2.0 SITE CHARACTERISTICS

2.1 Geography and Demography

2.1.1 Site Location and Description

2.1.1.1 Introduction

This section provides details about the site location and site area description for the VEGP site. The proposed ESP Units 3 and 4 would be built on the VEGP site adjacent to existing VEGP Units 1 and 2. The 3169-acre VEGP site is located on coastal plain bluff southwest of the Savannah River in eastern Burke County. The site exclusion area boundary (EAB) is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River. The site is approximately 30 river-miles above the U.S. Highway 301 bridge and directly across the river from the DOE Savannah River Site (SRS), in Barnwell County, South Carolina. The VEGP site is approximately 15 miles northeast of Waynesboro, Georgia, and 26 miles southeast of Augusta, Georgia, which is the nearest population center (with more than 25,000 residents).

2.1.1.2 Regulatory Basis

The acceptance criteria for site location and description are based on meeting the relevant requirements of 10 CFR 52.17, "Contents of applications," and 10 CFR Part 100. The NRC staff considered the following regulatory requirements in reviewing the site location and area description:

- 10 CFR 52.17, as it relates to the applicant submitting information needed for evaluating factors involving the characteristics of the site environment, and describing the boundaries of the site and the proposed general location of each facility on the site.

- 10 CFR Part 100, Subpart B, as it relates to site acceptance being based on the consideration of factors relating to the proposed reactor design and the site characteristics.

Review Standard (RS)-002, "Processing Applications for Early Site Permits," Section 2.1.1, specifies that an applicant has submitted adequate information if it satisfies the following criteria:

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

- The site location, including the exclusion area and the proposed location of a nuclear power plant or plants of specified type that might be constructed on the proposed site, are described in sufficient detail to allow a determination (in Sections 2.1.2, 2.1.3, and 15.0 of RS-002) that 10 CFR Part 100, Subpart B is met.

In addition to identifying specific acceptable criteria to meet the relevant requirements, RS-002 indicates the NRC staff's review of the site location and description typically involves reviewing the following:

- reactor location with respect to (1) latitude and longitude, and the Universal Transverse Mercator (UTM) coordinates, (2) political subdivisions (i.e., counties, cities, states, or their respective agencies), and (3) prominent natural and manmade features of the area for use in independent evaluations of the exclusion area authority and control, the surrounding population, and nearby manmade hazards

- the site area map containing the reactor and associated principal plant structures to determine (1) the distance from the reactor to the boundary lines of the EAB and (2) the location, distance, and orientation of plant structures with respect to highways, railroads, and waterways that traverse or lie adjacent to the exclusion area to ensure that they are adequately described to permit analyses of the possible effects of plant accidents on these transportation routes

2.1.1.3 Technical Evaluation

Following the procedures described in RS-002, Section 2.1.1, the NRC staff reviewed Section 2.1.1 of the SSAR in the VEGP application regarding the site location and site area description, as well as the information the applicant provided in response to the NRC staff's RAI 2.1.1-2 and 2.1.1-3.

The applicant provided the following information regarding the site location and site area description:

- the site boundary for the proposed VEGP, Units 3 and 4 to be built on the proposed ESP site with respect to the existing VEGP, Units 1 and 2

- the site layout for the proposed VEGP, Units 3 and 4 to be built on the proposed ESP site

- the site location with respect to political subdivisions and prominent natural and manmade features of the area within the 6-mile LPZ and the 50-mile population zone

- the topography and characteristics of the land surrounding the proposed ESP site

- the commercial, industrial, institutional, recreational, and residential structures located within the site area

- the distance from the proposed ESP site to the nearest EAB, including the direction and distance

- the potential radioactive release points and their locations for the proposed units

- the distance of the proposed Units 3 and 4 to be built on the proposed ESP site from regional U.S. and State highways

The proposed Units 3 and 4 would be located within the existing VEGP site adjacent to existing Units 1 and 2. The ESP site boundary, as shown in Figure 1-4 of the SSAR, is the same as the site boundary for the existing VEGP Units 1 and 2. This figure depicts both the existing units and the proposed units in addition to the site boundary, EAB, PA for the proposed units, visitor's center, and Plant Wilson, a six-unit oil-fueled combustion turbine facility owned by GPC, which is also located on the VEGP site.

The NRC staff has verified the following latitude and longitude and UTM co-ordinates of the proposed units, as provided in the SSAR:

UTM Coordinates	Latitude/Longitude Deg/Min/Sec
Unit 3: Zone 17 3,667,170 m N; 428,320 m E	33 08 27 N; 81 46 07 E
Unit 4: Zone 17 3,667,170 m N; 428,070 m E	33 08 27 N; 81 46 16 E

The EAB for the VEGP, Units 1 and 2 will also apply to the proposed ESP VEGP, Units 3 and 4. There are no residents in this exclusion area. The site EAB is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River. The property boundary encompasses the entire EAB and extends beyond River Road in some areas. The nearest point to the EAB is located approximately 3400 feet southwest of the proposed VEGP, Units 3 and 4 power block area. The applicant established this EAB to meet the siting and evaluation factors in Subpart B of 10 CFR Part 100, as well as the radiation exposure criterion "as low as is reasonably achievable," defined in 10 CFR Part 50.

The 3,169-acre proposed ESP site is located on coastal plain bluff on southeast of the Savannah River in eastern Burke county. The VEGP is situated within three major resource areas (1) the Southern Piedmont, (2) Carolina and Georgia Sand Hills, and (3) the Coastal Plain. These characteristics are typical of land forms that resulted from historical marine sediment deposits in central and eastern Georgia. There are no mountains in the general area.

The proposed ESP site is approximately 15 miles east-northeast of Waynesboro, Georgia, and 26 miles southeast of Augusta, Georgia, the nearest population center having more than 25,000 residents. It is also about 100 miles from Savannah, Georgia, and 150 river-miles from the mouth of the Savannah River. Burke County includes five incorporated towns (1) Waynesboro, (2) Girard, (3) Keysville, (4) Midville, and (5) Sardis. Of these five towns, only the town of Girard is within 10 miles of the ESP site. Girard has a population of 227 residents, according to the 2000 census.

Based on the NRC staff's review of the general site area and the information collected from the local officials during the site visit, the applicant's information with regard to the site location and area description is adequate and acceptable because it satisfies the acceptance criteria specified in RS-002, Section 2.1.1.

First, although the site is accessible by River Road via U.S. Highway 25 and Georgia Routes 56, 80, 24, and 23, and a railroad spur connects the site to the Norfolk Southern Savannah-to-Augusta track, there are no highways, railroads, or waterways that traverse the proposed ESP site EAB. Accordingly, because there are no highways, railroads, and waterways that traverse the exclusion area, routine use of these routes is not likely to interfere with normal plant operations.

Second, based on the NRC staff's review of the general site area and the information collected from the local officials during the site visit, the applicant's information with regard to the site location and area description is adequate and acceptable to allow the NRC to evaluate whether the applicant met the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The NRC staff has verified that the EAB distance is consistent with the distance the applicant used in its radiological consequence analyses described in Chapter 15 and in Chapter 13.3 of the SSAR. The applicant stated that all areas outside the EAB will be unrestricted in the context of 10 CFR Part 20, "Standards for Protection Against Radiation," and the gaseous effluent release limits, per guidelines provided in 10 CFR Part 50, for the proposed ESP units, would apply to the EAB. Further information regarding the site location and site description is provided in Sections 2.1.2, 2.1.3, and 11 of this SER.

2.1.1.4 *Conclusion*

As set forth above, the applicant provided and substantiated information concerning the site location and description of site area. The NRC staff has reviewed the information provided and, for the reasons given above, concludes that the applicant established site characteristics that meet the requirements of 10 CFR 52.17 and 10 CFR Part 100. The NRC staff further concludes that the applicant provided sufficient details about the site location and description of the site area to allow the NRC staff to evaluate, as documented in Sections 2.1.2, 2.1.3, 11, 13.3, and 15 of this SER, whether the applicant met the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100.

2.1.2 Exclusion Area Authority and Control

2.1.2.1 Introduction

This section addresses the information concerning the legal authority to regulate any and all access and activity within the entire plant exclusion area for the proposed VEGP, Units 3 and 4. Part 1, Chapter 3, of the SSAR provides general information pertaining to the owners/co-owners group. The applicant stated that GPC, for itself and as an agent for the other co-owners, has delegated complete authority to SNC to determine and regulate all activities within the designated exclusion area. "No Trespassing" signs are posted on the perimeter of the VEGP EAB on land and along the Savannah River, and indicate the actions to be taken in the event of emergency conditions at the plant.

2.1.2.2 Regulatory Basis

The acceptance criteria for exclusion area authority and control are based on meeting the relevant requirements of 10 CFR Part 100 with respect to the applicant's authority over the designated exclusion area.

- 100 CFR 100.3 states: 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. Residence within the exclusion area shall normally be prohibited. In any event, residents shall be the subject to ready removal in case of necessity. 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.

As stated in RS-002, Section 2.1.2, specifies that an applicant has submitted adequate information if it satisfies the following criteria:

- The applicant demonstrates, prior to issuance of an ESP, that it has the authority within the exclusion area, as required by 10 CFR 100.3, or provides reasonable assurance that it will have such authority prior to start of construction of a proposed nuclear unit that might be located on the proposed ESP site.

- Activities unrelated to operation of a nuclear power plant or plants of specified type that might be constructed on the proposed site within the exclusion area are acceptable provided: (a) such activities, including accidents associated with such activities, represent no significant hazard to a nuclear power plant or plants of specified type that might be constructed on the proposed site, or are to be accommodated as part of the plant design basis at the COL stage. (See Section 2.2.3 of RS-002); (b) the applicant is aware of such activities and has made appropriate arrangements to evacuate persons engaged in such activities, in the event of an accident; and (c) there is reasonable assurance that persons engaged in such activities can be evacuated without receiving radiation doses in excess of the reference values of 10 CFR 50.34(a)(1).

RS-002, Section 2.1.2 also addresses review procedures that allow the NRC staff to determine whether the relevant requirements are met. This typically involves the NRC staff reviewing (1) the applicant's legal authority to determine all activities within the designated exclusion area, (2) the applicant's authority and control in excluding or removing personnel and property in the event of an emergency, and (3) proposed or permitted activities in the exclusion area which are unrelated to operation of the reactor to ensure that they do not result in a significant hazard to public health and safety.

2.1.2.3 Technical Evaluation

Following the procedures described in RS-002, Section 2.1.2, the NRC staff reviewed SSAR Chapter 2.1.2 of the VEGP ESP application regarding exclusion area authority and control, in addition to the applicant's responses to RAIs 2.1.2-1, 2.1.2-2, and 2.1.2-3.

In the SSAR Chapter 2.1.2, the applicant presented information concerning the following:

- complete legal authority to regulate any and all access and activity within the entire plant exclusion area

- identification of two facilities (the visitor's center and the GPC combustion turbine plant, Plant Wilson) within the EAB that have authorized activities unrelated to nuclear plant operations

- emergency planning, including arrangements for traffic control

Figure 1-4 of the SSAR depicts the boundary lines of the exclusion area for the proposed ESP site, which is the same as the EAB for the existing VEGP, Units 1 and 2. The EAB is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River. No state or county roads, railroads, or waterways traverse the VEGP exclusion area. The nearest point to the EAB is located approximately 3400 feet southwest of the proposed VEGP, Units 3 and 4 ESP power block area.

The applicant stated that pursuant to the VEGP owner's agreement, GPC, for itself and as agent for the co-owners, has delegated to SNC (the applicant) complete authority to regulate any and all access and activity within the entire plant exclusion area. The applicant also stated that the perimeter of the VEGP EAB is adequately posted with "No Trespassing" signs on land and along the Savannah River, that indicate the actions to be taken in the event of emergency conditions at the plant. The applicant stated that, it has complete authority to regulate any and all access and activity within the ESP EAB.

The NRC staff verified the applicant's description of exclusion area, the authority under which all activities within the exclusion area can be controlled, and the methods by which access and occupancy of the exclusion area can be controlled during normal operation and in the event of an emergency situation and concluded that the applicant has the required authority to control activities within the designated exclusion area.

The NRC staff verified for consistency the EAB the applicant considered for the radiological consequence evaluations in Chapters 15 and 13.3 of the SSAR.

The applicant stated that two facilities within the EAB have authorized activities unrelated to nuclear plant operations. These are the visitor's center and the GPC combustion turbine plant, Plant Wilson. The applicant also stated that the exclusion area outside the controlled area fence, including along the Savannah River, will be posted and closed to persons who have not received permission to enter the property.

The applicant stated that access to the visitor's center is controlled by security at the pavilion on the entrance road to the plant. Normally, only a few administrative personnel are located at the visitor's center, and the number of visitors at the center is minimal. In the event of emergency conditions at the plant, the emergency plan for the proposed Units 3 and 4 provides for notification of visitors to the center concerning the proper actions to be taken and evacuation instructions.

The applicant also stated that the VEGP staff control Plant Wilson, and locked gates limit access to the facility from New River Road. The emergency plan for the proposed Units 3 and 4 also provides for notification and evacuation of VEGP personnel at Plant Wilson. In addition, the applicant stated that SNC normally will not control passage or use of the Savannah River along the EAB. “No Trespassing” signs are posted near the river indicating the actions to be taken in the event of emergency conditions at the plant.

The NRC staff has evaluated and verified in Section 13.3 of this SER, the emergency plans and detailed information on the activities in the EAB as described above and in SSAR Chapter 13.3 to ensure that proper plans and procedures are in place and concludes that the specified activities unrelated to operation of a nuclear plant or plants that might be constructed on the proposed site within the exclusion area are acceptable.

2.1.2.4 Conclusion

As set forth above, the applicant appropriately described the exclusion area, the authority under which all activities within the exclusion area can be controlled, and the methods by which access and occupancy of the exclusion area can be controlled during normal operation and in the event of an emergency situation. In addition, the applicant has the required authority to control activities within the designated exclusion area, including the exclusion and removal of persons and property, and has established acceptable methods for control of the designated exclusion area. Therefore, the NRC staff concludes that the applicant’s exclusion area is acceptable and meets the requirements of 10 CFR Part 100.

2.1.3 Population Distribution

2.1.3.1 Introduction

This section addresses the information provided by the applicant concerning the estimated population distribution surrounding the proposed ESP site up to a 50-mile radius, based on the year 2000 census. Data concerning the resident population distribution within the LPZ, the nearest population center, and population densities up to a 20-mile radius from the proposed site are provided by the applicant. The estimated transient population data out to 50 miles is also provided by the applicant. The cumulative population, including both the resident and transient population in 2000 within the LPZ, within 10 miles of the site, and within 50 miles from the center of the proposed ESP site is presented. The estimated population projections based on a 20-year (1980-2000) growth rate are also presented for the years 2010, 2020, 2030, 2040, and 2070. The established LPZ for the proposed Units 3 and 4 is the same as the LPZ for the existing VEGP, Units 1 and 2, falling within a 2-mile radius of the midpoint between the Units 1 and 2 containment buildings.

2.1.3.2 Regulatory Basis

The acceptance criteria for population distribution are based on the relevant requirements of 10 CFR 50.34, “Contents of Applications: Technical Information;” 10 CFR 52.17; and 10 CFR Part 100. The NRC staff considered the following regulatory requirements in reviewing the site location and area description:

- 10 CFR 50.34(a)(1), insofar as it establishes the dose limits at the EAB and LPZ resulting from potential reactor accidents, as it relates to the requirements of 10 CFR 100.21(c).

- 10 CFR 52.17, insofar as it requires each applicant to provide a description of the existing and projected future population profile of the area surrounding the site.

- 10 CFR Part 100, insofar as it establishes the following requirements with respect to population.

  - 10 CFR 100.20(a), as it relates to population distribution and population density.

  - 10 CFR 100.21(a), which states that every site must have an exclusion area and an LPZ, as defined in 10 CFR 100.3.

  - 10 CFR 100.21(b), which states that the population center distance, as defined in 10 CFR 100.3, must be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ.

  - 10 CFR 100.3, which defines exclusion area, LPZ, and population center distance.

RS-002, Section 2.1.3, specifies that an applicant has submitted adequate information if it satisfies the following criteria:

- Either there are no residents in the exclusion area, or if so, such residents 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 100.3) 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 or plants of specified type 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 (a) they contain population data for the latest census, projected year(s) of startup of a nuclear power plant or plants of specified type that might be constructed on the proposed site (such date or dates reflecting the term of the ESP) and projected year(s) of end of plant life; (b) they describe the methodology and sources used to obtain the population data, including the projections; (c) they include information on transient populations in the site vicinity; and (d) 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 Position C.4 of Regulatory Guide (RG) 4.7 "General Site Suitability Criteria for Nuclear Power Stations," Revision 2, issued April 1998, special attention to the consideration of alternative sites with lower population densities is necessary. A site that exceeds the population density guidelines of 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.

Position C.4 of RG 4.7 states that, preferably, a reactor would be located so that, at the time of initial site approval and within about 5 years thereafter, the population density, including weighted transient population, averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the circular area at that distance), does not exceed 500 persons per square mile.

In addition to identifying specific acceptance criteria to meet the relevant requirements, RS-002 also indicates the NRC staff review of population distribution typically involves reviewing the following:

- data about the population in the site vicinity

- the population in the exclusion area

- the LPZ to determine whether appropriate protective measures could be taken on behalf of the populace in that zone in the event of a serious accident

- the nearest boundary of the closest population center containing 25,000 or more residents to determine whether this boundary is at least one and one-third times the distance from the reactor to the outer boundary of the LPZ

- the population density in the site vicinity, including weighted transient population at the time of initial site approval and within 5 years thereafter, to determine whether it exceeds 500 persons per square mile averaged over any radial distance out to 20 miles

2.1.3.3 Technical Evaluation

Following the procedures described in RS-002, Section 2.1.3, the NRC staff reviewed SSAR Chapter 2.1.3 regarding population distribution, as well as the applicant's responses to RAIs 2.1.3-1 through 2.1.3-6.

