ClinchRiverESPHFNPEm Resource

From: Edmondson, Carla <cedmondson@tva.gov>
Sent: Monday, September 25, 2017 5:17 PM
To: Fetter, Allen; Sutton, Mallecia
Cc: Montague, Kelvin Jevon; Schiele, Raymond Joseph
Subject: [External_Sender] CNL-17-127 CRN Response to RAI 9, eRAI-8972
Attachments: CNL-17-127 R0 - CRN RAI Number 9 Response.pdf

Subject letter has been transmitted to the NRC ML17268A391

CNL-17-127 CRN Response to RAI 9, eRAI-8972, Onsite Meteorological Measurements Programs

Hard copies to follow in mail.

On behalf of
Joe Shea
VP Nuclear Regulatory Affairs & Support Services

Carla Edmondson
Executive Management Assistant to Joe Shea
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Hearing Identifier: ClinchRiver_ESP_HF_NonPublic
Email Number: 439

Mail Envelope Properties (7D5D7C9A93A2F1418E8AF559D2DAFAF099BAC8E7)

Subject: [External_Sender] CNL-17-127 CRN Response to RAI 9, eRAI-8972
Sent Date: 9/25/2017 5:17:19 PM
Received Date: 9/25/2017 5:17:47 PM
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Files	**Size**	**Date & Time**
MESSAGE	348	9/25/2017 5:17:47 PM
CNL-17-127 R0 - CRN RAI Number 9 Response.pdf		1506726

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Tennessee Valley Authority, 1101 Market Street, Chattanooga, TN 37402

CNL-17-127

September 25, 2017

10 CFR 52, Subpart A

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Clinch River Nuclear Site
NRC Docket No. 52-047

Subject: Response to Request for Additional Information RAI Number 9, eRAI-8972, Regarding Onsite Meteorological Measurements Programs in Support of Early Site Permit Application for Clinch River Nuclear Site

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. NRC Electronic Mail, "Issuance of RAI pertaining to Section 02.03.03, Onsite Meteorological Measurements Programs of TVA Application, RAI Number 9, eRAI-8972," dated August 25, 2017

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. By electronic mail dated August 25, 2017 (Reference 2), Nuclear Regulatory Commission (NRC) issued a request for additional Information (RAI) regarding Onsite Meteorological Measurements Programs associated with the CRN Site.

The Enclosure to this letter provides the response to the RAI including Site Safety Analysis Report (SSAR) markups. The SSAR markups will be incorporated in a future revision of the early site permit application.

There are no new regulatory commitments associated with this submittal. If any additional information is needed, please contact Dan Stout at (423) 751-7642.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 25th day of September 2017.

Respectfully,

J. W. Shea
Vice President, Nuclear Regulatory Affairs and Support Services

Enclosure:

Response to NRC Request for Additional Information Number 9, eRAI-8972

cc: (enclosure)

M. Sutton, Project Manager, Division of New Reactor Licensing (1 copy)

cc: (without enclosure)

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ENCLOSURE

Response to NRC Request for Additional Information Number 9, eRAI-8972

Background

Site Safety Analysis Report (SSAR) Subsection 2.3.3.2, "Primary Meteorological Facility," provides a description of the primary meteorological system used to collect onsite meteorological data. In the review of this subsection of the Clinch River Nuclear (CRN) Site Early Site Permit Application (ESPA), the staff could not find a sufficient description of the tower design, mounting, and exposure of the meteorological instrumentation to confirm if RG 1.23 was followed. In addition, in the review of SSAR Subsection 2.3.3.2.4, "Data Recording and Display", the staff could not determine whether the reported data was obtained using scalar or vector averaging. The staff issued Request for Additional Information (RAI) Number 9, eRAI-8972 based on these reviews.

NRC RAI 02.03.03

Regulatory Background

10 CFR 100.21(c) requires that site atmospheric dispersion characteristics be evaluated and dispersion parameters established such that (1) radiological effluent release limits associated with normal operation from the type of facility to be located at the site can be met for any individual located offsite; and (2) radiological dose consequences of postulated accidents shall meet the criteria set forth in 10 CFR 50.34(a)(1) for the type of facility proposed to be located at the site. Regulatory Guide (RG) 1.23, Revision 1 provides guidance for the siting of meteorological instruments so that recorded data can provide measurements representative of the atmospheric conditions into which material will be released and transported.

