2. SITE CHARACTERISTICS

2.1 Geography and Demography

2.1.1 Site Location and Description

2.1.1.1 Technical Information in the Application

In Section 2.1.1.1 of the site safety analysis report (SSAR), the applicant presented information concerning the location and area of the early site permit (ESP) site that could affect the design of structures, systems, and components (SSCs) important to the safety of a nuclear power plant(s) falling within the applicant's plant parameter envelope (PPE) that might be constructed on the proposed ESP site. The applicant stated that the Exelon Generating Company (EGC) ESP site will be located approximately 700 feet south of the existing Clinton Power Station (CPS), which lies within Zone 16 of the Universal Transverse Mercator (UTM) coordinates. The applicant further stated that the exact UTM coordinates for a new unit(s) constructed on the proposed ESP site will be finalized at the time of a combined license (COL) application. The applicant provided the following information on site location and area:

- the site boundary for a new unit(s) on the proposed ESP site with respect to the location of CPS
- the site location with respect to political subdivisions and prominent natural and manmade features of the area within the low-population zone (LPZ) and the 50-mile population zone
- the topography surrounding the proposed ESP site
- the distance from the proposed ESP site to the nearest exclusion area boundary (EAB), including the direction and distance
- the location of potential radioactive material release points associated with a proposed new unit(s)
- the distance of the proposed ESP site from U.S. and State highways
- confirmation that no physical characteristics unique to the proposed ESP site were identified that could pose a significant impediment to the development of emergency plans

2.1.1.2 Regulatory Evaluation

In Request for Additional Information (RAI) 1.5-1, the U.S. Nuclear Regulatory Commission (NRC) staff asked the applicant to provide a comprehensive listing of regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," Attachment 2, identifies the NRC regulations applicable to its ESP SSAR. RS-002, Attachment 2, identifies the applicable NRC regulations regarding site location and description in Title 10 of the *Code of Federal*

Regulations, (10 CFR) Section 52.17, "Contents of Applications," and Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997," to 10 CFR Part 100, "Reactor Site Criteria." The staff finds that the applicant correctly identified the applicable regulations. The staff considered the following two regulatory requirements in reviewing the site location and site area:

(1) 10 CFR Part 100, which requires the consideration of factors relating to the size and location of proposed sites

(2) 10 CFR 52.17, which requires the applicant to submit information needed to evaluate factors involving the characteristics of the site environs

According to Section 2.1.1 of RS-002, Attachment 2, an applicant has submitted adequate information if it satisfies the following criteria:

- The site location, including the exclusion area and the proposed location of a nuclear power plant(s) of specified type falling within the applicant's PPE that might be constructed on the proposed site, is described in sufficient detail to determine whether the requirements of 10 CFR Part 100 and 10 CFR 52.17 are met, as discussed in Sections 2.1.2, 2.1.3, and 3.3 of this safety evaluation report (SER).

- Highways, railroads, and waterways which traverse the exclusion area are sufficiently distant from the planned or likely locations of any structures of a nuclear power plant(s) of specified type falling within the applicant's PPE that might be constructed on the proposed site so that routine use of these routes is not likely to interfere with normal plant operation.

2.1.1.3 Technical Evaluation

The proposed EGC ESP site is located approximately 700 feet south of the existing CPS facility. The CPS lies within Zone 16 of the UTM coordinates. Figure 2.1-8 of the SSAR depicts the EAB and the LPZ for the proposed ESP site. The applicant stated that the exact UTM coordinates for a new unit(s) constructed on the proposed ESP site will depend upon the specific reactor technology selected for deployment. This decision will be finalized at the time of a COL application. The staff will review the exact UTM coordinates of the new unit(s) at the time of a COL application. This is **COL Action Item 2.1-1**.

The applicant elected to define the EAB envelope as a circular radius of 3,362 feet (0.64 miles) and the LPZ as a circular radius of 13,182 feet (2.5 miles) from the center of the proposed ESP facility footprint. The EAB for the proposed ESP site overlaps the existing EAB for CPS; however, the two are not concentric. Also, the EAB for the existing CPS is slightly smaller, with a circular radius of 3199 feet (0.6 miles), and both CPS and the proposed ESP site have the same LPZ. The applicant established the EAB and the LPZ to ensure that the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1) and the siting evaluation factors in Subpart B of 10 CFR Part 100 are met. No persons live within either the CPS EAB or the proposed ESP site EAB. The staff verified that the exclusion area distance is consistent with the distance used in the radiological consequence analyses the applicant performed and

which Section 3.3 of the SSAR describes, as well as the analysis the staff performed and which Section 3.3 of this SER describes.

The proposed ESP site, located in east-central Illinois, falls within Harp Township in DeWitt County. Specifically, the site is about 6 miles east of the City of Clinton and lies between the cities of Bloomington and Decatur, 22 miles to the north and 22 miles to the south, respectively. Regionally, the proposed site is located between the cities of Lincoln and Champaign-Urbana, 28 miles to the west and 30 miles to the east, respectively. The nearest major highways are Illinois State Routes 54, 10, and 48, all of which cross the CPS facility property. Other major highways within the region include Interstate 155 to the west, Interstate 72 to the southeast, Interstate 55 to the northwest, Interstate 74 to the northeast, Interstate 39 to the north, and Interstate 57 to the east. The closest of these highways (State Route 54) approaches within 1 mile north of the proposed ESP facility footprint. Routine use of State Route 54 is not likely to interfere with normal plant operation.

The gaseous effluent release limits for a new unit(s) would apply at the proposed ESP exclusion area site boundary, and the liquid effluent release limits for a new unit(s) would apply at the end of the discharge canal into Clinton Lake, the outfall of which joins the Sangamon River approximately 56 miles downstream. The staff finds that these release points are acceptable for determining whether the radiation exposures to the public meet the criterion, "as low as reasonably achievable," cited in Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable,' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." (For a further discussion of this subject, see Section 5.4 of the staff's environmental impact statement (EIS) for the Exelon ESP application.)

In addition, for the reasons set forth in Section 13.3 of this SER, the staff finds that no physical characteristics unique to the proposed ESP site have been identified that could pose a significant impediment to the development of emergency plans.

2.1.1.4 Conclusions

As set forth above, the applicant provided and substantiated information concerning the site location and area that could affect the design of SSCs important to the safety of a nuclear power plant(s) of specified type falling within the applicant's PPE that might be constructed on the proposed ESP site. The staff has reviewed the applicant's information, as described above, and concludes that it is sufficient for the staff to evaluate compliance with the siting evaluation factors in 10 CFR Part 100 and 10 CFR 52.17, as well as with the radiological consequence evaluation factors in 10 CFR 50.34(a)(1). The staff further concludes that the applicant provided sufficient details about the site location and site area to allow the staff to evaluate, as documented in Sections 2.1.2, 2.1.3, and 3.3 of this SER, whether the applicant met the relevant requirements of 10 CFR Part 100 and 10 CFR 52.17.

2.1.2 Exclusion Area Authority and Control

2.1.2.1 Technical Information in the Application

In Section 2.1.2 of the SSAR, the applicant presented information concerning its plan to ensure the legal authority necessary to determine all activities within the designated EAB, if the applicant decides to proceed with the development of a new reactor unit(s) at the proposed ESP site. The regulations at 10 CFR 100.3, "Definitions," require that a reactor licensee have the authority to determine all activities within the designated exclusion area, including the exclusion or removal of personnel and property. With respect to this requirement, the applicant stated the following:

> EGC will ensure that it has or will be granted the necessary authority, rights, and control of the EGC ESP Site, including the exclusion area prior to commencing actions allowed pursuant to any ESP granted from the Application.

In RAI 2.1.2-1, the staff asked the applicant for additional information regarding its approach to obtaining a grant from the appropriate regulatory agencies and other private parties for the necessary authority, rights, and control of the ESP site. In its response, the applicant stated the following:

> EGC plans to enter into an agreement with AmerGen prior to construction that will grant EGC an exclusive and irrevocable option to purchase, enter a long-term lease for, and/or procure other legal right in the land required for the EGC ESP facility. Additionally, EGC will enter into an Exclusion Area Agreement with AmerGen. This agreement will provide EGC with authority to determine the activities within the EGC ESP exclusion area, including the exclusion of personnel and property, to the extent necessary to comply with applicable NRC guidance. EGC anticipates that this Agreement and the lease will extend for 99 years.

2.1.2.2 Regulatory Evaluation

In RAI 1.5-1, the staff asked the applicant to provide a comprehensive listing of NRC regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to its ESP SSAR. RS-002, Attachment 2, identifies the applicable NRC regulations regarding exclusion area authority and control as 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 50.34(a)(1). The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance.

In reviewing the applicant's legal authority to determine all activities within the designated exclusion area, the staff considered the relevant requirements of 10 CFR 100.3 which state the following:

> Exclusion area means that area surrounding the reactor, in which the reactor licensee has the authority to determine all activities including exclusion or removal of personnel and property from the area. This area may be traversed by

> a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations of the facility and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety.... Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

To meet the requirements of 10 CFR Part 100, the applicant must demonstrate, before the issuance of an ESP, that it has an exclusion area and an LPZ, as defined in 10 CFR 100.3, and that it has the required authority within the exclusion area, also defined in 10 CFR 100.3. If not, the applicant must provide reasonable assurance that it will have such authority before construction of a new unit(s) commences.

2.1.2.3 Technical Evaluation

The applicant has stated that it plans to enter into an agreement with AmerGen, before any construction, that will grant Exelon an exclusive and irrevocable option to purchase, enter a long-term lease, and/or procure other legal right in the land required for the EGC ESP facility. The applicant has not attempted to demonstrate that it currently has the authority to determine all activities, including exclusion or removal of personnel and property from the area, as required by 10 CFR 100.3. To meet the exclusion area control requirements of 10 CFR 100.21(a), “Non-Seismic Site Criteria,” and 10 CFR 100.3, the applicant does not need to demonstrate total control of the property before issuance of the ESP. In the draft safety evaluation report (DSER), the NRC staff stated that the applicant must provide reasonable assurance that it can acquire the required control, i.e., that it has the legal right to obtain control of the exclusion area. The staff had not then obtained information sufficient to enable the staff to determine whether the applicant had such a legal right. Accordingly, the NRC staff identified DSER Open Item 2.1-1, which stated:

> Demonstrate that the applicant has the legal right to control the exclusion area, or has an irrevocable right to obtain such control.

Specifically, the applicant should provide a detailed explanation of the corporate relationship between Exelon (the parent company) and AmerGen (the subsidiary).

In its response to the open item, the applicant indicated as follows: AmerGen is the licensed owner and operator of the Clinton Power Station. AmerGen is a wholly-owned subsidiary of the applicant, Exelon Generation Company, LLC (EGC). EGC is a wholly owned subsidiary of Exelon Ventures Company, LLC, which in turn is a wholly-owned subsidiary of Exelon Corporation. Additionally, the AmerGen Management Committee, which has the authority to manage AmerGen, authorized AmerGen’s officers to negotiate all necessary agreements to support EGC with its ESP application, which may include, without limitation, a long-term interest in the real estate that is the subject of the ESP application and an exclusion area agreement. (See letter from Marilyn C. Kray, Vice President, Project Development, Exelon Nuclear, to NRC, “Response to Draft Safety Evaluation Report (DSER) Items” (April 26, 2005), ADAMS Accession No. ML051230326.)

Based on the above information, the staff has determined that AmerGen is prepared to negotiate with EGC in order to grant the applicant an exclusive and irrevocable option to purchase, enter a long-term lease, and/or procure other legal right in the land required for the EGC ESP facility, and no new nuclear power plant could be built in the absence of an agreement. It further appears that there is no legal impediment to EGC's acquisition of such rights.

Accordingly, the NRC staff proposes to include a condition in any ESP that might be issued regarding the Clinton site, to govern exclusion area control. This condition would require that an agreement granting EGC an exclusive and irrevocable option to purchase, enter a long-term lease, and/or other legal right in the land required to satisfy the requirements of 10 CFR Part 100 for the EGC ESP facility, be obtained and executed before submission of an application for a COL seeking authority to construct and operate a nuclear power plant referencing the ESP. Such a condition provides reasonable assurance for purposes of issuance of an ESP. This is **Permit Condition 1**. Therefore, DSER Open Item 2.1-1 is closed.

The applicant stated that the CPS operator, AmerGen, owns the property associated with the proposed ESP site, with the exception of a right-of-way for the township road that traverses the exclusion area. This road provides access to privately owned property which lies outside the proposed ESP exclusion area. The applicant further stated that in an emergency, Exelon, together with the local law enforcement agency, will control access to the exclusion area via this road. Furthermore, the property ownership and mineral rights provide AmerGen the authority to control activities, including exclusion and removal of personnel and property, within the exclusion area. There are no residents within the EAB.

Should the NRC grant the ESP, and the ESP holder decide to perform the activities authorized by 10 CFR 52.25, "Extent of Activities Permitted," the ESP holder, or the applicant for a construction permit (CP) or COL who references the permit, will need to obtain the authority to undertake such activities on the ESP site. In obtaining such a right, the ESP holder, or the applicant for a CP or COL who references the permit, will also need to obtain the corresponding right to implement the site redress plan described in the staff's final EIS in the event that no plant is built on the ESP site. This is **Permit Condition 2**.

A small area of Clinton Lake lies within the proposed ESP EAB and is used for public recreation lake activities. Should the NRC grant the ESP and the ESP holder decide to apply for a COL (or for a CP and operating license), the ESP holder will need to make arrangements with the appropriate Federal, State, local, or other public agencies to provide for control of the portion of Clinton Lake that lies within the exclusion area. These public agencies, together with the ESP holder, will need sufficient authority over these bodies of water to allow for the exclusion and ready removal, in an emergency, of any persons present on them. This is **COL Action Item 2.1-2**.

2.1.2.4 Conclusions

As set forth above, the applicant provided and substantiated information concerning its plan to obtain legal authority to determine all activities within the designated exclusion area. The staff has reviewed the applicant's information and concludes that it is sufficient to evaluate compliance with the exclusion area control requirements of 10 CFR 100.21(a) and 10 CFR

100.3. In addition, the applicant appropriately described the exclusion area and the methods by which it will control access and occupancy of this exclusion area during normal operation and in the event of an emergency situation.

Based on the above, the staff concludes that the applicant's exclusion area is acceptable and meets the requirements of 10 CFR Part 100, subject to the limitation and conditions identified in this SER. Such permit conditions provide reasonable assurance that an ESP provides for control of the exclusion area. Further, the ESP holder must demonstrate that it will have authority to perform the activities authorized by 10 CFR 52.25, should it choose to do so, and the corresponding right to implement the site redress plan, as described in the discussion of Permit Condition 2 above.

2.1.3 Population Distribution

2.1.3.1 Technical Information in the Application

In SSAR Section 2.1.3, the applicant estimated and provided the population distribution within a 50-mile radius of the proposed ESP site, based on the most recent U.S. Census data, and the projected population estimates up to 2060, including transient populations. The applicant also provided the population distribution within the LPZ, facilities and institutions within the vicinity of the LPZ, the nearest population center, population densities within a 50-mile radius of the proposed ESP site for 2000, and estimated population data for 2060.

The population distribution provided by the applicant encompasses nine concentric rings at various distances out to 50 miles from the proposed ESP site and 16 directional sectors. The applicant also estimated and provided transient population data out to 50 miles for 2000 and projected population estimates to 2060 based on the recreational use of Clinton Lake State Recreational Area, seasonal residents, and business and migrant workers that normally do not live in the area.

2.1.3.2 Regulatory Evaluation

In RAI 1.5-1, the staff asked the applicant to provide a comprehensive listing of NRC regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to its ESP SSAR. RS-002, Attachment 2, identifies the applicable NRC regulations and guidance regarding population distribution as 10 CFR 52.17, 10 CFR Part 100, and Regulatory Guide (RG) 4.7, "General Site Suitability Criteria for Nuclear Power Stations," issued April 1998. The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance.

The staff considered the following regulatory requirements in its review of this SSAR section:

- 10 CFR 52.17, which requires each applicant to provide a description and safety assessment of the site and which requires site characteristics to comply with the criteria of 10 CFR Part 100

- 10 CFR Part 100, which establishes requirements with respect to population center distance and the LPZ

In particular, the staff considered the population density and use characteristics of the site environs, including the exclusion area, LPZ, and population center distance. The regulations in 10 CFR Part 100 provide definitions and other requirements for determining an exclusion area, LPZ, and population center distance.

As stated in Section 2.1.3 of RS-002, Attachment 2, the applicable requirements of 10 CFR 52.17 and 10 CFR Part 100 are deemed to have been met if the population density and use characteristics of the site meet the following criteria:

- Either there are no residents in the exclusion area or, if residents do exist, they are subject to ready removal, in case of necessity.

- The specified LPZ is acceptable if it is determined that appropriate protective measures could be taken on behalf of the enclosed populace in the event of a serious accident.

