

U.S. EPR Design Certification Activities for FSAR Tier 2 Chapter 11

March 5, 2014



▶ Attendees

◆ AREVA

◆ NRC

Meeting Purpose

- ▶ Discuss remaining activities for closure of FSAR Tier 2 Chapter 11
- ▶ Confirm mutual understanding regarding content of and expectations for RAI 625

► Discussion

- ◆ RAI 625 - supersedes and subsumes:
 - RAI 528, Question 11.05-28
 - RAI 527, Question 14.02-163
- ◆ Open RAI items related to FSAR Chapter 11
- ◆ Resolution of Past Comment from November/December 2013 Meeting
- ◆ RAIs identified in NRC eRAI Database

► Next Steps

RAI 625

- ▶ 35 items, each having multiple questions
- ▶ Affects FSAR Tier 2 Chapters 3, 5, 6, 7, 9, 10, 11, 12, and 14
- ▶ NRC reviewer has thoroughly pinpointed remaining issues associated with radiation measurement point(s) for each system
 - ◆ Identified inconsistencies/discrepancies fall into general categories
 - ◆ Categories are consistent with those identified in AREVA Condition Report (CR) issued in June 2013
- ▶ Mostly housekeeping/clarification – RAI provides a punch-list
- ▶ Resolution involves coordination between pertinent disciplines:
 - ◆ Radiological
 - ◆ Systems Engineering
 - ◆ Engineering Integration
 - ◆ Instrumentation & Controls (I&C), with input from Human Factors
- ▶ Draft RAI 625 does not address related Tier 1 system descriptions and ITAACs, which may be in a supplemental RAI

RAI 625, Item 34 (a)

- ▶ Information in FSAR Revision 5 was found to be acceptable in addressing the issues noted in Items 1, 2, 3, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 26, 30, 31, 32, and 33 listed in RAI 528, Question 11.05-28
- ▶ Information in FSAR Revision 5 was found to be not acceptable in addressing the issues noted in Items 4, 7, 8, 13, 22, 25, 27, 28, 29, 32, and 34 listed in RAI 528, Question 11.05-28
- ▶ RAI 625 supersedes RAI 528, Question 11.05-28, Items 4, 7, 8, 13, 22, 25, 27, 28, 29, 32, and 34
- ▶ That is,

Re-submittal of response to RAI 528 Question 11.05-28 is NOT required for these items.

RAI 625, Item 34 (b)

- ▶ The information in FSAR Revision 5 was found to be acceptable in addressing the issues noted in Items a. through g. listed in RAI 527, Question 14.02-163
- ▶ The information in FSAR Revision 5 was found to be not acceptable in addressing the issues noted in Items i., j., and k. listed in RAI 527, Question 14.02-163
- ▶ AREVA understands that RAI 625 supersedes RAI 527, Question 14.02-163, Items i., j., and k.
- ▶ That is,

Re-submittal of response to RAI 527 Question 14.02-163 is NOT required for these items.

Overview of Proposed Response to RAI 625

- ▶ REFINE/CLARIFY Design Basis for Radiation Measurement Points:
 - ◆ Monitor Ranges, Types, Descriptions (and their Interface with PWR–GALE inputs, assumptions and results)
 - ◆ Relation to Automatic Control Features/Functions (ACFs)
 - ◆ Design changes, if any
- ▶ CONFIRM compliance with pertinent regulations
- ▶ RESOLVE or CLARIFY remaining inconsistencies/discrepancies
- ▶ SUBMIT response to RAI 625 with associated FSAR Tier 2 updates
 - ◆ Alternate solutions are proposed for 2 categories:
 - Initial Test Program (ITP) Citations {Example 5}
 - Cross-Chapter References {Example 6}
 - ◆ To minimize duplicate, redundant information
 - ◆ To reduce potential for further inconsistency
 - ◆ To reduce associated update burden