The NRC staff notes that there are no residents in the exclusion area.

In SSAR Chapter 2.1.3, the applicant estimated and provided the population distribution surrounding the ESP site, up to a 50-mile radius, based on the 2000 census. In this section, the applicant provided the resident population distribution within the LPZ, the nearest population center, and population densities up to a 20-mile radius from the site.

The NRC staff reviewed the population data presented by the applicant in the 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 described in Section 2.1.3.2 of this SER. The NRC staff also evaluated whether, consistent with Regulatory Position C.4 of RG 4.7, the applicant should consider alternative sites with lower population densities. The NRC staff also reviewed whether appropriate protective measures could be taken on behalf of the enclosed populace within the EPZ, which encompasses the LPZ, in the event of a serious accident.

The NRC staff obtained the 1980 and 2000 U.S. Census Bureau (USCB) population data for the 16 counties in Georgia and the 12 counties in South Carolina that are within a 50-mile radius of the center of the ESP site. By accounting the percentage of each county falling within the 50-mile radius, the NRC staff was able to estimate the 2000 population within the 50-mile radius. The NRC staff also estimated the 1980 population within a 50-mile radius using the same approach. As a confirmatory check, the NRC staff compared the applicant's 2000 population data against the NRC staff's estimated 2000 population data. The NRC staff found that the staff's estimate was within 2 percent of the data that the applicant presented in the SSAR.

The NRC staff also reviewed the projected population data provided by the applicant. The NRC staff reviewed information pertaining to the cumulative populations, including the weighted transient populations, for the years 2010, 2020, 2030, 2040, and 2070. The population projections have been verified for consistency with the population projections presented in Section 13.3 of this SER as part of emergency planning and preparedness. The NRC staff also made confirmatory population projection estimates using annualized growth rates calculated for each county within 50 miles of the site based on data from the USCB Web site. The NRC staff-estimated population projections are slightly higher than the applicant's estimated projections, which may be because of the NRC staff's application of growth rate on a county basis, rather than on a census-block basis within each county. Therefore, the NRC staff deems the applicant's methodology for estimating population projections appropriate, reasonable, and acceptable. If the NRC staff were to approve and issue an ESP in 2010 (assuming a combined operating license (COL) application is submitted at the end of the ESP-approved period of 20 years), with a projected startup of new units in 2030 and an operational period of 40 years, the projected year for end of plant life is 2070. Accordingly, the NRC staff finds that the applicant's projected population data set covers an appropriate number of years and is reasonable.

The NRC staff reviewed the applicant's transient population data. The transient population within a 10-mile radius includes 200 hunters and fishermen at recreational areas along the Savannah River. The transient population between 10 and 50 miles from the VEGP site includes workers at and occupants of colleges, schools, hospitals, a military base, and the SRS. In addition, the thousands of people who visit Augusta and the surrounding area annually during the week of the Masters Tournament and for other annual events are included. Based on this information, the NRC staff finds that the applicant's estimate of the transient population to be reasonable.

The applicant estimated and provided the cumulative population, including a transient population of 50 hunters and fishermen, in the LPZ. No towns, recreational facilities, hospitals, schools, prisons, or beaches are within the LPZ, and River Road is the only road within the LPZ. The applicant evaluated representative design-basis accidents (DBAs) in Chapter 15 of the SSAR, and the NRC staff independently verified the applicant's evaluation in Chapter 15 of this SER to demonstrate that the radiological consequences of design-basis reactor accidents at the proposed ESP site are within the dose limits set forth in 10 CFR 50.34(a)(1) as required by 10 CFR 100.21(c).

The distance to Augusta, Georgia, the nearest population center, is about 26 miles and is well in excess of 2.67 miles (one and one third times the distance of 2 miles from the reactor to the outer boundary of the LPZ). In addition, the applicant, as well as the NRC staff, did not identify any other population center closer than the population center distance, as identified above. Therefore, the NRC staff concludes that the proposed site meets the population center distance requirement, as defined in 10 CFR Part 100, Subpart B. The NRC staff has also determined and concluded, based on the projected cumulative resident and transient population within 10 miles of the site, during the lifetime of plant, that there is no likelihood of a future population center of 25,000 people or more within 2.7 miles of the ESP site.

The NRC staff evaluated the site against the criterion in Regulatory Position C.4 of RG 4.7, Revision 2, regarding whether it is necessary to consider alternative sites with lower population densities. The evaluation included the review and verification of whether the population densities in the vicinity of the proposed site, including the weighted transient population, projected at the time of initial site approval and 5 years thereafter, would exceed the criteria of 500 persons per square mile averaged over a radial distance of 20 miles (cumulative population at a distance divided by the area at that distance). The NRC staff has independently determined population density for the lifetime of the plant based on the NRC staff's confirmatory population projection estimates discussed earlier, and has found that the population densities for the proposed site would be well below this criterion. Therefore, the NRC staff concludes that the site conforms to Regulatory Position C.4 in RG 4.7, Revision 2. Based on the applicant's projected population data and population densities, assuming initial approval of the ESP in 2010, construction beginning at the end of the term of 20 years of the ESP approval, and a plant operating life of 40 years, the NRC staff finds that the site also meets the guidance of RS-002 regarding population densities over the lifetime of facilities that might be constructed on the site. Specifically, the population density over that period is not expected to exceed 500 persons per square mile averaged out to 20 miles from the site.

Based on the information provided by the applicant in SSAR Chapter 13.3, the applicant's response to RAI 2.1.3-3, and the NRC staff's conclusions discussed in Section 13.3 of this SER, the NRC staff finds that appropriate protective measures could be taken, on behalf of the populace in the LPZ in the event of a serious accident. Therefore, the NRC staff finds the applicant's response to be satisfactory.

2.1.3.4 Conclusion

As set forth above, the applicant provided an acceptable description of current and projected population densities in and around the site. The NRC staff concludes that the population data provided are acceptable and meet the requirements of 10 CFR Part 52 and 10 CFR Part 100, Subpart B. This conclusion is based on the applicant having provided an acceptable description and safety assessment of the site, which contain present and projected population densities that are within the guidelines of Regulatory Position C.4 of RG 4.7. In addition, the applicant properly specified the LPZ and population center distance. The NRC staff has reviewed and confirmed, by comparison with independently obtained population data, the applicant's estimates of the present and projected populations surrounding the site, including transients. The applicant also evaluated the radiological consequences of DBAs at the proposed site in SSAR Chapter 15 and provided reasonable assurance that appropriate protective measures can be taken within the LPZ to protect the population in the event of a radiological emergency.

2.2 Nearby Industrial, Transportation, and Military Facilities and Descriptions

2.2.1-2.2.2 Identification of Potential Hazards in Site Vicinity

2.2.1.1-2.2.2.1 Introduction

For its ESP application, the applicant provided information on the relative location and separation distance of the site from industrial, military, and transportation facilities and routes in its vicinity. Such facilities and routes include air, ground, and water traffic; pipelines; and fixed manufacturing, processing; and storage facilities. The purpose of the review is to verify that the applicant has submitted sufficient information concerning the presence and magnitude of potential external hazards, so that the reviews and evaluations described in Sections 2.2.3 and 3.5.1.6 can be performed. Section 2.2 of the SSAR covers information concerning the industrial, transportation, and military facilities in the vicinity of the proposed ESP site. The NRC staff prepared Sections 2.2.3 and 3.5.1.6 of this SER using information presented in SSAR, Section 2.2, in accordance with the procedures described in RS-002.

2.2.1.2- 2.2.2.2 Regulatory Basis

The acceptance criteria for identifying potential hazards in the site vicinity are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The NRC staff considered the following regulatory requirements in reviewing the identification of potential hazards in site vicinity:

- 10 CFR 52.17, with respect to the requirement that the application contain information on the location and description of any nearby industrial, military, or transportation facilities and routes.

- 10 CFR 100.20(b), which requires that the nature and proximity of man-related hazards (e.g., airports, dams, transportation routes, military and chemical facilities) be evaluated to establish site parameters for use in determining whether a plant design can accommodate commonly occurring hazards, and whether the risk of other hazards is very low.

- 10 CFR 100.21(e), which requires that the potential hazards associated with nearby transportation routes, industrial, and military facilities be evaluated and site parameters established such that potential hazards from such routes and facilities will not pose undue risk to the type of facility proposed to be located at the site.

RS-002, Section 2.2.1-2.2.2, specifies that an applicant has submitted adequate information to meet the above requirements, if the submitted information satisfies the following criteria:

- data in the site safety assessment adequately describes the locations and distances of industrial, military, and transportation facilities in the vicinity of the plant, a nuclear power plant or plants of specified type that might be constructed on the proposed site, and are in agreement with data obtained from other sources, when available.

- descriptions of the nature and extent of activities conducted at the site and nearby facilities, including the products and materials likely to be processed, stored, used, or transported, are adequate to permit identification of possible hazards.

- sufficient statistical data with respect to hazardous materials are provided to establish a basis for evaluating the potential hazard to a nuclear power plant or plants of specified type that may be constructed on the proposed site.

2.2.1.3-2.2.2.3 Technical Evaluation

Following the procedures detailed in RS-002, Sections 2.2.1-2.2.2, the NRC staff evaluated the potential for man-made hazards in the vicinity of the proposed ESP site by reviewing

- information the applicant provided in Section 2.2.1-2.2.2 of the SSAR,

- information the NRC staff obtained during a visit to the proposed ESP site and its surrounding vicinity,

- other publicly available reference material, such as U.S. Geological Survey (USGS) topographic maps, geographic information system (GIS) information, road and railroad maps, and electric transmission lines and natural gas pipeline maps, and

- information the NRC staff collected independently from such sources as state and local authorities.

In SSAR Chapters 2.2.1 and 2.2.2, the applicant identified and described the following facilities and routes, within a 5-mile radius of the existing VEGP site, which may generate potential hazards or which may engage in potentially hazardous activities:

- Georgia State Highway 23,

- the CSX Railroad,

- Plant Wilson, a combustion turbine electrical plant owned by the GPC,

- the SRS,

- a coal-fired steam electrical plant operated by Washington Savannah River Company in the D-Area of the SRS,

- VEGP, Units 1 and 2,

- the Chem-Nuclear Systems radioactive disposal site (18 miles east of the proposed site) in South Carolina, and

- the Unitech Service Group Nuclear Laundry Facility (21 miles east of the proposed site) in South Carolina.

The applicant included maps that show the locations of these facilities and routes (along with airways and military operations) in comparison to the proposed ESP site (SSAR Figures 2.2.2 and 2.2.3). The applicant presented descriptions of these facilities and routes in SSAR Chapter 2.2.2.

In SSAR Chapter 2.2.2.3, the applicant described the roads within a 5-mile radius of the site. Segments of Georgia State Highways 23, 80, and 56 Spur are located within a 5-mile radius. The nearest highway with commercial traffic is Georgia State Highway 23. State Highway 23 serves as a major link between Augusta and Savannah. The heaviest truck traffic along State Highway 23, near the proposed site, consists primarily of timber and wood products and materials. In SSAR Table 2.2-3, the applicant provided available statistical data on personal injury accidents on these roads between 1999 and 2003.

SSAR Chapter 2.2.2.4 states that the CSX Railroad in South Carolina is the nearest railroad with commercial traffic and is approximately 4.5 miles northeast of the VEGP site. The CSX Railroad runs through and services the SRS. The railroad carries a number of major chemical substances, including cyclohexane, anhydrous ammonia, carbon monoxide, molten sulfur, and elevated temperature material liquids (ETMLs).

(Two local Norfolk Southern rail lines exist in Burke County, operated by Norfolk Southern, one through Waynesboro and one through Midville. These rail lines are approximately 12 miles west of the VEGP site.)

Plant Wilson is located approximately 6000 feet east-southeast from the proposed VEGP, Units 3 and 4. This combustion turbine plant is a GPC electrical peaking power station. The plant consists of six combustion turbines with a total rated capacity of 351.6 MW. The storage capacity of the fuel oil storage tanks at Plant Wilson is 9,000,000 gallons.

The SRS borders the Savannah River for approximately 17 miles opposite the VEGP site. It occupies an approximately circular area 310 square miles (198, 344 acres), encompassing parts of Aiken, Barnwell, and Allendale Counties in South Carolina. The SRS is owned by DOE and operated by an integrated team led by the Washington Savannah River Company. The site is a closed Government reservation except for through traffic on South Carolina Highway 125 and the CSX railroad. The current and near-term operating SRS facilities are engaged in various activities. The SRS processes and stores nuclear materials in support of the national defense and the U.S. non-proliferation efforts. This site also develops and deploys technologies to improve the environment and treat nuclear and hazardous wastes left from the Cold War. Because the SRS facilities are distant (i.e., more than 17 miles) from the proposed units, they are not considered to pose a viable threat to the safe operation of the proposed units.

Washington Savannah River Company operates the 70 megawatt coal-fired steam and electrical plant in the D-Area of SRS. This plant has been in operation since 1952 and supplies steam and electricity to several facilities throughout the SRS.

Chem-Nuclear Systems developed, constructed, and currently operates the largest radioactive waste disposal site in the country, near Barnwell, South carolina. In addition, Unitech Services Nuclear laundry facility is located in the Barnwell County Industrial park and provides radiological laundry and respirator services. However, these facilities are not considered to be an external hazard to the proposed nuclear units because of their distance (18 and 21 miles, respectively) from the VEGP site.

The existing VEGP, Units 1 and 2, are located about 3600 feet and 3900 feet respectively, west of the Savannah River. Besides the activities at Plant Wilson, the only other activities unrelated to plant operations that may occur within the exclusion area are those associated with the operation of the visitor's center. VEGP has made arrangements to control and, if necessary, evacuate the exclusion area in the event of an emergency.

In SSAR Chapter 2.2.2.1, the applicant referenced the "Burke County Comprehensive Plan: 2010, Part 1," which forecasts a relatively slow, stable population growth pattern for Burke County, indicative of the fact that nearby industries have not significantly grown. The applicant stated that currently no major development of industrial, military, or transportation facilities is projected to occur within a 25-mile radius of the VEGP site, except for the development of proposed VEGP, Units 3 and 4.

The applicant also identified and described in SSAR, Chapter 2.2.2, the nature, extent, and location of any:

- mining activities,
- commercially-traversable waterways,
- airports,
- airways,
- military-operation areas and routes,
- natural gas or petroleum pipelines,
- military facilities, and
- storage tanks and chemicals found on the current VEGP site.

In SSAR Chapter 2.2.2.2, the applicant stated that no mining activities occur within 5 miles of the VEGP site.

SSAR Chapter 2.2.2.5 states that the footprint of the proposed VEGP, Units 3 and 4 is located about 4850 feet southwest of the Savannah River. The small amount of water traffic on the Savannah River that does exist is primarily composed of barge-tug tows moving up and down the river channel out of the Port of Savannah. There are no locks or dams in the vicinity of the proposed plant site. In 2004, only 13 commercial vessels were recorded on the Savannah River below Augusta. Within this section of the river, a total of less than 500 tons of nonexplosive residual fuel oil was transported near or past the VEGP site. Except for the residual fuel oil, there were no flammable or potentially explosive materials transported on this portion of the Savannah River. However, in its response to the NRC staff's RAI dated March 16, 2007, the applicant stated that fuel oil is no longer transported by barge past the VEGP site, and the barge hazard has been eliminated from additional consideration. The proposed intake structure is located approximately 1800 feet upstream of the existing VEGP, Units 1 and 2 intake structures.

In SSAR Chapter 2.2.2.6.1, the applicant addressed nearby airports. There are no airports within 10 miles of the VEGP site. The closest airport, Burke County Airport, is approximately 16 miles west-southwest of the site. The average number of operations (landings and takeoffs) is about 57 per week. The closest commercial airport is the Augusta Regional Airport at Bush

Field, which is located approximately 17 miles north-northwest of the VEGP site. Based on Federal Aviation Administration (FAA) information, 17 aircraft are based on the field, of which 10 are single-engine airplanes, 4 are multi-engine airplanes, and 3 are jet-engine airplanes. The average number of operations is about 91 per day. Approach and departure paths at Bush Field are not aligned with the VEGP site, and no regular air traffic patterns for Bush Field extend into the airspace over the VEGP site.

A small, un-improved grass airstrip is located immediately north of the VEGP site (north of Hancock Landing Road and west of the Savannah River). At its closest point, the airstrip is about 1.4 miles from the power block of the proposed new units. This privately owned and operated airstrip has a 1650-foot runway oriented east-west. Therefore, the takeoffs and landings are tangential to the site and oriented away from the plant. No FAA information is available for this airstrip. Informal communication with the owner and operator revealed that the airstrip is for personal use, and the associated traffic consists only of small single-engine aircraft. In addition, there is a small helicopter landing pad on the VEGP site. This facility exists for corporate use and for use in case of an emergency. The traffic associated with both of these facilities is characterized as sporadic.

In Section 2.2.2.6.2 of the SSAR, the applicant addresses airways. The applicant stated that the centerline of Airway V185 is approximately 1.5 miles west of the VEGP site. Additionally, Airway V417 is about 12 miles northeast of the VEGP site, and Airway V70 is approximately 20 miles south of the VEGP site. Because of its close proximity to the VEGP site, SSAR Chapter 3.5.1.6 evaluates hazards from air traffic along the V185 airway.