- The population center distance (as defined in 10 CFR Part 100) is at least one and one-third times the distance from the reactor to the outer boundary of the LPZ.

- The population center distance is acceptable if there are no likely concentrations of greater than 25,000 people over the lifetime of a nuclear power plant(s) of specified type, or falling within a PPE, that might be constructed on the proposed site (plus the term of the ESP) closer than the distance designated by the applicant as the population center distance. The boundary of the population center shall be determined upon considerations of population distribution. Political boundaries are not controlling.

- The population data supplied by the applicant in the safety assessment are acceptable if (1) they contain population data for the latest census, projected year(s) of startup of a nuclear power plant(s) of specified type (or falling within a PPE) that might be constructed on the proposed site (such date(s) reflecting the term of the ESP) and projected year(s) of end of plant life, all in the geographical format given in Section 2.1.3 of RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants—LWR Edition," Revision 3, issued November 1978, (2) they describe the methodology and sources used to obtain the population data, including the projections, (3) they include information on transient populations in the site vicinity, and (4) the population data in the site vicinity, including projections, are verified to be reasonable by other means, such as U.S. Census publications, publications from State and local governments, and other independent projections.

- If the population density at the ESP stage exceeds the guidelines given in RG 4.7, special attention to the consideration of alternative sites with lower population densities is necessary. A site that exceeds the population density guidelines of Regulatory Position C.4 of RG 4.7 can nevertheless be selected and approved if, on balance, it offers advantages compared with available alternative sites, when all of the environmental, safety, and economic aspects of the proposed and alternative sites are considered.

2.1.3.3 Technical Evaluation

The staff reviewed the population data in the site environs, as presented in the applicant's SSAR, to determine whether the exclusion area, LPZ, and population center distance for the proposed ESP site comply with the requirements of 10 CFR Part 100 and the acceptance criteria in Section 2.1.3.2 of this SER. The staff also evaluated whether, consistent with Regulatory Position C.4 of RG 4.7, the applicant should consider alternate sites with lower population densities. The staff also reviewed whether appropriate protective measures could be taken on behalf of the enclosed populace within the emergency planning zone (EPZ), which encompasses the LPZ, in the event of a serious accident.

The staff compared and verified the applicant's population data against U.S. Census Bureau Internet data. The staff reviewed the projected population data provided by the applicant, including transient populations for 2010, 2020, 2030, 2040, 2050, and 2060 (see Section 13.3 of this SER). If the ESP were approved and issued in 2006, assuming a COL application is submitted around the middle of the ESP term, with a projected startup of a new unit(s) in about 2020 and an operational period of 40 years, the projected year for end of plant life is about 2060. Accordingly, the staff finds that the applicant's projected population data cover an appropriate number of years and are therefore reasonable.

The staff reviewed the transient population data provided by the applicant. The transient population up to a 50-mile radius is based on recreational use of Clinton Lake Recreational Area, seasonal residents, special populations (e.g., schools, hospitals, nursing homes, and correctional facilities), and business and migrant workers who do not normally live in the area. The applicant stated that it collected the transient population estimates for the larger business transient population, recreation areas, and special populations using surveys performed during August and September 2002; the DeWitt County Emergency Services and Disaster Agency Coordinator verified the data. The applicant further stated that it obtained the data on the recreation area population from the Illinois Department of Natural Resources. The applicant obtained data on migrant workers from the Bureau of Economic Analysis, U.S. Department of Commerce. Based on this information, the staff finds that the applicant's estimate of the transient population is reasonable.

The staff notes that no member of the public lives within the exclusion area.

Section 3.3 of the SSAR describes the applicant's evaluation of design-basis accidents (DBAs); Section 3.3 of this SER describes the staff's independent verification of the applicant's evaluation. These analyses demonstrate that the radiological consequences of design-basis reactor accidents at the proposed EAB and LPZ would be within the dose consequence evaluation factors set forth in 10 CFR 50.34(a)(1).

The applicant stated that the nearest population center greater than 25,000 people likely to exist over the lifetime of the proposed ESP site is Decatur, Illinois, with a population of 81,860, located approximately 22 miles south-southwest of the proposed ESP site. The distance to Decatur is well in excess of the minimum population center distance of 3.3 miles (one and one-third times the distance of 2.5 miles from the reactor to the outer boundary of the LPZ as required per 10 CFR 100.21(b)). The proposed LPZ is the area immediately surrounding the exclusion area encompassed by a circle, centered on the proposed ESP facility footprint, with a radius of 2.5 miles.

Therefore, the staff concludes that the proposed ESP site meets the population center distance requirement, as defined in 10 CFR Part 100. The staff determined that it is unlikely that a population center with 25,000 people or more will exist within the 3.3-mile minimum population center distance during the lifetime of any new unit(s) that might be constructed on the site. This conclusion is based on projected cumulative resident and transient populations within 10 miles of the site during the lifetime of any new unit(s) (i.e., to 2060).

The staff evaluated the site against the criterion in Regulatory Position C.4 of RG 4.7 regarding the need to consider alternative sites with lower population densities. This criterion specifies that if the population densities in the vicinity of the proposed site, including the transient population, projected at the time of initial site approval and within about 5 years thereafter, were to exceed 500 persons per square mile averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the area at that distance), then alternative sites should be considered. The staff has determined that population densities for the proposed ESP site would be well below 500 persons per square mile. Therefore, the staff concludes that the site conforms to Regulatory Position C.4 in RG 4.7, Revision 2. Assuming that construction of a new nuclear reactor(s) at the proposed site would begin near the middle of the term of the ESP, and based on its review of the applicant’s population density data and projections, the staff finds that the site also meets the guidance of RS-002, Attachment 2, regarding population densities over the lifetime of any facility that might be constructed at the site. Specifically, the population density over that period would be expected to remain below 500 persons per square mile averaged out to a radial distance of 20 miles from the site.

The staff reviewed the applicant’s information regarding its ability to take appropriate protective measures on behalf of the permanent and transient residents in the LPZ in the event of a serious accident. The applicant stated that the LPZ was selected to provide reasonable probability that appropriate protective measures could be taken in such an event. The staff finds that the applicant’s statement is satisfactory because it is consistent with emergency planning for the 10-mile plume exposure EPZ. The LPZ is located entirely within the 10-mile EPZ. Comprehensive emergency planning for the protection of all persons within the 10-mile EPZ, as addressed in Section 13.3 of this SER, would include those persons within the LPZ. Based on the information the applicant presented on this subject and the staff’s review provided in Section 13.3 of this SER, the staff concludes that appropriate protective measures could be taken on behalf of the populace enclosed within the LPZ in the event of a serious accident.

2.1.3.4 Conclusions

As set forth above, the applicant provided an acceptable description of current and projected population densities in and around the site. These densities projected at the time of initial site approval (assuming a new unit(s) is constructed on the site) and within about 5 years thereafter are within the guidelines of Regulatory Position C.4 of RG 4.7. The applicant has properly specified the LPZ and population center distance. The staff finds that the proposed LPZ and population center distance meet the definitions in 10 CFR 100.3. Therefore, the staff concludes that the applicant’s population data and population distribution are acceptable and meet the requirements of 10 CFR 52.17 and 10 CFR Part 100. In Section 3.3 of this SER, the staff documents that the radiological consequences of bounding DBAs at the EAB and the outer boundary of the LPZ also meet the requirements of 10 CFR 52.17.

2.2 Nearby Industrial, Transportation, and Military Facilities

2.2.1–2.2.2 Identification of Potential Hazards in Site Vicinity

For an ESP application, the NRC staff reviews the site distance from industrial, military, and transportation facilities and routes. Facilities and routes of potential concern include air, ground, and water traffic; pipelines; and fixed manufacturing, processing, and storage facilities. The staff's review focuses on potential external hazards or hazardous materials that are present or which may reasonably be expected to be present during the projected lifetime of a nuclear power plant(s) that might be constructed on the proposed site. The staff prepared Sections 2.2.1 through 2.2.2 of this SER in accordance with the review procedures described in RS-002, Attachment 2, using information presented in Section 2.2 of the applicant's SSAR, responses to staff RAIs, and the reference materials described in the appropriate sections of RS-002, Attachment 2.

2.2.1.1–2.2.2.1 Technical Information in the Application

Section 2.2 of the SSAR presents information on the industrial, transportation, and military facilities in the vicinity of the proposed ESP site.

Specifically, in Section 2.2.2.1, the applicant states that the proposed site is in DeWitt County, Illinois, which is a rural and agricultural area. According to the applicant, the 461-acre ESP site is zoned for industrial uses. The applicant identifies three small industrial facilities within 5 miles of the proposed ESP site: two agricultural chemical and fertilizer production and storage facilities, and a propane storage facility. Figure 2.2.1-1 shows the locations of the facilities. EGC's wholly owned subsidiary, AmerGen, owns the surrounding areas within the exclusion area boundary. No industrial facilities, pipelines, or other developments are located in the proposed exclusion area other than CPS, operated by AmerGen.

Section 2.2.1 of the SSAR describes the roads within 5 miles of the proposed ESP site. Several Illinois State routes (Routes 54, 48, and 10) pass 1 mile or more from the proposed site, and U.S. Route 51 passes about 6 miles west of the proposed site. The applicant states that the Gilman Line of the Canadian National Railroad parallels State Route 54 and passes about 1 mile to the north of the proposed site.

In SSAR Section 2.2.2.3, the applicant states that five pipelines cross the CPS property; one of these pipelines passes within 1 mile of the ESP site. The Shell/Equilon 14-inch pipeline currently transports gasoline and diesel, but is configured so it could transport higher volatility products like propane. The SSAR states that the pipeline owner has agreed to notification protocols if propane or other high-volatility substances are moved through the pipeline. However, the SSAR states that recent discussions with the pipeline owner indicate that the use of the pipeline is not likely to change. Table 2.2-4 of the SSAR indicates that three other pipelines carrying refined petroleum products pass no closer than 12,000 feet from the ESP site.

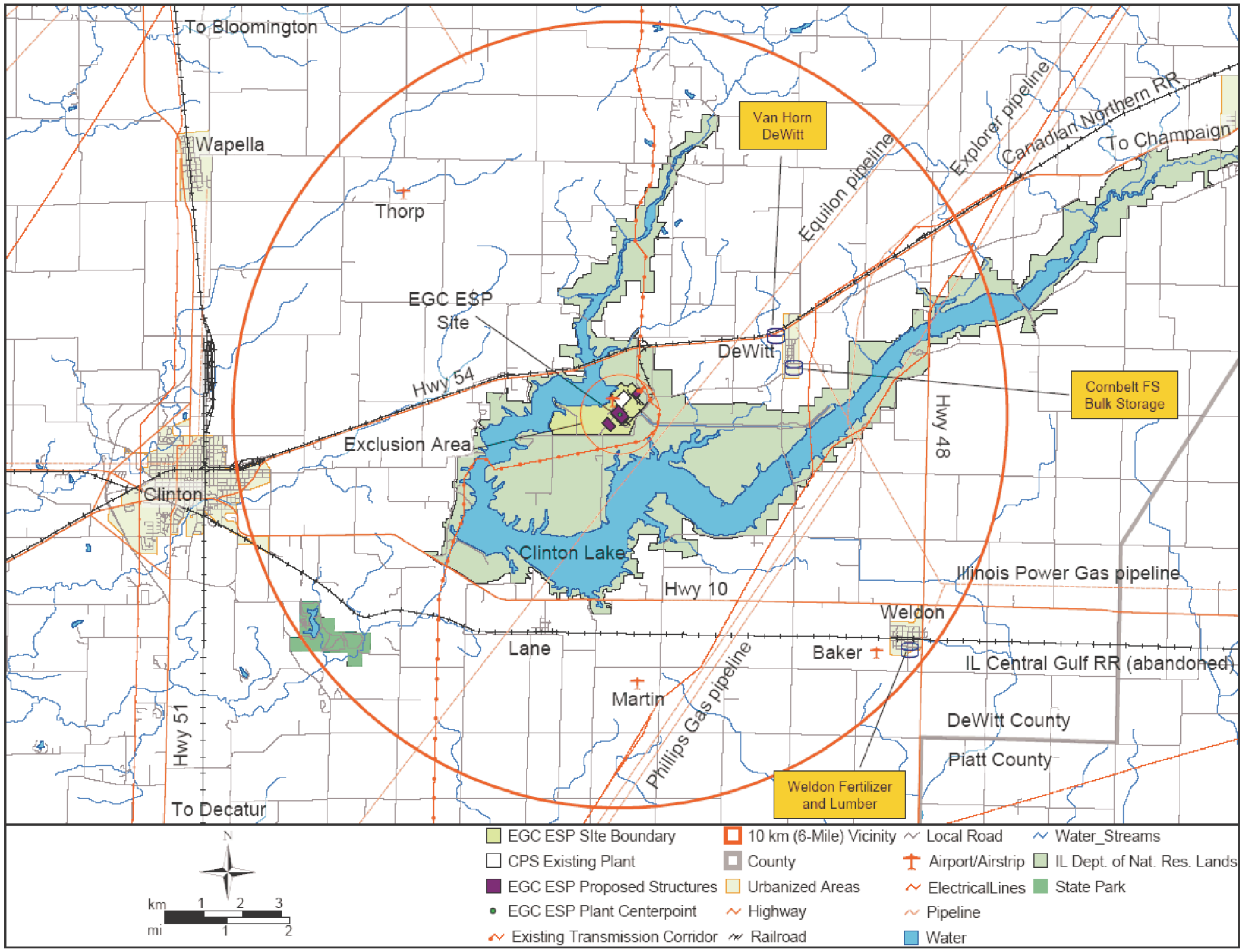

Figure 2.2.1-1 Industrial facilities in the vicinity of the ESP site.

In SSAR Section 2.2.2.5, the applicant describes aircraft activities (nearby airports and airways) in the vicinity of the proposed ESP site. SSAR Figure 2.2-1 identifies four small private airstrips within 6 miles of the ESP site. The SSAR indicates that these small private strips have turf runways of 1500–2000 feet and can only accommodate small single- or twin-engine propeller craft. The airstrip closest to the ESP site (Spencer), owned by AmerGen, is not operational. A heliport at CPS is for the exclusive use of CPS staff. The applicant revised SSAR Section 2.2.2.5.1 in response to RAI 2.2.2-1 to include flight traffic estimates for these airstrips.

The aircraft activities associated with the three operational airstrips in the vicinity of the ESP site involve light aircraft. These airstrips handle an estimated 800 operations per year in aircraft traffic. In SSAR Figure 2.2-3, EGC indicates that four low-altitude Federal airways cross near the ESP site. Airway V313 passes 2 miles east of the ESP site. Airway V233 passes 3 miles northwest. Airway V72 passes 5 miles to the northeast, and Airway V434 passes 6 miles north-northeast of the ESP site.

The SSAR states that Clinton Lake is the only navigable waterway in the vicinity of the ESP site. The only water navigation on the lake is recreational boating. Seven public boat launch ramps and one marina provide boat access to the lake.

2.2.1.2–2.2.2.2 Regulatory Evaluation

In RAI 1.5-1, the staff asked the applicant to provide a comprehensive list of NRC regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to its ESP SSAR. The staff considered the following regulatory requirements identified in RS-002, Attachment 2, in reviewing information on potential site hazards that could affect the safe design and siting of a nuclear power plant(s) that might be constructed at the proposed site within the applicant's PPE:

- 10 CFR 52.17(a)(1)(vii) with respect to information on the location and description of any nearby industrial, military, or transportation facilities and routes

- 10 CFR 100.20(b) with respect to information on the nature and proximity of man-related hazards

- 10 CFR 100.21(e) with respect to potential hazards associated with nearby transportation routes and industrial and military facilities

In SSAR Section 2.2, the applicant identifies the following applicable NRC guidance on potential hazards in the vicinity of the proposed ESP site:

- RG 1.91, "Evaluation of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plant Sites," issued February 1978

- RG 1.78, Revision 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," issued December 2001

- RG 1.70, Revision 3

- NUREG-0800, Revision 3, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” issued in July 1981 (Standard Review Plan (SRP))

- RS-002, Attachment 2

The staff used the regulatory positions and criteria in RG 1.91 and RG 1.78, Revision 1, which describe acceptable methods for hazard evaluation, to determine the applicant’s compliance with the NRC regulations listed above.

Sections 2.2.1–2.2.2, 2.2.3, and 3.5.1.6 of RS-002, Attachment 2, and RG 1.70, Revision 3, provide guidance on the information appropriate for identifying, describing, and evaluating potential man-related hazards. The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance.

