

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

### APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: 126-8012  
 SRP Section: 02.03.01 – Regional Climatology  
 Application Section: 2.3.1  
 Date of RAI Issue: 08/04/2015

### **Question No. 02.03.01-1**

APR1400 DCD, Tier 2 Table 2.0-1, “Site Parameters,” and Tier 1 Table 2.1-1, “Site Parameters,” includes numerous site parameter values that do not use consistent precision regarding the number of decimal places. For example, in APR1400, Tier 2, Table 2.0-1:

<p>Ambient Design Temperature for Cooling Tower</p> <p>- Ambient 5 % annual exceedance values for Circulating water system (CWS)</p> <ul style="list-style-type: none"> <li>· Maximum 26.1 °C (79 °F) non-coincident wet bulb</li> <li>· Minimum</li> </ul>	<p>26.1 °C (79 °F) non-coincident wet bulb</p> <p>-20.6 °C (-5 °F)</p>
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In the table above the parameter values presented in Celsius (°C) are presented with one decimal place (e.g., 26.1 °C) whereas the values presented in Fahrenheit (°F) are presented with no decimal place (e.g., 79 °F).

Please update DCD Tier 2 Table 2.0-1 and Tier 1 Table 2.1-1 to ensure consistent precision of site parameter values and to avoid potential confusion for any future ESP or COL applicants.

### **Response**

Regarding temperature values in Table 2.0-1 of DCD Tier 2 and Table 2.1-1 of Tier 1, Note 5 will be added to avoid potential confusion when Fahrenheit (°F) is converted to Celsius (°C), as follows:

(5) Degrees Fahrenheit (°F) are the main units and temperatures in Celsius (°C) are reference values that are converted from the main units.

Also, some parameter values on Table 2.0-1 of Tier 2 and Table 2.1-1 of Tier 1 will be revised as indicated on the attached markup to present with one decimal place.

**Impact on DCD**

DCD Tier 2, Table 2.0-1 (1, 2, and 4 of 4) and DCD Tier 1, Table 2.1-1 will be revised as indicated on the attached markup.

**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 2.0-1 (1 of 4)

Site Parameters

Parameter Description	Parameter Value
Maximum Elevation of Groundwater	0.61 m (2 ft) below plant grade <sup>(1)</sup> in the vicinity of the SSCs important to safety
Maximum Flood Elevation	0.30 m (1 ft) below plant grade in the vicinity of the SSCs important to safety
Precipitation - Maximum precipitation rate (1 mi <sup>2</sup> ) - 100-year snowpack roof load - Extreme winter precipitation roof load - Depth of 48-hour probable maximum winter precipitation (PMWP)	492.7 mm (19.4 in) over 1 hour 157 mm (6.2 in) in 5 minutes 2.873 kPa (60 lbf/ft <sup>2</sup> ) 5.985 kPa (125 lbf/ft <sup>2</sup> ) 914.4 mm (36 in)
HVAC Outdoor Design Temperature <sup>(5)</sup> - 5 % exceedance values · Maximum · Minimum - 1 % exceedance values · Maximum · Minimum - 0 % exceedance values (historical limit excluding peaks < 2 hours) · Maximum · Minimum	35.0 25.0 25.0 25.0 -40.0 46.1 °C (115 °F) dry bulb and 26.7 °C (80 °F) coincident wet bulb 40 °C (-40 °F)
Ambient Design Temperature for Cooling Tower <sup>(5)</sup> - Ambient 5 % exceedance values for circulating water system (CWS)	.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
· Maximum	26.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
· Minimum	27.2 °C (81 °F) non-concurrent wet bulb

[Insert blank row]



157.5

35.0

25.0

25.0

-40.0

(5)

## APR1400 DCD TIER 2

Table 2.0-1 (2 of 4)