RAI 625 Categories for Discussion

Category	Questions	Radiation Measurement Points
Airborne Monitors – 10 DAC-Hours {Example 1}	4a, 5a, and 8e	R-7 to R-9, R-10, R-20, R-22, R-23, and R-24
Monitor Ranges – Noble Gas Monitors {Example 2}	3b, 4b, 7g, 10d, 11a	(R-4, R-5) R-6, R-9, R-19, R-26, R-27, R-29, and R-30
Monitor Ranges – N-16 {Example 3}	27a	R-55, R-56, R-57, and R-58 (Main Steam Line)
PWR-GALE Code Input Validation {Example 4}	4f, 5e, 6f, 7i, 8f, 9g, 10e	R-7, R-8, R-9, R-17, R-18, R-19, R-20, R-22, R-23, R-24, R-26, and R-28 (All HVAC Measurement points)
Initial Test Program (ITP) Citations {Example 5}	1b, 2d, 2e, 3b, 3c, 4b, 4c, 7g, 7h, 9e, 9f, 10d, 13b, 13c, 17b, 19a, 19b, 20d, 22a, 22b, 33a, 33b, 33c, 33d	
Cross-References {Example 6}	5b, 6d, 24e, 27b, 27c, 28a, 2f, 4d, 4e, 5c, 5d, 6b, 7a, 7b, 7e, 7h, 9b, 10b, 11c, 11d, 11e, 15a, 15b, 16a, 20a, 20b, 21a, 22d, 22e, 25a, 26a, 26b, 29a, 31a, 31d, 32a, 32d	
Design Changes {Example 7}	22f, 35a, 35b, 35c	SGBD, Process Effluent Filtration, Ventilation Exhaust
Other ?		

Selected Example 1: Airborne Monitors – DAC-hours

Question:

- ▶ Monitor ranges in Table 12.3-4 and Table 11.5-1 are inconsistent. How does the activity range relate to 10 CFR 20, App. B concentration limits?

Proposed Resolution:

- ▶ Confirm below radiation measurement points, listed in FSAR Tier 2 Table 12.3-4, are capable of detecting 10 Derived Air Concentration (DAC)-hours and delete activity range (μCi):
 - ◆ R-7 (aerosol & iodine) located in Fuel Building
 - ◆ R-11, R-12, R-13, R-17, R-18, and R-25 (aerosol & iodine); R-14, R-15 (aerosol) located in Nuclear Auxiliary Building
 - ◆ R-20 and R-22 (aerosol & iodine); R-23 and R-24 (aerosol) located in Radwaste Building

Selected Example 1 (cont'd)

Airborne Monitors – DAC-hours

Proposed Resolution (cont'd):

- ▶ Delete 10 DAC-hr detection capability statement and activity range (μCi) for radiation measurement point R-10 from FSAR Tier 2 Table 12.3-4
 - ◆ To be consistent with Section 12.3.4.2.1 and Table 11.5-1
 - ◆ Compartments inside Reactor Building that are monitored by R-10 are normally unoccupied
 - ◆ Primary function of R-10 is to provide for Reactor Coolant System (RCS) leakage detection
- ▶ Delete credit for 10 DAC-hr detection capability for dose rate monitors (R-19, R-29 and R-30) from Table 12.3-4

Selected Example 2: Monitor Ranges - Noble Gas Monitors

Question(s):

- ▶ Measurement points R-6, R-9, R-19, R-26, R-27, R-29, and R-30:
 - ◆ Monitor ranges cited in terms of dose rate (rad/hr) in FSAR Tier 2 Table 11.5-1
 - ◆ Questioned since "airborne radioactivity concentrations" (in $\mu\text{Ci/cc}$) would provide for direct comparison to the normal operation limits under 10 CFR Part 20, Appendix B:
 - Table 1 (Col. 3, occupational) and Table 2 (Col. 1, plant effluents)
 - ◆ Any correlation between "dose rate" and "radioactivity concentration" is unique to a given 1) source term and 2) source/receptor geometry including:
 - Radionuclide mix
 - Dilution volume and air flows
 - Along with detector view angles and energy-dependent detector sensitivities
 - ◆ Request is that all pertinent information be provided that would define the basis for the monitor ranges in terms of dose rate

