Response to Action Item 15-7 Chapter 15

RP Issue List Regarding APR1400, DCD Tier 2, CHAPTER 15

DCD Tier 2, Chapter 15 #1(15-7.1)

The main control room (MCR) and technical support center (TSC) dose results listed in DCD Table 6.4-2 does not agree with the results listed in DCD Chapter 15 accident-specific dose result tables

Response

KHNP agrees with the NRC comment. The values in DCD Table 6.4-2, which are not consistent with the values in DCD Chapter 15, will be updated for consistency.

Impact on DCD

DCD Table 6.4-2 will be updated as indicated in the attachment below.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Table 6.4-2

MCR and TSC Doses from Design Basis Accidents

Design Basis Accident		TEDE (mSv)[1]
Steam system piping failure	1 % Fuel Failure	~~3.26E+01~~ 3.78E+01
	Pre-accident spike	~~7.82E+00~~ 1.30E+01
	Event-generated spike	~~1.29E+01~~ 1.81E+01
Feedwater system pipe break		~~5.91E+00~~ 1.11E+01
RCP rotor seizure		~~1.93E+01~~ 2.45E+01
Control element assembly ejection	Containment leakage	~~1.84E+01~~ 2.36E+01
	Steam system release case	~~3.41E+01~~ 3.94E+01
Failure of small lines carrying primary coolant outside containment		~~6.41E+00~~ 1.16E+01
Steam generator tube rupture	Pre-accident spike	~~1.00E+01~~ 1.52E+01
	Event-generated spike	~~7.94E+00~~ 1.32E+01
Loss of coolant accident		~~3.88E+01~~ 4.40E+01
Fuel handing accident		~~1.19E+01~~ 6.25E+00

(1) TEDE: Total effective dose equivalent

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DCD Tier 2, Chapter 15 #2(15-7.2)

On DCD page 6.5-17, last sentence under 6.5.2.3.3, make the follow change because the referenced documents are not regulations: “The removal rates of elemental and particulate iodine by natural deposition (process) or by containment spray are used based on the above guidance and as described below.”

Response

DCD Subsection 6.5.2.3.3 will be updated to incorporate the NRC comment.

Impact on DCD

DCD Subsection 6.5.2.3.3 will be updated as indicated in the attachment below.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

a. Minimum boron concentrations for each water source

b. Minimum water sources

c. Maximum IRWST water temperature

The major parameters used in pH calculations are presented in Table 6.5-4. The results of the calculations show that the time required to reach a pH of 7.0 for the minimum pH condition is estimated to be 157 minutes after the onset of a LOCA. The maximum pH value is calculated not to exceed 8.5 for the maximum pH condition. Therefore, the pH of IRWST water is maintained between 7.0 and 8.5 after 157 minutes.

6.5.2.3.3 Airborne Fission Product Removal Coefficient

The fission products are released from the RCS into the containment atmosphere following a DBA through the three steps: coolant activity release, gap activity release, and early in-vessel release according to NUREG-1465 (Reference 11). Fission products are divided into eight radionuclide groups on the basis of chemical behavior. Of the radioiodine released from the RCS to the containment atmosphere, 95 percent is particulate iodine, 4.85 percent is elemental iodine, and 0.15 percent is organic iodine. With the exception of elemental and organic iodine and noble gases, fission products are assumed to be in a particulate form.

The removal of airborne radioactivity in the containment by natural deposition is credited by acceptable models for elimination of iodine and aerosols in SRP 6.5.2 and in NUREG/CR-6189 (Reference 12). The removal of airborne radioactivity in the containment by CSS is credited by acceptance models in SRP 6.5.2.

guidance

The removal rates of elemental and particulate iodine by natural deposition (process) or by containment spray are used based on the above ~~regulations~~ and as described below.