Parameter Description	Parameter Value
- Ambient 0 % exceedance values for essential service water system (ESWS) (5) · Maximum · Minimum	-40.0 °C (-40 °F)
Extreme Wind - 50-year 3-second wind gust speed - Importance factor	64.8 m/s (145 mph) 1.15 <sup>(2)</sup>
Tornado Parameters - Maximum horizontal wind speed - Translational speed - Rotational speed - Radius of maximum rotational speed - Maximum pressure differential - Rate of pressure drop - Missile spectra	102.8 m/s (230 mph) 20.6 m/s (46 mph) 82.2 m/s (184 mph) 45.7 m (150 ft) 8.274 kPa (1.2 psi) 3.447 kPa/s (0.5 psi/s) Table 2 (Region I) of NRC RG 1.76 (Reference 1)
Hurricane Parameters - Maximum 3-second wind gust speed - Missile spectra	116 m/s (260 mph) Table 1 of NRC RG 1.221 (Reference 2)
Accident Release $\chi/Q$ Values at exclusion area boundary (EAB) · 0-2 hr	$1.00 \times 10^{-3} \text{ s/m}^3$
Accident Release $\chi/Q$ Values at low-population zone (LPZ) · 0-8 hr · 8-24 hr · 24-96 hr · 96-720 hr	$2.20 \times 10^{-4} \text{ s/m}^3$ $1.60 \times 10^{-4} \text{ s/m}^3$ $1.00 \times 10^{-4} \text{ s/m}^3$ $8.00 \times 10^{-5} \text{ s/m}^3$
Annual Average $\chi/Q$ Values at Site Boundary · Undepleted/no decay · Undepleted/2.26-day decay · Depleted/8.00-day decay · Relative deposition factor (D/Q)	$2.00 \times 10^{-5} \text{ s/m}^3$ $1.99 \times 10^{-5} \text{ s/m}^3$ $1.84 \times 10^{-5} \text{ s/m}^3$ $2.00 \times 10^{-7} \text{ 1/m}^2$
Inventory of radionuclides that could seep into the groundwater	See Table 11.2-9
Safe Shutdown Earthquake (SSE)	0.3 g peak ground acceleration

## APR1400 DCD TIER 2

Table 2.0-1 (3 of 4)

Parameter Description	Parameter Value
Certified Seismic Design Response Spectra (CSDRS) Referencing SSE	See Figures 2.0-1 and 2.0-2
Hard Rock High Frequency (HRHF) Response Spectra <sup>(4)</sup>	0.46g peak ground acceleration See Figures 2.0-3 and 2.0-4
Fault Displacement Potential (yes/no)	No
Minimum Allowable Static Bearing Demand	718.2 kPa (15 ksf) <sup>(3)</sup>
Minimum Allowable Dynamic Bearing Demand	2,872.8 kPa (60 ksf) <sup>(3)</sup>
Minimum Shear Wave Velocity	304.8 m/s (1,000 ft/s)
Liquefaction Potential (yes/no)	No
Maximum Differential Settlement inside Building	12.7 mm (0.5 in) per 15.24 m (50 ft) in any direction
Maximum Differential Settlement between Buildings	12.7 mm (0.5 in)
Minimum Soil Angle of Internal Friction	35 degrees
Slope Failure Potential (yes/no)	No
Backfill Material Density	<del>137 pcf</del> <span style="border: 1px solid red; padding: 2px;">2.2 g/cm<sup>3</sup> (137 pcf)</span>
Backfill Material Dynamic Poisson's Ratio	0.33
Backfill Material Dynamic Properties (Minimum Dynamic Shear Modulus, kg/cm <sup>2</sup> ) - Shear strain	
1 %	0.05
0.1 %	0.22
0.01 %	0.54
0.001 %	0.85
0.0001 %	1.00

## APR1400 DCD TIER 2

Table 2.0-1 (4 of 4)

Parameter Description	Parameter Value
Backfill Material Dynamic Properties (Minimum Damping Ratio, %)	
- Shear strain	
1 %	24
0.1 %	16
0.01 %	6
0.001 %	2
0.000 1%	1
Strain-compatible Minimum Shear-wave Velocity of Backfill	510 fps ← 155 m/s (510 fps)

- (1) Plant grade represents the level of ground adjacent to the nuclear island buildings and is established at a plant elevation 98 ft 8 in.
- (2) 100-year recurrence interval: Value to be used for design of seismic Category I and II structures only.
- (3) Bearing capacity is defined at the foundation level of the nuclear island structures.
- (4) The HRHF response spectra are provided for evaluation of site-specific ground motion response spectra which exceed the CSDRS in the high frequency range at hard rock sites.