RAI Question: 02.03.03-1

SSAR Section 2.3.3.2, "Primary Meteorological Facility," provides a description of the primary meteorological system used to collect onsite meteorological data in support of the CRNS ESP application.

The staff could not find a sufficient description of the tower design, mounting, and exposure of the meteorological instrumentation to confirm if RG 1.23 was followed with respect to the following guidance:

- Measurements should be recorded on an open-latticed tower or mast.
- Wind sensors should be located on top of the measurement tower or mast or extended outward on a boom to reduce airflow modification and turbulence induced by the supporting structure itself. Because the tower structure can affect downwind measurements, wind sensors on the side of a tower should be mounted at a distance equal to at least twice the longest horizontal dimension of the tower (e.g., the side of a triangular tower). The sensors should be on the upwind side of the mounting object in areas with a dominant prevailing wind direction. In areas with two distinct prevailing wind directions (e.g., mountain valleys), the sensors should be mounted in a direction perpendicular to the primary two directions.

- Ambient temperature and atmospheric moisture measurements should be made to avoid air modification by heat and moisture sources (e.g., ventilation sources, cooling towers, water bodies, large parking lots). The aspirated temperature shields should either be pointed downward or laterally towards the north and the shield inlet should be at least 1½ times the tower horizontal width away from the nearest point on the tower.

Please update the SSAR to provide sufficient information to confirm that the following meteorological monitoring system attributes meet the guidance provided in RG 1.23.

a) Type of tower.
b) Mounting of the wind sensors.
c) Mounting of the temperature and humidity sensors.

<u>TVA Response</u>

The tower design, mounting, and exposure of the meteorological instrumentation used for the collection of meteorological data at the CRN Site followed the guidance provided in RG 1.23 with the exception of the period from April to October of 2011.

- The tower used to collect meteorological data for the CRN Site was an open-latticed tower.
- The wind sensor for each level was mounted on a boom that extends towards the southeast (approximately 140°). The wind sensor mounting booms extended 100 inches from the tower, so the sensors were mounted 2.08 tower widths from the tower. Data collection began April 21, 2011 and ended July 9, 2013. An April 26, 2011 inspection of the meteorological facility at the CRN Site discovered that the wind sensors were less than the required distance from the tower (1.90 times instead of 2.00 times the tower width). In the inspection report, TVA determined that this discrepancy had negligible impact on the accuracy of the measured wind observations based on the resolution of the installed wind sensor (0.10 mph). This discrepancy was corrected on October 18, 2011.
- The air temperature sensors were mounted in downward pointing radiation shields that extended towards the east. The sensor inlet was 72 inches from the tower, so the sensors were mounted 1.50 tower widths from the tower. The dewpoint sensors also had downward pointing radiation shields and were mounted approximately 1 meter directly above the air temperature sensors.

TVA will revise SSAR 2.3.3 to reflect the information stated above. The SSAR markups will be incorporated in a future revision of the ESPA.

NRC RAI 02.03.03

Regulatory Background

10 CFR 52.17(a)(1)(ix) states, in part, that an Early Site Permit (ESP) application shall include: "[a] description and safety assessment of the site on which a facility is to be located", that "[t]he assessment must contain an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in paragraphs (a)(1)(ix)(A) and (a)(1)(ix)(B) of this section", that "[t]he applicant shall perform an evaluation and analysis of the postulated fission product release…including site meteorology, to evaluate offsite radiological consequences", and that "[s]ite characteristics must comply with part 100 of this chapter".

With respect to 10 CFR Part 100, paragraph 100.20(c)(2) states that the "[m]eteorological characteristics of the site that are necessary for safety analysis or that may have an impact upon plant design…must be identified and characterized". Further, 10 CFR 100.21(c) states that "[s]ite atmospheric dispersion characteristics must be evaluated and dispersion parameters established such that: (1) [r]adiological effluent release limits associated with normal operation…can be met for any individual located offsite; and (2) [r]adiological dose consequences of postulated accidents shall meet the criteria set forth in [section] 50.34(a)(1) of this chapter".