2.2.1.3–2.2.2.3 Technical Evaluation

The staff evaluated the potential for man-related hazards in the vicinity of the proposed ESP site by reviewing (1) the information in SSAR Sections 2.2.1–2.2.2, (2) the applicant’s responses to the staff’s RAIs, (3) information obtained during the staff’s visit to the proposed ESP site and its vicinity, and (4) other publicly available reference material published by the U.S. Geological Survey (USGS) (see the Clinton, Heyworth, Maroa, Farmer City North, Farmer City South, LeRoy, Weldon East, Weldon West, and DeWitt, Illinois, 7.5-minute quadrangle maps) and other topographic maps (see *Illinois Atlas and Gazetteer*, issued in 2000), aerial imagery (Terraserver-usa.com, 2004), and Geographic Information System (GIS) coverage files (see the Platts POWERmap GIS spatial data, issued 2004, which include map layers depicting natural gas pipelines, railroads, and electric transmission lines).

The staff reviewed the information provided by the applicant on nearby industrial facilities. Because the ESP facility would be located adjacent to the existing CPS facility, the applicant relied on the CPS updated safety analysis report (USAR), which identifies and evaluates the potential hazards from nearby industrial facilities. The applicant provided a list of the volumes of the chemical and potentially hazardous materials stored at the CPS site. Van Horn-DeWitt stores herbicides, insecticides, and fertilizers within 5 miles of the site. Cornbelt FS has a large propane tank at its facility in DeWitt. The staff’s review did not identify any relevant facilities not previously noted by the applicant.

The applicant neither identified nor evaluated any hazards that the existing CPS may pose to a new facility that might be constructed and operated on the proposed ESP site. Design-specific interactions between the existing unit and any new units would need to be evaluated and addressed in a COL application that references an ESP for the EGC ESP site. This is **COL Action Item 2.2-1**.

2.2.1.4–2.2.2.4 Conclusions

As discussed above, in accordance with the requirements of 10 CFR 52.17 and the guidance of RG 1.70, Revision 3, the applicant’s SSAR provides enough information on potential site hazards, for the staff to evaluate the applicant’s compliance with the requirements of 10 CFR

100.20 and 10 CFR 100.21. The staff reviewed the nature and extent of activities involving potentially hazardous materials at industrial, military, and transportation facilities near the ESP site to identify any potential hazards that might pose an undue risk to the proposed facility in this ESP application. Figure 2.2.1-1 shows the locations of the facilities in relation to the ESP site. On the basis of its evaluation of the SSAR, a review of the information in responses to RAIs, and independently obtained information, the staff concludes that the applicant has identified all potentially hazardous activities on and near the site. SSAR and SER Sections 2.2.3 and 3.5.1.6 discuss the evaluation of the hazards.

2.2.3 Evaluation of Potential Accidents

In SSAR Section 2.2.3, the applicant identifies potential accident situations on and near the ESP site. The staff reviewed this information to determine its completeness and accuracy as a basis for the potential accidents that need to be considered in the design of a facility that might be constructed on the proposed ESP site within the applicant's PPE (see SER Section 2.2.1–2.2.2).

The applicant elected to use a PPE approach as a surrogate for plant design in analyzing potential accidents. The applicant has not determined the precise design of the facility control room. Some potential accidents on or near of the ESP site might affect control room habitability (e.g.,toxic gases, asphyxiants). The design of the actual facility that might be constructed on the proposed site must address design basis accidents (as determined by the review conducted using Section 2.2.3 of RS-002, Attachment 2). The staff will review these potential accidents at the COL or CP stage, using the guidance in SRP Section 6.4.

The staff reviewed the applicant's probability analyses of potential accidents involving hazardous materials or activities on and near a new nuclear power plant(s) constructed on the ESP site and determined that these analyses used the appropriate data and analytical models. The staff also reviewed the applicant's analyses of the consequences of accidents involving nearby industrial, military, and transportation facilities to determine if any should be identified as design-basis events.

2.2.3.1 Technical Information in the Application

Section 2.2.3 of the SSAR presents information on potential accidents including flammable vapor clouds, aircraft crashes, and toxic chemicals. The SSAR states that potential accidents involving transportation routes or flammable, explosive, chemical, or toxic storage at the CPS site were dismissed as design concerns in the CPS USAR. The SSAR further states that certain toxic chemical hazards cannot be evaluated until the COL stage because the precise design of the ESP control room habitability systems will not be known until then.

Section 2.2.2.5.3 of the SSAR describes the applicant's analysis of the potential for accidents originating from airports or airways. SER Section 2.2.1–2.2.2 discusses the locations of airports and airways, as identified by the applicant. The applicant relied on the CPS USAR and the SRP for guidance on determining the accident probabilities of airways 5 miles from the ESP site. The applicant determined that the probability of accidents from plane crashes in the civil and military airways in the vicinity was less than the SRP guideline of about 10^{-7} per year.

The SSAR also states that none of the airports within 10 miles of the ESP site support operations in excess of the threshold criteria in RG 1.70, Revision 3. Section 2.2.3.1.3 of the SSAR describes the applicant's analysis of potential accidents involving toxic chemicals. The Van Horn-DeWitt facility stores and distributes agricultural products such as pesticides, herbicides, and fertilizers. This facility is next to State Route 54, about 2.6 miles from the ESP site. The applicant used the guidance in RG 1.78 to demonstrate that a potential spill of anhydrous ammonia is not a concern because of the small number of shipments made to the Van Horn-DeWitt facility.

The applicant also found that the CPS USAR used the guidance in RG 1.78 to determine that the likelihood of potential accidents on the Gilman Line of the Canadian National Railroad, which runs parallel to State Route 54, is acceptably low. However, CPS has committed to survey the rail line every 3 years to keep abreast of changes in hazardous material shipments. The applicant states in SSAR Section 2.2.3.1.2, that a new analysis will be required at the COL stage for the hazards associated with the Gilman Line. Specifically, the applicant will have to evaluate the location of the control room of the EGC ESP facility, the control room ventilation system design, and the analytic methodology for dispersion and transport of airborne hazardous materials.

SSAR Section 2.2.3.1.2 also states that the probability of a flammable vapor cloud and an explosion and subsequent overpressure, which could exceed the RG 1.91 acceptance criteria, is less than 10^{-6} per year.

2.2.3.2 Regulatory Evaluation

In RAI 1.5-1 the staff asked the applicant to provide a comprehensive list of NRC regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to its ESP SSAR. The staff considered the following regulatory requirements identified in RS-002, Attachment 2, in reviewing information on potential accidents that could affect the safe design and siting of a nuclear power plant(s) that might be constructed at the proposed site within the applicant's PPE:

- 10 CFR 52.17(a)(1)(vii) with respect to the location and description of any nearby industrial, military, or transportation facilities and routes

- 10 CFR 100.20(b) with respect to the nature and proximity of man-related hazards

- 10 CFR 100.21(e) with respect to the evaluation of potential hazards associated with nearby transportation routes and industrial and military facilities

In SSAR Section 2.2, the applicant identifies the following applicable NRC guidance regarding the evaluation of potential accidents in the vicinity of the proposed ESP site:

- RG 1.91
- RG 1.78, Revision 1
- RG 1.70, Revision 3
- NUREG-0800 (SRP)
- RS-002, Attachment 2

The staff used the regulatory positions and criteria in Revision 3 of RG 1.70 to determine the applicant's compliance with the regulations listed above. Sections 2.2.1–2.2.2, 2.2.3, and 3.5.1.6 of RS-002, Attachment 2, and RG 1.70, Revision 3, provide guidance on the information appropriate for identifying, describing, and evaluating potential accidents. The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance.

2.2.3.3 Technical Evaluation

The staff evaluated potential accidents in the vicinity of the proposed ESP site by reviewing (1) the information provided by the applicant in SSAR Section 2.2.3, (2) the applicant's responses to RAIs, (3) information obtained during a visit to the proposed ESP site and its vicinity, and (4) other publicly available reference material published by the USGS (see the Clinton, Heyworth, Maroa, Farmer City North, Farmer City South, LeRoy, Weldon East, Weldon West, and DeWitt, Illinois, 7.5-minute quadrangle maps) and other topographic maps (see the Illinois Atlas and Gazetteer), aerial imagery (see Terraserver-usa.com, 2004), and GIS coverage files (see the Platts POWERmap GIS spatial data).

Section 2.2.1–2.2.2 of this SER describes potential hazards affecting the ESP site. These hazards include the presence of commercial airways and airport facilities in or near the ESP site, the onsite storage of chemicals and other materials at the CPS site, three additional industrial plant sites in the vicinity, and the Gilman Line of the Canadian National Railroad. The staff notes that the CPS USAR did not find that the potential hazards from flammable, chemical, explosive, and toxic material storage at CPS constitute design concerns. Therefore, the staff believes it is unlikely that these hazards would be significant for the ESP site. However, the staff will review the impact of these hazards at the COL stage to verify that no design-specific vulnerabilities exist.

Section 3.5.1.6 of this SER provides the staff's evaluation of aircraft hazards.

The staff reviewed the applicant's analysis of the effects of potential explosions and the formation of flammable vapor clouds. The staff finds that, because of the distance of the potential ESP facility from the worst-case train tank explosion accident (according to RG 1.91), no significant damage would be expected to the typical nuclear power plant safety related structures, systems, and components that might be located on the ESP site. The staff relied on the CPS USAR analysis of a single year of rail shipment data during the 1981–1982 period. Reporting of significant changes in the shipment data for the Gilman Rail Line will be required at the COL stage to account for current shipment characteristics and the actual design of the control room systems of the new nuclear unit(s).

To ensure that the hazards of the Gilman Rail Line remain acceptably low, the applicant has noted that the rail shipment data for hazardous materials may need to be periodically updated.

The staff reviewed the applicant's analysis of potential toxic chemical accidents. These accidents include train and truck tanker spills of anhydrous ammonia, chemical materials that are stored and used on site at CPS and that could be used and stored at future facilities that might be constructed on the ESP site, and anhydrous ammonia storage tank failure at the Van Horn-DeWitt facility. Since the PPE does not specify a control room design, no specific determination can be made with respect to control room habitability in the event of a toxic

chemical accident at the site or in the vicinity. Although the applicant cited the USAR's inventory of toxic chemicals, the actual determination of their impact on a specific plant design cannot be determined at the ESP stage without a precise set of plant design parameters. Therefore, the staff cannot evaluate the potential effects of accidents on control room habitability at this time. The staff will evaluate such effects at the COL stage.

2.2.3.4 Conclusions

As discussed above, the applicant has identified potential accidents related to the presence of hazardous materials or activities on or near the ESP site that could affect a nuclear power plant(s) represented by the chosen PPE. The applicant also identified accidents that should be considered as design-basis events at the COL or CP stage according to 10 CFR Part 100. Therefore, the staff concludes that the site location is acceptable with regard to potential accidents that could affect a nuclear power plant(s) based on the applicant's PPE that might be constructed on the site, and that the site location meets the requirements of 10 CFR 52.17(a)(1)(vii), 10 CFR 100.20(b), and 10 CFR 100.21(e).

2.3 Meteorology

To ensure that a nuclear power plant(s) can be designed, constructed, and operated on an applicant's proposed ESP site in compliance with the NRC regulations, the NRC staff evaluates regional and local climatological information, including climate extremes and severe weather occurrences, that may affect the design and siting of a nuclear plant. The staff reviews information concerning the atmospheric dispersion characteristics of a nuclear power plant site to determine whether the radioactive effluents from postulated accidental releases, as well as routine operational releases, are within Commission guidelines. The staff prepared Sections 2.3.1 through 2.3.5 of this SER in accordance with the review procedures described in RS-002, Attachment 2, using information presented in Section 2.3 of the SSAR, responses to staff RAIs, and generally available reference materials, as described in the applicable sections of RS-002, Attachment 2.

2.3.1 Regional Climatology

2.3.1.1 Technical Information in the Application

In this section of the SSAR, Exelon Generation Company, LLL (EGC or the applicant) presented information concerning the averages and the extremes of climatic conditions and regional meteorological phenomena that could affect the design and siting of a nuclear power plant(s) that falls within the applicant's PPE and that might be constructed on the proposed site. The applicant provided the following information:

- a description of the general climate of the region with respect to types of air masses, synoptic features (high- and low-pressure systems and frontal systems), general airflow patterns (wind direction and speed), temperature and humidity, precipitation (rain, snow, and sleet), and relationships between synoptic-scale atmospheric processes and local (site) meteorological conditions

- seasonal and annual frequencies of severe weather phenomena, including tornadoes, waterspouts, thunderstorms, lightning, hail (including probable maximum size), and high air pollution potential

- meteorological site characteristics to be used as minimum design and operating bases, including the following:

  - the maximum snow and ice load (water equivalent) on the roofs of safety-related structures

  - the ultimate heat sink (UHS) meteorological conditions resulting in the maximum evaporation and drift loss of water and minimum water cooling

  - the tornado parameters, including translational speed, rotational speed, and the maximum pressure differential with the associated time interval

  - the 100-year return period straight-line winds

  - other meteorological conditions used for design- and operating-basis considerations

The applicant characterized the regional climatology pertinent to the EGC ESP site using data reported by the U.S. National Weather Service (NWS) at the Peoria, Illinois, and Springfield, Illinois, first-order weather stations, as well as nearby cooperative observer stations, such as Decatur, Illinois. The applicant considered the Peoria and Springfield weather stations to be representative of the climate at the EGC ESP site, because of their relatively close proximity to the site and similarities in terrain and vegetation features. The applicant obtained information on severe weather from a variety of sources, such as publications by the National Climatic Data Center (NCDC), the American Society of Civil Engineers (ASCE), the Illinois State Climatologist Office (ISCO), and the Illinois State Water Survey (ISWS).

The EGC ESP site is located in the central climatic division of Illinois. The applicant described the climate as continental, with cold winters, warm summers, and frequent, short-period fluctuations in temperature, humidity, cloudiness, and wind direction. The great variability in the central Illinois climate is because of its location in a confluence zone, particularly during the cooler months, between different air masses. The air masses that affect central Illinois typically include maritime tropical air, which originates in the Gulf of Mexico; continental tropical air, which originates in Mexico and the southern Rockies; Pacific air, which originates in Mexico and the eastern North Pacific Ocean; and continental polar and continental arctic air, which originates in Canada.

The applicant noted that, for the most part, the general synoptic conditions dominate the climactic characteristics of the site region. However, during periods of extreme temperatures or light wind conditions, the local conditions influence the site's meteorology. Nearby Clinton Lake can have a moderating effect with respect to extreme temperatures in the immediate vicinity of the site.

The applicant reported that Peoria and Springfield average approximately 2.2 hail days per year, with about 55 percent of all hail days occurring in the spring. There is considerable year-to-year

variation in the number of days with hail, with some years reporting as many as 8 hail days. During the 13-year period from 1955 to 1967, the 1-degree latitude by longitude square containing the EGC ESP site (approximately 9400 square kilometers) had 15 hailstorms producing hail 0.75 inch in diameter or greater.

According to the applicant, about 48 thunderstorm days can be expected yearly, most frequently during June and July. The applicant conservatively estimated that there are approximately 9.4 lightning flashes to earth per year per square kilometer around the site area. Considering the frequency of thunderstorms and the size of the EGC ESP site (14,000 acres or 56.7 square kilometers (the EGC ESP site boundary is the same as the Clinton Power Station (CPS) property lines), the applicant estimated the expected frequency of lightning flashes at the site at 533 per year. The expected frequency of lightning flashes within the 3.3 square kilometer exclusion area is 31 flashes per year.

The applicant originally reported 11 tornadoes for DeWitt County during the period 1950–2002. Since there were numerous tornadoes reported in Illinois during 2003, the staff requested, in RAI 2.3.1-1, that the applicant update the tornado data presented in its SSAR to include tornado occurrences recorded during 2003. In its response to RAI 2.3.1-1, the applicant revised its tornado statistics for DeWitt County, stating that 18 tornadoes were reported during the period 1950–2003. Using various sets of tornado data statistics for the EGC ESP site region, the applicant calculated an annual tornado probability for a tornado of any intensity in the EGC ESP site region as ranging from 1.5×10^{-3} to 3.1×10^{-3}, which corresponds to a tornado return period ranging from 325 to 670 years. For violent tornadoes (F4 or greater; wind speeds in excess of 207 miles per hour (mi/h)), the applicant calculated an annual tornado probability ranging from 3.8×10^{-5} to 7.9×10^{-5}, which corresponds to a return period ranging from 12,800 to 26,300 years.

The applicant chose a tornado site characteristic wind speed of 300 mi/h based on the maximum tornado wind speed recommended in SECY-93-087, “Policy, Technical, Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,” for use in the design of evolutionary and passive advanced light-water reactors (ALWRs). Since it does not believe that citing SECY-93-087 (or any other document related to design certification) is an adequate justification for selecting a site characteristic tornado wind speed, the staff requested, in RAI 2.3.1-9, that the applicant provide a safety justification for choosing 300 mi/h as the site characteristic tornado wind speed. In its response to RAI 2.3.1-9, the applicant cited a tornado study covering much of the United States east of the Rocky Mountains which showed that the maximum tornado wind speed expected in central Illinois (where the EGC ESP site is located), at a probability level of $10^{!7}$ per year, is between 250 and 300 mi/h. The applicant chose the other tornado site characteristics (e.g., maximum pressure drop, rate of pressure drop) based on the characteristics associated with a tornado wind speed of 300 mi/h, as identified in the staff’s interim position on the design-basis tornado (NRC, “ALWR Design-Basis Tornado”).
Table 2.3.1-1 lists the applicant’s proposed tornado site characteristics.