Section 2.2.2.6.3 of the SSAR describes military air training routes. The west edge of the Pointsett Military Operation Area (MOA) is about 75 miles east-northeast of the VEGP site. The east edge of the Bulldog MOAs is about 11 miles west of the VEGP site. Military aircraft in the Bulldog MOA come mainly from Shaw Air Force Base (about 32 miles east of Columbia, South Carolina) and McEntire Air National Guard Station (about 13 miles east-southeast of Columbia). Among the military training air routes, VR97-1059 is located closest to the VEGP site. The distance between the centerline of VR97-1059 and the VEGP site is about 18 miles. The maximum route width of VR97-1059 is 20 nautical miles; therefore, the width on either side of the route centerline is assumed to be 10 nautical miles (11.5 miles). The VEGP site is located more than 6 miles from the edge of this training route. The total number of military aircraft using route VR97-1059 is approximately 833 per year.

In Section 2.2.2.7 of the SSAR, the applicant addressed the existence of natural gas and petroleum pipelines nearby the VEGP site. The applicant stated that there are three natural gas pipelines within 25 miles of the VEGP site (However, none are located within 10 miles of the VEGP site):

- Pipeline 1 is located approximately 21 miles northeast of the VEGP site.
- Pipeline 2 is located approximately 19 miles southwest of the VEGP site.
- Pipeline 3 is located approximately 20 miles northwest of the VEGP site.

Section 2.2.2.8 of the SSAR describes any existing nearby military facilities. The applicant stated that no military facilities are within 5 miles of the VEGP site.

Section 2.2.2.9 of the SSAR addresses the existence of any storage tanks and chemicals currently held on the VEGP site. The list of such chemicals can be found in the SSAR on Table 2.2.5.

Based on its review of the information provided by the applicant in SSAR Chapter 2.2.1-2.2.2, as supplemented by responses to the NRC staff's RAI 2.2.2-1 and 2.2.2-2, and the information discussed above, the NRC staff did not identify any potential source of additional hazards beyond those that the applicant has identified and described.

2.2.1.4-2.2.2.4 Conclusion

As set forth above, the applicant provided information in the SSAR regarding potential site hazards in accordance with RS-002, such that compliance with the requirements of 10 CFR 52.17, 10 CFR 100.20(b) and 10 CFR 100.21(e) can be evaluated. In the SSAR, the applicant identified the facilities and reviewed the nature and extent of activities involving potentially hazardous materials on or in the vicinity of the site and identified hazards that might pose undue risk to the proposed nuclear facility. Based on the information presented in the SSAR, as well as information the NRC staff obtained independently, the NRC concludes that all potential hazards and potentially hazardous activities on and in the vicinity of the site have been identified. These potential hazards and potentially hazardous activities have been reviewed and are discussed in Sections 2.2.3 and 3.5.1.6 of this safety evaluation report (SER).

2.2.3 Evaluation of Potential Accidents

2.2.3.1 Introduction

In this section of the SER, Section 2.2.3, the NRC staff documents its review and evaluation of potential accident sequences on and in the vicinity of the proposed ESP site, such as an explosion of a flammable substance or a release of a toxic chemical. The NRC staff reviews the applicant's probability analyses of potential accident sequences involving hazardous materials or activities on the proposed ESP site and its vicinity to determine that appropriate data and analytical models have been utilized and to ensure that the calculated risks associated with potential accident sequences are sufficiently low.

2.2.3.2 Regulatory Basis

The acceptance criteria for the evaluation of potential accidents are based on meeting the relevant requirements of 10 CFR 52.17, 10 CFR 100.20 and 10 CFR 100.21, as they relate to factors considered in site evaluation. These requirements stipulate that individual and societal risk of potential plant accident sequences must be low. The NRC staff considered the following regulatory requirements in evaluating the potentiality and consequences of accident sequences:

- 10 CFR 52.17, with respect to the requirement that the application contain information on the location and description of any nearby industrial, military, or transportation facilities and routes.
- 10 CFR 100.20(b), which states that the nature and proximity of man-related hazards (e.g., airports, dams, transportation routes, military and chemical facilities) be evaluated to establish site parameters for use in determining whether a plant design can

accommodate commonly occurring hazards, and whether the risk of other hazards is very low.

- 10 CFR 100.21(e), which requires that the potential hazards associated with nearby transportation routes, industrial, and military facilities be evaluated and site parameters established such that potential hazards from such routes and facilities will not pose undue risk to the type of facility proposed to be located at the site.

RS-002, Section 2.2.3 specifies that an application meets the above requirements, if the application satisfies the following criteria:

- None of the identified potential accidents are design basis events. A design basis event is defined as an accident that has a probability of occurrence on the order of 10^{-7} per year (or greater) and the expected rate of radiological exposure, as a postulated consequence of the accident, is in excess of 10 CFR 100.21 exposure standards.

If any of the identified potential accidents are considered design basis events, a detailed analysis is required, for each of the accidents so categorized, of the effects of the accident on the plant's safety-related structured and components. Because of the difficulty of assigning accurate numerical values to the expected rate of unprecedented potential hazards, on the probabilistic order of 10^{-7}, the NRC staff employed its judgement as to the acceptability of the overall risk calculated for a potential accident.

To evaluate the information provided in SSAR 2.2.1-2.2.2 per the above acceptance criteria, applicant applied the NRC-endorsed analytical methodologies found in the following:

- RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3, issued November 1978, which defines design basis events external to the nuclear plant as those accidents that have a probability of occurrence on the order of about 10^{-7} per year or greater.

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

- RG 1.91, ""Evaluation of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plant Sites," Revision 1, issued February 1978.

When independently assessing the applicant's analysis in SSAR Chapter 2.2.3, the NRC staff applied the same above-cited analytical methodologies.

2.2.3.3 Technical Evaluation

The NRC staff reviewed the information presented in SSAR Chapter 2.2.3 of the VEGP ESP application pertaining to potential accidents, as well as the applicant's responses to RAIs 2.2.3-1 through 2.2.3-16.

The applicant analyzed postulated accidents for various types, sources and locations:

- explosions and flammable vapor clouds
- release of hazardous chemicals
- fires
- radiological hazards

The applicant reviewed the existing analysis of potential hazards to VEGP, Units 1 and 2 to determine its applicability to the proposed VEGP, Units 3 and 4, in evaluating the postulated releases of flammable materials and toxic gases from transportation accidents or materials stored at industrial facilities within a 5-mile radius of the VEGP site. In addition, the applicant evaluated new chemicals identified for either VEGP, Units 1 and 2, or VEGP, Units 3 and 4, to determine their impact on the proposed VEGP, Units 3 and 4. The NRC staff has reviewed the applicant's analyses and has made independent confirmatory checks and calculations to determine the applicant's conformance to the requirements and the applicant's reasonableness and approach in assessing these potential hazards.

2.2.3.3.1 Explosions and Flammable Vapor Clouds

<u>Truck Traffic</u>

The applicant analyzed the potential consequences of explosions postulated to occur on transportation routes near the proposed ESP site using the methodology given in RG 1.91. RG 1.91 details a method for determining distances from critical plant structures to a railway, highway, or navigable waterway beyond which any explosion that might occur on these transportation routes is not likely to have an adverse effect on plant operation or to prevent a safe shutdown. Under those conditions, a detailed review of the transport of explosives on those transportation routes would not be required. The RG 1.91 methodology is based on a level of peak positive incident over-pressure, below which no significant damage would be expected to plant structures. The NRC staff, in RG 1.91, conservatively chose 1 psi for this level. The calculation to determine the minimum safe distance at the chosen peak positive incident over-pressure (1 psi) is as follows:

$R \geq kW^{1/3}$, whereas R is the distance in feet from an exploding charge of W pounds of trinitrotoluene (TNT). When R is in feet and W is in pounds, k = 45. When R is in meters and W is in kilograms, k = 18.

The concept of TNT equivalence (i.e, finding the mass of substance in question that will produce the same blast effect as a unit mass of TNT) has long been used in establishing safe separation distances for solid explosives.

Based on the previous analysis done for VEGP, Units 1 and 2, the applicant identified six chemicals as potential hazards when transported by truck. The applicant used the U.S. Environmental Protection Agency (EPA) Tier II reports for Burke and Richmond Counties in Georgia, along with the EPA Landview database to confirm and/or update the list of chemicals for the analysis. The applicant also performed a traffic corridor evaluation, which showed that even fewer chemicals pass by the site now than was previously assumed in the analysis for Units 1 and 2. The applicant concluded that the only hazardous chemicals likely transported by truck in the vicinity of the site are gasoline and diesel/fuel oil.

Georgia State Highway 23 is the closest ground route to the VEGP site, by which the previously-identified chemicals are being transported by truck. The nearest point from State Highway 23 to the center of VEGP, Units 1 and 2, is 4.7 miles and to the center of VEGP, Units 3 and 4, 4.2 miles. The applicant concluded that, due to the distance between Highway 23 and the proposed ESP site, any explosions induced by flammable clouds of these chemicals will not adversely affect the safe operation of the proposed units. The NRC staff independently confirmed these findings using the methodology described in RG 1.91. For an explosion from a flammable cloud, the maximum distance that would result in a peak incident blast pressure of 1 psi is conservatively determined to be 2479 feet from the road.

For an 8500-gallon gasoline truck carrying a TNT equivalent of 56,165 pounds, the critical distance would be 1723 feet from the explosion point. Since the above calculated critical distances of 2479 feet and 1723 feet for the two types of explosions discussed, are much less than 4.2 miles, the distance between Highway 23 (at its closest point) and proposed Units 3 and 4, the NRC staff concludes that the potential explosion of a gasoline truck would not adversely impact the safe operation of the plant.

In addition to the above-discussed highway transit, gasoline is delivered to the site by tank wagon containing a maximum volume of 4000 gallons. For an explosion from a 4000 gallon truck, the NRC staff calculated the critical distance (beyond which the blast pressure would be less than 1 psi) to be 1340 feet. For an explosion from a flammable cloud in the equivalent circumstances, the critical distance is 1658 feet. The closest distance from the site delivery route to the power block circle is approximately 2000 feet. That distance is greater than the above calculated critical distances. Therefore, the NRC staff concludes that the potential explosion of a gasoline delivery tank truck would not have an adverse impact on the safety of the plant operation. Because of its higher quantity and TNT equivalent and because it is more volatile than diesel fuel, gasoline impacts are considered bounding for the truck-borne hazards evaluation.

Pipelines and Mining Facilities

No natural gas pipeline or mining facilities are located within 10 miles of the VEGP site. Based on RG 1.70, because there are no pipelines or mining activities within 5 miles of the VEGP site, the applicant did not evaluate potential hazards from this source.

Waterway Traffic

The potential impact of barge traffic was analyzed for VEGP, Units 1 and 2. However, the Savannah River is not currently navigable and there are no plans in the near future to make it navigable. Because the Savannah River is not being used to transport chemicals by barge, a hazard evaluation was not required.

Railroad Traffic

The nearest railroad to the VEGP site is the CSX Railroad, which is approximately 4.5 miles northeast of the center point of VEGP, Units 1 and 2. Based on the information obtained from CSX, the top four U.S. Department of Transportation (DOT) qualified hazardous chemicals are cyclohexane (64 percent), anhydrous ammonia (9 percent), carbon monoxide (3 percent), and ETML (3 percent). Because cyclohexane is both flammable and toxic, it was analyzed in detail to evaluate the potential for an explosion hazard from a railcar and from a flammable vapor cloud.

For the explosion from a railcar, the equivalent TNT mass of 117.5 pounds, based on an Upper Flammability Limit (UFL) of 8.34 percent of cyclohexane at the point of release, would produce a peak overpressure of 1 psi at a distance of 220 feet from the railroad. For an explosion from a flammable vapor cloud, the TNT-equivalent maximum distance beyond which the blast pressure would be less than 1 psi is calculated to be 1026 feet from the railcar. The separation distance between the railroad and the proposed units is 4.5 miles, which is far greater than the above calculated critical distances. Even for a maximum railcar load of 132,000 pounds, the critical distance that could cause a peak overpressure of 1 psi to safety-related structures from an explosion or flammable vapor-cloud-induced explosion is calculated to be 2293 ft. Since the amounts of chemicals transported are much lower than the maximum railcar load, and that the actual distance (approximately 4.5 miles) between the railroad and the VEGP site is greater than the critical distance of 2293 ft, the NRC staff has determined that if such an explosion were to occur, it would not pose a hazard to safety-related structures at the plant.

2.2.3.3.2 Release of Hazardous Chemicals

Using the methodology found in RG 1.78, the applicant analyzed the potential impacts of hazardous chemical releases on control room habitability. RG 1.78 provides guidance on the detailed evaluation of such release events and describes assumptions and criteria for screening out release events that need not be considered in the evaluation of control room habitability. RG 1.78 provides that chemicals stored or situated at distances greater than 5 miles from the plant need not be considered because, if a release occurs at such a distance, atmospheric dispersion will dilute and disperse the incoming plume to such a degree that either toxic limits will never be reached or there would be sufficient time for the control room operators to take appropriate action. In addition, the probability of a plume remaining within a given sector for a long period of time is small. Likewise, if hazardous chemicals are known or projected to be shipped by rail, water, or road routes outside a 5-mile radius of nuclear power plant, the shipments need not be considered further for evaluation.

As another screening criteria, for stationary sources of hazardous chemicals within the 5-mile radius of a nuclear power plant, a detailed analysis need only be performed if the hazardous chemicals are in quantities greater than the limits provided in RG 1.78 for a toxicity limit and stable meteorological conditions. Mobile sources, within the 5-mile radius, need not be considered further if the total shipment frequency for all hazardous chemicals (i.e., all hazardous chemicals considered as a singular cargo category without further distinction of the nature of those chemicals) does not exceed the specified number by traffic type (10 shipments per year for truck traffic, 30 per year rail traffic, or 50 per year for barge traffic - these frequencies are based on transportation accident statistics, conditional spill probability given an accident, and a limiting criterion for the number of spills or releases). Frequent shipments (i.e., shipments exceeding the specified number by traffic type) do not need to be considered in detailed analysis if the quantity of hazardous chemicals is less than the quantity provided in RG 1.78 (as adjusted for the appropriate toxicity limit, meteorology, and control room air exchange rate).

Since there are no manufacturing plants, chemical plants, storage facilities, or oil or gas pipelines are located within 5 miles of the VEGP site, only the following potential scenarios were evaluated:

Release of Hazardous Chemicals from a Transportation Accident

The applicant concluded that the only hazardous chemicals likely to be transported by truck in the vicinity of the VEGP site are gasoline and diesel/fuel oil. Therefore, the control room habitability analysis conducted by the applicant only included those two chemicals. Because gasoline is more volatile than diesel/fuel oil, the applicant applied the flammable properties of gasoline for the purposes of the analysis. Per the analytical methodology in RG 1.78, the calculated toxic vapor concentration of gasoline at the control room resulting from a release of gasoline from a 8500 gallon truck on Georgia State Highway 23 (4.2 miles from VEGP, Units 3 and 4) is 34.9 parts per million, and from a 4000 gallon tank wagon during delivery (2000 feet from the center of the power block for Units 3 and 4) is 95.1 parts per million. The calculated vapor concentrations are much smaller than the toxicity limit of 300 parts per million (American Conference of Governmental Industrial Hygienists Threshold Limit Value) and, therefore, the applicant asserted that no adverse impact on control room habitability from the accidental release of gasoline or diesel/fuel oil is expected. The NRC staff has reviewed and verified the applicant's information through independent analysis. The NRC staff has found the applicant's methodology acceptable and the results and conclusions reasonable. Based on the above information, the NRC staff concludes that the accidental release of gasoline or diesel/fuel oil by truck transportation would not cause concentrations of these chemicals to affect control room habitability at or above the corresponding toxicity limits.

The information obtained by the applicant from CSX, revealed that the railroad carried four major hazardous chemicals in 2005: cyclohexane, anhydrous ammonia, carbon monoxide, and ETMLs. Accidental spills of carbon monoxide or ETMLs are not expected to create a vapor hazard for the site, as they are molten nonhazardous materials. Therefore, evaluations were performed for cyclohexane and anhydrous ammonia. Assuming a railcar capacity of 67 tons of cyclohexane (based on RG 1.91 limit of 132,000 pounds for a railcar load) and 26 tons of anhydrous ammonia (analyzed previously for VEGP, Units 1 and 2), the vapor concentrations at the control room, which is approximately 4.5 miles from railroad, were estimated based on stable atmospheric conditions using a windspeed of 1 meter per second (m/s). The calculated vapor concentration of 34.3 parts per million for cyclohexane is much less than the toxicity limit of 1300 parts per million, and the calculated concentration of 112 parts per million for anhydrous ammonia is also less than the toxicity limit of 300 parts per million. The NRC staff reviewed the applicant's calculations of the concentrations of these chemicals and conducted independent confirmatory analyses using the methodology provided in RG 1.78. In light of the above evaluation and analyses, the NRC staff finds that the applicant's approach and calculations are reasonable and its conclusions acceptable. Based on these estimated toxic vapor concentrations for these chemicals, the NRC staff has determined that the potential hazard from these chemicals is minimal and will not affect the safe operation of the proposed units.

Potential Hazard from Major Depots or Storage Areas

The applicant stated that the only chemical storage areas within 5 miles of the VEGP site are located at the SRS and the Plant Wilson combustion turbine plant. The original analysis performed for VEGP, Units 1 and 2 discussed the storage at SRS “D-Area” (which is 4.5 miles from the center of Units 1 and 2) and of the chemicals chlorine and ammonia. Since these chemicals (or any others) are no longer used at D-Area, the analysis for VEGP, Units 3 and 4, considered only the chemicals stored at Plant Wilson.