(5) Degrees Fahrenheit (°F) are the main units and temperatures in Celsius (°C) are reference values that are converted from main units.

**APR1400 DCD TIER 1**

Table 2.1-1 (1 of 3)

Site Parameters

Ground Water	
Maximum Elevation of Groundwater	0.61 m (2 feet) below plant grade <sup>(1)</sup> in the vicinity of the SSCs important to safety
Flood (or Tsunami) Level <b>0.30</b>	
Maximum Flood Elevation	<b>0.3</b> m (1 foot) below plant grade in the vicinity of the SSCs important to safety
Precipitation	
Maximum Precipitation Rate [1 mi <sup>2</sup> ]	<b>157.5</b> 492.7 mm (19.4 in) over 1-hour - 157 mm (6.2 in) in 5 minutes
100-Year Snowpack Roof Load	- 2.873 kPa (60 lbf/ft <sup>2</sup> )
Extreme Winter Precipitation Roof Load	- 5.985 kPa (125 lbf/ft <sup>2</sup> )
Depth of 48-Hour Probable Maximum Winter Precipitation (PMWP)	- 914.4 mm (36 in)
Design Ambient Temperatures <sup>(5)</sup>	
HVAC Outdoor Design Temperature - 5 % exceedance values · Maximum · Minimum	<b>35.0</b> 35 °C (95 °F) dry bulb and <b>25.0</b> 25 °C (77 °F) coincident wet bulb -20.6 °C (-5 °F)
- 1 % Exceedance Values · Maximum · Minimum	43.3 °C (100 °F) dry bulb and <b>25.0</b> 25 °C (77 °F) coincident wet bulb -23.3 °C (-10 °F)
- 0 % Exceedance Values (historical limit excluding peaks < 2 hours)	
· Maximum · Minimum	46.1 °C (115 °F) dry bulb and 26.7 °C (80 °F) coincident wet bulb -40.0 °C (-40 °F)
Ambient Design Temperature for Cooling Tower - Ambient 5 % Exceedance Values for CWS · Maximum · Minimum	26.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
- Ambient 0 % Exceedance Values for ESWS · Maximum · Minimum	27.2 °C (81 °F) non-concurrent wet bulb -40.0 °C (-40 °F)
Extreme Wind	
50-Year 3-Second Wind Gust Speed	64.8 m/s (145 mph)
Importance Factors	1.15 <sup>(2)</sup>

## APR1400 DCD TIER 1

Table 2.1-1 (3 of 3)

Soil Properties (Cont'd)	
Backfill Material Dynamic Properties (Minimum Damping Ratio, %) - Shear Strain	
• 1%	24
• 0.1%	16
• 0.01%	6
• 0.001%	2
• 0.0001%	1
Strain-compatible Minimum Shear-wave velocity of Backfill	510 fps
Seismology	
Safe Shutdown Earthquake (SSE)	0.3g peak ground acceleration
Certified Seismic Design Response Spectra (CSDRS) Referencing SSE	See Figures 2.1-1 and 2.1-2
Hard Rock High Frequency (HRHF) Response Spectra <sup>(4)</sup>	0.46g peak ground acceleration See Figures 2.1-3 and 2.1-4
Meteorology	
Accident Release $\chi/Q$ Values at EAB · 0-2 hr	$1.00 \times 10^{-3} \text{ s/m}^3$
Accident Release $\chi/Q$ Values at LPZ · 0-8 hr · 8-24 hr · 24-96 hr · 96-720 hr	$2.20 \times 10^{-4} \text{ s/m}^3$ $1.60 \times 10^{-4} \text{ s/m}^3$ $1.00 \times 10^{-4} \text{ s/m}^3$ $8.00 \times 10^{-5} \text{ s/m}^3$
Meteorology (Cont'd)	
Annual Average $\chi/Q$ Values at Site Boundary · Undepleted/No Decay · Undepleted/2.26-Day Decay · Depleted/8.00-Day Decay · D/Q	$2.00 \times 10^{-5} \text{ s/m}^3$ $1.99 \times 10^{-5} \text{ s/m}^3$ $1.84 \times 10^{-5} \text{ s/m}^3$ $2.00 \times 10^{-7} \text{ /m}^2$
Inventory of Radionuclides Which Could Potentially Seep into the Groundwater	See Table 2.1-2