Selected Example 2 (cont'd): Monitor Ranges – Noble Gas Monitors

Proposed Resolution:

- ▶ Measurement Points R-6, R-9, R-19, R-26, R-27, R-29, and R-30:
 - ◆ Instruments associated with these U.S. EPR noble gas monitors provide primary measurement range displayed in dose-rate units
 - ◆ All these measurement points also have the capability of displaying radiation level in concentration units
 - ◆ Therefore:
 - Source/receptor geometry, which is specific to each instrument, is included in the processing unit
 - Appropriate radionuclide mix is used for the source term
 - Krypton (Kr-85) and
 - Xenon (Xe-133)
 - as reported in FSAR Tier 2 Table 11.5-1

Selected Example 2 (cont'd): Monitor Ranges - Noble Gas Monitors

Proposed Resolution (cont'd):

- ◆ Regulatory Guide 1.97, Rev. 3, Table 3, indicates for Type E variables:
 - Radiation measurements in concentrations are not required if effluent discharges are through a common vent
 - R-9, R-19, R-26 and R-27 monitor ventilation system exhausts that discharge to the environment via the vent stack.
 - Effluent concentration units are provided by R-4 and R-5
- ◆ Radiation measurement points R-6, R-26, and R-27 meet the requirements of 10CFR50.34(f)(2)(xvii)(E) to monitor noble gas effluents at potential *accident* release points
- ◆ ACFs for R-19 (fuel building ventilation), R-29 and R-30 (Main Control Room air intakes) can be readily accomplished based on “dose rate” measurements, thus negating the need for “concentration” units in the measurement range

Selected Example 2 (cont'd): Monitor Ranges - Noble Gas Monitors

Proposed Resolution (cont'd):

- ▶ Radiation measurement point R-6 (Vent Stack Release System):
 - ◆ Vent stack is properly equipped with radiation monitors (R-4, R-5, R-6) that continuously monitor plant effluents (noble gases, aerosols and iodine) during *normal* and *accident* conditions
 - ◆ Noble gas measurement point R-6, range cited in 'rad/hr', will not be relied upon for ensuring compliance with concentration limits in 10CFR 20, App. B, Table 2 for airborne radioactivity released to the environment

Selected Example 2 (cont'd): Monitor Ranges - Noble Gas Monitors

Proposed Resolution (cont'd):

- ◆ Effluent concentrations units are provided by three other radiation measurement points namely:
 - R-4 (KLN70CR001, beta-sensitive detector)
 - R-5 (KLN90CR001, beta-sensitive detector)
 - R-5 (KLN90CR002, gamma-sensitive multi-channel analyzer)
- ◆ Radiation measurement points R-4 and R-5 have a cited range of $3E-7$ to $1E+4$ $\mu\text{Ci/cc}$ for Kr-85 and Xe-133
 - Lower range meets 10CFR20, Appendix B, Table 2 offsite concentration limits at the release point
 - Upper and lower range complies with Reg. Guide 1.97, Rev. 3, Table 3, Type E variables for the Plant Vent (with multi-system discharges, including Containment purge)

Selected Example 3: Monitor Ranges – N-16

Question(s):

- ▶ Radiation Measurement Points R-55 through R-58 (Main Steam Lines)
 - ◆ Questions the bases for revisions to instrumentation response ranges reported in FSAR Tier 2 Revision 5, Section 11.5.4.1
 - ◆ FSAR Tier 2 Section 11.5.4.1 provides the expected Nitrogen (N-16) concentrations and radiation fields at monitor locations, but does not describe the basis of a 4-fold increase in estimated N-16 concentrations and external radiation levels