The chemicals stored at Plant Wilson (approximately 5500 feet from the new power block of Units 3 and 4) consist of three 3-million gallon tanks of fuel oil, sulfuric acid, and several other chemicals in small quantities. Because the sulfuric acid and the other chemicals are present in small quantities and have low volatility and toxicity, the applicant stated that they do not pose a potential hazard to control room habitability. Therefore, the applicant only analyzed one of the 3-million gallon fuel oil tanks, as a bounding case, for the toxic vapor concentration from potential accidental release. The applicant estimated the vapor concentration of fuel oil to be less than 50 parts per million at 5500 feet from the storage tank. Since the calculated concentration is much less than the toxicity limit of 300 parts per million, the applicant concluded that the Plant Wilson fuel oil storage tanks do not present a hazard to VEGP, Units 3 and 4. The NRC staff conducted a confirmatory analysis and found that the calculated concentration is much less than the toxicity limit of 300 parts per million.

Potential Hazard from Onsite Storage Tanks

SSAR, Table 2.2-5 lists the chemicals that are stored at VEGP. Of the many chemicals listed that are stored and used on the site, only three chemicals, hydrazine, phosphoric acid, and methoxypropylamine (MPA), were evaluated by the applicant for potential hazard effects that would be bounding. Phosphoric acid and MPA are new chemicals that are being used at VEGP, Units 1 and 2. The applicant stated that the other listed chemicals were not considered for evaluation based on low volatility, low toxicity, or the relatively small quantities stored. In evaluating the control room habitability conditions, the applicant used the guidelines of NUREG-0570, “Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release,” to determine the toxic concentrations of these chemicals at the control room intake.

Hydrazine is stored northeast of the VEGP, Unit 1 reactor and is separated by a minimum distance of 1800 feet from Units 3 and 4. The applicant’s analysis of the hydrazine for Units 1 and 2 showed that at least 2 minutes would be available between detection and the time the short-term toxicity limit (as defined in RG 1.78) would be reached. Since hydrazine storage is separated by 1800 feet for Units 3 and 4, the impact on the new units from an accidental release of hydrazine would be less than the impact on the existing VEGP, Units 1 and 2. Due to the impact on control room habitability, these calculations will be evaluated at the time of the COL application. This is **COL Action Item 2.2-1**. When addressing this COL action item, Section 6.4 of the FSAR should also be taken into consideration.

Phosphoric acid is stored in a 5050-gallon tank at a distance of approximately 3200 feet from the air intake for the Unit 3 control room. The applicant calculated phosphoric acid concentration outside the control room intake under stable conditions (F stability) with 1 m/s windspeed to be 94 microgram/m^3, much lower than the 8-hour threshold limit value of 1 milligram/m^3 and the short-term exposure limit of 3 milligram/m^3.

The applicant had previously evaluated MPA for VEGP, Units 1 and 2. The applicant calculated the MPA release concentration based on a 400-gallon release at 59 meters from the control room intake under atmospheric conditions of 2.5 m/s wind speed and G stability. Using these parameters, the applicant calculated the MPA concentration for VEGP, Units 1 and 2 to be 1.5 parts per million, which is much lower than the short term exposure limit of 15 parts per million. Since VEGP, Units 3 and 4 are farther away from the MPA release point than VEGP, Units 1 and 2, the MPA concentration at the new control room intake is expected to be lower than that calculated for VEGP, Units 1 and 2.

SSAR Table 2.2-6 lists the chemicals that will be used at Units 3 and 4. However, the applicant did not provide the quantity of chemicals. Potential toxic concentrations of these chemicals based on their volatility, toxicity, and quantity, including their impact on control room habitability will be evaluated at the time of the COL application. This is **COL Action Item 2.2-2**. When addressing this COL action item, Section 6.4 of the FSAR should also be taken into consideration.

The NRC staff used screening models (ALOHA, 2007; HPAC, 2005) to perform confirmatory analyses to independently determine the toxic concentrations of the above discussed chemicals. The NRC staff's estimated concentrations are comparable to those calculated by the applicant. Based on the NRC staff's confirmatory checks, the staff concludes that the applicant's assumptions, and its approach in determining the toxic concentrations of these chemicals at the control room intake are reasonable and acceptable. Therefore, the NRC staff agrees with the applicant's conclusion that the control room will remain habitable for most release scenarios without any operator action. Furthermore, the applicant demonstrated that in the hydrazine release scenario control room operators will have sufficient time to take emergency action (e.g., donning emergency breathing apparatus).

2.2.3.3.3 Fires

The preceding sections addressed the potential fire hazards associated with transportation accidents, industrial storage facilities, and onsite storage. The applicant considered the fire hazard from a forest fire resulting in release of potentially toxic chemicals CO, NO_2, and CH_4, and determined that such a scenario would produce only negligible concentrations outside the control room air intakes. In addition, because of the long distances separating the tree line from the control room, the NRC staff finds that there would be no adverse heat impact in the form of heat flux from the forest fire.

2.2.3.4 Radiological Hazards

Radiation monitoring of the main control room environment is provided by the radiation monitoring system. The habitability systems are capable of maintaining the main control room environment suitable for prolong occupancy throughout the duration of postulated accidents that require protection from external fire, smoke, and airborne activity. In addition, safety related SSCs have been designed to withstand the efforts of radiological events and consequential releases. However, this site specific information would be reviewed in Chapters 11 and 15 of a COL application.

2.2.3.5 Conclusion

The NRC staff has reviewed the applicant's potential accidents analysis using the procedures set forth in RS-002, Section 2.2.3. As discussed, the NRC staff has made confirmatory checks and calculations and has verified the applicant's evaluation of potential accidents by using screening models with conservative assumptions and comparing and verifying pertinent data available in the literature.

Based on these considerations, the NRC staff concludes that the potential accidents considered by the applicant would allow for a determination of whether a plant design is adequate to accommodate potential hazards in the site vicinity. Therefore, the NRC staff finds that, with respect to the hazards associated with evaluated potential accidents, the proposed site is acceptable for the planned units and the site meets the relevant requirements of 10 CFR 52.17, 10 CFR 100.20(b), and 10 CFR 100.21(e).

2.3 Meteorology

To ensure that a nuclear power plant or plants can be designed, constructed, and operated on an applicant's proposed ESP site in compliance with the Commission's 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 on 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 has prepared Sections 2.3.1 through 2.3.5 of this SER in accordance with the review procedures described in RS-002, using information presented in Section 2.3 of the SSAR, responses to staff requests for additional information (RAIs), and generally available reference materials (as cited in applicable sections of RS-002).

2.3.1 Regional Climatology

2.3.1.1 Introduction

In Section 2.3.1 of the SSAR, the applicant presented information on the climatic conditions and regional meteorological phenomena (both the averages and extremes thereof) that could affect the design and operating bases of safety- and/or nonsafety-related SSCs for the proposed nuclear power plant. Specifically, the applicant provided the following information:

- data sources used to characterize the regional climatological conditions pertinent to the proposed site.
- a description of the general climate of the region with respect to types of air masses, synoptic features (high- and low-pressure systems), general airflow patterns (wind direction and speed), temperature and humidity, and precipitation (rain, snow, and sleet).
- frequencies and descriptions of severe weather phenomena that have affected the proposed site, including extreme wind, tornadoes, tropical cyclones, precipitation extremes, winter precipitation (hail, snowstorms, and ice storms), and thunderstorms (including lightning).
- a justification as to why the identification of meteorological conditions associated with the ultimate heat sink (UHS) maximum evaporation and drift loss of water and minimum water cooling is not necessary for a description of design-basis dry- and wet-bulb temperatures for the proposed site.
- a description of design-basis dry- and wet-bulb temperatures for the proposed site.
- the potentiality for restrictive air dispersion conditions and high air pollution at the proposed site.

Based on the above information, the applicant provided a table, SSAR Table 1-1, of proposed site characteristics. Site characteristics are the actual physical, environmental, and demographic features of a site and are used to verify the suitability of a proposed plant design for a site. The following are climatic site characteristics the applicant proposed as minimum design and operating bases for the proposed site:

- the maximum winter precipitation load (i.e., 100-year snowpack and 48-hour probable maximum winter precipitation (PMWP)) on the roofs of safety-related structures.

- tornado parameters, including maximum wind speed, maximum rotational and translational wind speed, the radius of maximum rotational wind speed, the maximum pressure drop, and the maximum rate of pressure drop.

- the 100-year return period straight-line (basic) wind speed.

- ambient air temperature and humidity extremes, including maximum dry-bulb (2-percent and 0.4-percent annual exceedance; 1-percent annual exceedance and 100-year return period with concurrent mean wet-bulb temperatures); minimum dry-bulb (99-percent and 99.6-percent annual exceedance; 100-year return period); and maximum wet-bulb (1-percent and 0.4-percent annual exceedance; 100-year return period).

- The site temperature basis for the AP1000, including the maximum safety dry-bulb temperature and coincident wet-bulb temperature; maximum safety noncoincident wet-bulb temperature; maximum normal dry-bulb temperature and coincident wet-bulb temperature; and maximum normal noncoincident wet-bulb temperature.

2.3.1.2 Regulatory Basis

The acceptance criteria for identifying regional climatological and meteorological information are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The staff considered the following regulatory requirements in reviewing the applicant’s identification of regional climatological and meteorological information:

- 10 CFR 52.17(a), which requires that the application contain a description of the seismic, meteorological, hydrological, and geological characteristics of the proposed site.

- 10 CFR 100.20(c), which requires that the meteorological characteristics of the site, necessary for safety analysis or that may have an impact on plant design, be identified and characterized as part of the NRC’s review of the acceptability of a site.

- 10 CFR 100.21(d), which requires that the physical characteristics of the site, including meteorology, geology, seismology, and hydrology be evaluated and site parameters established, such that the potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site.

The climatological and meteorological information assembled in compliance with the above regulatory requirements would be necessary to determine, at the COL stage, a proposed facility’s compliance with the following requirements in Appendix A of 10 CFR Part 50:

- GDC 2, which requires that structures, systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

- GDC 4, “Environmental and Dynamic Effects Design Bases,” which requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, included loss-of-coolant accidents.

An ESP applicant, though, need not demonstrate compliance with the above GDC, with respect to regional climatology.

RS-002, Section 2.3.1 specifies that an application meets the above requirements, if the application satisfies the following criteria:

- The description of the general climate of the regions should be based on standard climatic summaries compiled by the National Oceanic and Atmospheric Administration (NOAA). 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 the standard meteorological records from nearby representative National Weather Service (NWS), military, or other stations recognized as standard installations which have long periods on record. The applicability of these data to represent site conditions during the expected period of reactor operation should be substantiated.

- Design basis straight-line wind velocity should be based on appropriate standards, with suitable corrections for local conditions.

- UHS meteorological data, as stated in RG 1.27, “Ultimate Heat Sink for Nuclear Power Plants,’ should be based on long-period regional records which represent site conditions.

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

- High air pollution potential information should be based on U.S. EPA studies.

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

To the extent applicable to the above-outlined acceptance criteria, the applicant applied the NRC-endorsed meteorological information selection methodologies and techniques found in the following:

- RG 1.23, “Onsite Meteorological Programs,” which provides criteria for an acceptable onsite meteorological measurements program, which can be used to monitor regional meteorology site characteristics.

- RG 1.70, which describes the type of regional meteorological data that should be presented in SSAR Section 2.3.1.

- RG 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” which provides criteria for selecting the design-basis tornado parameters.

When independently assessing the veracity of the information presented by the applicant in SSAR Chapter 2.3.1, the NRC Staff applied the same above-cited methodologies and techniques.

2.3.1.3 Technical Evaluation

The NRC staff reviewed the application, as supplemented by letters dated January 30, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070330054); March 26, 2007 (ADAMS Accession No. ML070880685); and March 30, 2007 (ADAMS Accession No. ML070940221) to verify the accuracy, completeness, and sufficiency of the information presented by the applicant regarding regional climatology. In reviewing and evaluating this information, the staff used (or relied on) none of the applicant's proposed design parameters and site interface values presented in SSAR Section 1.3.

2.3.1.3.1 Data Sources

The applicant characterized the regional climatology of the proposed VEGP site's area using data from the National Climatic Data Center (NCDC), including the NWS station in Augusta, Georgia, and from nine other nearby cooperative observer stations. Five of these cooperative observer stations are located in Georgia counties, including Burke, Jefferson, Jenkins, Richmond, and Screven. The other four stations are located in the South Carolina counties, including Aiken, Bamberg, Barnwell, and Orangeburg. The regional climatic observation stations used by the applicant are included in the list presented in SER Table 2.3.1-1.

The applicant also obtained information on mean and extreme regional climatological phenomena from a variety of sources, such as publications by the NCDC, the Air Force Combat Climatology Center (AFCCC), the American Society of Civil Engineers (ASCE), the National Oceanic and Atmospheric Administration—Coastal Services Center (NOAA-CSC), and the Southeast Regional Climate Center (SERCC).

In RAI 2.3.1-1, the NRC staff asked the applicant to explain how it selected the observation stations it used to characterize regional climatology in SSAR Section 2.3.1. The applicant responded by revising its SSAR to enumerate the following selection criteria:

- The applicant chose stations in “proximity” to the site (i.e., within the general site area, less than or equal to 50 kilometers).

- The applicant attempted to select stations surrounding the site equally in all directions, to the greatest extent possible.

- Where more than one station exists in the same general direction from the site, the applicant selected the station that recorded a more extreme value for one or more meteorological conditions or phenomena (e.g., rainfall, snowfall, temperatures).

In addition to the ten climatic stations identified by the applicant, the NRC staff reviewed data from an additional seven climatic stations. Generally, the staff used data from stations within 50 miles (80 kilometers) and with a period of record greater than 10 years. SER Table 2.3.1-1 lists the observation stations used by the staff, in addition to those used by the applicant, to evaluate the regional climatology characteristics of the site.

During a site audit conducted on December 6, 2006, the staff asked the applicant to include all applicable stations which recorded the most extreme value for a particular meteorological condition or phenomena. The applicant responded by revising its SSAR to include data from the Louisville and Bamberg observation stations.

The NRC staff also used information reported by the NWS, NCDC, NOAA-CSC, Storm Prediction Center, National Severe Storms Laboratory (NSSL), National Hurricane Center (NHC), SERCC, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Structural Engineering Institute (SEI), AFCCC, and ASCE.

2.3.1.3.2 General Climate

The applicant described the proposed VEGP site's general climate as mild with short winters. The region often experiences long periods of mild weather in the autumn and spring, coupled with long hot summers. The predominant air mass over the region is maritime tropical. In the winter, continental polar air, associated with high-pressure systems that move southeastward out of Canada, periodically affects the region. However, in general, down sloping and land modification warm the cold air that reaches the proposed site.

The regional climate is primarily influenced by the Azores high-pressure system. During the summer, the Bermuda High and the Gulf High have the strongest influence on Georgia's precipitation and temperature patterns. These circulation patterns are less defined in the transitional seasons and winter months, because of the passage of synoptic and meso-scale weather systems.

The applicant stated that monthly precipitation exhibits a cyclical pattern, with one maximum during the winter into early spring and a second maximum during late spring into summer. These two precipitation maxima are related to eastward moving low-pressure systems and thunderstorm activity, respectively. During the summer and early autumn, heavy precipitation can also be associated with tropical cyclones.

The staff agrees with the applicant's description of the general climate of the region, which is consistent with the NCDC narrative, "Annual Summary with Comparative Data for Augusta, Georgia;" the NCDC climatic data summary for Augusta shows an annual mean wind speed of 6.1 miles per hour (mi/h) and an annual prevailing wind direction from the west-southwest.

2.3.1.3.3 Severe Weather

2.3.1.3.3.1 ***Extreme Wind***

Estimating wind loading on plant structures involves identifying the site's "basic" wind speed, which is defined by ASCE/SEI 7-02, "Minimum Design Loads for Buildings and Other Structures," as the "3-second gust speed at 33 feet (10 meters) above the ground in Exposure Category C".[4] Using linear interpolation on a plot of basic wind speeds presented in ASCE/SEI 7-02 for the portion of the United States that includes the proposed VEGP site, the applicant defined the basic wind speed for the proposed site as 97 mi/h. This value is associated with a mean recurrence interval of 50 years. Using a conversion factor listed in ASCE/SEI 7-02, the applicant derived a 100-year return period 3-second gust wind speed site characteristic value of 104 mi/h, as presented in SER Table 2.3.1-4.

Based on Section C6.0 of ASCE/SEI 7-02, the ratio of the 100-year to 50-year mean recurrence interval values is typically 1.07, which means that the 50-year return period basic wind speed value of 97 mi/h corresponds to a 100-year return period basic wind speed value of 104 mi/h. Therefore, the staff concludes that a site characteristic 3-second gust basic wind speed value of 104 mi/h is acceptable.

2.3.1.3.3.2 ***Tornadoes***

The applicant used an approximate 55-year period of tornado reports (January 1950 through April 2005) from the NCDC to calculate the probability of a tornado strike near the proposed VEGP site. The applicant stated that 348 tornadoes have been reported to have touched down in the vicinity (i.e., within a 2-degree latitude and longitude area) of the proposed ESP site. Following the methodology presented in WASH-1300, "Technical Basis for Interim Regional Tornado Criteria," issued May 1974, the applicant used the following formula to calculate the probability that a tornado will strike a particular location during any one year period:

$$P_s = n(a/A)$$

where:

P_s = mean tornado strike probability per year
n = average number of tornadoes per year in the area being considered
a = average individual tornado area
A = total area being considered

The applicant calculated the probability of a tornado strike in the vicinity of the proposed ESP site of 774×10^{-7} per year, or, put differently, a recurrence interval of once every 12,920 years. The staff verified the applicant's probabilistic calculation, using the same tornado database, "Storm Events for Georgia and South Carolina, Tornado Event Summaries," from NCDC.

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4. Exposure Category C is defined as open terrain with scattered obstructions, having heights generally less than 30 feet (9.1 meters). This category includes flat open country, grasslands, and all water surfaces in hurricane-prone regions.