- (1) Plant grade represents the level of ground adjacent to the nuclear island buildings and is established plant elevation of 98 ft 8 in.
- (2) 100-year recurrence interval; value to be used for design of seismic Category I and II structures only.
- (3) Bearing capacity is defined at the foundation level of the Nuclear Island Structures.
- (4) The HRHF response spectra are provided for evaluation of site-specific ground motion response spectra which exceed the CSDRS in the high frequency range at hard rock sites.

(5) Degrees Fahrenheit (°F) are the main units and temperatures in Celsius (°C) are reference values that are converted from main units.



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Application Section: Regional Climatology  
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### **Question No. 02.03.01-2**

APR1400 DCD, Tier 2 Table 2.0-1, “Site Parameters,” and Tier 1 Table 2.1-1, “Site Parameters,” each contain a site parameter value for the “Maximum 1% exceedance dry-bulb temperature) of 43.3 °C (100 °F). The staff believes either the Celsius temperature or the Fahrenheit temperature to be in error as 43.3 °C is equal to 110 °F.

Update APR1400 DCD, Tier 2 Table 2.0-1 and Tier 1 Table 2.1-1 to correct this error.

### **Response**

DCD, Tier 2 Table 2.0-1 and Tier 1, Table 2.1-1 will be revised to correct the errors.

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### **Impact on DCD**

DCD, Tier 2 Table 2.0-1 and Tier 1, Table 2.1-1 will be revised as indicated in Attachment.

### **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 2.0-1 (1 of 4)

Site Parameters

Parameter Description	Parameter Value
Maximum Elevation of Groundwater	0.61 m (2 ft) below plant grade <sup>(1)</sup> in the vicinity of the SSCs important to safety
Maximum Flood Elevation	0.30 m (1 ft) below plant grade in the vicinity of the SSCs important to safety
Precipitation - Maximum precipitation rate (1 mi <sup>2</sup> ) - 100-year snowpack roof load - Extreme winter precipitation roof load - Depth of 48-hour probable maximum winter precipitation (PMWP)	492.7 mm (19.4 in) over 1 hour 157 mm (6.2 in) in 5 minutes 2.873 kPa (60 lbf/ft <sup>2</sup> ) 5.985 kPa (125 lbf/ft <sup>2</sup> ) 914.4 mm (36 in)
HVAC Outdoor Design Temperature - 5 % exceedance values · Maximum · Minimum - 1 % exceedance values · Maximum · Minimum - 0 % exceedance values (historical limit excluding peaks < 2 hours) · Maximum · Minimum	35 °C (95 °F) dry bulb and 25 °C (77 °F) coincident wet bulb -20.6 °C (-5 °F)  <del>43.3</del> °C (100 °F) dry bulb and 25 °C (77 °F) coincident wet bulb -23.3 °C (-10 °F) 46.1 °C (115 °F) dry bulb and 26.7 °C (80 °F) coincident wet bulb -40 °C (-40 °F)
Ambient Design Temperature for Cooling Tower - Ambient 5 % exceedance values for circulating water system (CWS)	.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
· Maximum	26.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
· Minimum	27.2 °C (81 °F) non-concurrent wet bulb

**APR1400 DCD TIER 1**

Table 2.1-1 (1 of 3)