Proposed Resolution:

- ◆ Reactor Coolant System (RCS) N-16 concentration adjustment factors reported in supplement to RAI 17 compare two different source terms:
 - The 2.59 factor reported in response to RAI 17 is derived by comparing ORIGENS (SCALE 5.1) N-16 source term to the original ORIGEN2 N-16 source term

Selected Example 3 (cont'd): Monitor Ranges – N-16

Proposed Resolution (cont'd):

- A factor of 10 is obtained by comparing the ORIGENS (SCALE 5.1) N-16 source term at the exit of the active fuel (398 $\mu\text{Ci/gm}$ from FSAR Figure 12.2-1) to the original ANSI/ANS 18.1-1999 N-16 source term (40 $\mu\text{Ci/gm}$)
- ◆ Monitor range for measurement points R-55 through R-58 reported in FSAR Tier 2 Revision 4 (1.0E-08 to 1.0E-02 $\mu\text{Ci/cc}$ N-16) is not changed in Revision 5
- ◆ Expected N-16 concentration in the MSLs adjacent to these monitors increased by a factor of 10, from 4.5E-06 to 4.5E-05 $\mu\text{Ci/cc}$ (at 150 gallons-per-day-per-generator Technical Specification (TS) limit for primary-to-secondary leakage)
- ◆ Increase in N-16 concentration in the main steam lines adjacent to the monitors moves the normal reading farther away from the monitor lower range (1.0E-08 $\mu\text{Ci/cc}$), corresponding to an increased sensitivity

Selected Example 3 (cont'd): Monitor Ranges – N-16

Proposed Resolution (cont'd):

- ◆ Monitor upper range was based on the required capability to identify the failed Steam Generator following a Steam Generator Tube Rupture (SGTR)
 - Based on the ensuing increase in the noble gas concentration
 - As such is not impacted by the increase in N-16 concentration during normal operation
- ◆ AREVA responses to RAIs 625 and 627 and associated FSAR Tier 2 updates will provide requested clarification and will update expected instrument response readings in FSAR Section 11.5.4.1

Selected Example 4: PWR-GALE Code Input Validation

Question(s):

- ▶ Request confirmation of PWR-GALE inputs and assumptions:
 - ◆ Containment ventilation systems purge flow rates and filtration credit
 - ◆ Given current ventilation/filtration system configurations, ACFs, and potential design changes

Proposed Resolution:

- ▶ Currently, PWR-GALE inputs assume filtration via both high efficiency particulate absorption (HEPA) and charcoal absorber for various ventilation systems including:
 - ◆ Fuel Building
 - ◆ Nuclear Auxiliary Building
 - ◆ Containment Building Low & High Purge Subsystems
- ▶ Confirm PWR-GALE models the current configuration during normal operation (for example, as it pertains to flow rates and filtration credit)

Selected Example 5: Initial Test Program Citation

Question(s):

- ▶ Various questions requesting addition or clarification of:
 - ◆ Cross-reference between FSAR sub-sections and ITP Test Abstracts
 - ◆ Acceptance criteria pertinent to particular radiation measurement points
 - ◆ Consistent listing of components
 - ◆ Other inconsistencies/discrepancies

Proposed (Alternate) Resolution:

- ▶ Resolve or clarify inconsistencies/discrepancies and document in Radiation Monitor Basis Document (maintained in auditable form)
- ▶ Add new Sections 11.5.3.3, and 11.5.4.19, “Testing and Calibration” with a level-of-detail that is consistent with other FSAR chapters

Selected Example 5 (cont'd) Initial Test Program Citations

Proposed (Alternate) Resolution (cont'd):

- ▶ Delete ITP discussion in FSAR Tier 2 Section 11.5.1
- ▶ Remove ITP test abstract citations and Note 10 from FSAR Tier 2 Table 11.5-1
- ▶ Remove duplicate/redundant information relative to ITPs (Test Abstracts) for radiation measurement points from other FSAR chapters
- ▶ ITP (Test Abstract) cross-reference examples:

“4.6.3 Testing and Verification of the Control Rod Drive System...

