Non-Proprietary

Radiation Protection

11TH Pre-Application Review Meeting

August 13, 2013

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1. Overview of Comment Incorporation

1. Overview (1/2)

- KHNP has reviewed and incorporated all NRC's comments on Radiation Protection

- NRC comments include:
  - Minimization of contamination and waste generation
  - Radiological consequence analyses
  - RG 1.143 classifications
  - Source terms and shielding
  - Airborne source terms
  - RCS and SG leakage detection
  - Equipment qualification, etc

1. Overview (2/2)

- DCD status since Pre-application audit on June 03, 2013
  - Revised based on
    - Responses to NRC PAAR comments
    - Consultant comments
    - Text editing
  - Added more design details including
    - Discussions on how design features address requirements
    - Tables and figures
    - Pointers and connectors

- Most of comments are incorporated in the revised DCD and will be prepared prior to submittal

2. RG 4.21 Comments

2. RG 4.21 Comments (1/3)

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2. RG 4.21 Comments (2/3)

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2. RG 4.21 Comments (3/3)

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3. Key Comments

3. Key Comments (1/9)

- **Ch.5 (RCS Leakage Detection)** Current industry operating experience and generic communications have not been used to calculate radiation monitor sensitivity for leakage detection
  - For this analysis, the realistic source terms using ANSI/ANS 18.1-1999 are used
  - Subsection 5.2.5.1.1.3 includes description on detection capability of 0.5 gpm leak in one hour by containment air particulate monitor

- **Ch.11 (Detection of SG Operational Leakage)** Sec. 11.5 should contain the methods to determine the minimum required radiation detection sensitivity values to monitor the required SG tube leakage rate detection
  - The Main Steam Line N-16 monitor provides continuous monitoring of radioactivity which is indicative of SG leakage
  - A sensitivity analysis is prepared to analyze the capability to detect SG tube leakage of 30 gpd
  - A description on detection capability is provided in DCD Subsection 11B and their range and type are summarized in Table 11.5-1

3. Key Comments (2/9)

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❖ **Ch.12 (Source for BAC, R/O)** Several major sources including the BAC, BAC tank, and R/O are not included

- Source terms for the BAC packages are added in Table 12.2-14
- R/O source terms are included in Table 12.2-21

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3. Key Comments (3/9)

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❖ **Ch.12 (Use of RUNT-G Code)** The RUNT-G code is not a code recognized by the NRC.

- The RUNT-G code was presented in the Clinton Power Station UFAR and was reviewed and approved for use by the NRC
- The DIGESTER computer code is used for the determination of the radionuclide activities in the LWMS processing components
- The DIGESTER computer code was used for similar calculations to support the development of responses to a RAI for the COL for the South Texas Project (STP) Units 3 and 4 (RAI Question 12.03-12.04-10, NRC Letter No. 274 for STP). The RAI has since been evaluated and closed

3. Key Comments (4/9)

- **Ch.3 (SGBD Application of RG 1.143)** Table 3.2-1 does not state to what level the SGBD is classified in accordance with RG 1.143
  - Table 3.2-1 is modified so that SGBD system applies RG 1.143 for seismic, code and standard and QA requirements

- **Ch.1, 3, 10, 11 (RG 1.143 Classification)** Table 1.9-2 does not include a reference to Ch.11. No classification is applied for the CPB. Only certain components in RWMSs were classified. No classification for the SGBD
  - Table 1.9-2 is modified to apply SRP 3.2.2 to Ch.11
  - Classification for CPB is added in Table 3.2-1 and classified as RW-IIa
  - Rest of the RWMS components are non-radioactive
  - Classification for SGBD components are added in Table 10.4.8-1

3. Key Comments (5/9)

- **Ch. 11 and 12 (ICI Sources and Waste)** DCD Section 4.4.6.2 states that the design uses Rhodium self-powered neutron detectors, but these irradiated sources are not described in DCD Section 12.2. Since these irradiated components are periodically replaced, they should also be described in the solid waste section of DCD Chapter 11
  - Descriptions on the source terms of irradiated components, such as in-core detectors and CEA, are supplemented in DCD Section 12.2
  - Descriptions on the irradiated components considered as the solid waste are added in DCD Section 11.4
  - Descriptions on handling and storage of the irradiated components are added in DCD Section 9.1.4