The applicant chose the tornado site characteristics based on the proposed Revision 1 to RG 1.76 (Draft Regulatory Guide DG-1143). DG-1143 provides design basis tornado characteristics for three tornado intensity regions throughout the United States, each with a 10^{-7} probability of occurrence. The proposed VEGP site is adjacent to both tornado intensity regions I and II. The applicant chose to use the more conservative design-basis tornado region (region I) and, correspondingly, proposed the following tornado site characteristics:

Maximum Wind speed	300 mi/h
Maximum Translational Speed	60 mi/h
Rotational Speed	240 mi/h
Radius of Maximum Rotational Speed	150 feet
Pressure Drop	2.0 lbf/in.^{2}
Rate of Pressure Drop	1.2 lbf/in.^{2}/s

In March, 2007 revision 1 to RG 1.76 was issued. Revision 1 reconfirmed that the design-basis tornado wind speeds for new reactors should correspond to the exceedance frequency of 10^{-7} per year. The design-basis tornado wind speeds presented in Revision 1 to RG 1.76 are based on the Enhanced-Fujita (EF) scale which relates the degree of damage from a tornado to the tornado's maximum wind speed. The original version of RG 1.76 and DG-1143 were based on the original Fujita scale. The applicant's design-basis tornado site characteristics conservatively bound those presented in Revision 1 to RG 1.76. For example, Revision 1 to RG 1.76 suggests a design-basis tornado wind speed of 230 mi/h for the proposed VEGP site, whereas the applicant chose a site characteristic design-basis wind speed of 300 mi/h.

Because the applicant's design-basis tornado site characteristics conservatively bound those presented in Revision 1 to RG 1.76, the staff concludes that the applicant has chosen acceptable tornado site characteristics. SER Table 2.3.1-4 presents the tornado site characteristics for the proposed VEGP site in the list of regional climatic site characteristics.

2.3.1.3.3.3 ***<u>Tropical Cyclones</u>***

According to information presented by the applicant, during the period of time between 1851 and 2004, 102 tropical cyclones centers passed within a 100-nautical mile (185-kilometer) radius of the proposed VEGP site. The applicant used the NOAA-CSC historical tropical database to derive these results. Using the same database, the staff was able to verify the statistics presented by the applicant. SER Table 2.3.1-3 presents the storm classifications and respective frequencies of tropical cyclones passing within 100 nautical miles of the site during the 154-year period tracked by the NOAA-CSC database.

Since 1850, only nine hurricanes of category 2 strength or greater, which had sustained (i.e., 1-minute average) winds greater than 96 mi/h, have impacted the 100-nautical mile area surrounding the proposed VEGP site. This translates to a reoccurrence interval of 0.06 years, or one hurricane of category 2 strength or greater every 17.1 years. Six of these category 2 and 3 storms that affected the 100-nautical mile area surrounding proposed site did so before 1900. No category 2 or 3 storms have affected the region since 1959.

The strongest recorded hurricane to pass within 100 nautical miles of the site was hurricane Gracie on September 29, 1959. Hurricane Gracie had sustained wind speeds of 120 mi/h as it crossed the Atlantic coastline approximately 100 nautical miles southeast of the proposed VEGP site. The forward speed of the storm, as it crossed the coastline, was about 12 mi/h, as reported by the NHC. Based on its forward speed, hurricane Gracie would have had to traveled approximately 7 hours overland to reach the proposed VEGP site, approximately 88 miles (142 kilometers) from the coast. The storm's sustained wind speeds had weakened to 70 mi/h within 6 hours after it crossed the coastline. Assuming the storm took a direct track over the proposed VEGP site, the maximum projected sustained winds at the site would have been 70 mi/h. The Hurricane Research Division, a specialized division of NOAA, recommends multiplying sustained winds by a factor of 1.3 to obtain 3-second gust estimates. This would have resulted in a 3-second gust wind speed of approximately 91 mi/h--well below the chosen 3-second gust basic wind speed site characteristic of 104 mi/h.

Although tropical systems generally weaken significantly before impacting the proposed VEGP site, they still can cause significant amounts of rainfall. The applicant reported that tropical cyclones produced at least 12 separate 24-hour and monthly rainfall records at eight NWS cooperative observer network stations in the vicinity of proposed site's area. The staff has independently confirmed these statistics.

2.3.1.3.3.4 ***<u>Precipitation Extremes</u>***

The applicant used historical climate data from 10 nearby observing stations, as listed in SER Table 2.3.1-1, to identify precipitation extremes (rainfall and snowfall) observed near the proposed VEGP site. Based on the similarity of precipitation extremes and areal distribution of the observing stations around the site, these data can be used to adequately represent precipitation extremes that might be expected to occur at the site.

In SSAR Table 2.3-3, the applicant provided a climatic summary for each of the utilized observation stations, including the ones with the maximum 24-hour rainfall and maximum monthly rainfall. The staff independently verified each of these rainfall records, using the NCDC "Cooperative Summary of the Day—Daily Surface Data (TD 3200/3210)" and confirmed that the statistics provided by the applicant are correct.

During a site audit conducted on December 6, 2006, the staff asked why the applicant did not use as input to SSAR Table 2.3-3 the monthly rainfall value of 22.16 inches at Louisville in October 1990, as reported in the NCDC "Climatology of the United States No. 20." The applicant responded in a letter dated January 30, 2007, that this value is suspect and most likely an error. The applicant used the NCDC "Cooperative Summary of the Day" and climate summaries from SERCC to show that the actual value should be 14.34 inches. The staff agrees with the applicant that the 22.16 inches is an error and accepts the overall highest monthly total of 17.32 inches, which occurred at Springfield.

Although most of the recorded precipitation extremes were associated with the occurrence of tropical cyclones, the overall highest 24-hour rainfall total and overall highest monthly rainfall total were not. On April 16, 1969, the 24-hour rainfall record in the area surrounding the proposed site was set at the Aiken 4NE Station, when 9.68 inches fell. The overall highest monthly total of 17.32 inches occurred during June 1973 in Springfield.

According to the applicant, winter storms accompanied by frozen precipitation in the proposed VEGP site area can be significant and disruptive. However, storms that produce significant amounts of snow are infrequent. With one exception, all of the 24-hour and monthly record snowfall totals around the proposed site were associated with a storm that occurred early in February 1973. The applicant originally reported that the highest daily and monthly snowfall totals were both 17.0 inches and occurred at the Blackville station in South Carolina (Most other surrounding stations recorded similar amounts, ranging from 14.0 to 16.0 inches). The staff found larger values of 19.0 inches and 22.0 inches for the daily and monthly snowfall records near the site--these occurred in February 1973 at Bamberg, South Carolina. During a site audit conducted on December 6, 2006, the staff asked the applicant to justify not including Bamberg as one of the cooperative observation stations considered in the SSAR. The applicant responded by adding climatic data from Bamberg to the SSAR and using data recorded by the Bamberg station to help characterize the regional climatology of the proposed VEGP site.

The staff notes that large snowfalls are very rare in the vicinity of the proposed site. At Waynesboro, the climatic observation station closest to the proposed site, maximum annual monthly snowfall totals from 1940 through 2006 (except for 1973) have ranged between 2 and 4 inches; only 5 years in the 66-year period have had months with snowfall greater than 2 inches at the Waynesboro cooperative observation site.

The staff concludes that the applicant has adequately identified precipitation extremes that might be expected to occur at or around the site. SER Table 2.3.1-2 lists the highest precipitation extremes that have occurred in the vicinity of the site.

2.3.1.3.3.5 ***Winter Precipitation Loads***

The methodology for assessing the potential winter precipitation load on the roofs of safety-related structures considers two climate-related components, the weight of the 100-year return period ground-level snowpack, and the weight of the 48-hour PMWP. Consistent with the staff's branch position on winter precipitation loads (NRC memorandum dated March 24, 1975, from Harold R. Denton to R.R. Maccary), 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 site 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 site 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 top of the snowpack and/or building roofs.

The applicant identified a 100-year return period ground-level snowpack value of 10-pounds-force per square foot (lbf/ft^2) for the proposed VEGP site, which was determined in accordance with ASCE/SEI 7-02. The applicant estimated the 48-hour PMWP as 28.3 inches (water equivalent) of precipitation. The applicant derived this PMWP estimate by using the guidance provided in the NOAA Hydrometeorological Report No. 53 (HMR 53), "Seasonal

Variation of 10-Square-Mile Probable Maximum Precipitation Estimates—United States East of the 105th Meridian."

Between February 9 and 11, 1973, heavy snowfall impacted the proposed VEGP site. Snowfall totals recorded at most of the surrounding climatic data stations ranged from 14.0 to 17.0 inches, with the highest recorded snowfall of 22.0 inches occurring at Bamberg. The storm produced the most snowfall in the climatic period of record for the region. Precipitation records from SERCC, "Period of Record Daily Climate Summary for Bamberg, SC," indicate the amount of liquid equivalent (i.e., liquid depth if all the snow melted) was 7.79 inches for this event. An inch of liquid water is equivalent to 5.2 lbf/ft^2, and, correspondingly, 7.79 inches of liquid water yields a snowpack of 40.5 lbf/ft^2.

In RAI 2.3.1-2, the staff asked the applicant to justify the adequacy of the proposed snowpack site characteristic, 10 lbf/ft^2, in consideration of the effects of the previously-discussed February 1973 storm. The applicant responded that the liquid equivalent value from SERCC is most likely bad datum and should have been removed. The applicant also stated that Section C7, Table C7-1, of the ASCE standard specifically lists the Augusta NWS location as having a maximum observed ground snow load of 8 lbf/ft^2 over a period of 40 years. The NRC staff accepts the applicant's response, and the applicant's proposed snowpack site characteristic of 10 lbf/ft^2, because other liquid equivalent estimates from other stations for the February 9–11, 1973, event are much smaller (less than 2.40 inches for most stations). The following is a list of the total snowfall and liquid equivalent, as recorded by NCDC in its Summary of the Day publications, for several surrounding climatic stations for the February 1973 storm:

STATION	SNOWFALL	LIQUID EQUIVALENT
Augusta	14.0 inches	2.13 inches
Louisville	14.8 inches	1.55 inches
Midville	10.0 inches	1.97 inches
Millen	14.0 inches	2.30 inches
Waynesboro	14.0 inches	2.39 inches

The staff, thus, agrees with the applicant that the 7.79 inches liquid equivalent value from SERCC is most likely incorrect.

The applicant has identified the 48-hour PMWP site characteristic of 28.3 inches using data from HMR-53. The applicant determined its 48-hour PMWP site characteristic value by using linear interpolation between the 24- and 72-hour probable maximum precipitation (PMP) values for December (Figures 35 and 45 of HMR-53), which had the largest values among the winter months December–February. The value of 28.3 inches converts to an estimated weight of the 48-hour PMWP of 147 lbf/ft^2, assuming that 1 inch of liquid water is equivalent to 5.2 lbf/ft^2. Using the same data from HMR-53, the staff found that the applicant has adequately identified an appropriate estimate of the 48-hour PMWP.

SER Table 2.3.1-4 presents the staff-accepted winter precipitation site characteristics for the proposed VEGP site as part of the list of regional climatic site characteristics.

2.3.1.3.3.6 *Hail, Freezing Rain, and Sleet*

The following discussion on hail, freezing rain, and sleet is intended to provide 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.

Hail can accompany severe thunderstorms and can be a major weather hazard, causing significant damage to crops and property. The applicant used the NOAA "Climate Atlas of the United States" to estimate that around the proposed VEGP site area--specifically to the northwest of the site--the annual mean number of days with hail of 0.75 inches or greater in diameter is approximately 1 to 2 per year. The applicant also stated that an extreme hailstorm event (i.e., hail with a diameter greater than 2.75 inches) was observed only once, on May 21, 1964, about 43 miles southeast of the proposed site.

The NCDC Storm Event Database, "Storm Events for Georgia, Query Results, Hail Event(s) Reported in Burke County, Georgia Between 01/01/1950 and 07/31/2006," reports that a total of 28 hail events with hail 0.75 inches or greater occurred in Burke County from January 1971 through May 2006. In four of those events, the hail had a diameter of 1.75 inches or greater.

The NRC staff notes that hailstorm events are point observations, which are often dependent on population density. Estimates of hail size can range widely based on the surrounding area population density and years considered. The applicant stated that Burke County can expect, on average, hail with a diameter of 0.75 inches or greater about 1 day per year and hail with a diameter of 1.0 inches or greater less than 1 day per year. The applicant also stated that the annual mean number of days reported with hail equal to or greater than 0.75 inches ranges from 1 to 2 days per year in the nearby, more populated counties of Richmond, Columbia, Aiken, and Edgefield. The annual mean number of days reported with hail equal to or greater than 1.0 inches ranges up to 1 day per year in those same counties. The staff verified the hail frequencies presented by the applicant from "The Climate Atlas of the United States." Based on the NSSL "Severe Thunderstorm Climatology, Total Threat," the staff finds that, considering data from 1980 through 1999, the total number of days per year with hail greater than 0.75 inches ranges from 2 to 4.

The applicant estimated that the highest average frequency of ice storms (i.e., sleet and freezing rain) occurs to the northeast, east, and southeast of the proposed VEGP site in South Carolina. These areas can expect an average of 3 to 5 days of freezing precipitation per year. Ice accumulations typically have a thickness of less than 1 inch.

The staff has independently confirmed and accepts the hail and ice storm frequencies provided by the applicant. The NCDC Storm Event Database, "Storm Events for Georgia, Query Results, Snow & Ice Event(s) Reported in Burke County, Georgia, Between 01/01/1950 and 07/31/2006," lists four ice events for Burke County in the period January 2002 through January 2005. "The Climate Atlas of the United States" estimates 3 to 5 days per year with freezing rain around the proposed VEGP site area. The staff notes that cold air damming events can bring cold air and an increased probability of ice storms during the winter months. In Jones, et al. (2002), the NCDC reports a 50-year return period uniform radial ice thickness of 0.75 inches because of freezing rain, with a concurrent 3-second gust wind speed of 30 mi/h for the proposed site area.

2.3.1.3.3.7 ***Thunderstorms***

The following discussion on thunderstorms is intended to provide 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.

The applicant estimated that, on average, approximately 52 days with thunderstorm occurrences happen per year in the site area. This frequency is taken from the NCDC local climatological data, annual summary with comparative data, for Augusta. The majority of thunderstorms recorded (60 percent) occurred between late spring and midsummer (i.e., from June through August). The applicant estimated that approximately 16 flashes to earth per square mile (6.2 flashes to earth per square kilometer) per year occur around the site. The staff finds this number appropriate based on similar values from “The Climate Atlas of the United States” (4.8–6 flashes to earth per square kilometer), a 5-year flash density map from Vaisala (4–8 flashes to earth per square kilometer), and a 1999 paper by G. Huffines and R.E. Orville, titled “Lightning Ground Flash Density and Thunderstorm Duration in the Continental United States: 1989-96” (3–7 flashes to earth per square kilometer). Assuming the size of the potential reactor area for the proposed Vogtle units is bounded by an area of 0.068 square miles (0.176 square kilometers), an approximate average of 1 lightning strike per year will occur in the reactor area.

2.3.1.3.4 Ultimate Heat Sink

The applicant has chosen a reactor design that does not use a cooling tower to release heat to the atmosphere following a loss-of-coolant accident. Instead, a passive containment cooling system (PCS) would provide the safety-related UHS. The applicant stated that the PCS is not significantly influenced by local weather conditions. If, at the COL or CP stage, the applicant chooses an alternative plant design that requires the use of a UHS cooling tower, the applicant will need to identify the appropriate meteorological site characteristics (i.e., maximum evaporation and drift loss and minimum water cooling conditions) used to evaluate the design of the chosen UHS cooling tower. At the time of the COL or CP, the staff will verify the design type and characteristics of the UHS. This is **COL Action Item 2.3-1**.

2.3.1.3.5 Temperatures

The applicant based its ambient air temperature and humidity site characteristics (e.g., the 0.4-percent, 2-percent, 99-percent, and 99.6-percent annual exceedance dry-bulb temperatures[5] and 0.4-percent annual exceedance wet-bulb temperature) on 1973–1996 Augusta data published by AFCCC in its 1999 long-term, engineering-related climatological data summaries. The values for the 0.4-percent, 2-percent, 99-percent, and 99.6-percent annual exceedance dry-bulb temperatures are 97 °F, 92 °F, 25 °F, and 21 °F, respectively. The staff performed an independent analysis for a longer period of record (1948–2006) using hourly data from Augusta, obtained from the NCDC “Integrated Surface Hourly Observations” data compilation. The Staff calculated the same values as the applicant. Consequently, the

5. The data presented by the applicant as minimum 1-percent and 0.4-percent annual exceedance values are referred to by the staff as 99-percent and 99.6-percent annual exceedance values throughout the SER.

staff finds the proposed site characteristics for ambient air temperature and humidity appropriate.

The applicant based the mean coincident wet-bulb temperatures associated with the annual 2-percent and 0.4-percent exceedance dry-bulb temperatures on data in the AFCCC report "Engineering Weather Data." The staff has confirmed that the mean coincident wet-bulb temperatures of 75 °F and 76 °F associated with the 2-percent and 0.4-percent exceedance probabilities are appropriate based on values presented in the AFCCC report.

To determine the site characteristic 0.4-percent annual exceedance maximum wet-bulb temperature value, the applicant selected a value of 79 °F from the AFCCC report for Augusta based on data from 1973 through 1996. The staff evaluated Augusta wet-bulb data from 1948 through 2006 and produced the same exceedance value. Thus, the staff finds the applicant's value of 79 °F appropriate for the 0.4-percent annual exceedance maximum wet-bulb temperature site characteristic.