Table 2.3.1-1 Applicant's Proposed Tornado Site Characteristics

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Maximum Wind Speed	300 mi/h	The design assumption for the sum of maximum rotational and maximum translational wind speed components
Maximum Translational Speed	60 mi/h	The design assumption for the component of tornado wind speed resulting from the movement of the tornado over the ground
Maximum Rotational Speed	240 mi/h	The design assumption for the component of tornado wind speed caused by the rotation within the tornado
Radius of Maximum Rotational Speed	150 feet	The design assumption for distance from the center of the tornado at which the maximum rotational wind speed occurs
Maximum Pressure Drop	2.0 pounds-force per square inch (lbf/in.^{2})	The design assumption for the decrease in ambient pressure from normal atmospheric pressure resulting from the passage of the tornado
Rate of Pressure Drop	1.2 lbf/in.^{2}/s	The assumed design rate at which the pressure drops resulting from the passage of the tornado

The applicant stated that the highest "fastest mile" wind speeds observed at the Peoria and Springfield weather stations were 75 mi/h. In RAI 2.3.1-3, the staff requested that the applicant clarify the fastest mile and peak wind speed data that it presented in the SSAR. As part of its response to RAI 2.3.1-3, the applicant reported that the Peoria and Springfield data represent the 67-year period between 1930 and 1996. The applicant selected this wind speed value as the basic wind speed site characteristic. In RAI 2.3.1-2, the staff asked the applicant to also provide a 3-second gust wind speed that represents a 100-year return. In its response to RAI 2.3.1-2, the applicant provided a 3-second gust wind speed value of 96 mi/h, but did not propose this value as a site characteristic. Instead, the applicant stated that the 3-second gust wind speed site characteristic will be determined at the COL or CP stage, based on the applicable design standard at the time. In its subsequent letter dated April 26, 2005, the applicant chose to identify the 3-second gust wind speed value of 96 mi/h as a site characteristic at the ESP stage rather than at the COL stage.

Table 2.3.1-2 presents the applicant's proposed basic wind speed site characteristics.

Table 2.3.1-2 Applicant's Proposed Basic Wind Speed Site Characteristics

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Basic Wind Speed	75 mi/h	The design wind, or fastest mile of wind with a 100-year return period, for which the facility is designed
3-Second Gust	96 mi/h	The 3-second gust wind velocity associated with a 100-year return period at 33 feet (10 meters) above the ground level in the site area

In the SSAR, the applicant reported that severe winter storms, which usually produce snowfall in excess of 6 inches and are often accompanied by damaging glaze ice, produce more damage than any other form of short-term severe weather, including hail, tornadoes, and lightning. Central Illinois had 107 occurrences of a 6-inch snow or glaze damage area during the years from 1900 through 1960, and about 42 of those storms deposited more than 6 inches of snowfall in DeWitt County. During this same 61-year period, there were 92 severe glaze storms in Illinois, defined as damaging, widespread, or both. The EGC ESP site region averaged slightly more than 5 days of glaze per year during the period 1901–1962, and 11 localized areas within the central third of Illinois can expect to receive damaging glaze during a typical 10-year period. An average of one storm every 3 years will produce glaze ice 0.75 inch or thicker on wires.

According to the applicant, the estimated 2-day and 7-day maximum snowfalls for the EGC ESP site region associated with a 50-year recurrence interval are 15.2 inches and 22.0 inches, respectively. The staff requested clarification on the regional snowfall and snowpack data, as well as the winter probable maximum precipitation value (also known as the "probable maximum winter precipitation" or PMWP) in RAIs 2.3.1-4, 2.3.1-5, 2.3.1-6, and 2.3.1-10. In its response to RAI 2.3.1-4, the applicant stated that the maximum monthly and 24-hour snowfalls recorded in the Springfield area are 24.4 inches and 15.0 inches, respectively. In its response to RAI 2.3.1-10, the applicant noted that the maximum recorded monthly snowfall in the EGC ESP site region is 30.5 inches, which was recorded in Decatur.

The applicant initially provided a 100-year return period ground-level snowpack estimate of 22 pounds-force per square foot (lbf/ft^2), which it later revised to 24.4 lbf/ft^2 in response to RAI 2.3.1-5. The applicant also provided a 48-hour PMWP value of 15.2 inches of water, which it subsequently revised to 16.6 inches of water in response to RAI 2.3.1-6. The 48-hour PMWP value of 16.6 inches corresponds to approximately 86 lbf/ft^2. The combined 100-year return snowpack and the estimated PMWP is 110.4 lbf/ft^2, which the applicant contends is an extremely conservative and highly unlikely snow/ice roof loading for a structure in Illinois. In its response to RAI 2.3.1-6, the applicant proposed defining the site characteristic ground snow load as 40 lbf/ft^2, which represents a combination of the 100-year return snowpack (24.4 lbf/ft^2) and the maximum recorded monthly snowfall in the region (30.5 inches of snow, which is approximately equivalent to 3 inches of water or 15.6 lbf/ft^2).

Table 2.3.1-3 cites the applicant's proposed winter precipitation site characteristics.

Table 2.3.1-3 Applicant's Proposed Winter Precipitation Site Characteristics

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Snow Load	40 lbf/ft^2	The maximum load on structure roofs resulting from the accumulation of snow that can be accommodated by a plant design

In the SSAR, the applicant indicated that the controlling meteorological parameters for the type of UHS that it selected (i.e., mechanical draft cooling towers with makeup water from Clinton Lake) is the wet-bulb temperature. In RAI 2.3.1-7, the NRC staff requested that the applicant clarify the meteorological data that it would use to evaluate the performance of the UHS mechanical draft cooling towers with respect to maximum evaporation, drift loss, and minimum water cooling, as discussed in RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants." In its response to RAI 2.3.1-7, the applicant reiterated that it calculated a maximum evaporation rate of 700 gallons per minute (Item 3.3.7 in SSAR Table 1.4-1) based on the maximum system heat load and the amount of water that would need to be evaporated to dissipate that heat load. The applicant considers this a highly conservative value because the actual amount of evaporative cooling that would be necessary would be less for any time period, including the worst 30-day period discussed in RG 1.27. The applicant stated that the final design of the cooling towers would account for the bounding ambient air temperature and humidity site characteristic conditions presented in SSAR Table 1.4-1, which include a design wet-bulb temperature of 77.2 EF that is exceeded less than 1 percent of the time and a maximum wet-bulb temperature of 86 EF. The applicant indicated that it did not expect drift loss to be a critical design parameter since the drift in a modern cooling tower is typically very low (on the order of 0.1 percent or less).

In Open Item 2.3-1, the staff reiterated that the applicant did not adequately identify the meteorological data to use in evaluating the performance of a mechanical draft cooling tower UHS with respect to maximum evaporation and minimum water cooling, as discussed in RG 1.27. In its submission to the NRC dated April 4, 2005, the applicant responded to Open Item 2.3-1 by examining temperature and humidity data from both the Peoria and Springfield weather stations for the years 1961–1990 to determine the meteorological site characteristics for the UHS, in accordance with RG 1.27. The applicant stated that the controlling parameters for the type of UHS it selected are the wet-bulb temperature and the coincident dry-bulb temperature. The applicant considered the worst (i.e., highest) 30-day running average of wet-bulb temperatures and coincident dry-bulb temperatures to represent the meteorological conditions resulting in maximum evaporation and drift loss. Likewise, the applicant considered the worst (i.e., highest) 1-day and 5-day running average of wet-bulb temperatures and coincident dry-bulb temperatures to represent the meteorological conditions resulting in minimum water cooling. Consequently, the applicant calculated the worst 1-day, worst 5-day, and worst 30-day running average wet-bulb temperatures and coincident dry-bulb temperatures as UHS meteorological site characteristic values.

In Open Item 2.3-2, the staff identified the need for an additional UHS meteorological site characteristic for use in evaluating the potential for water freezing in the UHS water storage facility, a phenomenon which would reduce the amount of water available for use by the UHS. In its submission to the NRC dated April 26, 2005, the applicant responded to Open Item 2.3-2 by proposing to use the maximum cumulative degree-days below freezing during the winter as the

relevant site characteristic. This site characteristic is discussed in detail in Section 2.4.7 of this SER.

Table 2.3.1-4 presents the applicant's proposed UHS meteorological site characteristics.

Table 2.3.1-4 Applicant's Proposed Ultimate Heat Sink Meteorological Site Characteristics

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Maximum 30-Day Average Wet-Bulb Temperature	74.7 EF	The historical maximum 30-day running average wet-bulb temperature observed in the site region
Coincident 30-Day Average Dry-Bulb Temperature	82 EF	The 30-day average dry-bulb temperature that coincides with the historical maximum 30-day average wet-bulb temperature
Maximum 1-Day Average Wet-Bulb Temperature	81 EF	The historical maximum 1-day average wet-bulb temperature observed in the site region
Coincident 1-Day Average Dry-Bulb Temperature	87.6 EF	The 1-day average dry-bulb temperature that coincides with the historical maximum 1-day average wet-bulb temperature
Maximum 5-Day Average Wet-Bulb Temperature	79.7 EF	The historical maximum 5-day average wet-bulb temperature observed in the site region
Coincident 5-Day Average Dry-Bulb Temperature	86.2 EF	The 5-day average dry-bulb temperature that coincides with the historical maximum 5-day average wet-bulb temperature

The applicant stated that central Illinois is in a relatively favorable dispersion regime that has a relatively low frequency of extended periods of high air pollution potential. Inversions based below 500 feet occur in the general area of the EGC ESP site during approximately 33 percent of the total hours throughout the year and occur most frequently in the fall (39 percent of the total time) and least frequently in the winter and spring (29 percent of the total time for each season). Seasonal morning average mixing layer heights in the EGC ESP site region range from a low of 330 meters during the summer to a high of 490 meters in the spring, and seasonal afternoon average mixing layer heights range from a low of 690 meters in the winter to a high of 1600 meters in the summer.

In RAI 2.3.1-8, the staff requested that the applicant provide ambient air temperature and humidity site characteristics. In its response to RAI 2.3.1-8, the applicant provided dry-bulb and wet-bulb temperature site characteristics based on temperature and humidity data recorded at the Peoria and Springfield weather stations. Table 2.3.1-5 presents the applicant's proposed ambient air temperature and humidity site characteristics.

Table 2.3.1-5 Applicant's Proposed Ambient Air Temperature and Humidity Site Characteristics

SITE CHARACTERISTIC		VALUE	DESCRIPTION
Maximum Dry-Bulb Temperature	2% annual exceedance	88 EF with 74 EF concurrent wet-bulb	Wet-bulb and dry-bulb temperatures associated with the listed exceedance values and the 100-year return period
	1% annual exceedance	91 EF	
	0.4% annual exceedance	94 EF with 77 EF concurrent wet-bulb	
	0% annual exceedance	117 EF	
	100-year return period	117 EF with 86 EF concurrent wet-bulb	
Minimum Dry-Bulb Temperature	1% annual exceedance	0 EF	
	0.4% annual exceedance	!6 EF	
	0% annual exceedance	!36 EF	
	100-year return period	!36 EF	
Maximum Wet-Bulb Temperature	1% annual exceedance	78 EF	
	0.4% annual exceedance	80 EF	
	0% annual exceedance	86 EF	
	100-year return period	86 EF	

2.3.1.2 Regulatory Evaluation

In response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the regulations applicable to the ESP SSAR. RS-002, Attachment 2, identifies the following applicable NRC regulations regarding regional climatology:

- Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50, "Domestic Licensing of Production and Utilization Facilities," of Title 10 of the *Code of Federal Regulations* (10 CFR), General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," with respect to information on severe regional weather

phenomena that have historically been reported for the region and that are reflected in the design bases for SSCs important to safety

- Appendix A to 10 CFR Part 50, GDC 4, “Environmental and Dynamic Effects Design Bases,” with respect to information on tornadoes that could generate missiles

- 10 CFR 100.20(c) and 10 CFR 100.21(d), with respect to the consideration of the regional meteorological characteristics of the site

In SSAR Sections 1.1.1, 1.5, and 2.3.1, the applicant identified the following applicable NRC guidance regarding regional climatology:

- RG 1.27, Revision 2, with respect to the meteorological conditions that should be considered in the design of the UHS

- Section 2.3.1 of RG 1.70 with respect to the type of general climate and regional meteorological data that should be presented

- RG 1.76, “Design-Basis Tornado for Nuclear Power Plants,” issued April 1974, with respect to the characteristics of the design-basis tornado

The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance, with the exception that an ESP applicant need not demonstrate compliance with the GDC.

Section 2.3.1 of RS-002, Attachment 2, and RG 1.70 provide the following guidance on information appropriate for determining regional climatology:

- The description of the general climate of the region should be based on standard climatic summaries that the National Oceanic and Atmospheric Administration compiles. Consideration of the relationships between regional synoptic-scale atmospheric processes and local (site) meteorological conditions should be based on appropriate meteorological data.

- Data on severe weather phenomena should be based on standard meteorological records from nearby representative NWS, military, or other stations recognized as standard installations that have long periods of data on record. The applicability of these data to represent site conditions during the expected period of reactor operation should be substantiated.

- Tornado site characteristics may be based on RG 1.76 or the staff’s interim position on design-basis tornado characteristics (NRC, “ALWR Design-Basis Tornado”). An ESP applicant may specify any tornado wind speed site characteristics that are appropriately justified, provided that it conducts a technical evaluation of site-specific data.

- Basic (straight-line) wind speed site characteristics should be based on appropriate standards, with suitable corrections for local conditions.
- The UHS meteorological data, as stated in RG 1.27, should be based on long-period regional records that represent site conditions. Suitable information may be found in

climatological summaries for the evaluation of wind, temperature, humidity, and other meteorological data used for UHS design.

- Freezing rain estimates should be based on representative NWS station data.

- High air pollution potential information should be based on U.S. Environmental Protection Agency (EPA) studies.

- All other meteorological and air quality data to be used for safety-related plant design and operating bases should be documented and substantiated.

2.3.1.3 Technical Evaluation

The staff evaluated regional meteorological conditions using information that the NCDC, National Severe Storms Laboratory (NSSL), ISCO, and ASCE reported. The staff reviewed statistics for the following climatic stations located in the vicinity of the EGC ESP site:

- Clinton, Illinois, located approximately 7 miles west-southwest of the ESP site
- Decatur, Illinois, located approximately 24 miles south-southwest of the ESP site
- Lincoln, Illinois, located approximately 26 miles west of the ESP site
- Springfield, Illinois, located approximately 50 miles west-southwest of the ESP site
- Peoria, Illinois, located approximately 56 miles west-northwest of the ESP site

The staff concurs with the applicant's description of the general climate of the region, which is consistent with a narrative of the climate of Illinois published by ISCO (ISCO, "Climate of Illinois"). The staff also finds the applicant's estimates of thunderstorm-day frequency consistent with regional data and its estimates of expected frequency of lightning flashes to be consistent with accepted methodology.

Hail often accompanies severe thunderstorms and can be a major weather hazard, causing damage to crops and property. According to NSSL, the threat of hail occurring within 25 miles of the EGC ESP site is approximately 2–3 days per year for damaging hail, or hail 0.75 inch in diameter or greater, and 0.50 to 0.75 days per year for hail 2 inches or more in diameter (NSSL, "Severe Thunderstorm Climatology").

The above discussion on lightning and hail provides a general climatic understanding of the severe weather phenomena in the site region but does not result in the generation of site characteristics for use as design or operating bases.

According to NSSL, the mean number of days per year with the threat of tornados occurring within 25 miles of the EGC ESP site is approximately 1.0 to 1.2 days per year for any tornado, approximately 0.20 to 0.25 days per year for a significant tornado (F2 or greater; wind speeds in excess of 113 mi/h), and approximately 0.015 to 0.020 days per year for a violent tornado (F4 or greater; wind speeds in excess of 207 mi/h) (NSSL, "Severe Thunderstorm Climatology").

At the staff's direction, Pacific Northwest National Laboratories (PNNL) prepared a technical evaluation report evaluating the tornado site characteristics for the EGC ESP site (Ramsdell, "Technical Evaluation Report on Design Basis Tornadoes for the EGC ESP Site"). This report derived a best estimate annual tornado strike probability of 1.2×10^{-3}, based on tornado data

from the period January 1950 through August 2003. This corresponds to a mean recurrence interval of 833 years, which is slightly less conservative than the applicant's calculated tornado return period (i.e., 325 to 670 years). The PNNL report also derived a best estimate 10^{-7} per year occurrence tornado site characteristic wind speed of 300 mi/h, which is equal to the applicant's tornado site characteristic wind speed. The applicant chose the other design-basis tornado characteristics (such as translation speed, rotational speed, etc.) associated with a tornado wind speed of 300 mi/h as identified in the staff's interim position (NRC, "ALWR Design Basis Tornado"). Therefore, the staff concludes that the applicant's design-basis tornado site characteristics are acceptable.