- **Ch. 12 (Handing of ICI)** Provisions for handling potentially high dose rate components, such as irradiated self-powered neutron detectors, are not described within DCD section 12.3
  - Description on handling of irradiated components, such as ICI and CEA, are added in DCD Section 12.2 and 9.1.4

3. Key Comments (6/9)

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3. Key Comments (7/9)

- **Ch. 12 (Cobalt contents)** For instance, neither section 12.3 nor the appropriate sections of Chapter 5 or Chapter 9 discussed the allowable cobalt content of components in contact with reactor coolant system fluids. Cobalt is a major contributor to ORE.
  - Cobalt content of the reactor materials applied in the plant design are added in DCD Section 12.3

3. Key Comments (8/9)

- **Ch.3 (Equipment Identification)** The Section does not appear to adequately describe the environmental conditions for equipment
  - Tables 3.11A-1 and 3.11B-1 are modified to incorporate equipment-based EQ information
  - The modified table includes more information

- **Ch.3 (EQ)** According to RG 1.89, it is recommended to use 1% fuel defect, otherwise the exception shall be justified
  - The EQ TID are re-performed using 1% fuel defect
  - The new TID values are incorporated in Table 3.11A

- **Ch.3 (EQ)** Section 3.11 regarding EQ does not contain radiation environment, including beta, gamma, and neutron exposure
  - Table 3.11A is modified to describe beta, gamma and neutron exposure

3. Key Comments (9/9)

- **Ch.3 (Method for EQ TID)** This Section does not provide a description of the methods, models, and assumptions used to calculate the Total Integrated Dose to equipment
  - Methods to calculate TID are added in Subsection 3.11.5.2
  - 1% fuel defect for 60 years of normal operation plus the RG 1.183 source terms for accident conditions are used

- **Ch.3 (Duration of Operation)** This Section does not appear to provide a clear description of the required operational duration of each piece of equipment
  - Operational duration for each of equipment is added in Table 3.11A

4. Other Comments

4. Other Comments (1/8)

- **Ch.15 (Powers Model)** Powers model is not discussed in Chapter 15 or Section 6.5.3
  - Applicability of Powers model to natural removal of aerosol is based on NUREG/CR-6189
  - Description is added to Section 6.5.2.3.3

- **Ch.15 (ORIGEN-S Version)** It is unclear which version of ORIGEN-S was used to calculate the core inventory
  - ORIGEN-S code in SCALE system (NUREG/CR-0200, Rev.6, 1998) is used for core inventory calculations
  - Reference 1 in Appendix 15A is added to address the version of ORIGEN-S code

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4. Other Comments (2/8)

- **Ch.15 (Inconsistency in Sec. 6.4 and Ch.15)** NRC staff found inconsistency between Section 6.4 and both Ch.15
  - Inconsistency of MCR dose values between Table 6.4-1 and Ch.15 are corrected

- **Ch.12 (Correlation of MS to CPS Sources)** Not able to correlate MS activity to the CPS demineralizer beds
  - DCD 12.2.1.1.5.3 (CPS) is modified to include a description of the correlation between main steam activity and CP demineralizer source terms
  - CPS demineralizer source terms are calculated based on processing 65% of the condensate by one out of six CPS demineralizers

4. Other Comments (3/8)

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4. Other Comments (4/8)

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4. Other Comments (5/8)

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4. Other Comments (6/8)

- **Ch.1 (Application of RG 1.40)** Table 1.9-1 should apply RG 1.40 for the safety-related motors located outside of containment.
  - Table 1.9-1 is modified to apply RG 1.40

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4. Other Comments (7/8)

- **Ch.1 (RG 8.25 in Sec. 1.9)** In Table 1.9-1 (Sheet 28 of 29) RG 8.25 “Air Sampling in the Workplace,” should be identified as applicable
  - Table 1.9-1 is corrected to apply RG 8.25

