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 all NRC's comments on Radiation Protection
  - Most of comments are incorporated in the Rev. J of DCD and the rest will be incorporated in Rev. 0

- 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

1. Overview (2/2)

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

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
  - In accordance with IN 2005-24, the realistic source terms based on ANSI/ANS 18.1-1999 are used in the sensitivity analysis
  - 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 UFSAR and was reviewed and accepted for use
  - The DIGESTER computer code is used for the determination of the radionuclide activities in the LWMS processing components
  - The DIGESTER computer code was used 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 is in compliance with the requirements of RG 1.143, including seismic, codes and standards and QA

- **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
  - Classification for SGBD components are added in Table 10.4.8-1
  - Non-radioactive components of the RWMS are not classified

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 12.2.1.1.6
  - Descriptions on handling, transport and storage of the irradiated components are added in DCD Section 9.1.4.2.1.10 and 9.1.4.2.1.12
  - Irradiated components are not handled in SWMS

- **Ch. 12 (Handling 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
  - Irradiated components, such as ICI and CEA, are handled underwater as described in Subsection 12.3.1.2(j)(6)

3. Key Comments (6/9)

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3. Key Comments (7/9)

- **Ch. 12 (Cobalt contents)** 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 for RCS components with a large wetted surface area and with operating temperature above 200 °F is restricted to a maximum content of 0.1 weight percent as described in Subsection 12.3.1.3(b)(1)

3. Key Comments (8/9)

- **Ch.3 (Equipment Qualification)** The Section does not appear to adequately describe the environmental conditions for equipment
  - Tables 3.11A-1 and 3.11B-1 will be modified to incorporate equipment-based EQ information
  - The modified table includes more information such as location, purpose, operational duration, environmental & radiation conditions, etc

- **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 calculations are re-performed using 1% fuel defect
  - The new TID values will be 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 will be 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 will be added in Table 3.11A

4. Other Comments

4. Other Comments (1/9)

- **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 (2/9)

- **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 in 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 (3/9)

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4. Other Comments (4/9)

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4. Other Comments (5/9)

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4. Other Comments (6/9)

- **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 will be updated in accordance with RG 1.40

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4. Other Comments (7/9)

- **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 updated in accordance with RG 8.25

- **Ch.11 (Definition of MF_i)** The meaning of MF_i 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 (8/9)

- **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 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 in compliance with requirements of 40 CFR 190

4. Other Comments (9/9)

- **Ch.12 (Operational Program)** It is not clear that DCD subsection contains a description of the Groundwater Protection program
  - Groundwater protection program is included in site radiological environmental monitoring program as part of RG 4.21 program for LWMS in Subsection 11.2.2.4.1
  - Site modeling program periodically monitors groundwater contamination levels from well samples around site area
  - Groundwater protection program is included in COL 11.2(3)

5. Comments To Be Clarified

5. Comments To Be Clarified (1/7)

- **Ch.15 (Single Failure)** Chapter 15 should clearly identify the single failure assumed for each DBA dose analysis
  - Assumed single failure for each event that may cause adverse effects on the radiological consequence is addressed in each T/H analysis section in Chapter 15
  - Single failure considered in T/H analysis is listed 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 SGTR release from MSSV from the affected SG is isolated at 30 min by opening the ADVs in unaffected SG
  - The cooldown capacity of the Auxiliary Feedwater System ensures that the shutdown cooling entry condition is reached before 8 hr for other DBAs

5. Comments To Be Clarified (2/7)

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5. Comments To Be Clarified (3/7)

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5. Comments To Be Clarified (4/7)

- **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
  - Subsection 12.3.1.2 is updated to include “a packless valve is used for isolation that is non-modulating, two inches or smaller in size, and operates intermittently on a weekly interval in the radioactive systems to minimize the leakage from the valves”
  - Modulating valves and valves greater than 5.08 cm (2 in) in diameter use live loading of the packing by conical spring washers or equivalent means to maintain a compressive force on the packing, where possible.
  - Valves utilizing stem packing are provided with backseat capability.

5. Comments To Be Clarified (5/7)

- **Ch. 12 (Industry experience - Valve)** Current industry documents, such as EPRI TR- 1000923, 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 indicates that current industry operating experience has not been reflected
  - KHNP is continuously integrating lessons learned from industry practices and operating experience (URD Vol. 2, Ch.1, Sec. 12.2.2.9 and EPRI NP-5697, EPRI TR-1000923) into the APR1400 design. Subsection 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

5. Comments To Be Clarified (6/7)

- Requirements for valve finish are incorporated into Subsection 12.3.1.2 as follows:
  - Internal valve surfaces are designed to be as smooth as possible and free of crevices to minimize the accumulation of crud
- Check valve reliability is improved by
  - Proper sizing to reduce flutter
  - Locating check valve in less turbulent zone, where practicable
- Cartridge type pump seals are
  - Used to facilitate easier removal and replacement , where practicable
  - Provided with drainage and flushing connections

5. Comments To Be Clarified (7/7)

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Thank you