Site Parameters

Ground Water	
Maximum Elevation of Groundwater	0.61 m (2 feet) below plant grade <sup>(1)</sup> in the vicinity of the SSCs important to safety
Flood (or Tsunami) Level	
Maximum Flood Elevation	0.3 m (1 foot) below plant grade in the vicinity of the SSCs important to safety
Precipitation	
Maximum Precipitation Rate [1 mi <sup>2</sup> ]	- 492.7 mm (19.4 in) over 1-hour - 157 mm (6.2 in) in 5 minutes
100-Year Snowpack Roof Load	- 2.873 kPa (60 lbf/ft <sup>2</sup> )
Extreme Winter Precipitation Roof Load	- 5.985 kPa (125 lbf/ft <sup>2</sup> )
Depth of 48-Hour Probable Maximum Winter Precipitation (PMWP)	- 914.4 mm (36 in)
Design Ambient Temperatures	
HVAC Outdoor Design Temperature - 5 % exceedance values · Maximum · Minimum	35 °C (95 °F) dry bulb and 25 °C (77 °F) coincident wet bulb -20.6 °C (-5 °F)
- 1 % Exceedance Values · Maximum · Minimum	<del>43.3</del> 37.8 °C (100 °F) dry bulb and 25 °C (77 °F) coincident wet bulb -23.3 °C (-10 °F)
- 0 % Exceedance Values (historical limit excluding peaks < 2 hours)	
· Maximum · Minimum	46.1 °C (115 °F) dry bulb and 26.7 °C (80 °F) coincident wet bulb -40.0 °C (-40 °F)
Ambient Design Temperature for Cooling Tower - Ambient 5 % Exceedance Values for CWS · Maximum · Minimum	26.1 °C (79 °F) non-concurrent wet bulb -20.6 °C (-5 °F)
- Ambient 0 % Exceedance Values for ESWS · Maximum · Minimum	27.2 °C (81 °F) non-concurrent wet bulb -40.0 °C (-40 °F)
Extreme Wind	
50-Year 3-Second Wind Gust Speed	64.8 m/s (145 mph)
Importance Factors	1.15 <sup>(2)</sup>

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Application Section: 2.3.1  
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### **Question No. 02.03.01-4**

APR1400 DCD, Tier 2, Table 2.0□1, “Site Parameters,” and Tier 1, Table 2.1□1, “Site Parameters,” each contain a site parameter value within the “Precipitation” parameter description row called “Extreme winter precipitation roof load.” This value is indicated in both Tier 1 and Tier 2 tables as 5.985 kPa (125 lbf/ft<sup>2</sup>).

In order for subsequent ESP and COL applicants to properly associate site characteristic values with the corresponding design parameter values listed in DCD Tier 1, Table 2.1□1 and DCD Tier 2, Table 2.0□1, and consistent with the guidance in SRP Section 2.3.1 for applicants to identify the “FSAR sections in which these conditions are used” (i.e., linked to specific structures, systems, and components (SSCs)), the applicant should clarify where the DCD FSAR already clearly identifies these associations or update the SSAR to indicate where in the APR1400 DCD FSAR this site parameter value is connected to specific SSCs or roof loads.

### **Response**

According to DC/COL-ISG-7 (Reference 1), no Standard Review Plan (SRP) sections such as SRP Section 3.8.4 currently provide guidance regarding how snow loads due to extreme winter precipitation events should be used for design of seismic Category I structures though the applicant should identify the “FSAR sections in which these conditions are used” in accordance with SRP Section 2.3.1.

Extreme winter precipitation roof load provided in Tier 1 and Tier 2 tables may be considered as an extreme environmental load that does not occur with other extreme environmental loads (e.g., seismic, tornado and probable maximum flood loads) simultaneously, and seismic loads govern in most extreme environmental loading conditions.

Therefore, the association between the extreme winter precipitation roof load in Tier 1 and Tier 2 tables and seismic Category I structures is not identified in the APR1400 DCD FSAR.

#### References

- 1) DC/COL-ISG-7, Assessment of Normal and Extreme Winter Precipitation Loads on the Roofs of Seismic Category I Structures, U.S. Nuclear Regulatory Commission, June 2009.
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#### **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.