- **Ch.11 (Definition of MF_i)** The meaning of MFi used in pages 11.2-15 and 11.3-14 is not clearly understood. Further description shall be provided in Section 11.2.3.1 as well as in Section 11.3.3.1
  - The MF (multiplication factor) is the ratio of design basis (1% fuel defect) primary coolant concentration to the expected (ANSI/ANS 18.1-1999) concentration for each nuclide
  - The expected annual effluent release rate is multiplied by this factor to calculate the design basis annual effluent release rate
  - More description is added in Section 11.2.3.1 and 11.3.3.1

4. Other Comments (8/8)

- **Ch.11 (References)** It is required to add references 10CFR50.36a, 10CFR50.34(f)(2)(xvii), RG1.33, RG1.112 in Section 11.3
  - References for 10CFR50.36a and 10CFR50.34(f)(2)(xvii) are already included in Section 11.5 since those are related to monitoring of radioactive releases and ODCM
  - References for RG 1.33 and RG 1.112 are newly included in Section 11.3

- **Ch.11 (40 CFR 190)** It is required to address compliance with requirement in 40 CFR 190 and its methodologies
  - Subsection 11.3.3.1 is changed to include that the COL applicant is to perform the dose calculations and compare the doses due to "total" gaseous effluent releases from the site comply with requirements of 40 CFR 190

5. Comments To Be Clarified

5. Comments To Be Clarified (1/6)

- **Ch.15 (Single Failure)** Chapter 15 should clearly identify the single failure assumed for each DBA dose analysis
  - Assumed single failures that may cause adverse effects on the radiological consequences are addressed in each T/H analysis section in Chapter 15 and summarized in Table 15.0-4

- **Ch.15 (Time to Release Termination)** "Time of shutdown cooling entry" or "time to isolate" and the assumed time should be listed in the Table 15.0-9
  - Table 15.0-9 is modified to describe that the time to reach shutdown cooling entry condition is less than 8 hours and to isolate the releases used in the radiological consequence analyses

5. Comments To Be Clarified (2/6)

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5. Comments To Be Clarified (3/6)

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5. Comments To Be Clarified (4/6)

- **Ch.12 (Recent experience - Valve)** Some recent industry operating experience or NRC generic communications may not have been incorporated into the design and documentation. For example, there was discussion of the use of gland leakoff controls which no longer current because valve designs have improved
  - Packless valves are widely used in various radioactive fluid systems such as CVCS
  - Packless valve is used for an isolation valve that is non-modulating, under two inches in size, and operates on a weekly interval in the radioactive material processing systems to minimize the external leakage from the valves." is added in DCD 12.3.1.2 for clarification

5. Comments To Be Clarified (5/6)

- **Ch. 12 (Industry experience - Valve)** Current industry documents, such as EPRI TR- 1000923 ," Valve Packing Performance Improvement," discourage the use of lantern rings, except where necessary, and when they are used, recommends the use of graphite lantern rings. Emphasis is also placed on the finish of the valve stem to reduce wear and leakage. Similar current guidance exist for the use of check valves, pump seals, internal finishes and polishing, is also not reflected in DCD Section 12.3. This is indicates that current industry operating experience has not been used to update the proposed DCD submittal
  - KHNP is continuously integrating lessons learned from industry practices and operating experience (URD Vol. 2, Ch.1, Sec. 12.2.2.9 and EPRI Report NP-5697, EPRI Report 100923) into the APR1400 DC. The DCD 12.3.1.2 and component specification will be updated to as follows;
    - Double stem packing with a leak-off between the packings and a graphite lantern ring is used for valves 10.16 cm (4 in) and larger, as well as normally open valves 5.08 cm (2 in) to 10.16 cm (4 in) in diameter. Stem leakage is piped to an appropriate drain sump or tank
  - Valve stem finish : The requirements for valve finish are incorporated into the APR1400 DCD TIER 2, Ch. 12, Sec. 12.3.1.2 and valve specification.
    - Internal valve surfaces are designed to be as smooth as possible and free of crevices to minimize the accumulation of crud

5. Comments To Be Clarified (6/6)

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Thank you