The applicant's proposed basic wind speed site characteristic of 75 mi/h is compatible with the fastest mile wind speeds having a 1 percent annual probability of being exceeded (100-year mean recurrence interval) of 75 mi/h and 74 mi/h for Peoria and Springfield, respectively, as reported in Table A7 of American National Standards Institute (ANSI) A58.1-1982, "Minimum Design Loads for Buildings and Other Structures." Therefore, the staff concludes that a fastest mile basic wind speed site characteristic of 75 mi/h is acceptable.

The applicant also defined a 3-second gust wind speed site characteristic of 96 mi/h, based on a 100-year return period at 10 meters above the ground. The applicant determined this value in accordance with the guidance provided by Structural Engineering Institute (SEI)/ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures." Therefore, the staff concludes that a 3-second gust basic wind speed site characteristic of 96 mi/h is acceptable.

The NCDC reports a 50-year period return period uniform radial ice thickness of 1 inch because of freezing rain, with a concurrent 3-second gust wind speed of 40 mi/h for the EGC ESP site area (Jones et al., "The Development of a U.S. Climatology of Extreme Ice Loads").

Snowfall in the site vicinity averages approximately 21.9 inches per year, based on historical data collected during the period 1971–2000 at the Decatur cooperative weather station. The highest monthly and seasonal total snowfalls recorded at Decatur during the period of record 1893–2001 were 30.5 inches and 49.7 inches, respectively (ISCO, "Historical Climate Summary—112193 Decatur, IL"). One of the highest reported 24-hour snowfall observations in the site region was 17.0 inches in December 1972 at Springfield (ISCO, "Historical Climate Summary—118179 Springfield WSO AP, IL").

RG 1.70 specifies both the weight of the 100-year return period snowpack and the weight of the 48-hour PMWP as a means of assessing the potential snow loads on the roofs of safety-related structures. The staff's branch position on winter precipitation loads (see memorandum dated March 24, 1975, from Harold R. Denton to R. R. Maccary) provides clarification as to the load combinations to be used in evaluating the roofs of safety-related structures. Consistent with the staff's branch position on winter precipitation loads, the winter precipitation loads included in the combination of normal live loads considered in the design of a nuclear power plant that might be constructed on a proposed ESP should be based on the weight of the 100-year snowpack or snowfall, whichever is greater, recorded at ground level. Likewise, the winter precipitation loads included in the combination of extreme live loads considered in the design of a nuclear power plant that might be constructed on a proposed ESP should be based on the weight of the 100-year snowpack at ground level plus the weight of the 48-hour PMWP at ground level for the month corresponding to the selected snowpack. A COL or CP applicant may choose to justify

an alternative method for defining the extreme winter precipitation load by demonstrating that the 48-hour PMWP could neither fall nor remain on the top of the snowpack and/or building roofs.

The applicant identified a 100-year return period snowpack of 24.4 lbf/ft^2 for the EGC ESP site, determining this value in accordance with the guidance of ASCE 7-98, "Minimum Design Loads for Buildings and Other Structures." Because the applicant performed its analysis in accordance with the appropriate guidance and the results bound the observations described above, the staff concludes that a 100-year return period snowpack site characteristic value of 24.4 lbf/ft^2 is acceptable.

The applicant identified a 48-hour PMWP value of 16.6 inches of water for the EGC ESP site. The applicant determined this value for a 296 square-mile drainage area (representing the drainage area surrounding the ESP site) using information available from HMR 51, "Probable Maximum Precipitation Estimates, United States East of the 105^{th} Meridian," and HMR 53, "Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian." The staff performed an independent 48-hour PMWP evaluation for a smaller (more conservative) 10 square-mile drainage basin using information available from HMR 53. The staff derived a 48-hour PMWP value of 18.2 inches of water for those months with the historically highest snow depths (i.e., December through March). The staff's slightly higher value is most likely the result of using a smaller drainage area (i.e., 10 square miles versus 296 square miles). Nonetheless, since the staff's 48-hour PMWP value is within 10 percent of the applicant's 48-hour PMWP value, the staff concludes that the applicant's 48-hour PMWP site characteristic value of 16.6 inches of water is acceptable.

The applicant proposed a site characteristic ground snow load value of 40 lbf/ft^2, which represents a combination of the 100-year return snowpack (24.4 lbf/ft^2) and the maximum-recorded monthly snowfall in the region (30.5 inches of snow, which is approximately equivalent to 15.6 lbf/ft^2). The applicant believes that the extreme winter precipitation roof load of 110.4 lbf/ft^2 (which represents the combined loading of the 100-year return snowpack and the 48-hour PMWP) is an unreasonable snow/ice roof loading for a structure at the EGC ESP site. Nonetheless, the staff has chosen not to include the applicant's proposed ground snow load value of 40 lbf/ft^2 as an ESP site characteristic. Once the roof design is known, the COL or CP applicant has the option to demonstrate that the 48-hour PMWP could neither fall nor remain entirely on top of the 100-year snowpack and/or building roofs.

In response to Open Item 2.3-1, the applicant provided UHS meteorological site characteristics to use in evaluating the performance of a mechanical draft cooling tower UHS with respect to maximum evaporation and minimum water cooling. To verify the applicant's site characteristics, the staff examined 30 years (1961–1990) of hourly temperature and humidity data from Peoria and Springfield (NCDC, "Solar and Meteorological Surface Observational Network (SAMSON) for Central U.S. CDROM"). The staff calculated 1-day, 5-day, and 30-day average wet-bulb temperatures from the hourly data and selected the periods with the highest average wet-bulb temperatures as the worst periods. The resulting maximum 1-day, 5-day, and 30-day average wet-bulb temperature values were similar to the values presented by the applicant. Therefore, the staff considers open Items 2.3-1 resolved.

The applicant provided an additional UHS meteorological site characteristic for use in evaluating the potential for water freezing in the UHS water storage facility in response to Open Item 2.3-2.

This site characteristic is discussed in detail in Section 2.4.7 of this SER. Based on the discussion in Section 2.4.7 of this SER, the staff considers open Items 2.3-2 resolved.

Based on the discussion presented above, the staff concludes that the UHS meteorological site characteristics proposed by the applicant are acceptable.

Large-scale episodes of atmospheric stagnation are not common in the site region. During the 40-year period from 1936 to 1975, high-pressure stagnation conditions lasting for 4 days or more occurred about 15 times, with an average of 5.4 stagnation days per case. Only two of these stagnation cases lasted 7 days or longer (Korshover, "Climatology of Stagnating Anticyclones East of the Rocky Mountains, 1936–1975"). This discussion of atmospheric stagnation provides a general climatic understanding of the air pollution potential in the region. Section 2.3.2 of this SER discusses the ESP air quality conditions considered for design and operating bases. Sections 2.3.4 and 2.3.5 of this SER present the atmospheric dispersion site characteristics used to evaluate short-term postaccident airborne releases and long-term routine airborne releases.

Normal climatic data for the period 1971–2000 that the NCDC reported for the central climatic division of Illinois indicate that the annual mean temperature in the area is about 50.9 EF and ranges from a low monthly mean value of 22.9 EF in January to a high monthly mean value of 74.9 EF in July (NCDC, "Central Illinois Divisional Normals—Temperature, Period 1971–2000"). One of the highest temperatures recorded in the site region was 113 EF at Decatur on July 14, 1954 (ISCO, "Historical Climate Summary—112193 Decatur, IL"), Lincoln on July 15, 1936 (ISCO, "Historical Climate Summary—115079 Lincoln, IL"), and Peoria on July 15, 1936 (ISCO, "Historical Climate Summary—116711 Peoria WSO Airport, IL"). One of the lowest temperatures recorded in the site region was !29 EF at Lincoln on December 26, 1914 (ISCO, "Historical Climate Summary—115079 Lincoln, IL").

The annual mean wet-bulb temperatures at Peoria and Springfield are 47.0 EF and 47.5 EF, respectively. The Peoria wet-bulb temperatures range from a high monthly mean value of 69.2 EF in July to a low monthly mean value of 23.4 EF in January, while the Springfield wet-bulb temperatures range from a high monthly mean value of 68.4 EF in July to a low monthly mean value of 25.5 EF in January. The annual mean relative humidity is 70 percent at both Peoria and Springfield (NCDC, "Peoria, Illinois, 2003 Local Climatological Data, Annual Summary with Comparative Data," and NCDC, "Springfield, Illinois, 2003 Local Climatological Data, Annual Summary with Comparative Data").

For the following reasons, the staff concurs with the applicant's temperature and humidity site characteristics. The applicant's 2-percent, 1-percent, and 0.4-percent annual exceedance maximum dry-bulb (and, where applicable, concurrent wet-bulb) temperatures, the 1-percent and 0.4-percent annual exceedance minimum dry-bulb temperatures, and the 1-percent and 0.4-percent exceedance maximum wet-bulb temperatures are based on the Peoria and Springfield data published by the NCDC (NCDC, "Engineering Weather Data CDROM").(1) The staff believes that the applicant used the record highest temperature for Illinois, as reported by both the NCDC (NCDC, "Temperature Extremes") and ISCO (ISCO, "Illinois Records"), to

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1 The data presented by the applicant as minimum 1-percent and 0.4-percent annual exceedance values are equivalent to the NCDC 99.0 and 99.6 percent occurrence values.

represent the 0-percent annual exceedance and 100-year return period maximum dry-bulb temperature values. Likewise, the applicant apparently used the record lowest temperature for Illinois, as reported by both the NCDC (NCDC, "Temperature Extremes") and ISCO (ISCO, "Illinois Records"), to represent the 0-percent annual exceedance and 100-year return period minimum dry-bulb temperature values. The applicant estimated the 100-year return period maximum wet-bulb temperature from the 2-percent occurrence and median annual extreme high wet-bulb temperatures reported for Peoria, Springfield, and Decatur (NCDC, "Engineering Weather Data CDROM").

To verify the applicant's 100-year return period data, the staff also calculated 100-year return period maximum and minimum dry-bulb temperatures and maximum wet-bulb temperatures using NCDC data for Peoria and Springfield during the period 1961–1990 (NCDC, "Solar and Meteorological Surface Observational Network (SAMSON) for Central U.S. CDROM") and algorithms based on the Gumbel Type 1 extreme value distribution defined in Chapter 27, "Climatic Design Information," of the 2001 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Handbook, *Fundamentals*. The staff found that the 100-year return period maximum and minimum dry-bulb temperatures and maximum wet-bulb temperature values presented by the applicant bound the corresponding values that the staff calculated.

The staff will include the regional climatology site characteristics listed in Table 2.3.1-6 in any ESP permit that the NRC might issue for the EGC ESP site.

Table 2.3.1-6 Staff's Proposed Regional Climatic Site Characteristics

SITE CHARACTERISTIC		VALUE	DESCRIPTION
Ambient Air Temperature and Humidity			
Maximum Dry-Bulb Temperature	2% annual exceedance	88 EF with 74 EF concurrent wet-bulb	The ambient dry-bulb temperature (and coincident wet-bulb temperature) that will be exceeded 2% of the time annually
	1% annual exceedance	91 EF	The ambient dry-bulb temperature that will be exceeded 1% of the time annually
	0.4% annual exceedance	94 EF with 77 EF concurrent wet-bulb	The ambient dry-bulb temperature (and coincident wet-bulb temperature) that will be exceeded 0.4% of the time annually
	100-year return period	117 EF	The ambient dry-bulb temperature that has a 1% annual probability of being exceeded (100-year mean recurrence interval)

SITE CHARACTERISTIC		VALUE	DESCRIPTION
Minimum Dry-Bulb Temperature	99% annual exceedance	0 EF	The ambient dry-bulb temperature below which dry-bulb temperatures will fall 1% of the time annually
	99.6% annual exceedance	!6 EF	The ambient dry-bulb temperature below which dry-bulb temperatures will fall 0.4% of the time annually
	100-year return period	!36 EF	The ambient dry-bulb temperature for which a 1% annual probability of a lower dry-bulb temperature exists (100-year mean recurrence interval)
Maximum Wet-Bulb Temperature	1% annual exceedance	78 EF	The ambient wet-bulb temperature that will be exceeded 1% of the time annually
	0.4% annual exceedance	80 EF	The ambient wet-bulb temperature that will be exceeded 0.4% of the time annually
	100-year return period	86 EF	The ambient wet-bulb temperature that has a 1% annual probability of being exceeded (100-year mean recurrence interval)
Basic Wind Speed			
Fastest Mile		75 mi/h	The fastest-mile wind speed to be used in determining wind loads, defined as the fastest-mile wind speed at 33 feet (10 meters) above the ground that has a 1% annual probability of being exceeded (100-year mean recurrence interval)
3-Second Gust		96 mi/h	The 3-second gust wind speed to be used in determining wind loads, defined as the 3-second gust wind speed at 33 feet (10 meters) above the ground that has a 1% annual probability of being exceeded (100-year mean recurrence interval)
Tornado			
Maximum Wind Speed		300 mi/h	Maximum wind speed resulting from passage of a tornado having a probability of occurrence of 10^{-7} per year
Translational Speed		60 mi/h	Translation component of the maximum tornado wind speed
Rotational Speed		240 mi/h	Rotation component of the maximum tornado wind speed
Radius of Maximum Rotational Speed		150 feet	Distance from the center of the tornado at which the maximum rotational wind speed occurs
Maximum Pressure Drop		2.0 lbf/in.^{2}	Decrease in ambient pressure from normal atmospheric pressure resulting from passage of the tornado

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Maximum Rate of Pressure Drop	1.2 lbf/in.^{2}/s	Rate of pressure drop resulting from the passage of the tornado
Winter Precipitation		
100-Year Snowpack	24.4 lbf/ft^2	Weight of the 100-year return period snowpack (to be used in determining normal winter precipitation loads for roofs)
48-Hour Probable Maximum Winter Precipitation	16.6 in. of water	Probable maximum precipitation during the winter months (to be used in conjunction with the 100-year snowpack in determining extreme winter precipitation loads for roofs)
Ultimate Heat Sink		
Meteorological Conditions Resulting in the Minimum Water Cooling during Any 1 Day	81 EF wet-bulb temperature with coincident 87.6 EF dry-bulb temperature	Historic worst 1-day average wet-bulb temperature and coincident dry-bulb temperature
Meteorological Conditions Resulting in the Minimum Water Cooling during Any Consecutive 5 Days	79.7 EF wet-bulb temperature with coincident 86.2 EF dry-bulb temperature	Historic worst 5-day average wet-bulb temperature and coincident dry-bulb temperature
Meteorological Conditions Resulting in the Maximum Evaporation and Drift Loss during Any Consecutive 30 Days	74.7 EF wet-bulb temperature with coincident 82 EF dry-bulb temperature	Historic worst 30-day average wet-bulb temperature and coincident dry-bulb temperature

The staff acknowledges that long-term climatic change resulting from human or natural causes may introduce trends into design conditions. However, no conclusive evidence or consensus of opinion is available on the rapidity or nature of such changes. If in the future the ESP site is no longer in compliance with the terms and conditions of the ESP (e.g., new information shows that the climatic site characteristics no longer represent extreme weather conditions resulting from climate change), the staff will seek to modify the ESP or impose requirements on the site in accordance with the provisions of 10 CFR 52.39, "Finality of Early Site Permit Determinations."

2.3.1.4 Conclusions

As set forth above, the applicant presented and substantiated information relative to the regional meteorological conditions important to the safe design and siting of a nuclear power plant(s) falling within its PPE that might be constructed on the proposed site. The staff reviewed the available information provided and, for the reasons given above, concludes that the identification and consideration of the regional and site meteorological characteristics set forth above meet the requirements of 10 CFR 100.20(c) and 10 CFR 100.21(d).

The staff finds that the applicant considered the most severe regional weather phenomena in establishing the site characteristics identified above. The staff has generally accepted the methodologies used by the applicant to determine the severity of the weather phenomena reflected in these site characteristics, as documented in SERs for previous licensing actions.

Accordingly, the staff concludes that the use of these methodologies results in site characteristics containing margin sufficient for the limited accuracy, quantity, and period of time in which the data were accumulated. In view of the above, the site characteristics identified above are acceptable for use as part of the design bases for SSCs important to safety, as may be proposed in a COL application.

With regard to tornado wind speed, the applicant cited a tornado study covering much of the United States east of the Rocky Mountains, including central Illinois where the EGC ESP site is located. The staff conducted its own evaluation of site-specific tornado data and concluded that the results justify the applicant's proposed site tornado characteristics. In addition, the staff finds that these tornado site characteristics are acceptable for the design-basis tornado used for the generation of missiles.