Elemental Iodine Removal by Containment Spray

The elemental iodine removal coefficients are estimated using the following equation:

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DCD Tier 2, Chapter 15 #3(15-7.3)

In TS 3.4.15 the reactor coolant system (RCS) specific activity Dose Equivalent Xe-133 limit is 1.11E+07 Bq/g. The bases for TS 3.4.15 state that the noble gas specific activity is assumed to be 1.11E+07 Bq/g DOSE EQUIVALENT XE-133 in the dose analyses. Contrary to this, DCD Tables 15.1.5-12 (main steam line break (MSLB)), 15.2.8-3 (feedwater line break (FWLB)), 15.3.3-3 (RCP rotor seizure), 15.4.8-4 (control element assembly ejection accident), 15.6.2-4 (small line break) and 15.6.3-5 (steam generator tube rupture (SGTR)) list the dose analysis input for initial RCS noble gas specific activity as 2.15E+07 Bq/g. RG 1.183 guidance states that the released activity should be the maximum coolant activity allowed by technical specifications. Is this difference only for conservatism in the coolant noble gas inventory?

Response

The radiological consequence analyses for APR1400 were conducted using the Dose Equivalent Xe-133 value of 2.15E+07 Bq/g (580 μCi/g) although the TS LCO value is 1.11E+07 Bq/g (300 μCi/g). This enables future plant operators to increase the TS LCO value up to 580 μCi/g without performing additional analyses to confirm if the plant meets the dose limit.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

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DCD Tier 2, Chapter 15 #4(15-7.4)

DCD Table 15A-10, "Dose Conversion Factors," has some apparent transcription errors. For example, the EDE dose conversion factor (DCF) (Sv-m^3/Bq-sec) value for Kr-85m is listed as $7.49x10^{-15}$, however the referenced Federal Guidance Report 12 (FGR-12) Table III.1 gives the air submersion EDE DCF for Kr-85m as $7.48x10^{-15}$. Similar discrepancies were also seen in the EDE DCFs for Kr-87 and Xe-138. Verify that all information in Table 15A-10 is taken correctly from the reference documents.

Response

KHNP agrees with the NRC comment. The values in DCD Table 15A-10 will be updated to be consistent with those in FGR-12 as indicated in the markups attached to this response. This will not affect the radiological consequences in the Chapter 15 as these are editorial errors.

Impact on DCD

DCD Table 15A-10 will be updated as indicated in the attachment below.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

APR1400 DCD TIER 2

Table 15A-10 (1 of 4)

Dose Conversion Factors

Nuclide	EDE Dose Conversion Factor (Sv-m^3/Bq-sec)	CEDE Dose Conversion Factor (Sv/Bq)
Noble Gases		
Kr-85	1.19×10^{-16}	-
Kr-85 m	~~7.49~~ $\times 10^{-15}$	-
Kr-87	~~4.11~~ $\times 10^{-14}$	-
Kr-88	1.02×10^{-13}	-
Xe131m	3.89×10^{-16}	-
Xe133m	1.37×10^{-15}	-
Xe-133	1.56×10^{-15}	-
Xe135m	2.04×12^{-14}	-
Xe-135	1.19×10^{-14}	-
Xe-138	~~5.76~~ $\times 10^{-14}$	-
Halogens		
I-131	1.82×10^{-14}	8.89×10^{-9}
I-132	1.12×10^{-13}	1.03×10^{-10}
I-133	~~2.95~~ $\times 10^{-14}$	1.58×10^{-9}
I-134	1.30×10^{-13}	3.55×10^{-11}
I-135	~~7.97~~ $\times 10^{-14}$	3.32×10^{-10}
Alkali Metals		
Rb-86	4.81×10^{-15}	1.79×10^{-9}
Cs-134	7.57×10^{-14}	1.25×10^{-9}
Cs-136	1.06×10^{-13}	1.98×10^{-9}
Cs-137	7.74×10^{-18}	8.63×10^{-9}

7.48 → ~~7.49~~ × 10^{-15}

4.12 → ~~4.11~~ × 10^{-14}

5.77 → ~~5.76~~ × 10^{-14}

2.94 → ~~2.95~~ × 10^{-14}

7.98 → ~~7.97~~ × 10^{-14}

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DCD Tier 2, Chapter 15 #5(15-7.5)

DCD 6.4 refers the reader to Table 15.6.5-13 (LOCA dose analysis inputs) for information on the control room dose analyses. However, Table 15.6.5-13 refers to Table 15.3.3-3 (RCP rotor seizure) for many of the main control room parameters. It would be better to also include the parameters in Table 15.6.5-13 for clarity.