To calculate 100-year return maximum and minimum dry-bulb temperatures, the applicant performed linear regression using daily maximum and minimum dry-bulb temperatures from Augusta from the 30-year period between 1966 and 1995. The staff used a methodology presented in the 2001 ASHRAE Handbook ("Fundamentals") to check the applicant's 100-year return values. The ASHRAE methodology is based on the assumption that the annual maxima and minima are distributed according to the Gumbel (Type 1 Extreme Value) distribution. Based on techniques presented in Chapter 27 of the Handbook, the staff calculated 100-year return values of maximum dry-bulb temperature for Waynesboro, Augusta, and Louisville; and 100-year return values of minimum dry-bulb temperature for Waynesboro, Augusta, and Aiken. The staff included Aiken and Louisville in its analysis because those are the two observation stations where the all-time maximum (112 °F) and minimum (−4 °F) temperatures occurred in the vicinity of the proposed VEGP site. Louisville data are available for the past 77 years, and Aiken data are available for the past 94 years; thus, a reasonably extensive record exists on which to base climate records. Based on techniques in the ASHRAE handbook, the staff calculated 100-year return maximum and minimum dry-bulb temperature values which are bounded by the applicant's proposed 100-year return period maximum and minimum dry-bulb temperature site characteristic values of 115 °F and −8 °F, respectively. The applicant's proposed 100-year return period maximum and minimum dry-bulb temperature site characteristic values also bound the all-time maximum and minimum temperatures observed in the area surrounding the proposed VEGP site (i.e., 112 °F at Aiken, and −4 °F at Louisville). Therefore, the staff finds that the applicant's values of 115 °F and −8 °F are appropriate for the 100-year return period maximum and minimum dry-bulb temperature site characteristics.

The applicant used a linear regression technique on 1966–1995 data from Augusta to estimate the 100-year return period maximum wet-bulb temperature of 88 °F. The staff conducted a similar linear regression technique, and, in addition, used the technique presented in the ASHRAE handbook, as previously discussed above, to calculate a similar 100-year return value using 1948–2006 data from the Augusta NWS site. The maximum hourly wet-bulb temperature recorded at Augusta from 1948 through 2006 was 86 °F. Based on these results, the staff believes that the applicant's 100-year return maximum wet-bulb temperature site characteristic value of 88 °F is appropriate.

The applicant based many of the proposed site characteristics on data from Augusta. The staff accepts this approach because meteorological conditions at Augusta tend to be representative of the proposed VEGP site. In SER Section 2.3.3, the staff shows a comparison between onsite meteorological data and corresponding Augusta data. Temperature, dew point, wind speed, and wind direction measurements are very similar between the two observation stations.

At the time of any COL application, the applicant would have to compare site characteristics presented in the ESP against the corresponding site parameters listed in the design certification document (DCD). The site characteristics discussed above are meant to be general, such that to encompass many potential designs and corresponding site parameters.

Since the applicant has expressed an interest in the AP1000 design, AP1000 specific temperature site characteristics have also been identified by the applicant. The applicant stated that Westinghouse provided the following definitions for the temperature site parameters listed in the AP1000 DCD, dated September 7, 2004:

- Maximum Safety Dry-Bulb Temperature and Coincident Wet-Bulb Temperature: These site parameter values represent a maximum dry-bulb temperature that exists for 2 hours or more, combined with the maximum wet-bulb temperature that exists in that population of dry-bulb temperatures.

- Maximum Safety Noncoincident Wet-Bulb Temperature: This site parameter value represents a maximum wet-bulb temperature that exists within a set of hourly data for a duration of 2 hours or more.

- Maximum Normal Dry-Bulb Temperature and Coincident Wet-Bulb Temperature: The dry-bulb temperature component of this site parameter pair is represented by a maximum dry-bulb temperature that exists for 2 hours or more, excluding the highest 1 percent of the values in an hourly data set. The wet-bulb temperature component is similarly represented by the highest wet-bulb temperature excluding the highest 1 percent of the data, although there is no minimum 2-hour persistence criterion associated with this wet-bulb temperature.

- Maximum Normal Noncoincident Wet-Bulb Temperature: This site parameter value represents a maximum wet-bulb temperature, excluding the highest 1 percent of the values in an hourly data set (i.e., a 1 percent exceedance), that exists for 2 hours or more.

The applicant identified the following AP1000 specific temperature site characteristics:

- a maximum safety dry-bulb temperature of 107.1 °F with a coincident wet-bulb temperature of 80.1 °F.

- a maximum safety noncoincident wet-bulb temperature of 83.0 °F.

- a maximum normal dry-bulb temperature of 94 °F with a coincident wet-bulb temperature of 78 °F.

- a maximum normal noncoincident wet-bulb temperature of 78 °F.

The applicant used a 30-year period of record, 1966 through 1995, from Augusta to define these site characteristics. The applicant used 1-hour averages to represent the 2-hour persistence criterion, which is a conservative assumption. Using data from AFCCC and NCDC, as discussed above, the staff verified the AP1000 specific site characteristics values as correct; however, the staff believes that AP1000 specific maximum safety dry-bulb and wet-bulb temperatures should be more conservatively based on a 100-year return period. This is **Open Item 2.3-1**.

2.3.1.3.6 Stagnation Potential

Large-scale episodes of atmospheric stagnation are not common in the region of the proposed site. Based on the 50-year period from 1948 through 1998, high-pressure stagnation conditions, usually accompanied by light and variable wind conditions, can be expected at the proposed VEGP site about 20 days per year, or about four cases per year with the mean duration of each case being about 5 days (Wang and Angell). Stagnation conditions usually occur during the months from May through October, with a peak in September. Winds are usually weakest in September due to influence from the Bermuda High pressure system.

The applicant also noted that, from a climatological standpoint, the lowest morning mixing heights occur in the autumn and are the highest during the winter. Conversely, afternoon mixing heights reach a seasonal minimum in the winter and a maximum during the summer--which is expected because of more intense summer heating. The applicant presented mixing height data from Athens, Georgia, which the applicant claims is reasonably representative of conditions at the proposed VEGP site.

The staff confirmed the information presented by the applicant regarding restrictive dispersion conditions as correct. Section 2.3.2 of this SER discusses the proposed VEGP site air quality conditions for design- and operating-basis considerations. Sections 2.3.4 and 2.3.5 of this SER discuss atmospheric dispersion site characteristics used to evaluate short-term post-accident airborne releases and long-term routine airborne releases, respectively.

2.3.1.3.7 Climate Change

As specified in RS-002, the applicability of data used to discuss severe weather phenomena that may impact the proposed ESP site during the expected period of reactor operation should be substantiated. Long-term environmental changes and changes to the region resulting from human or natural causes may affect the applicability of the historical data to describe the site’s climate characteristics. Although there is no scientific consensus regarding the issue of climate change, the staff believes current climate trends should be analyzed for the potential of ongoing environmental changes.

During a site audit conducted on December 6, 2006, the staff asked the applicant to evaluate trends in temperature and precipitation extremes in the proposed VEGP site vicinity and discuss whether such trends may be indicative of climatic change. In a letter dated January 30, 2007, the applicant stated that initial investigations showed no consistent long-term climate change in the proposed site area. The applicant also revised its SSAR to include a discussion of long-term climatic changes.

The applicant analyzed trends in temperature and rainfall normals / standard deviations over a 70-year period for successive 30-year intervals based on the NCDC Web site "Climatography of the United States." The applicant stated that average temperature has increased only slightly (i.e., 0.2 to 0.3 °F) over the latest 30-year period and rainfall, on average, has increased by 1.5 inches over the same period.

The staff has confirmed and accepts the numbers provided by the applicant. The staff analyzed 1-year, 10-year, and 20-year trends in annual average daily maximum and minimum temperatures, annual extreme maximum and minimum temperatures, annual average precipitation, and annual extreme daily precipitation at Waynesboro and Augusta for potential indications of climate change using data from 1951 through 2004. The trends over 20 years show that annual extreme minimum temperatures have increased 2 °F and average annual precipitation has increased about 1.5 to 2.5 inches over the period of record. All other meteorological parameters showed no discernible signs of climate change.

The Intergovernmental Panel on Climate Change (IPCC) issued its Fourth Assessment Report on Climate Change in February 2007. The staff considered Chapter 11 in "Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the 4th Assessment Report of the Intergovernmental Panel on Climate Change," regarding the southeastern portion of the United States. The IPCC models projecting potential future climate change depend on human activity and land use. To account for this, the IPCC uses different global scenarios as input to the models. Chapter 11 of the IPCC report discusses the following three scenarios:

- (A2) "A more divided world with self-reliant, independently operating nations"
- (A1B) "A more integrated world with an emphasis on all energy sources"
- (B1) "A world more integrated and ecologically friendly" (i.e., less energy consumption and more cooperating nations)

During the 100-year period under the A1B scenario (i.e., 1980–1999 as compared to 2080–2099), the IPCC projection estimates that the proposed VEGP site may see an increase in average annual temperature of 3 °C and an increase in precipitation of 0 to 5 percent. Under the more and less extreme scenarios, increases in annual average temperature may range from 2 °C to 7.5 °C. The projection also shows a general decrease in snow depth as a result of delayed autumn snowfall and earlier spring snow melt.

The staff also analyzed climate-change-induced hurricane trends within 100 nautical miles of the site and found no discernible trends in hurricane frequency or intensity. The "Summary for Policymakers" based on the February 2007 IPCC report makes the following statement concerning tropical cyclones:

> Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea surface temperatures. (IPCC Sections 3.8, 9.5, and 10.3)

However, the question of whether hurricanes are becoming more destructive because of global warming is a contested issue in the scientific debate over climate change. A number of academic papers have been published either supporting or debunking the idea that warmer temperatures linked to human activity have created more intense storms, and the issue is currently unresolved (Dean; Eilperin; Kerr; Witze). Based on the current amount of scientific uncertainty regarding this subject, the staff believes the applicant has adequately addressed the issue of hurricanes and provided conservative site characteristics.

The applicant stated that the number of recorded tornado events has increased, in general, since detailed records were routinely kept beginning around 1950. However, some of this increase is attributable to a growing population, greater public awareness and interest, and technological advances in detection. These changes are superimposed on normal year-to-year variations. Consequently, the number of observations recorded within a 2-degree latitude and longitude square centered on the VEGP site reflects these effects. The staff has confirmed and accepts the applicant's statements regarding tornadoes. The "Summary for Policymakers" based on the February 2007 IPCC report states, "there is insufficient evidence to determine whether trends exist in small scale phenomena such as tornadoes, hail, lightning, and dust storms." (IPCC Sections 3.8 and 5.3).

In conclusion, the staff acknowledges that long-term climatic change resulting from human or natural causes may introduce changes into the most severe natural phenomena reported for the site. 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., if new information shows that the climate has changed and that the climatic site characteristics no longer represent extreme weather conditions), the staff may 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," if necessary to bring the site into compliance with Commission requirements to assure adequate protection of the public health and safety.

2.3.1.4 Conclusion

The NRC staff has evaluated the relevant sections of the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007, pursuant to the acceptance criteria described RS-002, Section 2.3.1 and applicable regulatory requirements of 10 CFR Part 52 and 10 CFR Part 100. The applicant has presented and substantiated information relative to the regional meteorological conditions. The staff has reviewed the information presented by the applicant and concludes that the identification and consideration of the regional and site meteorological characteristics meet the requirements of 10 CFR 52.17(a)(1), 10 CFR 100.20(c), and 10 CFR 100.21(d).

Table 2.3.1-1 - Regional Climatic Observation Stations

STATION NAME	COUNTY	STATE CLIMATE DIVISION	DISTANCE FROM ESP SITE (km)	DIRECTION FROM ESP SITE	STATION ELEV. (m)	DIFFERENCE FROM ESP SITE ELEVATION (m)	YEARS OF DATA
Appling 2NW [1]	Columbia	GA-6	69	NW	113	46	46
Augusta Bush Field [2]	Richmond	GA-6	32	NW	40	-27	57
Augusta [1]	Richmond	GA-6	41	NW	40	-27	13
Louisville 1 E [2]	Jefferson	GA-6	59	SW	98	31	77
Midville Exp. Station [2]	Burke	GA-6	51	SW	85	18	50
Millen 4 N [2]	Jenkins	GA-6	36	SSW	59	-8	68
Newington [2]	Screven	GA-6	65	SSE	64	-3	43
Sylvania 2 SSE [1]	Screven	GA-6	47	SE	76	9	13
Waynesboro 2 S [2]	Burke	GA-6	25	WSW	82	15	67
Allendale 2 NW [1]	Allendale	SC-7	44	ESE	55	-12	26
Bamberg [2]	Bamberg	SC-7	70	ENE	50	-17	57
Blackville 3 W [2]	Barnwell	SC-7	47	NE	99	32	93
Hampton 1S [1]	Hampton	SC-7	68	SSE	29	38	55
Aiken 5SE [2]	Aiken	SC-5	41	N	150	83	94
Clarks Hill 1 W [1]	McCormick	SC-5	71	NW	116	49	56
Trenton 1 NNE [1]	Edgefield	SC-5	68	NNE	189	122	47
Springfield [2]	Orangeburg	SC-5	60	NNE	91	24	58

[1] Only the staff used these stations.

[2] Both the staff and applicant used these stations.

Data Reference: NCDC, "Local Weather Observation Station Record," October 2006.

Table 2.3.1-2 Climatic Precipitation Extremes within 50 Miles of the ESP Site

PARAMETER	SITE EXTREMES	STATION
Maximum 24-hr Rainfall	9.68 in.	Aiken 5SE
Maximum Monthly Rainfall	17.32 in.	Springfield
Minimum Monthly Rainfall	0 in.	Multiple
Maximum 24-hr Snowfall	19 in.	Bamberg
Maximum Monthly Snowfall	22 in.	Bamberg
Maximum Daily Snow Depth	19 in.	Bamberg

Table 2.3.1-3 - Tropical Cyclone Frequency within a 100-Nautical Mile Radius of the Proposed VEGP Site between 1851 and 2004

CLASSIFICATION	NUMBER OF OCCURRENCES	MAXIMUM SUSTAINED (1-MIN AVG) Wind speed RANGE
Saffir-Simpson Category 5 Hurricanes	0	>155 mi/h
Saffir-Simpson Category 4 Hurricanes	0	131–155 mi/h
Saffir-Simpson Category 3 Hurricanes	5	111–130 mi/h
Saffir-Simpson Category 2 Hurricanes	4	96–110 mi/h
Saffir-Simpson Category 1 Hurricanes	16	74–95 mi/h
Tropical Storms	46	39–73 mi/h
Tropical Depressions	23	<39 mi/h
Subtropical Storms	1	<74 mi/h
Subtropical Depressions	2	<39 mi/h
Extra-Tropical Storms	5	N/A

Table 2.3.1-4 - Regional Climatology Site Characteristics

SITE CHARACTERISTIC	VALUE		DESCRIPTION
Ambient Air Temperature and Humidity			
Maximum Dry-Bulb Temperature	2% annual exceedance	92 °F	The ambient dry-bulb temperature that will be exceeded 2% of the time annually
	0.4% annual exceedance	97 °F	The ambient dry-bulb temperature that will be exceeded 0.4% of the time annually
	100-year return period	115 °F	The ambient dry-bulb temperature that has a 1% annual probability of being exceeded (100-year mean recurrence interval)
Minimum Dry-Bulb Temperature	99% annual exceedance	25 °F	The ambient dry-bulb temperature below which dry-bulb temperatures will fall 1% of the time annually
	99.6% annual exceedance	21 °F	The ambient dry-bulb temperature below which dry-bulb temperatures will fall 0.4% of the time annually
	100-year return period	-8 °F	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	2% annual exceedance	79 °F	The ambient wet-bulb temperature that will be exceeded 2% of the time annually
	0.4% annual exceedance	88 °F	The ambient wet-bulb temperature that will be exceeded 0.4% of the time annually
Site Temperature Basis for AP1000			
Maximum Safety Dry-Bulb and Coincident Wet-Bulb	(See Open Item 2.3-1)		These AP1000 specific site characteristics values represent a maximum dry-bulb temperature that exists for 2 hours or more, combined with the maximum wet-bulb temperature that exists in that population of dry-bulb temperatures.
Maximum Safety Wet-Bulb (Non-Coincident)	(See Open Item 2.3-1)		This AP1000 specific site characteristic value represents a maximum wet-bulb temperature that exists within a set of hourly data for a duration of 2 hours or more.

SITE CHARACTERISTIC	VALUE	DESCRIPTION
Maximum Normal Dry-Bulb and Coincident Wet-Bulb	94 ◦F and 78 ◦F	The dry-bulb temperature component of this AP1000 specific site characteristics pair is represented by a maximum dry-bulb temperature that exists for 2 hours or more, excluding the highest 1 percent of the values in an hourly data set. The wet-bulb temperature component is similarly represented by the highest wet-bulb temperature excluding the highest 1 percent of the data, although there is no minimum 2-hour persistence criterion associated with this wet-bulb temperature.
Maximum Normal Wet-Bulb (Non-Coincident)	78 ◦F	This AP1000 specific site characteristic value represents a maximum wet-bulb temperature, excluding the highest 1 percent of the values in an hourly data set (i.e., a 1 percent exceedance), that exists for 2 hours or more.
Basic Wind Speed		
3-Second Gust	104 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 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
Maximum 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
Pressure Drop	2.0 lbf/in.^{2}	Decrease in ambient pressure from normal atmospheric pressure resulting from passage of the tornado
Rate of Pressure Drop	1.2 lbf/in.^{2}/s	Rate of pressure drop resulting from the passage of the tornado
Winter Precipitation		

SITE CHARACTERISTIC	VALUE	DESCRIPTION
100-Year Snowpack	10 lb/sq ft	Weight of the 100-year return period snowpack (to be used in determining normal precipitation loads for roofs)
48-Hour Probable Maximum Winter Precipitation	28.3 inches of water	PMP during the winter months (to be used in conjunction with the 100-year snowpack in determining extreme winter precipitation loads for roofs)

2.3.2 Local Meteorology

2.3.2.1 Introduction

In Section 2.3.2 of the SSAR, the applicant presented information on local (site) meteorological parameters. Specifically, the applicant provided the following information:

- a description of the local (site) meteorology in terms of airflow, atmospheric stability, temperature, water vapor, precipitation, fog, and air quality.
- an assessment of the influence on the local meteorology of construction and operation of the nuclear power plant that is planned to be constructed on the proposed site and its facilities, 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 the nuclear power plant that is planned to be built on the proposed site.

