional Information No. 436(4849, 4968), Revision 1, Supplement 1

8/27/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 11.02 - Liquid Waste Management System
SRP Section: 11.05 - Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems

Application Sections: 11.2 & 11.5

QUESTIONS for Health Physics Branch (CHPB)

Question 11.05-26:

OPEN ITEM

Follow-up to Open Item 405, Question 11.05-22 (Re: Supplement 1 response)

The following presents comments based on joint reviews conducted by CHPB and CTSB staff because the response, in part, invokes technical specifications (TS). The applicant is requested to address and resolve the following items in the FSAR:

1. Regarding the proposed update to FSAR Section 11.5.4.1, the applicant is requested to include in the last paragraph the estimated NG concentration in the MSL corresponding to a SG tube leak rate of 150 gpd, as was done for N-16 concentration – see 2nd paragraph. This information is contained in the associated calculation package previously reviewed by the staff.
2. The applicant is requested to confirm that the supporting descriptive information on the MLS MSL radiation monitoring system used to monitor radioactivity in the MSL will be updated in FSAR Table 11.5-1 in light of the response to this supplemental and the initial RAI.
3. CHPB and CTSB staff find the response to item 5 of this RAI not acceptable. The reliance on a TS is not acceptable because TS do not include design information. As was noted in the initial response, Areva acknowledged that some design features and operating characteristics of the MSL radiation monitoring system cannot be defined at this stage of the design certification. As a result, the staff requested Areva to include a COL information item that places the responsibility on the COL applicant to provide supporting design information describing how plant-specific design features, installation, and implementation of operating procedures for this system will address compliance with the SG TS leakage rate of 150 gpd under U.S. EPR TS 16.3.4.12.d. Given that this information is contained in the associated calculation package previously reviewed by the staff, the applicant is requested to include in FSAR Section 11.5.4.1, as a COL item or as adequately descriptive information, the pertinent technical details that a COLA needs to be aware of in finalizing the design and determining the response characteristics of the MLS radiation monitoring system taking into consideration plant-specific conditions.

Response to Question 11.05-26 (1):

The following paragraph will be included in U.S. EPR FSAR Tier 2, Section 11.5.4.1, as requested:

> “Specifically, for the same N-16 and noble-gas concentration at the radiation monitor location, N-16 will yield a radiation field at the detector which is about 50 times higher than that generated by the realistic noble-gas mix. The noble-gas concentration at the radiation monitor location is expected to range between 1.1E-06 μCi/cc at 10 percent power to 8.1E-07 μCi/cc at full power, based on the reactor coolant system (RCS) realistic noble gas concentration of 2.0 μCi/gm (from Table 11.1-7—RCS and Secondary Coolant System Realistic Source Terms) and the Technical Specification limit of 150 gallons per day for primary-to-secondary leakage.”

Response to Question 11.05-26 (2):

The supporting descriptive information on the main steam line (MSL) radiation monitoring system (RMS) used to monitor radioactivity in the MSL will be revised in the Response to RAI 273 and its associated U.S. EPR FSAR Tier 2, Table 11.5-1 markups. The revised table will show the MSL radiation monitor range as 1E-8 – 1E-2 μCi/cc (N-16).

Response to Question 11.05-26 (3):

U.S. EPR FSAR Tier 2, Section 11.5.4.1, "Main Steam Radiation Monitoring System," will be revised to provide supporting technical details for a COLA applicant's use in the incorporation of plant-specific features of the MSL RMS that verifies compliance with U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications 16.3.4.12.d, specifically the capability to detect a steam generator (SG) leakage rate of 150 gpd.

Many factors potentially impact the ability of the MSL radiation monitors to perform their function. A list of these factors and their potential impacts are will be added to U.S. EPR FSAR Tier 2. Specifically, U.S. EPR FSAR Tier 2, Section 11.5.4.1 will be revised to include sufficient information for the development of procurement specifications by a COLA applicant related to the radiation monitoring instrumentation, and for its placement, shielding, and operational requirements. Plant procedures will verify that the given particulate radiation monitor sensitivity is sufficient to satisfy the primary-to-secondary RCS leakage rate technical basis.

US EPR FSAR Tier 2, Section 11.5.4.1, "Main Steam Radiation Monitoring System," will be revised as described in this response.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 11.5.4.1 will be revised as described in the response and indicated on the enclosed markup.