The staff reviewed the applicant's proposed site characteristics related to climatology for inclusion in an ESP for the site, if one is issued, and finds these characteristics acceptable. The staff also reviewed the applicant's proposed design parameters (PPE values) for inclusion in such an ESP (SSAR Section 1.3) and finds them to be reasonable. The staff did not perform a detailed review of these parameters.

2.3.2 Local Meteorology

2.3.2.1 Technical Information in the Application

In this section of the SSAR, the applicant presented local (site) meteorological information. This SSAR section also addresses the potential influence of construction and operation of a nuclear power plant(s) falling within the applicant's PPE on local meteorological conditions that might in turn adversely impact such plant(s) or the associated facilities. Finally, the applicant provided a topographical description of the site and its environs and presented the following information:

- a description of the local (site) meteorology in terms of airflow, temperature, atmospheric water vapor, precipitation, fog, atmospheric stability, and air quality

- an assessment of the influence on the local meteorology of the construction and operation of a nuclear power plant(s) and its facilities falling within the applicant's PPE that might be built on the proposed site, including the effects of plant structures, terrain modification, and heat and moisture sources resulting from plant operation

- a topographical description of the site and its environs, as modified by the structures of a nuclear power plant(s) falling within the applicant's PPE that might be constructed on the proposed site

The applicant characterized local meteorological conditions using data collected from the meteorological monitoring program at the existing CPS. According to the applicant, the meteorological variables collected by the CPS monitoring program are appropriate for use in describing local meteorological conditions because of the proximity of the CPS meteorological tower to the ESP site. The applicant used two periods of record to characterize local meteorological conditions—April 1972 through April 1977 (pre-CPS construction) and January 2000 through August 2002 (post-CPS construction).

The applicant presented wind data from the 10-meter (33-foot) level of the CPS onsite meteorological tower for both the pre-CPS construction period (1972–1977) and the post-CPS construction period (2000–2002). The 1972–1977 wind direction data indicate that the predominant wind directions were from the south and south-southwest (about 10 percent of the time for each sector). The 2000–2002 wind data indicate that the predominant wind directions were from the south (about 11 percent of the time) and south-southwest (about 10 percent of the time). The 1972–1977 median wind speed was about 3.8 meters per second (m/s) as compared to the 2000–2002 median wind speed of approximately 2.8 m/s. Seasonal variations are also evident from the data, with winter months showing generally higher wind speeds, fewer calms, and more west-northwest wind in comparison to the summer months.

The average ambient dry-bulb temperature recorded on site during the period of record 1972–1977 was 10.5 EC (50.9 EF), ranging from a low monthly mean value of !5.1 EC (22.8 EF) in January to a high monthly mean value of 23.6 EC (74.5 EF) in July. The annual average relative humidity during the same period of record was 68.3 percent. The annual average dewpoint temperature was 4.7 EC (40.5 EF), ranging from a low monthly mean value of !7.8 EC (18.0 EF) in January to a high monthly mean value of 16.5 EC (61.7 EF) in July. Table 2.3-13 of the SSAR also contains a summary of CPS wet-bulb temperature measurements.

In RAI 2.3.2-6, the staff inquired about the CPS wet-bulb temperature statistics, given that nearly all of the CPS wet-bulb temperature values presented in SSAR Table 2.3-13 exceeded the corresponding CPS dry-bulb temperature values presented in SSAR Table 2.3-9. In its response to RAI 2.3.2-6, the applicant agreed that the wet-bulb temperatures presented in SSAR Table 2.3-13 were inconsistent with what would be expected when compared to the dry-bulb temperatures in SSAR Table 2.3-9. Since it did not use the wet-bulb temperatures presented in Table 2.3-13 to define any site characteristics, the applicant committed to deleting the SSAR Table 2.3-13 wet-bulb temperature data from the SSAR.

Since the temperature and humidity data presented in the SSAR were collected during the period 1972–1977 (before the installation of Clinton Lake and the operation of the CPS once-through cooling system), the staff asked the applicant in RAI 2.3.2-2 whether these data remain representative of the EGC ESP site, given that the site is now adjacent to a heated lake. The applicant responded that, since the meteorological tower is located approximately 0.5 miles from the nearest shoreline and the nearest shoreline is more than 4 miles downstream of the CPS thermal plume discharge location, it expects that the heating effects attributable to elevated water temperatures in the lake are minimal, if even measurable, at the location of the meteorological tower. The applicant made qualitative comparisons of the 1972–1977 and 2000–2002 temperature and humidity datasets, concluding that the two datasets were compatible, given the kinds of variations that would be expected for the two periods of record.

The average yearly precipitation recorded on site during the period of record, 1972–1977, was 25.47 inches, with monthly averages ranging from 1.15 inches in February to 4.16 inches in June.

According to the applicant, the closest locations to the EGC ESP site that have a fog dataset are Peoria and Springfield. Peoria averages 20 days per year of heavy fog, whereas Springfield averages 18.5 days of heavy fog per year. The highest occurrence of fog is in the winter months for both locations. The applicant noted that the Peoria and Springfield fog statistics should be considered regional estimates because they do not account for any local fog occurrences

resulting from the once-through cooling system (Clinton Lake) used by the existing CPS. The applicant presented the results of an analytical model used as part of the license application for CPS to estimate the impacts of fog associated with the presence of Clinton Lake and the once-through cooling system. This model predicted that 316 hours of heavy fog would occur at the CPS reactor building complex. The model also predicted the maximum horizontal extent of steam fog from Clinton Lake as 1 mile or less, with the extent of extremely dense steam fog being limited to an area immediately adjacent to Clinton Lake.

The SSAR presents atmospheric stability data for the periods 1972–1977 and 2000–2002, based on delta-temperature measurements between the 60-meter and 10-meter levels on the CPS meteorological tower and the variation of horizontal wind direction. Data for the later time period show that neutral (Pasquill type “D”) and slightly stable (Pasquill type “E”) conditions predominate, occurring about 35 percent and 25 percent of the time, respectively. Moderately stable (Pasquill type “F”) and extremely stable (Pasquill type “G”) conditions occur about 9 percent and 4 percent of the time, respectively.

In RAI 2.3.2-5, the staff asked the applicant to identify the air quality characteristics that would be included in the design and operating bases for a nuclear plant(s) that might be constructed on the ESP site. The applicant responded that the ESP site is located within the east-central Illinois Interstate Air Quality Control Region, which has been designated as in attainment of the national ambient air quality standards. Before construction, the Illinois EPA will require the ESP facility to obtain air permits demonstrating that the ambient air quality standards will not be threatened or exceeded as a result of the facility’s operation.

The applicant stated that the construction and operation of the ESP facility may influence the local meteorology of the area in the immediate vicinity of the ESP facility, primarily because of minor changes to the topography resulting from the construction of additional buildings and supporting infrastructure and the use of cooling towers for system heat rejection to the atmosphere. The applicant expects that the minor changes in local topography will not have a significant impact on diffusion characteristics except in the immediate vicinity of the buildings themselves.

The use of natural draft cooling towers or mechanical draft cooling towers or both for system heat rejection will result in visible moisture plumes from the cooling towers, primarily during winter months when ambient air temperatures are cool and the air is moist. Icing caused by the freezing of condensed water vapor from the cooling tower plumes could affect vertical surfaces (such as buildings and equipment) and horizontal surfaces (such as roadways) in the immediate vicinity of the cooling towers. The applicant expects that these impacts will occur only at onsite locations. In the SSAR, the applicant stated that the quantification of these ambient impacts will require a more in-depth assessment once it determines the facility’s cooling system configuration and design parameters.

The applicant stated that the ESP site region is characterized by relatively flat terrain ranging from 95 feet below to 25 feet above the site elevation within 5 miles of the site. A large portion of the topographic relief in the immediate site area is filled by Clinton Lake, which is approximately 45 feet below plant grade. Because of the lake’s complex configuration, over-water trajectories would generally be less than 1.1 miles. The applicant expects that the low hills and shallow river valleys that exist in the site region could exert a small effect upon nocturnal wind drainage patterns and fog frequency under certain atmospheric conditions.

2.3.2.2 Regulatory Evaluation

In response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the regulations applicable to the ESP SSAR. RS-002, Attachment 2, identifies the following applicable NRC regulations regarding local meteorology:

- Appendix A to 10 CFR Part 50, GDC 2, with respect to information on severe regional weather phenomena that has historically been reported for the region and that is reflected in the design bases for SSCs important to safety

- 10 CFR 100.20(c) and 10 CFR 100.21(d), with respect to the consideration that has been given to the regional meteorological characteristics of the site

In SSAR Sections 1.1.1 and 1.5, and in response to RAI 2.3.3-2, the applicant identified the following applicable NRC guidance regarding local meteorology:

- RG 1.23, second proposed Revision 1, "Meteorological Measurement Programs for Nuclear Power Plants," issued April 1986, with respect to the criteria for an acceptable onsite meteorological measurements program

- Section 2.3.2 of RG 1.70, with respect to the type of local meteorological information that should be presented, including the potential impact of the plant on local meteorology and the local meteorological and air quality conditions used for design- and operating-basis considerations

The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance, with the exception that an ESP applicant need not demonstrate compliance with the GDC.

Section 2.3.2 of RS-002, Attachment 2, and RG 1.70 provide the following guidance on information appropriate for a presentation on local meteorology:

- Local meteorological data based on onsite measurements and data from nearby NWS stations or other standard installations should be presented in the format specified in Section 2.3.2 of RG 1.70. Guidance related to onsite meteorological measurements is in RG 1.23.

- A topographical description of the site and environs should be provided. Section 2.3.2.2 of RG 1.70 provides guidance on the topographical description.

- A discussion and evaluation of the influence of a nuclear power plant(s) and its facilities of specified type (or falling within a PPE) that might be constructed on the proposed site on local meteorological and air quality conditions should be provided. Potential changes in the normal and extreme values resulting from plant construction and operation should be discussed.

2.3.2.3 Technical Evaluation

The staff evaluated local meteorological conditions using data from the CPS onsite meteorological monitoring system, as well as climatic data that NCDC and ISCO reported. Section 2.3.3 of this SER provides a discussion of the representativeness of the CPS onsite data.

The staff's review of the applicant's wind data from April 1972 through April 1977 and January 2000 through August 2002 shows that the data from these two periods compare well, with a general shift toward lower wind speeds in the more recent data. A comparison of the atmospheric stability distributions for these two measurement periods indicates that there may have been a shift in the distribution toward unstable conditions between the earlier period and the later period. This shift may be because of the heated cooling water in Clinton Lake from CPS affecting the lower level of the delta-temperature measurements. Clinton Lake was created and heated for the first time after the applicant completed the first data collection period and before it began the second data collection period.

The NCDC-reported normal climatic data for the period 1971–2000 for the central climatic division of Illinois indicate an annual mean temperature in the area of 50.9 EF, ranging from a low monthly mean value of about 22.9 EF in January to a high monthly mean value of about 74.9 EF in July (NCDC, "Central Illinois Divisional Normals—Temperature, Period 1971–2000"). These climatic division mean temperature values compare well with the mean temperature values recorded on site during the period of record 1972–1977 (e.g., annual mean temperature of 10.5 EC (50.9 EF) with a low monthly mean value of !5.1 EC (22.8 EF) in January and a high monthly mean value of 23.6 EC (74.5 EF) in July). One of the highest temperatures recorded in the site region was 113 EF at Decatur on July 14, 1954 (ISCO, "Historical Climate Summary—112193 Decatur, IL"), and one of the lowest temperatures recorded in the site region was !29 EF at Lincoln on December 26, 1914 (ISCO, "Historical Climate Summary—115079 Lincoln, IL"). These values bound the highest and lowest temperatures recorded on site, 35.2 EC (95.4 EF) and !28.8 EC (!19.8 EF), respectively, during the relatively short onsite period of record, 1972–1977.

The annual mean wet-bulb temperature at Peoria is 47.0 EF and ranges from a high monthly mean value of 69.2 EF in July to a low monthly mean value of 23.5 EF in January. The normal relative humidity at Peoria (71 percent) is similar to the onsite annual relative humidity (68.3 percent). Likewise, the mean dewpoint temperature at Peoria (42.2 EF) is compatible with the onsite annual dewpoint temperature of 4.7 EC (40.5 EF) (NCDC, "Peoria, Illinois, 2003 Local Climatological Data, Annual Summary with Comparative Data").

Precipitation for the central Illinois climatic division averages 37.39 inches per year, with monthly climate division normals ranging from a minimum of about 1.70 inches in January and February to a maximum of about 4.29 inches in May (**NCDC, "Central Illinois Divisional Normals—Precipitation, Period 1971-2000"**). Onsite precipitation data recorded during the period 1972–1977 show slightly lower precipitation totals. Maximum and minimum monthly amounts of precipitation observed in the area are 16.96 inches in May 1961 at Clinton (ISCO, "Historical Climate Summary—111743 Clinton, IL") and 0 inches in September 1979 at Springfield (ISCO, "Historical Climate Summary—118179 Springfield WSO AP, IL"). One of the highest 1-day precipitation totals recorded for the site region was 14.25 inches at Clinton on May 8, 1961 (ISCO, "Historical Climate Summary—111743 Clinton, IL").

The staff reviewed the applicant’s description of the local meteorology and determined that it represents the conditions at and near the site. The wind, temperature, precipitation, and atmospheric stability data are based on onsite data recorded by the CPS meteorological monitoring system. Section 2.3.3 of this SER provides a discussion of the representativeness of the CPS onsite data. The other meteorological summaries are based on data from nearby stations with long periods of record. A review of the recorded extreme values shows that they are reflected in the site characteristics presented in SSAR Section 2.3.1.

The staff reviewed the topographic maps and topographic cross sections included in the SSAR, concluding that the information needed is well labeled and can be readily extracted.

Because of the limited and localized nature of the expected terrain modifications associated with the development of the ESP facility, the staff finds that these terrain modifications, along with the resulting plant structures and associated improved surfaces, will not have enough of an impact on local meteorological conditions to affect plant design and operation. However, the use of natural draft cooling towers or mechanical draft cooling towers or both would cause visible moisture plumes and icing on nearby surfaces during the winter months. The applicant noted that the quantification of these ambient impacts will require a more in-depth assessment once the facility’s cooling system configuration and design parameters are determined. The COL or CP applicant will then need to describe how these potential increases in atmospheric moisture and icing would impact plant design and operation. This is **COL Action Item 2.3-1.**

Since the EGC ESP site is located in an air quality control region that has been designated as being in attainment of the national ambient air quality standards, the staff finds that it is not likely that the ESP site air quality conditions would be a significant factor in the design and operating bases for the ESP facility.

2.3.2.4 Conclusions

As set forth above, the applicant presented and substantiated information on local meteorological, air quality, and topographic characteristics of importance to the safe design and operation of a nuclear power plant(s) falling within its PPE that might be constructed on the proposed site. The staff reviewed the available information provided, and, for the reasons given, concludes that the applicant’s identification and consideration of the meteorological, air quality, and topographical characteristics of the site and the surrounding area meet the requirements of 10 CFR 100.20(c) and 10 CFR 100.21(d) and are sufficient to determine the acceptability of the site.

The staff also reviewed available information relative to severe local weather phenomena at the site and in the surrounding area. As set forth above, the staff concludes that the applicant identified the most severe local weather phenomena at the site and surrounding area.

2.3.3 Onsite Meteorological Measurements Program

2.3.3.1 Technical Information in the Application

In this section of the SSAR, the applicant presented the following information concerning its onsite meteorological measurements program, including instrumentation and measured data:

- a description of meteorological instrumentation, including siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, the quality assurance program for sensors and recorders, and data acquisition and reduction procedures

- meteorological data, including consideration of the period of record and amenability of the data for use in characterizing atmospheric dispersion conditions

The applicant currently uses the existing onsite meteorological measurements program for the CPS facility to collect data for the EGC ESP site and intends to use it in the future for any additional reactors that might be constructed on the ESP site.

The existing CPS monitoring program began in April 1972. The applicant referenced and used two different periods of onsite meteorological data in the SSAR. The first period, April 1972 through April 1977, is representative of the EGC ESP site before construction of CPS (including the filling of Clinton Lake). The applicant used data from this first period in the original construction and operating license environmental reports and the updated safety analysis report for CPS. The applicant used data from the second period, January 2000 through August 2002, to characterize current site-specific meteorological conditions. The applicant obtained data from both periods from the same instrumented onsite tower at the same levels above ground. During the course of operation, the applicant replaced various electronic components and sensors with equivalent or upgraded components as a matter of routine maintenance and repair.

In RAI 2.3.3-2, the staff asked the applicant to clarify the EGC ESP meteorological monitoring program commitments to regulatory guidance documents. In response to RAI 2.3.3-2, the applicant indicated that, since the meteorological monitoring system at CPS began operation, the system has been in compliance with NRC requirements. The CPS meteorological monitoring system currently meets the guidance of ANSI/American Nuclear Society (ANS) 2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Plants," proposed as Revision 1 to RG 1.23 with some exceptions.