To that end, NUREG-0800, Standard Review Plan (SRP) Section 2.3.3, Onsite Meteorological Measurements Program, establishes criteria that the NRC staff uses to evaluate whether an applicant meets the NRC's regulations. SRP Section 2.3.3, Subsection III (Review Procedures), Item (1)(e), Data Acquisition and Reduction, indicates that there are many methods of acquiring data from meteorological measurement systems which are acceptable to the staff and that among the basic components, reviewed by the NRC Staff to ascertain the acceptability of meteorological data acquisition and reduction, is the averaging time of system outputs for final disposition and accuracy of these data.

RAI Question: 02.03.03-2

In SSAR Subsection 2.3.3.2.4, "Data Recording and Display", the applicant provided a description of the data acquisition system for the primary meteorological monitoring system, including data processing output. With respect to the processing of wind measurements, the description indicates that "15-minute and hourly average wind speed and vector wind speed" are calculated, and that "15-minute and hourly vector wind direction and horizontal wind direction sigma" values were generated.

The NRC staff notes that the discussions in SSAR Sections 2.3.3, 2.3.4 (Short-Term Accident Diffusion Estimates), or 2.3.5 (Long-Term (Routine) Diffusion Estimates) do not indicate whether various data summaries included in the SSAR or as part of the meteorological input to the accident- and routine release-related dispersion modeling analyses were based on vector-averaged wind direction data, as might reasonably be inferred from the list of meteorological output listed in SSAR Subsection 2.3.3.2.4. The staff further notes that the dispersion modeling results could be markedly different depending on whether a scalar average (i.e., based on a unit vector wind direction) or a true vector average (i.e., based on the magnitude of the wind speeds and the actual orientations of the wind direction over the averaging interval) were used.

Consequently, the applicant should update SSAR Subsection 2.3.3.2.4 (and any other related sections or subsections directly or by cross-reference, as appropriate) to indicate and provide justification for which type of wind direction and/or wind speed data (i.e., scalar and/or vector average) were used to generate the following summaries and model input data:

a) the wind roses presented in SSAR Figures 2.3.2-3 through 2.3.2-28;

b) the joint frequency distributions presented in SSAR Tables 2.3.4-2 through 2.3.4-8;

c) the sequential hourly meteorological data provided to the NRC staff via DVD (received 6/10/2016);

d) the joint frequency distributions provided as input to the PAVAN and XOQDOQ atmospheric dispersion models (in SSAR Subsections 2.3.4.2 and 2.3.5.2, respectively); and

e) the sequential hourly meteorological data provided as input to the CALPUFF atmospheric dispersion model (in SSAR Subsection 2.3.5.3).

TVA Response

Scalar meteorological data was used to develop:

a) the wind roses presented in SSAR Figure 2.3.2-3 through 2.3.2-28;

b) the joint frequency distributions presented in SSAR Table 2.3.4-2 through 2.3.4-8;

c) the sequential hourly meteorological data provided to the NRC staff via letter CNL-16-097 (Reference 1);

d) the joint frequency distributions provided as input to the PAVAN and XOQDOQ atmospheric dispersion models (in SSAR Subsections 2.3.4.2 and 2.3.5.2, respectively); and

e) the sequential hourly meteorological data provided as input to the CALPUFF atmospheric dispersion model (in SSAR Subsection 2.3.5.3).

TVA is revising SSAR Section 2.3 to clarify the use of scalar wind data. The SSAR markups will be incorporated in a future revision of the ESPA.

Reference: 1. Letter from TVA to NRC, CNL-16-097, “Submittal of Meteorological Data in in Support of Early Site Permit Application for Clinch River Nuclear Site,” dated June 10, 2016

Attachment 1
SSAR Subsections 2.3 Markups

SSAR Subsection 2.3.2.1.1 is being revised as indicated. Underline indicates text to be added. Strikethroughs indicates text to be deleted.