Question 11.05-27:

OPEN ITEM

Follow-up to Open Item RAI 405, Question 11.05-25 (Re: Supplement 1 response)

While the staff confirms the derived dose result presented in RAI 405 Supp. 1, Question 11.05-25, the response is deemed partly responsive to the staff's question. The response notes that the FSAR will not be changed as a result of this question. The staff disagrees with this conclusion. FSAR Section 11.3.3.6 should provide and describe the essential parameters and assumptions supporting the analysis and its stated dose result. The following information and parameters are missing in the currently proposed revision of FSAR Section 11.3.3.6:

1. a citation to FSAR Table 11.1-2 for the assumed TS DE Xe-133 concentration of 210 uCi/g, as adjusted upward by 10% to 230 uCi/g for this analysis;
2. basis and value for the degasification rate of 20 kg/sec.;
3. basis and value for the X/Q of 1.0E-03 sec/m^3;
4. basis and value for the DE Xe-133 dose conversion factor; and
5. a summary of the underlying accident assumptions using descriptions given in the first and fourth bullets of the RAI response but not included in the FSAR mark-up.

The applicant is requested to revise the response, commit to include in FSAR Section 11.3.3.6 the information and parameters described above, and submit a proposed markup of FSAR Section 11.3.3.6.

Response to Question 11.05-27:

U.S. EPR FSAR Tier 2, Section 11.3.3.6 will be revised to include the requested information in this question.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 11.3.3.6 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

For both normal and maximum defined fuel failure cases, individual site boundary concentrations for the U.S. EPR are less than the applicable limits specified in 10 CFR Part 20, Appendix B, Table 2.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific annual average gaseous effluent concentrations are bounded by those specified in Table 11.3-6. For site-specific annual average gaseous effluent concentrations that exceed the values provided in Table 11.3-6, a COL applicant that references the U.S. EPR design certification will demonstrate that the annual average gaseous effluent concentrations for expected and design basis conditions meet the limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas.

11.3.3.6 Radioactive Gaseous Waste System Leak or Failure

The purge system of the gaseous waste processing system operates at sub-atmospheric pressures, thus preventing leakage from the purge section to the building atmosphere. The positive pressure section of the system is designed to be leak tight, thus limiting the potential for leakage. The leak tightness of the system is verified by pre-operational testing as described in Section 11.3.2.5.2.

The gaseous waste processing system is capable of detecting leaks by monitoring the system operating parameters for abnormalities. For example, if a leak were to exist in the purge section of the system. the upstream O_2 instrument would detect a higher than normal oxygen concentration due to building air ingress. If a leak were to exist in the positive pressure section, the system instrumentation would indicate flow rates and pressures outside the normal operating range. Once identified through system instrumentation and controls (I&C), the operator can take appropriate action to isolate the leak.

A bounding analysis was performed for the hypothetical event where an operator error leads to an inadvertent bypass of the delay beds and the exhaust from the coolant degasification system is released directly to the environment. Based on a one-hour release to the environment, the exposure at the exclusion area boundary is less than

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0.1 rem, in accordance with BTP 11-5 (Reference 3). The scenario and associated assumptions and parameters used in the radiological evaluation are as follows:

- Inadvertent valve misalignment leads to direct exhaust of the degasification system to the atmosphere, via the auxiliary building ventilation system, until the misalignment is recognized and isolated. This condition is unlikely because of the alarms and mechanical interlocks used to prevent the simultaneous opening of both atmospheric release pathways (i.e., auxiliary building ventilation system and gaseous waste processing system). Also, alarms are provided in the event that the gaseous waste processing system valve to the degasification system vacuum pump discharge is open and the auxiliary building ventilation system release pathway is open. This event alerts the operator that the system is misaligned. In addition, 11.05-27

there is a radiation monitor in the auxiliary building ventilation system exhaust that alerts MCR operators of the discharge of radioactive gas.