The CPS meteorological monitoring program consists of a guyed, triaxial, open lattice 199-foot-tall tower located approximately 3200 feet south-southeast of the center of the CPS containment structure and approximately 1800 feet south-southeast of the center of the proposed location for a future EGC ESP facility. Wind speed and direction are measured at the 10-meter (33-foot) and 60-meter (198-foot) elevations. Ambient temperature and dewpoint temperature are measured at the 10-meter elevation and vertical temperature difference (delta-temperature) is measured between the 60-meter and 10-meter elevations. Precipitation is monitored at the ground level.

For the 1972–1977 period of operation, meteorological data were recorded on strip charts. The hourly database used for the climatic data summaries and atmospheric dispersion analyses was derived from the strip charts. For the 2000–2002 period of operation, a microprocessor recorded the meteorological data and generated the hourly database used for the climatic data summaries and atmospheric dispersion analyses presented in the SSAR.

The wind sensors are mounted on booms approximately twice the tower face width and are positioned so that the tower does not influence the prevailing south-southwest windflow. The

ambient temperature, dewpoint temperature, and delta-temperature sensors are housed in motor-aspirated shields to insulate them from the effects of precipitation and thermal radiation.

The meteorological monitoring system is calibrated at least semiannually. Data recovery for the 2000–2002 period of record used to evaluate atmospheric dispersion exceeded 90 percent.

Measurements are also available from a backup system. The backup monitoring system consists of wind speed and wind direction sensors located at the 10-meter level on the CPS microwave tower. The backup system is intended to function when the primary system is out of service, providing further assurance that basic meteorological information will be available during and immediately following an accidental release of airborne radioactivity.

In RAI 2.3.3-1, the staff asked the applicant to provide an hourly listing of the January 2000–August 2002 onsite meteorological database used to generate the SSAR Section 2.3.4 short-term diffusion estimates and the SSAR Section 2.3.5 long-term diffusion estimates. In its response to RAI 2.3.3-1, Exelon provided a copy of the January 2000–December 2002 database.

2.3.3.2 Regulatory Evaluation

In response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies regulations applicable to the ESP SSAR. RS-002, Attachment 2, identifies the following applicable NRC regulations regarding onsite meteorological measurement programs:

- Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 CFR Part 50, as it relates to meteorological data used to determine compliance with the numerical guides for doses in meeting the criterion of "as low as is reasonably achievable" (ALARA)

- 10 CFR 100.20(c), 10 CFR 100.21(c), and 10 CFR 100.21(d), as they relate to meteorological data collected for use in characterizing the site's meteorological conditions

In SSAR Sections 1.1.1, 1.5, and 2.3.3, as well as in its response to RAI 2.3.3-2, the applicant identified the following applicable NRC guidance regarding onsite meteorological measurements programs:

- RG 1.23, with respect to the criteria for an acceptable onsite meteorological measurements program

- Section 2.3.3 of RG 1.70, with respect to describing the meteorological measurements at the site and providing joint frequency distributions of wind speed and direction by atmospheric stability class

The staff reviewed this portion of the application for conformance with the applicable regulations, and considered the corresponding regulatory guidance.

Both RG 1.23 and RS-002, Attachment 2, Section 2.3.3, document the criteria for an acceptable onsite meteorological measurements program. The onsite meteorological measurements program should produce data that describe the meteorological characteristics of the site and its vicinity for the purpose of making atmospheric dispersion estimates for both postulated accidental and expected routine airborne releases of effluents, as well as for comparing with offsite sources to determine the appropriateness of climatological data used for design considerations.

Section 2.3.3 of RS-002, Attachment 2, and RG 1.70 provide guidance on information appropriate for presentation on an onsite meteorological measurements program. As set forth in this guidance, at least one annual cycle of onsite meteorological data should be provided. These data should be presented in the form of joint frequency distributions of wind speed and wind direction by atmospheric stability class in the format described in RG 1.23. If a site has a high occurrence of low wind speeds, a finer category breakdown should be used for the lower speeds so that data are not clustered in a few categories. A listing of each hour of the hourly averaged data should also be provided on electronic media in the format described in Appendix A to RS-002, Attachment 2, Section 2.3.3. Evidence of how well these data represent long-term conditions at the site should be discussed.

2.3.3.3 Technical Evaluation

The staff evaluated the onsite meteorological measurements program by reviewing the program description presented in the SSAR and conducting a site visit. The site visit consisted of reviewing the meteorological monitoring system location and exposure, sensor type and performance specifications, data transmission and recording, data acquisition and reduction, and instrumentation maintenance and calibration procedures. In addition, the staff reviewed an hourly listing of the January 2000–December 2002 meteorological database that the applicant provided in its response to RAI 2.3.3-1.

The staff considers the meteorological data collected by the existing CPS monitoring program to be representative of the dispersion conditions at the EGC ESP site. The EGC ESP site is within the existing CPS site, and the new nuclear unit(s) are intended to be in close proximity to the existing facility. The CPS meteorological tower is located far enough away from existing plant structures to preclude any adverse impact on measurements. The base of the tower is at an elevation similar to plant grade at both CPS and at the proposed location for a future EGC ESP facility. The ground cover at the base of the meteorological tower is primarily native grasses.

The staff reviewed the location of the meteorological tower with respect to nearby ground features and potential obstructions to flow (e.g., trees, buildings), including existing and proposed plant structure layouts, and concluded that there are minimal adverse effects on the measurements taken at the towers. The staff also evaluated the types and heights of the meteorological variables being measured and found them compatible with the criteria of RG 1.23. During the site visit, the staff reviewed the sensor types and performance specifications, data transmission, and recording methods, as well as the inspection, maintenance, and calibration procedures and frequencies, and found them to be consistent with the guidance in RG 1.23.

The staff performed a quality review of the post-CPS construction (January 2000–December 2002) hourly meteorological database that the applicant provided in response to RAI 2.3.3-1

using the methodology described in NUREG-0917, "Nuclear Regulatory Commission Staff Computer Programs for Use with Meteorological Data." The staff performed further review using computer spreadsheets. Its examination of the data revealed generally stable and neutral atmospheric conditions at night and unstable and neutral conditions during the day, which was expected. Wind speed, wind direction, and stability class frequency distributions for each measurement channel were reasonably similar from year to year. The post-CPS construction 2000–2002 wind speed, wind direction, and stability class frequency distributions were also reasonably consistent with the pre-CPS construction 1972–1977 data, with a general shift toward lower wind speeds and more unstable conditions in the more recent data. The shift toward unstable conditions may have resulted from the effect of the heated cooling water in Clinton Lake from CPS on the lower level of the delta-temperature measurements or from the more frequent use of the variation of horizontal wind direction to determine atmospheric stability.

The staff compared the January 2000–December 2002 joint frequency distribution used by the applicant as input to the NRC-sponsored PAVAN atmospheric dispersion model (NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations") and a staff-generated January 2000–December 2002 joint frequency distribution from the hourly database and found them to be consistent.

2.3.3.4 Conclusions

As set forth above, the applicant provided and substantiated information on the onsite meteorological measurements program. The staff reviewed the available information relative to the meteorological measurements program and the data collected by the program. On the basis of this review and as set forth above, the staff concludes that the system provides data adequate to represent onsite meteorological conditions, as required by 10 CFR 100.20. The onsite data also provide an acceptable basis for (1) making estimates of atmospheric dispersion for design-basis accident and routine releases from a nuclear power plant(s) falling within the applicant's PPE that might be constructed on the proposed site, and (2) meeting the requirements of 10 CFR Part 100 and Appendix I to 10 CFR Part 50.

2.3.4 Short-Term Diffusion Estimates

2.3.4.1 Technical Information in the Application

In this section of the SSAR, the applicant presented the following information on atmospheric dispersion estimates for postulated accidental airborne releases of radioactive effluents to the EAB and LPZ:

- atmospheric transport and diffusion models to calculate relative concentrations for postulated accidental radioactive releases
- meteorological data summaries used as input to diffusion models
- specification of diffusion parameters
- probability distributions of relative concentrations

- determination of relative concentrations used for assessment of consequences of postulated radioactive atmospheric releases from design-basis and other accidents

The applicant used PAVAN to estimate relative concentration (χ/Q) values at the EAB and LPZ for potential accidental releases of radioactive material. The PAVAN model implements the methodology outlined in RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants."

The PAVAN code estimates χ/Q values for various time-averaging periods ranging from 2 hours to 30 days. The meteorological input to PAVAN consists of a joint frequency distribution of wind speed, wind direction, and atmospheric stability data. The PAVAN code computes χ/Q values at the EAB and LPZ for each combination of wind speed and atmospheric stability for each of the 16 downwind direction sectors. The code then ranks χ/Q values for each sector in descending order, and it derives an associated cumulative frequency distribution based on the frequency distribution of wind speed and stabilities for that sector. The χ/Q value that is equaled or exceeded 0.5 percent of the total time is determined for each sector, and the highest 0.5 percentile χ/Q value among the 16 sectors becomes the maximum sector-dependent χ/Q value. The code also ranks χ/Q values independent of wind direction into a cumulative frequency distribution for the entire site. The PAVAN program then selects the χ/Q value that is equaled or exceeded 5 percent of the total time. The code uses larger of the two values, the maximum sector-dependent 0.5-percent χ/Q value or the overall site 5-percent χ/Q value to represent the χ/Q value for a 0–2-hour time period.

To determine χ/Q values for longer time periods, PAVAN calculates annual average χ/Q values. Logarithmic interpolation is then used between the 0–2-hour χ/Q values and the annual average χ/Q values to calculate the values for intermediate time periods (i.e., 8 hours, 16 hours, 72 hours, and 624 hours).

The applicant used the following input data and assumptions in applying the PAVAN model to the EGC ESP site:

- The initial meteorological input to PAVAN consisted of a joint frequency distribution of wind speed, wind direction, and atmospheric stability data based on January 2000 through August 2002 onsite meteorological data. The wind data were from the 10-meter (33-foot) level of the onsite meteorological tower. The stability data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 60-meter (198-foot) and 10-meter (33-foot) levels of the onsite meteorological tower, as well as horizontal wind variability. In RAI 2.3.3-4, the staff asked the applicant to explain why it used only 32 months of onsite data (January 2000 through August 2002) to generate the χ/Q values, since potential bias could exist resulting from the underrepresentation of autumn and the early winter months. The applicant responded that the data from the period January 2000 through August 2002 represented the most recent continuous data record available that was obtained and processed using a consistent methodology. While there is a potential for a seasonal bias in the 32-month period of record data, the applicant noted that it performed a variety of comparisons with the original 1972–1977 data analyses and concluded that there were no undue biases in the results.

The staff made an independent evaluation of the resulting atmospheric diffusion estimates by rerunning the PAVAN computer model using a joint frequency distribution derived from the 3-year meteorological database (January 2000–December 2002) provided in the applicant's response to RAI 2.3.3-1 and concluded that the resulting EAB χ/Q value could increase as much as 10 percent. Consequently, the staff identified in Open Item 2.3-3 the need to use appropriately conservative meteorological data to calculate short-term accident atmospheric dispersion estimates.

- The applicant modeled one ground-level release point and took no credit for building wake effects.

- The proposed EAB is the perimeter of a circle having a radius of 1025-meter centered on the ESP facility footprint (e.g., the proposed area for locating the ESP site powerblock structures), and the proposed LPZ is the area encompassed by a 4018-meter radius circle centered on the same ESP facility footprint. The applicant placed the release point at the center of the ESP facility footprint for the purposes of determining the downwind distances to the EAB and LPZ (1025 meters and 4018 meters, respectively). In RAI 2.3.4-2, the staff asked the applicant to recalculate the EAB and LPZ χ/Q values using the shortest distances between the ESP plant envelope boundaries and the EAB and LPZ radii for each downwind sector. The applicant responded that, although the major potential release point(s) would be somewhat displaced from the center point, it did not expect the resultant changes in χ/Q values to be significant and did not recalculate the EAB and LPZ χ/Q values. The staff made an independent evaluation of the resulting atmospheric diffusion estimates by rerunning the PAVAN computer model and concluded that reducing the downwind distance to the EAB from 1025 meters to 805 meters could result in increasing the EAB χ/Q value by as much as 30 percent. Consequently, the staff identified in Open Item 2.3-3 the need to use appropriately conservative distances from postulated release points to calculate short-term accident atmospheric dispersion estimates.

In its submission to the NRC dated April 4, 2005, the applicant responded to Open Item 2.3-3 by recalculating its short-term accident χ/Q values using 3 complete years of meteorological data (January 2000–December 2002) and a distance of 805 meters to the EAB. The applicant also provided a copy of the input files it used to execute PAVAN. The applicant stated that 805 meters is the minimum distance to the proposed EAB from any point on the envelope of the ESP facility footprint.

Based on the PAVAN modeling results presented in its submission dated April 4, 2005, the applicant proposed the short-term (accident release) atmospheric dispersion site characteristics presented in Table 2.3.4-1 for inclusion in an ESP, should one be issued for the applicant's proposed ESP site.

Table 2.3.4-1 Applicant's Proposed Short-Term (Accident Release) Atmospheric Dispersion Site Characteristics

SITE CHARACTERISTIC	VALUE	DEFINITION

0–2 hour χ/Q Value @ EAB (5% value)	2.52×10^{-4} s/m^3	The atmospheric dispersion coefficients used in the SSAR to estimate dose consequences of accidental airborne releases
0–8 hour χ/Q Value @ LPZ (5% value)	3.00×10^{-5} s/m^3	
8–24 hour χ/Q Value @ LPZ (5% value)	2.02×10^{-5} s/m^3	
1–4 day χ/Q Value @ LPZ (5% value)	8.53×10^{-6} s/m^3	
4–30 day χ/Q Value @ LPZ (5% value)	2.48×10^{-6} s/m^3	

2.3.4.2 Regulatory Evaluation

In response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to the ESP SSAR regarding short-term (accident release) diffusion estimates. RS-002, Attachment 2, identifies the applicable regulation as 10 CFR 100.21, with respect to the meteorological considerations used in the evaluation to determine an acceptable exclusion area and LPZ.

In SSAR Sections 1.5 and 2.3.4, the applicant identified the following applicable NRC guidance regarding accident release diffusion estimates:

- RG 1.23, with respect to the criteria for an acceptable onsite meteorological measurements program

- Section 2.3.4 of RG 1.70, with respect to providing conservative and realistic estimates of atmospheric diffusion at the EAB and LPZ, based on the most representative meteorological data and impacts caused by local topography

- RG 1.145, with respect to acceptable methods for choosing atmospheric dispersion factors (χ/Q values) for evaluating the consequences of potential accidents

The staff reviewed this portion of the application for confirmation with applicable regulations, and considered the corresponding regulatory guidance.

Section 2.3.4 of RS-002, Attachment 2, and RG 1.70 provide the following guidance on information appropriate for a presentation on short-term (accident release) diffusion estimates. The application should present or describe the following:

- conservative estimates of atmospheric transport and diffusion conditions at appropriate distances from the source for postulated accidental releases of radioactive materials to the atmosphere

- a description of the atmospheric dispersion models used to calculate relative concentrations (χ/Q values) in air resulting from accidental releases of radioactive material to the atmosphere, with models documented in detail and substantiated within

the limits of the model so that the staff can evaluate their appropriateness to site characteristics, plant characteristics (to the extent known), and release characteristics

- the meteorological data used for the evaluation (as input to the dispersion models), which represent annual cycles of hourly values of wind direction, wind speed, and atmospheric stability for each mode of accidental release

- an explanation of the variation of atmospheric diffusion parameters used to characterize lateral and vertical plume spread (σ_y and σ_z) as a function of distance, topography, and atmospheric conditions, as related to measured meteorological parameters, and a description of a methodology for establishing these relationships that is appropriate for estimating the consequences of accidents within the range of distances that are of interest with respect to site characteristics and established regulatory criteria

- cumulative probability distributions of relative concentrations (χ/Q values) and the probabilities of these χ/Q values being exceeded for appropriate distances (e.g., the EAB and LPZ) and time periods, as specified in Section 2.3.4.2 of RG 1.70, as well as an adequate description of the methods used for generating these distributions

- the relative concentrations used for assessing the consequences of atmospheric radioactive releases from design-basis and other accidents

2.3.4.3 Technical Evaluation

The applicant generated its atmospheric diffusion estimates for postulated accidental airborne releases of radioactive effluents to the EAB and LPZ using the staff-endorsed computer code PAVAN. The staff evaluated the applicability of the PAVAN model and concluded that no unique topographic features preclude the use of the PAVAN model for the EGC ESP site. The staff also reviewed the applicant's input to the PAVAN computer code, including the assumptions used concerning plant configuration and release characteristics and the appropriateness of the meteorological data input. The staff found that the applicant made conservative assumptions by ignoring building wake effects and treating all releases as ground-level releases.