2.3.2.1.1 Winds

Average Wind Direction and Wind Speed Conditions

Joint frequency distributions of wind direction, average (scalar) wind speed, and stability class from wind instruments at 10-m at the CRN Site are presented in Subsection 2.3.4. The CRN Site data are presented as wind roses in Figures 2.3.2-3 through 2.3.2-28. Wind roses for Chattanooga, based on ten years of data (2000–2009), are presented in Figures 2.3.2-29 through 2.3.2-41. Wind roses for Oak Ridge, based on ten years of data (2000–2009), are presented in Figures 2.3.2-42 through 2.3.2-54.

Wind speeds at the CRN ~~s~~Site during 2011–2013 (Table 2.3.2-3) were generally light with an average 10-m speed of 2.74 mph. The highest 10-m hourly average observed speed was 15.1 mph. The geographic orientation of the ridges and valleys generally aligns with the prevailing regional winds from the southwest, but the gaps in the ridges permit wind flow from other directions as well. The combination of high pressure associated with the Azores-Bermuda anticyclonic circulation and the nearby ridges result in generally light wind speeds with average surface wind speeds for the site are less than 4 mph. The CRN Site is surrounded by complex terrain, with alternating ridges and valleys oriented along a southwest (SW) to northeast (NE) axis. The local wind patterns are influenced by the complex terrain, with up-valley (SW-WSW)/down-valley (NE-ENE) flow patterns common and stable conditions with light winds frequently observed, especially during the summer and fall seasons. These nonlinear flow patterns influence the dispersion around the CRN Site.

…

SSAR Subsection 2.3.3.2 is being revised as indicated. Underline indicates text to be added. Strikethroughs indicates text to be deleted.

2.3.3.2 Primary Meteorological Facility

The primary meteorological facility consisted of a 110-meter open-latticed tower with wind, temperature, and dewpoint measurements at the two lowest levels (10- and 60-meters); a ground-based instrument for rainfall measurements; and an environmental data station (EDS), which housed the data processing and recording equipment. A system of lightning and surge protection circuitry and proper grounding was included in the facility design. This facility was located approximately 830 meters south-southeast of the expected plant site and had a base elevation of seven meters below plant grade.

Two obstructions to wind flow have been evaluated and determined to have minimal impact on the wind measurements. The obstructions include a lattice structure transmission tower approximately 120 meters northeast from the primary tower and a stand of trees limited to a small arc approximately 70 meters southeast of the tower. The location of the obstructions with respect to the tower is shown in Figure 2.3.3-1. The obstructions are shown in Figure 2.3.3-2.

Data collected included:

- Wind direction and wind speed at 10 and 60 meters.
- Temperature at 10 and 60 meters.
- Dewpoint at 10 and 60 meters.
- Solar radiation at tower base.
- Precipitation just below tower base (-0.3 meter).

More exact measurement heights for the wind and temperature parameters are given in the TVA EDS manual (Reference 2.3.3-1). Data collection for all variables began April 21, 2011 and ended July 9, 2013. <u>The tower design, mounting, and exposure of the meteorological instrumentation used for the collection of meteorological data at the CRN Site followed the guidance provided in RG 1.23. The tower used to collect meteorological data for the CRN Site was an open-latticed tower. The wind sensor for each level was mounted on a boom that extends towards the southeast (approximately 140°). The wind sensor mounting booms extended 100 inches from the tower, so the sensors were mounted 2.08 tower widths from the tower. The air temperature sensors were mounted in downward pointing radiation shields that extended towards the east. The sensor inlet was 72 inches from the tower, so the sensors were mounted 1.50 tower widths from the tower. The dewpoint sensors also had downward pointing radiation shields and were mounted approximately 1 meter directly above the air temperature sensors.</u> Further details on the meteorological sensors are available in Reference 2.3.3-1.

SSAR Subsection 2.3.3.2.4 is being revised as indicated. Underline indicates text to be added. Strikethroughs indicates text to be deleted.

2.3.3.2.4 Data Recording and Display

Data acquisition is controlled by a computer program. The output of each meteorological sensor was scanned periodically, scaled, and the data values were stored. Meteorological sensor outputs (except rainfall) were measured every five seconds (720 per hour). Rainfall was measured continuously as it occurred.