Response

KHNP agrees with the NRC comment. The DCD Table 15.6.5-13 will be updated to include the main control room parameters and the other tables in Chapter 15 will also be updated to refer to Table 15.6.5-13. This will avoid duplication of the information while the LOCA dose analysis, which has the most significant impact on the doses of the public, include all necessary information. The relevant DCD Tables will be updated to incorporate the above changes.

Impact on DCD

DCD Table 15.6.5-13 will be updated in the attachment below.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Table 15.6.5-13 (3 of 3)

Parameter	Value
Chemical Form of Iodine in ESF Elemental Organic	 97 % 3 %
Fraction of Core Iodine in Sump Water	40 %
Auxiliary Building Emergency Ventilation Charcoal Filter Efficiency (elemental and organic iodines removal)	95%
~~MCR Parameters~~ MCR and TSC Model Parameters	
MCR Wall Thickness East West North South Ceiling	 0.91 m (3.0 ft) 0.91 m (3.0 ft) 0.91 m (3.0 ft) 0.91 m (3.0 ft) 0.46 m (1.5 ft)
Minimum MCR Envelope Concrete Shielding	0.46 m (1.5 ft)
Emergency Ventilation HVAC Filter Charcoal Density	0.45 g/cc (28.1 lb/ft^3)
Emergency Ventilation HVAC Filter Charcoal Tray Dimension	1.65 m (L) × 1.65 m (W) × 2.34 m (H) 1.65 m (L) × 1.65 m (W) × 1.65 m (H)
~~Other MCR Parameters~~	~~See Table 15.3.3-3~~
Containment Low Volume Purge System (CLVPS) Release Parameters	
CLVPS Valve Closure Time	5.0 sec
Volume Flow Rate of CLVPS Release	11 m^3/sec (2.34 × 10^4 cfm)
Reactor Coolant Mass	300,000 kg (661,000 lbm)
Reactor Coolant Specific Activity	≤ 3.7 × 10^4 Bq/g (1.0 μCi/g) DE I-131
Onsite χ/Qs	See Tables 2.3.2 ~ 2.3-12
Offsite Model Parameters	
χ/Qs	See Table 2.3-1
Breathing Rate	See Table 15A-11
Minimum Concrete Density	2,240 kg/m^3 (140 lb/ft^3)

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MCR and TSC Model Parameter	
Envelope Volume	5,663 m^3 (200,000 ft^3)
Normal Ventilation Flow Rate (unfiltered)	105 m^3/min (3,700 cfm)
Emergency Ventilation Makeup Rate (filtered)	105 m^3/min (3,700 cfm)
Emergency Ventilation Recirculation Flow Rate (filtered)	122 m^3/min (4,300 cfm)
Emergency HVAC Delay Time	5 min
Emergency Ventilation Charcoal Filter Efficiency (elemental and organic iodine removal)	99 %
Emergency Ventilation HEPA Filter Efficiency (particulate removal)	99 %
Unfiltered Inleakage	8.50 m^3/min (300 cfm)
Occupancy Factors 0 ~ 24 hr 24 ~ 96 hr 96 ~ 720 hr	 100 % 60 % 40 %
Onsite χ/Qs	See Tables 2.3.2 ~ 2.3.12

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DCD Tier 2, Chapter 15 #6(15-7.6)

The fuel handling accident (FHA) dose results in DCD Table 15.7.4-2 for the exclusion area boundary (EAB) and low population zone (LPZ) do not make sense relative to each other. Considering the ratio of the EAB short-term atmospheric dispersion factor (χ/Q) to the LPZ 0-8 hr χ/Q, the ratio of the EAB to LPZ dose results is off by an order of magnitude. Either the EAB results are 38.9 mSv (which seems likely compared to preliminary staff calculations) or the LPZ results are 0.856 mSv.

Response

KHNP agrees with the NRC comment. The values in DCD Table 15.7.4-2 were found as editorial errors, which will be updated to correct the values as indicated in the markups attached to this response.

Impact on DCD

DCD Table 15.7.4-2 will be updated in the attachment below.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Table 15.7.4-2

Radiological Consequences of Fuel Handling Accident

Activity Release Path	TEDE Dose (mSv)		
	MCR and TSC	EAB	LPZ
Fuel handling area vent release	6.25E+00	3.89E+00	~~8.56E+00~~ 8.56E-01
Allowable TEDE limit	5.00E+01	6.30E+01	6.30E+01