- The RCS noble-gas concentration is at 230 DE Xe-133 μCi/g, based on the minimum RCS degasification flow rate of 10 kg/second (79365 lbm/hr). This concentration is about 10 percent higher than the TS limit of 210 DE Xe-133 μCi/g (see Table 11.1-2 for the individual radionuclide concentrations), which was also based on 10 kg/second degasification rate.
- The RCS degasification flow rate is then increased to 20 kg/second (158730 lbm/hr, the upper range for normal operation), at which time the valve-misalignment error is assumed to take place. Noble-gas injection into the RCS from fuel defects is assumed to continue.
- Ensuing release to the atmosphere is assumed to be direct, continuous, and unabated. The release is terminated one hour after the incident as a result of the automatic alarm in the MCR and operator action (an assumed conservative interval that is twice as long as the typical time allocated for such applications).
- Atmospheric dispersion factor at the receptor of interest (at the EAB) is 1.0E-03 seconds/m^3 (FSAR Table 2.1-1).
- Ensuing dose is computed by considering each individual noble-gas isotope in the release, along with the corresponding dose conversion factors in Federal Guidance Report 12 for submersion in a semi-infinite medium.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific accident atmospheric dispersion data is bounded by the values provided in Table 2.1-1. For site-specific accident atmospheric dispersion data that exceed the values provided in Table 2.1-1, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis demonstrating that the resulting dose at the exclusion area boundary associated with a radioactive release due to gaseous waste system leak or failure does not exceed 0.1 rem in accordance with SRP Section 11.3, BTP 11-5.

11.3.3.7 Quality Assurance

The quality assurance program governing design, fabrication, procurement, and installation of the gaseous waste processing system conforms to RG 1.143 as indicated in Table 3.2.2-1. Implementation of the quality assurance program is described in Chapter 17. For the containment isolation valves and associated piping, the quality assurance program meets the requirements of Appendix B to 10 CFR Part 50 and Section III-ND of the ASME Boiler and Pressure Vessel Code (Reference 4).

11.3.4 Gaseous Waste Management System Cost-Benefit Analysis

10 CFR Part 50, Appendix I requires that plant designs consider additional items based on a cost-benefit analysis. Specifically, the design must include all items of reasonably

that closes the redundant discharge valves on high activity. The safety classification for the R-32 instruments is non-safety augmented quality.

11.5.4 Process Monitoring and Sampling

Process radiation monitoring detects, at an early stage, the escape of radioactive materials from radioactivity-containing systems into systems that are normally free of activity. Process radiation monitors generally operate continuously and provide both local and control room indication and alarm. Certain systems automatically initiate isolation actions along with control room alarm upon the detection of high radiation levels. Information regarding subsystem checks, tests, and maintenance may be found in Section 7.1.1.5.5.

11.5.4.1 Main Steam Radiation Monitoring System

Radioactivity releases from the reactor coolant system (RCS) to the main steam system (nitrogen-16, noble gases) can occur because of steam generator tube leakage. Radioactivity (nitrogen-16, noble gases) in the main steam system is monitored over a wide power range by four redundant detectorsmeasuring arrangements per main steam line, for a total of 16 detectors for the system. These detectors are located at measuring points R-55, R-56, R-57, and R-58 as shown on Figure 10.3-1. The gamma sensitive detectors are mounted adjacent to the main steam lines within the main steam and feedwater valve compartments. At low power levels, radioactivity is detected in the main steam due to the presence of noble gas. At high power levels, radiation is detected from the strong gamma from nitrogen-16. Shielding of detectors helps to prevent false readings from the detectors on the other main steam lines. The redundant measurement signals are processed, and provide alarm in the control room upon detection of radioactivity.The detectors are placed within specially designed lead shields that limit the angle of view to the steam line being monitored. Such an arrangement minimizes the contribution of scatter radiation as well as direct radiation emanating from the adjacent steam lines. The redundant measurement signals are processed, and provide alarm in the control room upon detection of radioactivity.

At both low and high power levels, the detected radiation emanating from the main steam lines is primarily due to the presence of N-16 (at a concentration of 4.5E-06 µCi/cc for full-power operation and the Technical Specification leakage rate of 150 gallons per day). The photon radiation from noble-gas decay is predominantly of low energy in comparison to the high-energy radiation emitted by N-16 and, as a result, undergoes significant attenuation in traversing the 1.9 inch steel wall of the main steam lines. Specifically, for the same N-16 and noble-gas concentration at the radiation monitor location, N-16 yields a radiation field at the detector which is about 50 times higher than that generated by the realistic noble-gas mix. The noble-gas concentration at the radiation monitor location is expected to range between 1.1E-06 µCi/cc at 10 percent power to 8.1E-07 µCi/cc at full power, based on the RCS realistic noble gas

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11.05-26 (Part 1)

concentration of 2.0 µCi/gm (from Table 11.1-7, RCS and Secondary Coolant System Realistic Source Terms) and the Technical Specification limit of 150 gallons per day for primary-to-secondary leakage.