Software data processing routines within the computer accumulated output and performed data calculations which generated the following:

- 15-minute and hourly average wind speed and vector wind speed.

  The average wind speed is a scalar value (without regard to wind direction) and is used for modeling calculations that use wind speed, because it best represents dispersion characteristics. The vector wind speed represents the net plume transport during the sampling period.

- 15-minute and hourly vector wind direction and horizontal wind direction sigma.
- 15-minute and hourly average temperature.
- 15-minute and hourly precipitation.
- Hourly average dewpoint.

Data were sent from the EDS to an offsite computer for validation, reporting, and archiving.

SSAR Subsection 2.3.4.2 is being revised as indicated. Underline indicates text to be added. Strikethroughs indicates text to be deleted.

2.3.4.2 Calculation Methodology and Assumptions

The atmospheric dispersion calculations were performed using the PAVAN computer program, NUREG/CR-2858, which was developed and is used by the U.S. Nuclear Regulatory Commission (NRC) (Reference 2.3.4-2). The PAVAN program implements the guidance provided in Regulatory Guide (RG) 1.145. The PAVAN model calculates X/Q values based on the theory that material released to the atmosphere would be normally distributed (Gaussian) about the plume centerline. Therefore, a straight-line trajectory is modeled between the point of release and distances for which X/Q values are calculated in accordance with NUREG/CR-2858 and RG 1.145.

RG 1.206 states that the Applicant should provide meteorological data from at least two consecutive annual cycles, including the most recent one-year period for calculating the short-term and long-term atmospheric dispersion estimates. RG 1.23 recommends using meteorological data from a consecutive 24-month period. Site-specific meteorological data covering the two year period of record from June 1, 2011 through May 31, 2013 was used to quantitatively evaluate such a hypothetical accident at the CRN Site. This data was used to calculate joint frequency distributions (JFDs) of wind direction, average (scalar) wind speed, and atmospheric stability class. The stability classes were based on the classification system given in Table 1 of RG 1.23, as listed in Table 2.3.4-1.

The CRN Site meteorological data were validated for the entire 2011-2013 period, meeting the requirements of NUREG-0917 (Reference 2.3.4-1) and RG 1.23. A combined total of 17,380 hours of valid wind direction, average (scalar) wind speed, and stability observations were used for the two-year period. One hundred sixty-four hours of data were considered invalid because at least one of the following variables was missing or bad for that hour: lower wind speed, lower wind direction, or stability class. RG 1.23 recommends that a data recovery goal of 90 percent be achieved for meteorological instruments. Joint data recoveries of 98.85 percent and 99.28 percent were achieved for the first 12 months and the second 12 months, respectively, resulting in a data recovery of 99.07 percent for the entire period.

JFDs are based on lower wind direction, 9.78 meters (m) (32.1 feet) (nominal 10 m), lower wind speed 9.78 m (32.1 feet) (nominal 10 m), and temperature differential between the 59.22 m (194.3 feet) (nominal 60 m) and 8.44 m (27.7 feet) (nominal 10 m) temperature measurements. According to RG 1.145, calms are classified as hourly average wind speeds below the vane or anemometer starting speed, whichever is higher. Calms were distributed into the first wind speed category in the JFDs, so they were not manually distributed in the PAVAN input file.

PAVAN produces the most accurate results if wind speeds are classified into a large number of categories at the lower wind speeds (Reference 2.3.4-2). Therefore, 13 wind speed categories were defined in the JFDs and used in the PAVAN analyses. The wind speed categories used in the PAVAN analysis are provided in the JFD tables (Tables 2.3.4-2 through 2.3.4-8). For the two years of data under consideration, there were no hourly recordings of wind speeds greater than 18.0 mph (8.0 m/s) as shown in Tables 2.3.4-2 through 2.3.4-8. The JFD tables for each stability class are given in Tables 2.3.4-2 through 2.3.4-8. The number of hours of wind direction and wind speed in each stability class is given in Table 2.3.4-9.