This section verifies that the applicant has identified and considered the meteorological and topographical characteristics of the site and the surrounding area, as well as changes that may result to those characteristics because of the construction and operation of the proposed facility.

2.3.2.2 Regulatory Basis

The acceptance criteria for identifying local meteorological parameters are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The staff considered the following regulatory requirements in reviewing the applicant's identification of local meteorological parameters:

- 10 CFR 52.17(a), which requires that the application contain a description of the seismic, meteorological, hydrological, and geological characteristics of the proposed site.
- 10 CFR 100.20(c), which requires that the meteorological characteristics of the site, necessary for safety analysis or that may have an impact on plant design, be identified and characterized as part of the NRC's review of the acceptability of a site.

- 10 CFR 100.21(c), which requires that site atmospheric dispersion characteristics be evaluated and dispersion parameters established such that (1) radiological effluent release limits associated with normal operation from the type of facility to be located at the site can be met for any individual located offsite; and (2) radiological dose consequences of postulated accidents shall meet the criteria set forth in 10 CFR 50.34(a)(1) for the type of facility proposed to be located at the site.

- 10 CFR 100.21(d), which requires that the physical characteristics of the site, including meteorology, geology, seismology, and hydrology be evaluated and site parameters established, such that the potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site.

The local meteorological information assembled in compliance with the above regulatory requirements would be necessary to determine, at the COL stage, a proposed facility's compliance with the following requirements in Appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR Part 50:

- GDC 2, which requires that structures, systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions; and further requires that consideration be given to the most severe local weather phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

An ESP applicant, though, need not demonstrate compliance with the above GDC, with respect to regional climatology.

RS-002, Section 2.3.2 specifies that an application meets the above requirements, if the application satisfies the following criteria:

- 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 RG 1.70.

- A complete topographical description of the site and environs set out to a distance of 50 miles from the site should be provided.

- A discussion and evaluation of the influence of a nuclear power plant of the type proposed to be constructed on the site on local meteorological and air quality conditions should be provided.

To the extent applicable to the above-outlined acceptance criteria, the applicant applied the NRC-endorsed meteorological information selection methodologies and techniques found in the following:

- RG 1.23, which provides criteria for an acceptable onsite meteorological measurements program to be used to monitor local (onsite) meteorology site characteristics.

- RG 1.70, which describes the type of local meteorological data that should be presented in SSAR Section 2.3.2.

When independently assessing the veracity of the information presented by the applicant in SSAR Chapter 2.3.2, the NRC staff applied the same above-cited methodologies and techniques.

2.3.2.3 Technical Evaluation

Using the approaches and methodologies described in RS-002 Section 2.3.2, the NRC staff reviewed the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007. In reviewing and evaluating the applicant's site meteorology, the staff used (or relied on) none of the applicant's proposed design parameters and site interface values presented in SSAR Section 1.3.

2.3.2.3.1 Local Meteorology Description

The applicant used data from the existing Vogtle meteorological monitoring program and 10 surrounding NWS observation stations (as listed in SSAR Section Table 2.3.1-2 and repeated in SER Section 2.3.1) to describe local meteorology. The applicant used data from the onsite meteorological monitoring program to describe wind speed, wind direction, and atmospheric stability conditions; surrounding offsite observation stations were data sources for temperature, atmospheric moisture, precipitation, and fog conditions.

The applicant presented means and historical extremes of temperature, rainfall, and snowfall data from the 10 offsite observation stations listed in SSAR Section 2.3.1. SER Table 2.3.2-1 summarizes the overall extremes from those stations, as compiled by the applicant.

The staff evaluated the information regarding local meteorological conditions submitted by the applicant using data from the Vogtle onsite meteorological monitoring system, as well as climatic data reported in "Monthly Station Climate Summaries," "U.S. Monthly Climate Normals," and "Daily Surface Data" (all from NCDC) and "Period of Record Daily Climate Summaries for Georgia and South Carolina" from SERCC. The staff has confirmed the normal and extreme values presented by the applicant in SSAR Tables 2.3-3 and 2.3-5, respectively.

2.3.2.3.1.1 ***Airflow***

The applicant presented hourly wind data from the Vogtle onsite meteorological monitoring program, as described in SSAR Section 2.3.3, from 1998 through 2002. The applicant also provided annual and seasonal wind roses based on 10-meter and 60 meter observation heights. The NRC staff confirmed that the wind directions from both levels are fairly similar. The prevailing annual wind direction for the site is generally from the southwest. Winds from the southwest predominate during the spring and summer, westerly winds predominate during the winter, and northeasterly winds predominate during the autumn months.

The applicant stated that annual average wind speeds at the 10- and 60-meter observation levels are 2.5 m/s and 4.6 m/s, respectively. This is consistent with the 6.1-meter measurement height annual average wind speed at Augusta, Georgia, of 2.7 m/s. The annual frequencies of calm wind conditions are 0.44 and 0.07 percent of the time for the 10-meter and 60-meter observation levels at the proposed VEGP site.

The staff reviewed the Vogtle onsite meteorological wind data from 1998 through 2002 for completeness and consistency. The wind measurements provided by the applicant had at least 95-percent data recovery. Initially, the staff did have concerns about the consistency of the data. The staff, having compared the 1998–2002 annual data used by the applicant to the 1972–1973, 1977–1978, 1978–1979, and 1980–1981 meteorological data presented in the original final safety analysis report (FSAR) for Vogtle Units 1 and 2, discovered that there were discrepancies between the two sets of data. During a site audit conducted on December 6, 2006, the staff asked the applicant to explain the differences in wind direction frequency at 60 meters and 10 meters during the spring, summer, and winter seasons, when comparing the submitted VEGP wind data to the original FSAR data for Vogtle Units 1 and 2. In its letter dated January 30, 2007, the applicant explained that while the winds are somewhat uniform (in that the overall peak sector for both the original FSAR data and the 1998–2002 data is the same (west)), there is some variability among the annual data due to the relatively low wind speeds at the site. The staff has confirmed that the wind speeds are typically light at the site and thus some degree of variability can be expected. When winds are light they are typically not produced by a large-scale pressure gradient (e.g., synoptic scale), rather by smaller, more random and turbulent motions (e.g., mesoscale).

During the December 2006 site audit, the staff also asked the applicant to explain the amount of variability in summer wind direction frequency between the two onsite observation heights of 10 and 60 meters. The applicant stated in its letter dated January 30, 2007 that it was revising the wind roses for the summer season to correct an error and would include the corrected wind roses in the next revision of the SSAR. In a letter dated March 26, 2007, the applicant also provided a revised onsite 1998–2002 database, in which periods of bad data were removed and coded as such. Based on an independent review of the revised onsite meteorological data, the staff accepts the changes and concludes that the onsite meteorological wind data from 1998 through 2002 are both complete and consistent.

The staff agrees with the applicant that the winds for the proposed VEGP site are predominately from the southwest through west sectors. The staff also agrees with the annual average wind speeds of 2.5 m/s and 4.6 m/s at 10 and 60 meters as presented by the applicant. The staff's conclusions are based on a comparison between the Vogtle onsite meteorological wind data and nearby Augusta climatological data, as presented in the NCDC 2004 "Local Climatological Data."

2.3.2.3.1.2 ***Atmospheric Stability***

The applicant classified atmospheric stability in accordance with the guidance provided in the proposed Revision 1 to RG 1.23. Atmospheric stability is a critical parameter for estimating dispersion characteristics in SSAR Sections 2.3.4 and 2.3.5. Dispersion of effluents is greatest for extremely unstable atmospheric conditions (i.e., Pasquill stability class A) and decreases progressively through extremely stable conditions (i.e., Pasquill stability class G). The applicant primarily based its stability classification on temperature change with height (i.e. delta-temperature or ΔT/ΔZ) between the 60-meter and 10-meter height, as measured by the Vogtle onsite meteorological monitoring program between 1998 and 2002.

The applicant provided seasonal and annual frequencies of atmospheric stability classes for the 5-year period of record for the onsite data from 1998–2002. According to the applicant, there is a predominance of slightly stable (Pasquill stability class E) and neutral stability (Pasquill stability class D) conditions at the proposed VEGP site, ranging from 50 to 60 percent of the time, on a seasonal and annual basis. Extremely unstable conditions (Pasquill stability class A) occur most frequently during spring and summer, and extremely stable conditions (Pasquill stability class G) occur most frequently during the fall and winter months. Based on past experience with stability data at various sites, a predominance of slightly stable (Pasquill stability class E) and neutral (Pasquill stability class D) conditions at the proposed site is generally consistent with expected meteorological conditions.

During a site audit conducted on December 6, 2006, the staff asked the applicant to explain the decrease in frequency of extremely unstable conditions (Pasquill stability class A) from 1998–2000 to 2001–2002, and the increase in frequency of slightly stable conditions (Pasquill stability class E) from 2000 to 2001. The staff also asked the applicant to explain a decrease in the number of occurrences of unstable conditions (Pasquill stability classes A–C) in 2001 and 2002, as compared to 1998 through 2000. The applicant responded, in its letter dated January 30, 2007, that there has been a slight decreasing trend in stability class A over the past 5 years; however, when individual stability classes are combined into the following three basic stability categories, (1) unstable (A-C), (2) neutral (D-E), and (3) stable (F-G) the decreasing trend is not as significant. The applicant stated that the increase in stability class E frequency was due to a data error. This error was corrected in the revised meteorological database. The staff reviewed the revised meteorological database and has concluded that its concerns regarding stability class frequencies have been resolved.

As a qualitative check of the hourly stability data provided by the applicant, the staff created plots of stability class as a function of time of day for each individual year, and, additionally, the 5 years together. SER Figure 2.3.2-1 is a plot of the proposed VEGP site 1998–2002 hourly stability class data as a function of time of day. Unstable conditions (Pasquill stability classes A–C) generally occurred during the day, and stable conditions (Pasquill stability classes F–G) generally occurred during the night, as expected due to daytime heating and nighttime cooling.

During a site audit conducted on December 6, 2006, the staff asked the applicant to explain a daytime increase in the number of occurrences of stable conditions (Pasquill stability classes F and G) in 2001, which is not seen in the other years. The applicant responded, in its letter dated January 30, 2007, that this could be attributed to a data error. This error was corrected in the revised meteorological database. The staff has confirmed that this problem has been fixed.

Frequency of occurrence for each stability class is one of the inputs to the dispersion models used in SSAR Sections 2.3.4 and 2.3.5. The applicant included this data in the form of a joint frequency distribution (JFD) of wind speed and direction data as a function of stability class. A comparison of a JFD developed by the staff from the hourly data submitted by the applicant with the JFD developed by the applicant showed reasonable agreement.

The staff accepts the 5 years of stability data presented by the applicant in SSAR Section 2.3.2 as complete and adequate. The staff believes that these data are appropriate to use as input to the dispersion models discussed in SER Sections 2.3.4 and 2.3.5.

2.3.2.3.1.3 ***Temperature***

The applicant characterized normal and extreme temperatures for the site based on the 10 surrounding observation stations listed in SSAR Section 2.3.1.1. The extreme maximum temperature recorded near the site is 112 °F, and the extreme minimum temperature recorded near the site is −4 °F. Annual average temperatures for the 10 surrounding observation stations in the site vicinity (which are based on the average of the daily mean maximum and minimum temperatures) range from 63.1 °F to 65.0 °F. The applicant stated that the annual average diurnal (day-to-night) temperature differences in the site vicinity range from 21.9 °F to 26.3 °F.

Using data from NCDC and SERCC, the staff reviewed the daily mean temperatures, the extreme temperatures, and the diurnal temperature ranges presented by the applicant. The staff confirmed the temperature characterizations, as presented in SSAR Section 2.3.2, and accepts them as correct.

2.3.2.3.1.4 ***Water Vapor***

The applicant presented wet-bulb temperature, dew point temperature, and relative humidity data summaries from the Augusta NWS observation station to characterize the typical atmospheric moisture conditions near the proposed VEGP site.

Based on a 49-year period of record, the applicant indicated that the mean annual wet-bulb temperature is 56.7 °F. The highest monthly mean wet-bulb temperature is 72.7 °F during July, and the lowest monthly mean wet-bulb temperature is 40.3 °F during January. According to the applicant, the mean annual dew point temperature at Augusta is 51.9 °F, which also reaches its maximum during summer and minimum during winter. The applicant gives the highest monthly mean dew point temperature as 69.7 °F during July, and the lowest monthly mean dew point temperature as 34.4 °F during January.

Based on a 30-year period of record, the applicant indicates that relative humidity averages 72 percent on an annual basis. The average early morning relative humidity levels exceed 90 percent during August, September, and October. Typically, the relative humidity values reach their diurnal maximum in the early morning and diurnal minimum during the early afternoon.

The staff has verified and accepts as correct and appropriate the wet-bulb temperature, dew point temperature, and relative humidity data presented by the applicant. The staff reviewed the data listed in the NCDC “Augusta, Georgia, 2004 Local Climatological Data, Annual Summary with Comparative Data.” Because of the proximity of Augusta to the proposed VEGP site and because of the similarity of topographic features at both locations (i.e., gently rolling terrain, adjacent to the Savannah River, and location within the broad river valley), the Augusta atmospheric moisture data should be typical of the atmospheric moisture conditions in the proposed site region. SER Section 2.3.1 discusses the wet-bulb site characteristics more quantitatively.

2.3.2.3.1.5 *Precipitation*

Based on data from the 10 surrounding observation stations, the applicant provided that the average annual precipitation (water equivalent) totals generally range from 43.85 to 48.57 inches. The highest average annual precipitation is 52.43 inches, which occurs at the Aiken 4NE Station.

According to the applicant, snowfall is infrequent, with normal annual totals ranging from 0.1 to 1.4 inches. SER Section 2.3.1 discusses in greater detail snowfall in the vicinity of the proposed VEGP site.

Using daily snowfall and rainfall data from NCDC and SERCC, the staff has independently verified the precipitation statistics presented in SSAR Section 2.3.2 and accepts them as accurate.

2.3.2.3.1.6 ***Fog***

Augusta is the closest station to the proposed VEGP site that makes fog observations. The applicant stated that, based on a 54-year period of record, Augusta averages about 35.1 days per year of heavy fog conditions (e.g., visibility is reduced to one-quarter mile or less).

According to the applicant, the frequency of typical fog conditions at Augusta is expected to be similar to that at the proposed VEGP site because of the proximity and similarity of topographic features between the two locations. Both sites are located in gently rolling terrain, adjacent to the Savannah River, and are situated in a broad river valley.

The staff confirmed the applicant's assertion that the Augusta NWS station reports 35.1 days per year with heavy fog observations. The staff agrees that the frequency of fog conditions at Augusta is expected to be similar to that at the proposed VEGP site because of the proximity and similarity of topographic features at both locations.

2.3.2.3.1.7 ***Air Quality***

The applicant provided that the proposed VEGP site is located in the Augusta—Aiken Interstate Air Quality Control Region. The counties within this region, including Burke County, have been designated as being in attainment or unclassified for all EPA criteria air pollutants (i.e., ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead) (40 CFR 81.311, "Georgia," and 40 CFR 81.34, "Metropolitan Dayton Intrastate Air Quality Control Region").

According to the applicant, the proposed nuclear steam supply system (NSSS) and other radiological systems related to the proposed facility will not be sources of criteria pollutants or other hazardous air pollutants. Other proposed supporting equipment such as diesel generators, fire pump engines, auxiliary boilers, emergency station-blackout generators, and other nonradiological emission-generating sources are not expected to be, in the aggregate, a significant source of criteria pollutant emissions. The staff agrees with this assessment because these systems will be used on an infrequent basis.

Because the EPA has designated the proposed VEGP site area as being in attainment or unclassified for all criteria air pollutants and the new facility is not expected to be a significant source of air pollutants, the staff finds that the VEGP site air quality conditions should not be a significant factor in the design and operating bases for the facility.

2.3.2.3.2 Impacts on Local Meteorology

The applicant stated that the associated paved, concrete, or other improved surfaces resulting from the construction of the proposed nuclear facility are insufficient to generate discernible, long-term effects to local- or micro-scale meteorological conditions. Wind flow may be altered immediately adjacent to and downwind of larger site structures, but these effects will likely dissipate within 10 structure heights downwind. SER Section 2.3.3 discusses the effects of these larger structures on wind flow.

Although temperature may increase above altered surfaces, the effects will be too limited in their vertical profile and horizontal extent to alter local- or regional-scale ambient temperature changes. Any water vapor releases from the proposed 600-foot-high natural draft cooling towers will have insignificant effects on local meteorology because of the high release height of thermal/water vapor plumes.

Because of the limited and localized nature of the expected modifications associated with the proposed plant structures and the associated improved surfaces, the staff agrees with the applicant that the proposed facility will not have significant impact on local meteorological conditions to affect plant design and operation.

The use of natural draft cooling towers could create visible plumes under certain atmospheric conditions, which could cause shadowing of nearby lands and salt deposition. Ground-level icing would be insignificant, though, because of the low probabilities of ground-level plumes and freezing conditions. The staff finds that these projected atmospheric impacts will not have significant impact on local meteorological conditions to affect plant design and operation.