Abstracts of CRDS tests performed as part of the initial test program are provided in Section 14.2. ...”

“10.4.8.5 Inspection and Testing Requirements

The SGBS components are inspected and tested during plant startup. Refer to Section 14.2 (test abstracts #067, #072, #185 and #204) for initial plant startup test program.”

Selected Example 5 (cont'd): Initial Test Program Citations

Proposed (Alternate) Resolution (cont'd):

- ▶ Provide requested clarifications in the response to RAI 625 without increasing related detail in FSAR; for example:
- ▶ Test Abstracts #099 & #216
 - ◆ #099 will perform preoperational test on radiation monitors R-1, R-2, R-40, & R-44
 - ◆ #216 has a different function, and will take data during power ascension as required by RG 1.68
- ▶ Test Abstracts #064 & #065
 - ◆ #065 will perform preoperational testing of radiation measurement points R-3 and R-65 (for main condenser evacuation system)
 - ◆ #064 will perform preoperational testing of gland steam system
 - ◆ Gland steam is supplied by Main Steam and Aux Boiler (startup only)
 - ◆ Radiation measurement points associated with main condenser evacuation system (R-63 and R-65) provide sufficient monitoring

Selected Example 5 (cont'd): Initial Test Program Citations

Proposed (Alternate) Resolution (cont'd):

▶ Test Abstract #153

- ◆ #153 will determine integrity of select systems, including some that contain potentially radioactive liquids or gasses
- ◆ That is, ASME code allows leakage from mechanical flange gaskets and valve packing that may be unacceptable for post accident conditions
- ◆ #153 will identify these leaks in order that corrective actions can be implemented, if necessary

▶ Test Abstract #205

- ◆ #205 will collect RCS and secondary samples and have them analyzed for calculation of a failed fuel ratio
- ◆ Required by RG 1.68 at current power ascension plateaus and typically performed at operating plants monthly with results reported to INPO
- ◆ IF a significant failed fuel ratio is calculated, THEN results will be compared to the radiation measurement point in the Nuclear Sampling System (R-41)

Selected Example 6: Cross-Chapter References

Question(s):

- ▶ Various requests for clarification or addition of cross-references to sub-sections, table, figures across the FSAR
- ▶ Specific cross-references, including citing of radiation measurement point(s), have been added to FSAR Tier 2 up to Revision 5

Proposed (Alternate) Resolution:

- ▶ Remove duplicate, redundant cross-reference information from various FSAR Tier 2 Chapters, such that:
 - ▶ References in other FSAR chapters to radiation monitoring / measurement information are to the appropriate section (e.g., 11.5) and/or Table (e.g., 11.5-1), unless reference to a particular sub-section is warranted
- ▶ Provide requested clarifications in the response to RAI 625 without increasing related detail in FSAR; for example:

Selected Example 6 (cont'd): Cross-Chapter References

Proposed (Alternate) Resolution (cont'd):

▶ 5.2.5.3.2 Steam Generator Tubes (proposed)

- ◆ These monitors (**described in Section 11.5 and Table 11.5-1**) indicate in the MCR. These measurements are supplemented by process sampling and laboratory analysis

▶ 5.2.5.3.3 Component Cooling Water System (existing)

- ◆ These methods are supplemented by radiation monitors, process sampling, and laboratory analysis, which indicate increased CCWS system activity from small leaks. Section 9.2.2 and Section 11.5 further address the control of RCS leakage into the CCWS

▶ 5.2.5.5.4 Main Steam Line Radiation Monitors for Steam Generator Tube Leakage (proposed)