Using the JFDs, PAVAN provides the X/Q values as functions of direction for various time periods at the EAB and LPZ. According to RG 4.7, an applicant is required by 10 CFR 100.21(a) to designate an exclusion area and to have authority to determine all activities within that area, including removal of personnel and property. The exclusion area is required to be of such a size that an individual assumed to be located at any point on its boundary would not receive a radiation dose in excess of 25 rem total effective dose equivalent (TEDE) over any 2-hour period following a postulated fission product release. The required exclusion area size involves consideration of the atmospheric characteristics of the site as well as plant design.

RG 1.145 requires that, for each of the 16 compass sectors, the distance to the EAB should be the minimum distance between the effluent release point and the EAB within a 45-degree sector centered on the compass direction of interest. For conservatism and simplicity, the effluent release point is evaluated as a circular effluent release boundary (ERB) that encloses potential release points from the nuclear island as shown in Figure 2.3.4-1. A circular analytical EAB is established 1100 ft (335 m) from the ERB. For X/Q modelling (Table 2.3.4-11), the analytical EAB is used as a bounding representative distance to the EAB. To account for multiple units on site, nuclear islands are positioned at multiple locations within the power block with associated ERBs and EABs in Figure 2.3.4-1 (note that although the nuclear islands of vendors 1 and 4 are depicted in the figure, the nuclear islands, associated ERBs, and analytical EABs for vendors 1, 2, 3, and 4 fit within the EAB ellipse). The analytical EABs can be encompassed by an ellipse fixed completely within the CRN Property boundary, i.e. the actual EAB (Figure 2.3.4-1), which demonstrates that dispersion factor computations are conservative.

The site center point is determined as the centerline midpoint of the EAB ellipse (Figure 2.3.4-1). The ellipse has a short axis of 0.326 mi (524 m) from the site center point and long axis of 0.535 mi (864 m) from the center point.

Although radioactive release from the turbine islands is possible, the effects of postulated releases from nuclear islands will bound those of the turbine island. Additional discussion regarding postulated accidents is provided in Section 15.1.

The various analytical EABs can be encompassed by an ellipse fixed completely within the CRN Property boundary, which demonstrates that the actual EAB conservatively bounds the analytical EAB for radiation dose computations. The ellipse has a short axis of 0.326 mi (524 m) from the site center point and long axis of 0.535 mi (861 m) from the center point. The site center point was determined by the centerline midpoint of the Release Zone EABs.

According to RG 4.7, an applicant is also required by 10 CFR 100 to designate an area immediately beyond the exclusion area as an LPZ. The size of the LPZ must be such that the distance to the nearest boundary of a densely populated center containing more than about 25,000 residents (population center distance) must be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. The boundary of the population center should be determined upon consideration of population distribution, not political boundaries. In addition, the LPZ must be of such a size that an individual located on its outer radius for the course of the postulated accident (assumed to be 30 days) would not receive a radiation dose in excess of 25 rem TEDE.

The LPZ was defined by a circular area with a radius of 1 mi (1609 m) from the center point of the site (Figure 2.3.4-2). For receptor locations remote from the site, such as the LPZ, using the center point as the release location is a reasonable assumption because of the proximity of the potential release locations is small in comparison to the receptor distances. This distance was used in the PAVAN model. The variable inputs used in the PAVAN model are listed in Table 2.3.4-10.

Other plant specific data considered for PAVAN include minimum building cross-sectional area, building height, and meteorological tower height at which the wind speed was measured. The building height and minimum cross-sectional area are used in the determination of building wake effects. Building cross-sectional area is defined in RG 1.145 as the smallest vertical-plane cross-sectional area of the containment structure, in square meters. RG 1.111 identifies the tallest adjacent building, either up- or downwind from the release point(s), as appropriate for use. For conservatism, no building wake credit was used in the PAVAN model (e.g., the building height and cross-sectional area were both set to zero in the model).

Based on RG 1.145, a ground release includes release points that are effectively less than two and one-half times the height of adjacent solid structures. Compared to an elevated release, a ground-level release usually results in higher ground-level concentrations at downwind receptors due to less dilution from shorter traveling distances. Because the ground-level release scenario provides a bounding case, elevated releases are not considered in this model.

The meteorological tower height used in PAVAN is the height above ground level at which the wind speed was measured. For a ground-level release, the lower wind speed measurement height of 10 m (32.8 feet) is used.