The staff made an independent evaluation of the resulting atmospheric diffusion estimates by running the PAVAN computer model using the following input data and assumptions:

- The meteorological input to PAVAN consisted of a joint frequency distribution of wind speed, wind direction, and atmospheric stability data derived from the complete 3-year meteorological database (January 2000–December 2002) provided in the applicant's response to RAI 2.3.3-1. Unlike the applicant's joint frequency distribution, the staff used a larger number of wind speed categories at the lower wind speeds as suggested in Section 4.6 of NUREG/CR-2858. The important aspect of having a large number of lower wind speed categories is to generate more χ/Q values at the lower end of the cumulative χ/Q frequency since the 0.5 percent χ/Q value is desired.

- The staff ignored building wake effects and treated all releases as ground-level releases.

- The proposed EAB is the perimeter of a circle having a radius of 1025-meter centered on the ESP facility footprint, and the proposed LPZ is the area encompassed by a

4018-meter radius circle centered on the same ESP facility footprint. To calculate the χ/Q values for the EAB, the staff used the shortest distance to the proposed EAB from any point on the envelope of the ESP facility footprint (805 meters). Similarly, to calculate the χ/Q values for the LPZ, the staff used the shortest distance to the proposed LPZ from any point on the envelope of the ESP facility footprint (3798 meters).

The staff obtained PAVAN results similar to that of the applicant.

From this review, the staff concludes that the applicant used an adequately conservative atmospheric dispersion model and appropriate meteorological data to calculate relative concentrations for appropriate offsite (EAB and LPZ) distances and directions from postulated release points for accidental airborne releases of radioactive materials.

To evaluate atmospheric dispersion characteristics with respect to radiological releases to the control room, detailed design information (e.g., vent heights, intake heights, distance and direction from release vents to the room) is necessary. Because little detailed design information is available for the nuclear power plant(s) that might be constructed on the proposed site, the COL or CP applicant will need to evaluate the dispersion of airborne radioactive materials to the control room at the COL or CP stage. This is **COL Action Item 2.3-2**.

The staff intends to include the short-term (accident release) atmospheric dispersion factors listed in Table 2.3.4-2 as site characteristics in any ESP that might be issued for the EGC ESP site. Based on the discussion above, the staff considers open Item 2.3-3 resolved.

Table 2.3.4-2 Staff's Proposed Short-Term (Accident Release) Atmospheric Dispersion Site Characteristics

SITE CHARACTERISTIC	VALUE	DEFINITION
0–2hour χ/Q Value @ EAB (5% value)	2.52×10^{-4} s/m^3	The 0–2 hour atmospheric dispersion factor to be used to estimate dose consequences of design-basis accidents at the EAB
0–8 hour χ/Q Value @ LPZ (5% value)	3.00×10^{-5} s/m^3	The 0–8 hour atmospheric dispersion factor to be used to estimate dose consequences of design-basis accidents at the LPZ
8–24 hour χ/Q Value @ LPZ (5% value)	2.02×10^{-5} s/m^3	The 8–24 hour atmospheric dispersion factor to be used to estimate dose consequences of design-basis accidents at the LPZ
1–4 day χ/Q Value @ LPZ (5% value)	8.53×10^{-6} s/m^3	The 1–4 day atmospheric dispersion factor to be used to estimate dose consequences of design-basis accidents at the LPZ
4–30 day χ/Q Value @ LPZ (5% value)	2.48×10^{-6} s/m^3	The 4–30 day atmospheric dispersion factor to be used to estimate dose consequences of design-basis accidents at the LPZ

2.3.4.4 Conclusions

As set forth above, the applicant made conservative assessments of postaccident atmospheric dispersion conditions using its meteorological data and appropriate diffusion models. The applicant calculated representative atmospheric transport and diffusion conditions for the EAB and the LPZ. The staff has reviewed the applicant's proposed short-term atmospheric dispersion site characteristics for inclusion in an ESP for the applicant's site, should one be issued, and, as discussed above, finds these characteristics to be acceptable. Therefore, the staff concludes that the applicant's atmospheric dispersion estimates are appropriate for the assessment of consequences from radioactive releases for postulated (i.e., design-basis) accidents, in accordance with 10 CFR 100.21.

Based on these considerations, the staff concludes that the applicant's short-term atmospheric dispersion estimates are acceptable and meet the relevant requirements of 10 CFR Part 100. The staff will address atmospheric dispersion estimates used to evaluate radiological doses for the control room in its review of the COL or CP application that references this information.

2.3.5 Long-Term Diffusion Estimates

2.3.5.1 Technical Information in the Application

In this section of the SSAR, the applicant presented its atmospheric diffusion estimates for routine releases of effluents to the atmosphere, providing the following information:

- the atmospheric dispersion models used to calculate concentrations in air and the amount of material deposited as a result of routine releases of radioactive material to the atmosphere
- the meteorological data used as input to diffusion models
- diffusion parameters
- relative concentration (χ/Q) and relative deposition (D/Q) values used to assess the consequences of routine airborne radioactive releases
- points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations

The applicant used the subprogram XDCALC from the MIDAS suite of software programs to estimate the χ/Q and D/Q values resulting from routine releases. The applicant indicated that the XDCALC model is consistent with the guidance in RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors." The applicant used the following input data and assumptions in applying the XDCALC model for the EGC ESP site:

- The meteorological input to XDCALC consisted of hourly CPS onsite wind speed, wind direction, and atmospheric stability data from January 2000 through August 2002. The wind data were from the 10-meter level of the onsite meteorological tower. The stability

data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 60-meter and 10-meter levels of the onsite meteorological tower, as well as horizontal wind variability.

- The applicant modeled one ground-level release point, assuming a minimum building cross-sectional area of 2069 square meters and a containment building height of 76.1 meters. The applicant placed the release point at the center of the ESP facility footprint for the purposes of determining the downwind distances to the EAB and LPZ.

The applicant calculated annual average undepleted/no decay, undepleted/2.26-day decay, and depleted/8.00-day decay χ/Q values and D/Q values for the site boundary, EAB, LPZ, and special receptors of interest (nearest milk cow, milk goat, garden, meat animal, and residence within 5 miles in each downwind sector), as well as for various radial sectors out to a distance of 50 miles.

Table 2.3.5-1 lists the long-term atmospheric dispersion estimates that the applicant derived based on the XDCALC modeling results.

Table 2.3.5-1 Applicant's Long-Term (Routine Release) Diffusion Estimates

TYPE OF LOCATION	χ/Q VALUE (s/m^3)			D/Q VALUE ($1/m^2$)
	UNDEPLETED NO DECAY	UNDEPLETED 2.26-DAY DECAY	DEPLETED 8.00-DAY DECAY	
EAB	2.04×10^{-6} (1025 meters NNE)	2.04×10^{-6} (1025 meters NNE)	1.84×10^{-6} (1025 meters NNE)	1.46×10^{-8} (1025 meters NNE)
Nearest Milk Cow	1.10×10^{-6} (1500 meters N)	1.10×10^{-6} (1500 meters N)	9.63×10^{-7} (1500 meters N)	6.76×10^{-9} (1500 meters N)
Nearest Goat Milk	9.90×10^{-8} (8000 meters NNE)	9.72×10^{-8} (8000 meters NNE)	7.28×10^{-8} (8000 meters NNE)	4.21×10^{-10} (8000 meters NNE)
Nearest Garden	1.10×10^{-6} (1500 meters N)	1.10×10^{-6} (1500 meters N)	9.63×10^{-7} (1500 meters N)	6.76×10^{-9} (1500 meters N)
Nearest Meat Animal	1.10×10^{-6} (1500 meters N)	1.10×10^{-6} (1500 meters N)	9.63×10^{-7} (1500 meters N)	6.76×10^{-9} (1500 meters N)
Nearest Resident	1.50×10^{-6} (1170 meters SW)	1.49×10^{-6} (1170 meters SW)	1.34×10^{-6} (1170 meters SW)	6.76×10^{-9} (1500 meters N)

2.3.5.2 Regulatory Evaluation

In response to RAI 1.5-1, the applicant stated that RS-002, Attachment 2, identifies the NRC regulations applicable to the ESP SSAR regarding long-term (routine release) diffusion estimates. RS-002, Attachment 2, identifies the applicable regulation as 10 CFR 100.21(c)(1), with respect to evaluating site atmospheric dispersion characteristics and establishing dispersion parameters such that radiological effluent release limits associated with normal operation from

the type of facility proposed to be located at the site can be met for any individual located off site.

The staff finds that the applicant should have also identified Appendix I to 10 CFR Part 50, which requires demonstrating compliance with the numerical guides for doses contained in this appendix by characterizing atmospheric transport and diffusion conditions to estimate the radiological consequences of routine releases of materials to the atmosphere. Nonetheless, the staff finds that the applicant meets these regulatory requirements.

In SSAR Sections 1.5 and 2.3.5, the applicant identified the following applicable NRC guidance regarding routine release diffusion estimates:

- Section 2.3.5 of RG 1.70, with respect to providing realistic estimates of annual average atmospheric transport and diffusion characteristics to a distance of 50 miles from the plant, including a detailed description of the model used and a calculation of the maximum annual average atmospheric dispersion factor (χ/Q value) at or beyond the site boundary for each venting location

- RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," with respect to the criteria for identifying specific receptors of interest (applicable at the ESP stage to the extent the applicant provides receptors of interest)

- RG 1.111 with respect to the criteria for characterizing atmospheric transport and diffusion conditions for evaluating the consequences of routine releases

The staff finds that the applicant should have also identified RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," issued May 1977, with respect to the criteria to be used to identify release points and release characteristics (applicable to the extent the applicant provides release points and release characteristics at the ESP stage). Nonetheless, the staff finds that the applicant meets the criteria in all applicable RGs for performing routine release diffusion estimates.

Section 2.3.5 of RS-002, Attachment 2, and RG 1.70 provide the following guidance on information appropriate for a presentation on long-term (routine release) diffusion estimates:

- The applicant should provide a description of the atmospheric dispersion models used to calculate concentrations in air and the amount of material deposited as a result of routine releases of radioactive material to the atmosphere. The models should be sufficiently documented and substantiated to allow a review of their appropriateness for site characteristics, plant characteristics (to the extent known), and release characteristics.

- The applicant should discuss the relationship between atmospheric diffusion parameters, such as vertical plume spread (σ_z), and measured meteorological parameters. The applicant should substantiate the appropriateness of the use of these parameters in estimating the consequences of routine releases from the site boundary to a radius of 50 miles from the plant site.

- The applicant should provide the meteorological data used as input to the dispersion models. Data used for this evaluation should represent hourly average values of wind speed, wind direction, and atmospheric stability, which are appropriate for each mode of release. The data should reflect atmospheric transport and diffusion conditions in the vicinity of the site throughout the course of a year.

- The applicant should provide the χ/Q and D/Q values used for assessing the consequences of routine radioactive gas releases, as described in Section 2.3.5.2 of RG 1.70.

- The applicant should identify points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations (if available at the ESP stage). Bounding values for these parameters may be provided at the ESP stage. In such a case, the applicant will need to confirm, at the COL or CP stage, that the parameters submitted at the ESP stage bound the actual values provided at the COL or CP stage, and that the calculational methodology used for the confirmation is consistent with that employed at the ESP stage.

2.3.5.3 Technical Evaluation

The applicant generated its atmospheric diffusion estimates for routine airborne releases of radioactive effluents to the site boundary, EAB, LPZ, and special receptors of interest using the MIDAS software subprogram XDCALC. The applicant stated that the XDCALC code is consistent with the guidance in RG 1.111. The staff reviewed the applicant's input assumptions to the XDCALC computer code concerning plant configuration and release characteristics and found these assumptions to be appropriate. The staff found that the applicant made conservative assumptions by treating all releases as ground-level releases.

The staff made an independent evaluation of the applicant's resulting atmospheric diffusion estimates by executing the staff computer code XOQDOQ (NUREG/CR-2919, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations") using the onsite January 2000–December 2002 meteorological data provided as part of the applicant's response to RAI 2.3.3-1. The XOQDOQ model implements the methodology outlined in RG 1.111. The staff obtained results similar to those obtained by the applicant.

From this review, the staff concluded that the applicant used an appropriate atmospheric dispersion model and adequate meteorological data to calculate relative concentration and relative deposition at appropriate distances from postulated release points for evaluation of routine airborne releases of radioactive material. Any COL or CP application referencing this information will need to confirm that the specific release point characteristics (e.g., release height, building height, and cross-sectional area) and the direction and distance to specific locations of receptors of interest (e.g., EAB and the nearest milk cow, goat milk, garden, meat animal, and resident) used to generate the ESP long-term (routine release) atmospheric dispersion site characteristics bound the actual values provided at the COL or CP stage. This is **COL Action Item 2.3-3**.

The staff will include the long-term (routine release) atmospheric dispersion factors listed in Table 2.3.5-2 as site characteristics in any ESP that the NRC might issue for the EGC ESP site.

Table 2.3.5-2 Staff's Proposed Long-Term (Routine Release) Atmospheric Dispersion Site Characteristics

SITE CHARACTERISTIC	VALUE	DEFINITION
Annual Average Undepleted/No Decay χ/Q Value @ EAB	2.04×10^{-6} s/m^3	The maximum annual average EAB undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ EAB	2.04×10^{-6} s/m^3	The maximum annual average EAB undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ EAB	1.84×10^{-6} s/m^3	The maximum annual average EAB depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average D/Q Value @ EAB	1.46×10^{-8} 1/m^2	The maximum annual average EAB D/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Milk Cow	1.10×10^{-6} s/m^3	The maximum annual average milk cow undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ Nearest Milk Cow	1.10×10^{-6} s/m^3	The maximum annual average milk cow undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ Nearest Milk Cow	9.63×10^{-7} s/m^3	The maximum annual average milk cow depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average D/Q Value @ Nearest Milk Cow	6.76×10^{-9} 1/m^2	The maximum annual average milk cow D/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Goat Milk	9.90×10^{-8} s/m^3	The maximum annual average goat milk undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ Nearest Goat Milk	9.72×10^{-8} s/m^3	The maximum annual average goat milk undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ Nearest Goat Milk	7.28×10^{-8} s/m^3	The maximum annual average goat milk depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual

SITE CHARACTERISTIC	VALUE	DEFINITION
Annual Average D/Q Value @ Nearest Goat Milk	4.21×10^{-10} 1/m^2	The maximum annual average meat animal D/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Garden	1.10×10^{-6} s/m^3	The maximum annual average garden undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ Nearest Garden	1.10×10^{-6} s/m^3	The maximum annual average garden undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ Nearest Garden	9.63×10^{-7} s/m^3	The maximum annual average garden depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average D/Q Value @ Nearest Garden	6.76×10^{-9} 1/m^2	The maximum annual average garden D/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Meat Animal	1.10×10^{-6} s/m^3	The maximum annual average meat animal undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ Nearest Meat Animal	1.10×10^{-6} s/m^3	The maximum annual average meat animal undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ Nearest Meat Animal	9.63×10^{-7} s/m^3	The maximum annual average meat animal depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average D/Q Value @ Nearest Meat Animal	6.76×10^{-9} 1/m^2	The maximum annual average meat animal D/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Resident	1.50×10^{-6} s/m^3	The maximum annual average resident undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Undepleted/2.26-Day Decay χ/Q Value @ Nearest Resident	1.49×10^{-6} s/m^3	The maximum annual average resident undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual
Annual Average Depleted/8.00-Day Decay χ/Q Value @ Nearest Resident	1.34×10^{-6} s/m^3	The maximum annual average resident depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual

SITE CHARACTERISTIC	VALUE	DEFINITION
Annual Average D/Q Value @ Nearest Resident	6.76×10^{-9} 1/m^2	The maximum annual average resident D/Q value for use in determining gaseous pathway doses to the maximally exposed individual

2.3.5.4 Conclusions

As set forth above, the applicant provided meteorological data and an atmospheric dispersion model appropriate for the characteristics of the site and release points. The applicant calculated representative atmospheric transport and diffusion conditions for 16 radial sectors from the site boundary to a distance of 50 miles, as well as for specific receptor locations. The staff reviewed the long-term atmospheric dispersion estimates that the applicant proposed for inclusion as site characteristics in an ESP for the site (if one is issued) and, for the reasons set forth above, finds these estimates to be acceptable. Therefore, the staff concludes that the applicant provided the information necessary to address the requirements of 10 CFR 100.21(c)(1).

Based on these considerations, the staff concludes that the applicant's characterization of long-term atmospheric transport and diffusion conditions is appropriate for use in demonstrating compliance with the numerical guides for doses contained in Appendix I to 10 CFR Part 50.

The applicant provided bounding values for points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations. Any COL or CP applicant will need to confirm that the parameters submitted at the ESP stage bound the actual values provided at the COL or CP stage and that the calculational methodology used for the confirmation is consistent with that employed at the ESP stage.