- ◆ In the presence of N-16, noble gas activity in the main steam lines has minimal contribution to the monitor response. The same monitors (**refer to Section 11.5.4.1**) are used for identification of the affected steam generator in a steam generator tube rupture (SGTR) event, based on the ensuing noble-gas activity within the steam line

Selected Example 6 (cont'd): Cross-Chapter References

Proposed (Alternate) Resolution (cont'd):

9.4.1.2.1 General Description (existing)

The air intake subsystem is illustrated in Figure 9.4.1-1—Control Room Air Intake and CREF (Iodine Filtration) Train Subsystem. The CRACS has two outside air intakes. The train 1 intake is located in Safeguard Building 2 and the train 4 intake is located in Safeguard Building 3. Outside air is supplied by each outside air intake through a wire mesh grille. Each outside air intake is equipped with an electrically heated, weather protected grille to prevent ice formation. Smoke detectors and radiation monitors (refer to Section 11.5.3.1.11 and Table 11.5-1, Monitors R-29 and R-30) are installed in the outside air intake ducting.

9.4.1.2.1 General Description (proposed)

The air intake subsystem is illustrated in Figure 9.4.1-1—Control Room Air Intake and CREF (Iodine Filtration) Train Subsystem. The CRACS has two outside air intakes. The train 1 intake is located in Safeguard Building 2 and the train 4 intake is located in Safeguard Building 3. Outside air is supplied by each outside air intake through a wire mesh grille. Each outside air intake is equipped with an electrically heated, weather protected grille to prevent ice formation. Smoke detectors and radiation monitors (refer to Sections 9.4.13 and 11.5.3, respectively) are installed in the outside air intake ducting.

Selected Example 7: Design Changes

Question(s):

- ▶ Various questions regarding the impact of design changes on compliance with 10 CFR 20, Appendix B limits, cited monitor ranges, etc. Systems of interest include:
 - ◆ Steam Generator Blowdown (SGBD)
 - ◆ Process Effluent Filtration
 - ◆ Heating Ventilation and Air Conditioning (HVAC) / Exhaust Filtration

Proposed Resolution:

- ▶ AREVA design change process will capture the impact of any changes on the affected disciplines (in particular):
 - ◆ Radiological
 - ◆ Systems Engineering (and Engineering Integration)
 - ◆ I&C (with input from Human Factors)
- ▶ Provide requested clarifications in response to RAI 625 with corresponding FSAR Tier 2 updates, if necessary

FSAR Tier 2 Chapter 11

Section-By-Section Open RAIs and CRs

▶ 11.1 Source Terms

◆ 11.1.2.3 RCS Design Basis Source Term

- RAI 17 and NRC questions (RAI 627), N-16 and tie to FSAR Chapter 10

▶ 11.2 Liquid Waste Management System

◆ 11.2.1.2.1 Capacity

- RAI 539 and AREVA CR—Inconsistencies with tank volumes in the FSAR and tank volumes used in RAI 539 Source Term Calculations

◆ 11.2.3.7 Liquid Waste Tank Rupture

- RAI 301, RAI 539 resulted in updated source terms for tanks outside containment. Potential impact LWTR

FSAR Tier 2 Chapter 11

Section-By-Section Open RAIs and CRs (cont'd)

▶ 11.3 Gaseous Waste

- ◆ RAI 625 and Validation of PWR-GALE Inputs, Assumptions & Results

▶ 11.4 Solid Waste

- ◆ No Outstanding RAIs

▶ 11.5 Process and Effluent Radiological Monitoring and Sampling Systems

- ◆ RAIs 527, 528, 557, 529, 562, 578, and 625
 - RAIs 527 and 528 are now superseded by RAI 625
 - RAI 557 Question 14.03.07-39, US EPR FSAR Tier 1, ITAACs and RG 1.143 radiological classifications for SGBD, LWMS, GWMS, and SWMS
 - RAI 562 Question 14.03.08-6, US EPR FSAR Tier 1, ITAACs for safety related radiation monitors (Deferred to RAI 527, Question 14.03.07-38)
 - RAI 578 (HVAC) inconsistent with RAIs 528 and 529