Because a ground-level release scenario provides the most conservative X/Q values at the site boundary, a ground-level release was used in the modeling. As detailed in RG 1.145, Section C.1.1.3.1, for release modes that are effectively lower than two and one-half times the height of adjacent solid structures (ground-release mode), two sets of meteorological conditions are treated differently in order to consider the effects of building wake mixing and ambient plume meander. During neutral (D) or stable (E, F, or G) atmospheric stability conditions when the average (scalar) wind speed is less than six meters per second (m/s), horizontal plume meander is considered. The PAVAN model calculates the relative concentration (X/Q) values

through the selective use of the following set of equations for ground-level relative concentrations at the plume centerline.

$$\frac{X}{Q} = \frac{1}{\bar{U}_{10}\left(\pi\sigma_y\sigma_z + \frac{A}{2}\right)} \qquad \text{Equation 2.3.4-1}$$

$$\frac{X}{Q} = \frac{1}{\bar{U}_{10}(3\pi\sigma_y\sigma_z)} \qquad \text{Equation 2.3.4-2}$$

$$\frac{X}{Q} = \frac{1}{(\bar{U}_{10}\pi\Sigma_y\sigma_z)} \qquad \text{Equation 2.3.4-3}$$

Where:

- *X*/Q = centerline ground-level relative concentration (s/m^3).
- σ_y = lateral plume spread as a function of atmospheric stability and distance (m).
- σ_z = vertical plume spread as a function of atmospheric stability and distance (m).
- A = minimum vertical-plane containment cross-sectional area (m^2).
- $\bar{U}_{10}$ is the average (scalar) wind speed at ten meters above plant grade (m/s).
- Σ_y is the lateral plume spread with meander and building wake effects, in meters, a function of atmospheric stability, average (scalar) wind speed, and distance.

The PAVAN model calculates *X*/Q values using Equations 2.3.4-1, 2.3.4-2, and 2.3.4-3. The model compares the values from Equations 2.3.4-1 and 2.3.4-2, and the higher value is selected. This value is then compared with the value from Equation 2.3.4-3, and the lower value of these two is selected as the appropriate *X*/Q value.

During unstable (A, B, or C) atmospheric stability and/or 10-m level average (scalar) wind speeds of six m/s or more, plume meander (Equation 2.3.4-3) is not considered. The higher value calculated from Equation 2.3.4-1 or 2.3.4-2 is then used as the appropriate *X*/Q value.

The RG 1.145 requires that the *X*/Q values at the EAB and LPZ be calculated based on both a directionally dependent methodology (maximum sector) and a directionally independent methodology (overall site limit) and that the most conservative (highest) values be chosen. Therefore, consistent with RG 1.145, the PAVAN model calculates the maximum sector *X*/Q by taking the *X*/Q value exceeded 0.5 percent of the time based on a cumulative probability distribution of *X*/Q values for each sector. Also in accordance with RG 1.145, the model calculates an overall site *X*/Q value by selecting the *X*/Q value that is exceeded five percent of the total time based on an overall cumulative probability distribution for the sixteen directions combined. The higher of the two values was then chosen to be the bounding *X*/Q value for each of the time periods analyzed.

SSAR Subsection 2.3.5.2 is being revised as indicated. Underline indicates text to be added. Strikethroughs indicates text to be deleted.

2.3.5.2 Calculation Methodology and Assumptions

RG 1.206, states that the Applicant should provide meteorological data from at least two consecutive annual cycles, including the most recent 1-year period for calculating the short-term and long-term atmospheric dispersion estimates. RG 1.23, recommends using meteorological data from a consecutive 24-month period. Site-specific, validated meteorological data covering the 2-year period of record from June 1, 2011 through May 31, 2013 was used to quantitatively evaluate routine releases at the CRN Site. The meteorological data needed for the X/Q and D/Q calculations in XOQDOQ included average (scalar) wind speed, wind direction, and atmospheric stability, in terms of JFDs (Table 2.3.4-2 through Table 2.3.4-8). Fourteen wind speed categories were defined in the JFDs and used in the XOQDOQ analyses.

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