Noble-gas radioactivity within the steam lines is relied upon for mitigation of a steam generator tube rupture accident (SGTR), after plant cooldown has already been initiated and the N-16 radiation field no longer exists. Following such an event, the noble-gas concentration at the MSL detectors of the affected steam generator would be sufficiently high to generate the needed post-accident signal for identification and automatic isolation of the affected SG.

The main steam radiation monitoring system is also used in conjunction with the condenser air removal and steam generator blowdown radiation monitoring systems to identify a steam generator tube leak. The main steam radiation monitoring system provides alarms and signals to the protection system for automatic isolation of an affected steam generator. This monitoring system provides control room indication and alarms. However, this is not the only required signal for the automatic control feature to actuate. With an actuated partial cooldown signal, either a high steam generator water level or high main steam activity will actuate the signal to isolate the affected steam generator. See Section 7.3.1.2.14 for additional information. ~~Measurement ranges of the main steam radiation monitoring system are shown in Table 11.5-1—Radiation Monitor Detector Parameters.~~

Measurement ranges of the main steam radiation monitoring system are shown in Table 11.5-1. The safety classification for the R-55, R-56, R-57, and R-58 instruments is safety. Built-in check sources are used to check the detector and instrumentation circuitry of measurement points R-55, R-56, R-57, and R-58.

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Quantification of the primary-to-secondary leakage rate by the MSL radiation monitors is based on correlations which account for the following:

- Power-related transit time of the leaking fluid to the radiation monitor location (for decay correction of the N-16 concentration from the SG leakage point)
- Geometry-dependent factor for conversion of the N-16 activity concentration within the MSLs to the corresponding radiation field at the monitors
- Monitor-dependent calibration data.

A similar approach is used under equilibrium conditions, along with measured values of the leakage rate based on SG blowdown activity, to determine the alarm setpoint.

Plant procedures verify that the installed MSL radiation monitor system sensitivity is sufficient to satisfy the primary-to-secondary RCS leakage rate technical basis. Items related to the development of procurement specifications by a COL applicant for the

11.05-26 (Part 3)

related radiation monitoring instrumentation, and for its placement, shielding, and operational requirements are listed below.

Monitor Location and Source/Receptor Geometry

The monitoring system consists of four high-sensitivity gamma radiation detectors installed on each main steam line in the valve compartments adjoining the annulus, in relatively low radiation areas. The detectors are arranged around the section of main steam pipe between the annulus and SG isolation valve within the valve compartment. The MSL piping has an internal diameter of 27.5 inches and a wall thickness of 1.9 inches, and is insulated by a 4 inch mineral fiber.

The radiation detectors are arranged parallel to the pipe axis, but held at a fixed distance by a cradle arrangement. The detector heads are mounted within lead housing with an open window towards the radiation source, as close as possible to the MSL. The housing lead thickness is suitable for attenuation of any extraneous radiation, including radiation emanating from the adjacent MSL. Direct shine from radiation emanating from within the reactor building is expected to affect each radiation monitor to the same degree, and can, therefore, be differentiated from radiation fields resulting from genuine leakage in any single steam generator.

Expected N-16 Concentrations and Radiation Fields at the Monitor Locations

At the Technical Specification limit of 150 gallons per day for primary-to-secondary leakage, the steam concentration of N-16 at the monitor locations is expected to vary between 1.7E-07 µCi/cc at 10 percent power and 4.5E-06 µCi/cc at full power. The corresponding radiation fields range between 0.14 and 3.6 µR/hr, respectively, at 4 inches from the pipe surface.

Monitor Instrumentation

To avoid spurious trip and failure, the four detectors on each steam line are linked in a two-out-of-four logic circuit.

11.5.4.2 ~~Condenser Air Removal~~Main Condenser Evacuation Radiation Monitoring System

Noncondensable gases (air and noble gases) in the secondary steam system are continuously removed during operation by the main condenser evacuation system (see Section 10.4.2). These gases discharge to the vent stack via a vent line. To monitor noble gas radioactivity, the monitoring system extracts part of the flow from the vent line (see Figure 10.4.2-2) and passes it through a measuring vessel with a beta-sensitive detector. If the monitoring system detects noble gas radioactivity in the secondary steam system, then it provides local and control room alarm. This alarm is an indication of breach of fuel cladding, primary coolant boundary, or containment leak.