Chapter 11 – Radioactive Waste Management

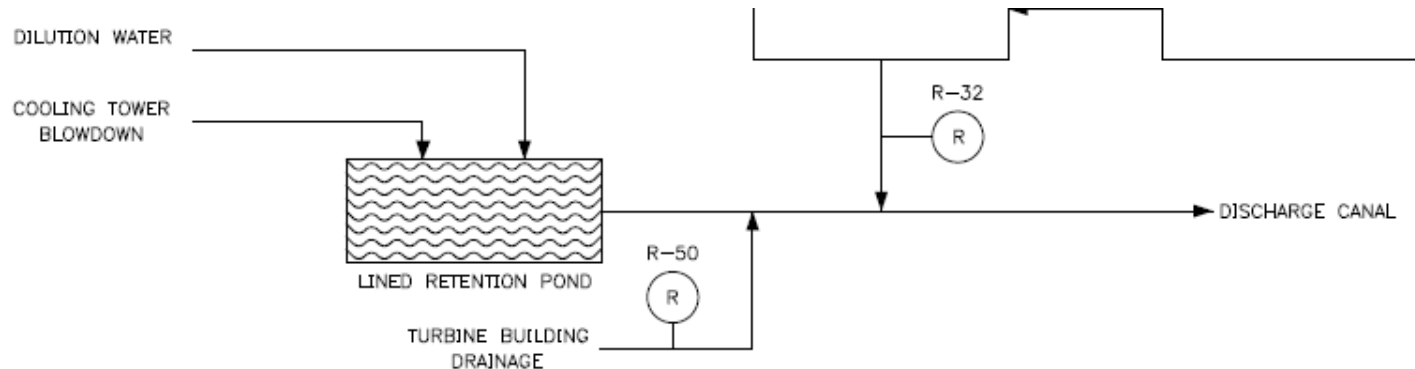
Action	AREVA Submittal	Notes
RAI 625 Q11.05-29	3Q CY2015	Chapter 11 closure plan
RAI 301 Q11.02-17 (Final)	2Q CY2015	Update source term information (RAI 539); Chapter 12 closure plan
RAI 578 Q09.04.03-7	1Q CY2015	Chapter 9 closure plan
RAI 627 Q12.02-7 RAI 529 Q12.03-12.04-28	2Q CY2015 3Q CY2015	Chapter 12 closure plan
RAI 610 Q10.04.08-5-10	2Q CY2014	Chapter 10 closure plan
RAI 527 Q14.03.07-38 RAI 557 Q14.03.07-39 RAI 562 Q14.03.08-6	1Q CY2016 1Q CY2016 CY2016 (est)	Chapter 14 closure plan

Resolution of Past Comment

► November / December 2013 Meetings:

- ◆ Comment: In Section 11.5.4.15, FSAR Rev. 5, AREVA reverted back to prior language regarding the description of the building drain monitoring system. Please explain the change

- ◆ Discussion:



Revision 5 updated the text to accurately represent the flow path, which was changed per Design Change Request (DCR).

Liquid effluents from TB drains are discharged to the environment via plant discharge not the retention pond.

RAIs for Chapter 11 in NRC eRAI

- ▶ **RAI 273 Q11.05-2: “Confirmatory Action”**
- ▶ **RAI 273 Q11.05-5: “In Evaluation”**
- ▶ **RAI 554 Q11.02-27: “In Evaluation”**

Next Steps

- ▶ Document actions from this meeting
- ▶ Document the agreed upon approach to resolution in a closure plan letter for FSAR Tier 2 Chapter 11
- ▶ Address remaining RAIs in a manner that will support a safety determination and issuance of the NRC SER without Open Items for FSAR Tier 2 Chapter 11
- ▶ Work the plan and drive to closure