During a site audit conducted on December 6, 2006, the staff asked the applicant to clarify whether any terrain modifications are expected to result from construction of the proposed facility and how they may affect the local meteorological characteristics of the site. The applicant responded in its letter dated January 30, 2007, that although there will be excavation, landscaping, site leveling, and clearing associated with the construction of the new units, these alterations to the site terrain would be localized and would not represent a significant alteration to the flat-to-gently-rolling topographic character of the area and region around the site. Therefore, the overall meteorological characteristics of the site will not be affected. The staff agrees that these activities are too small-scale to impact the local meteorological characteristics of the site.

2.3.2.3.3 Topographic Description of the Site

The proposed VEGP site is located in Burke County, Georgia, west of the Savannah River on approximately 2169 acres of land. The applicant provided maps of topographic features within a 5-mile radius of the site. The applicant also provided terrain elevation profiles along each of the 16 standard 22.5-degree compass radials out to a distance of 50 miles. Based on these profiles, the applicant characterized the proposed site terrain as flat to gently rolling. The only significant nearby topographic feature mentioned by the applicant is the broad Savannah River valley. The staff agrees with this terrain characterization based on topography data from the USGS and a site visit. The staff concludes that the applicant provided all the necessary topographic information.

2.3.2.4 Conclusion

The NRC staff has evaluated the relevant sections of the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007, pursuant to the acceptance criteria of RS-002 Section 2.3.2 and applicable regulatory requirements of 10 CFR Part 52 and 10 CFR Part 100. As discussed above, the applicant has identified and provided acceptable consideration of the meteorological and topographical characteristics of the site and the surrounding area, including the potential impact on plant design and operation due to changes in local meteorology caused by plant construction and operation. Therefore, the staff finds that the applicant has provided the information required to address 10 CFR 52.17(a), 10 CFR 100.20(c), 10 CFR 100.21(c), and 10 CFR 100.21(d).

Table 2.3.2-1 - Offsite Temperature and Precipitation Extremes

PARAMETER	VALUE (DATE)	LOCATION
Maximum Temperature	112 °F (7/24/52)	Louisville 1E
Minimum Temperature	−4 °F (1/21/85)	Aiken 4NE
Maximum 24-hr Rainfall	9.68 in. (4/16/69)	Aiken 4NE
Maximum Monthly Rainfall	17.32 in. (6/73)	Springfield
Maximum 24-hr Snowfall	19.0 in. (2/10/73)	Bamberg
Maximum Monthly Snowfall	22.0 in. (2/73)	Bamberg

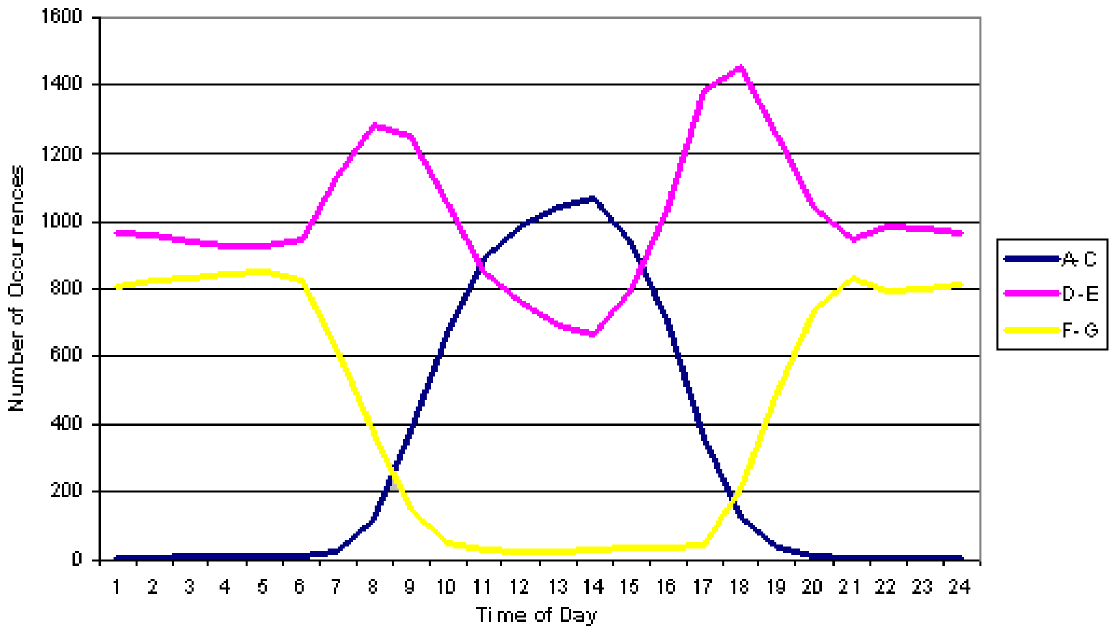

Figure 2.3.2-1 - Vogtle 1998–2002 Hourly Stability Class Frequency

2.3.3 Onsite Meteorological Measurements Program

2.3.3.1 Introduction

In Section 2.3.3 of the SSAR, the applicant presented information concerning the onsite meteorological measurements program in support of its ESP application. Specifically, the applicant provided the following information:

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

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

This section verifies that the applicant successfully implemented an appropriate onsite meteorological measurements program and that data from this program provide an acceptable basis for estimating atmospheric dispersion for DBA and routine releases from a nuclear power plant of the type specified by the applicant.

2.3.3.2 Regulatory Basis

The acceptance criteria for the development and implementation of an onsite meteorological program are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The staff considered the following regulatory requirements in reviewing the applicant's development and implementation of an onsite meteorological program:

- 10 CFR 52.17(a), which requires that the application contain a description of the seismic, meteorological, hydrological, and geological characteristics of the proposed site.

- 10 CFR 100.20(c), which requires that the meteorological characteristics of the site, necessary for safety analysis or that may have an impact on plant design, be identified and characterized as part of the NRC's review of the acceptability of a site.

- 10 CFR 100.21(c), which requires that site atmospheric dispersion characteristics be evaluated and dispersion parameters established such that (1) radiological effluent release limits associated with normal operation from the type of facility to be located at the site can be met for any individual located offsite; and (2) radiological dose consequences of postulated accidents shall meet the criteria set forth in 10 CFR 50.34(a)(1) for the type of facility proposed to be located at the site.

- 10 CFR 100.21(d), which requires that the physical characteristics of the site, including meteorology, geology, seismology, and hydrology be evaluated and site parameters established, such that the potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site.

The assessment and conclusions made in this section, regarding the site-specific adequacy of onsite meteorological instrumentation (including siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, the QA program for sensors and recorders, and data acquisition and reduction procedures), are pertinent to the staff's evaluation, in SER Chapter 13, of the applicant's proposed emergency plan, in accordance with the following requirements of 10 CFR 50.47, "Emergency Plans," and 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities":

- 10 CFR 50.47(b), which requires that the onsite emergency response plan have adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition.

- 10 CFR Part 50, Appendix E, which requires emergency plans to have adequate provisions for equipment for determining the magnitude of and for continuously assessing impact of the release of radioactive materials to the environment.

The development and implementation of an onsite meteorological program is necessary for the collection of onsite meteorological information, so as to be able to demonstrate compliance, at the COL stage, with the numerical guides for doses contained in 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and limiting Conditions for Operation to Meet the Criterion 'As Low as Reasonable Achievable' for Radioactive material in Light-Water-Cooled Nuclear Power Reactor Effluents."

RS-002, Section 2.3.3 specifies that an application meets the above requirements, if the application satisfies the following criteria:

- The onsite meteorological measurements programs should produce data that describe the meteorological characteristics of the site and its vicinity for the purpose of making atmospheric dispersion estimate for both postulated accidental and expected routine airborne releases of effluents and for comparison with offsite sources to determine the appropriateness of climatological data used for design considerations. The criteria for an acceptable onsite meteorological measurements program are documented in the Regulatory Position, Section C, "Meteorological Monitoring Programs for Nuclear Power Plants," of RG 1.23.

To the extent applicable to the above-outlined acceptance criteria, the applicant applied the NRC-endorsed methodologies and parameters found in the following:

- RG 1.23, which provides criteria for an acceptable onsite meteorological measurements program, data from which are used as input to atmospheric dispersion models.

- RG 1.70, which provides guidance on information appropriate for presentation regarding an onsite meteorological measurements program.

- RG 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," which states that the meteorological description of the site and its surrounding area should include data from the onsite meteorological program.

When independently assessing the sufficiency of the information presented by the applicant in SSAR Chapter 2.3.3, the NRC staff applied the same above-cited methodologies and parameters.

2.3.3.3 Technical Evaluation

Using the approaches and methodologies described in RS-002 Section 2.3.3, the NRC staff reviewed the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007. In reviewing and evaluating the applicant's onsite meteorological program, the staff used (or relied on) the following design parameters and site interface values proposed by the applicant in SSAR Section 1.3: containment building height, cooling tower height, cooling tower base diameter, and cooling tower diameter at the top.

The applicant used the existing onsite meteorological measurements program at the Vogtle facility (Units 1 & 2) to collect data for the proposed VEGP site and plans to continue to use this monitoring program to support operation of the proposed facility. If any changes are made to the monitoring program, the COL applicant should update the description of the proposed operational onsite meteorological measurements program at the time of the COL application in accordance with Section C.III.2.2.3.3 of RG 1.206, "Combined License Applications for Nuclear Power Plants."

2.3.3.3.1 Instrument Description

The Vogtle meteorological monitoring program began operation in 1979. Instruments for measuring pertinent meteorological parameters were mounted on a 45-meter tower located on a cleared area on the site. The facility updated the meteorological monitoring program in 1984 to meet the requirements of NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans [RERP] and Preparedness in Support of Nuclear Power Plants." The updated monitoring equipment has observation heights at 10 and 60 meters above ground level. Measured data include wind speed and direction at 10 and 60 meters, temperature at 10 meters, differential temperature between 60 and 10 meters, dew point temperature at 10 meters, precipitation at the tower base, and sigma theta (wind direction standard deviation) at 10 and 60 meters. Currently, the original 45-meter tower is used as a backup meteorological monitoring system during periods of equipment failure on the 60-meter tower. The backup system can measure wind speed, wind direction, temperature, and sigma theta at the 10-meter level.

The meteorology tower is located about 4525 feet south of the proposed power block area. The applicant stated that the closest major structures to the meteorological measurement tower would be the proposed Unit 3 and 4 reactor buildings and proposed natural draft cooling towers. The cooling towers would be the largest structures in the vicinity of the meteorology tower and would have the greatest potential to influence the accuracy of future measurements because of the postulated downwind wake created by these structures

The applicant stated that the region potentially affected by wake from the proposed cooling towers will extend about 1650 feet downwind. It based this value on the EPA 1981 version of the "Guideline for Determination of Good Engineering Practice Stack Height," which states that the distance downwind affected by the wake of a hyperbolically shaped natural draft cooling tower is about five times the width of the tower at the top of the structure. Since the closest cooling tower will be 3025 feet from the primary meteorological tower, the applicant determined that the primary meteorology tower will be outside of the potential wake zone.

RG 1.23 indicates that obstructions to flow (such as buildings) should be located at least 10 obstruction heights from the meteorological tower to prevent adverse building wake effects. Since the height of the proposed reactor buildings is 234 feet above plant grade, the zone of turbulent flow created by the reactor buildings will be limited to about 2340 feet downwind. The staff concludes that building wake from the proposed reactor buildings will not cause any adverse affects on measurements because the meteorology tower is located 4525 feet south of the proposed power block area.

The 10-building-height distance of separation is typically applied to square or rectangular structures, whereas rounded and sloping structures such as hyperbolic natural draft cooling towers can be expected to produce a smaller wake zone. According to the applicant, the preliminary design for the natural draft cooling towers calls for them to be about 600 feet high, with a base diameter of 550 feet and a top diameter of 330 feet. In RAI 2.3.3-2, the staff asked the applicant to include the proposed natural draft cooling tower height and width as part of SSAR Table 1-1, which lists postulated design parameters, since this information is used to determine the potential wake effects from these towers. The applicant complied with this request.

Section 123 of the Clean Air Act as amended in 1990 defines good engineering practice stack height as the height necessary to ensure that emissions from a stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of a source as a result of atmospheric downwash, eddies, and wakes which may be created by the source itself, by nearby structures, or by nearby terrain obstacles. The EPA defines “nearby structures” in its regulations (40 CFR 51.100(jj)(1)) as that distance up to five times the lesser of the height or the width dimension of a structure; that is, the downwind distance in which a structure is presumed to have a significant influence as a result of downwash, eddies, and wakes extends downwind approximately five times either the height or width (whichever is less) of the structure. The EPA regulatory guidance document for determining good engineering practice stack heights (EPA-450-4/80/023R, June 1985) also states that this area of influence becomes significantly smaller as the height to width ratio of a structure increases. Based on the EPA guidance for this type of structure, which will have a maximum width of 550 feet, the outermost boundary of influence exerted by the proposed cooling towers is estimated to be no more than 2750 feet. Since this distance is shorter than the 3025-foot separation between the proposed cooling towers and the primary meteorological tower, the staff concludes that the proposed natural draft cooling towers will not adversely affect measurements made at the primary meteorological tower. The staff calculated a larger area that may be affected by cooling tower wake because the updated 1985 EPA guidance used by the staff recommends using the maximum width of the structure, whereas the 1981 EPA guidance used by the applicant recommended using the width at the top of the structure for calculating potential wake influences.

The base of the primary tower is at an elevation similar to plant grade for the proposed facility, and the ground cover at the base of the tower is primarily native grass. The applicant stated that it evaluated minor structures in the vicinity of the primary meteorological tower as having no adverse effect on the measurements taken at the meteorological measurement tower. After conducting a site audit on December 6, 2006, the staff agrees with the applicant that the meteorology towers are sited in an appropriate area and these minor structures will have no adverse impact on the accuracy of measurements. The staff also noted during its site audit that the meteorology towers are located far enough from the surrounding tree line to prevent adverse effects on measurements. SER Figure 2.3.3-1 shows the proposed layout of the VEGP site.

The primary meteorological equipment is mounted on a 200-foot Unarco-Rohn, Inc., Model 55G tower. All instrumentation (primary and backup) is mounted on a Tower Systems, Inc., Model TS-2500 instrument elevator system. The instruments are standard Climatronics products. The applicant uses Yokogawa digital equipment to receive the observations, which are displayed using the Meteorological Information and Dispersion Assessment System (MIDAS). The Climatronics Signal Conditioning Equipment is powered by dual (redundant) Hewlett Packard Model 6291A direct current power supplies.

During a site audit conducted on December 6, 2006, the staff reviewed the applicant's meteorology equipment calibration procedures in detail and found them to be adequate to ensure a reliable meteorological measurements program in accordance with RG 1.23. For example, the delta temperature calibration involves temperature baths using reference temperatures of 32 °F and 100 °F; the applicant checks to ensure on a regular basis that the delta-temperature instrumentation is taking accurate measurements. The applicant uses similar procedures for the other meteorological measurement equipment.

The applicant monitors the meteorology instruments at least once a week. Maintenance is performed in accordance with instrument manuals and is intended to maintain, at least, a 90-percent data recovery. From 1998–2002, the average data recovery rates are well above the RG 1.23 90-percent threshold.

Although all of the 5-year average recovery rates were still above 90 percent, the staff computed slightly different values for some of the annual data recovery rates. During a site audit conducted on December 6, 2006, the staff asked the applicant to verify the validity of the yearly data recovery statistics presented in the application. In a letter dated January 30, 2007, the applicant agreed with the values presented by the staff and stated that the hourly meteorological database was going to be updated. In RAI 2.3.3-1, the staff asked the applicant to provide the NRC with a copy of the updated hourly meteorological database. The applicant complied with this request. After receiving the updated and revised meteorological data, the staff was able to produce the same data recovery statistics as the applicant.

The applicant provided system performance specifications for the meteorological monitoring program, which are listed in SER Table 2.3.3-1. These values are consistent with RG 1.23 and thus accepted by the staff. Meteorological data samples are taken every 5 seconds and recorded as 15- and 60-minute averages. The 15-minute averages are used for emergency planning purposes, while the January 1998 through December 2002 hourly averages were used to compute the short-term and long-term diffusion estimates presented in SSAR Sections 2.3.4 and 2.3.5.

The description of meteorological instrumentation, including siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, the QA program for sensors and recorders, and data acquisition and reduction procedures are in compliance with the guidelines of RG 1.23. Thus, the staff considers the meteorological instrumentation to be acceptable.

2.3.3.3.2 Meteorological Data

The applicant used the existing onsite meteorological measurements program from the Vogtle facility (Units 1 & 2) to collect hourly meteorological data. The applicant provided seasonal and annual summaries of onsite meteorological data in the SSAR, based on hourly measurements, from instrumentation mounted on the primary tower, taken over the 5-year period from 1998 through 2002. The applicant provided a copy of this 1998–2002 hourly database to the staff.

The staff performed a quality review of the 1998–2002 hourly meteorological database using the methodology described in NUREG-0917, "Nuclear Regulatory Commission Staff Computer Programs for Use with Meteorological Data," issued July 1982. The staff used computer spreadsheets to perform further review. During a site audit conducted on December 6, 2006, the staff notified the applicant that it had identified a few inconsistencies in the data (such as overly persistent wind directions or stability classes, temperature observations switching between degrees Celsius (°C) and Fahrenheit (°F), or delta-temperature measurements exceeding the auto-convective lapse rate) and asked the applicant for an explanation. The applicant responded in a letter dated January 30, 2007, that it would revise the onsite meteorological database to address these concerns. The staff reviewed a copy of this revised database and finds that the applicant has addressed all of the above concerns; a comparison between the JFD used by the applicant as input to the PAVAN and XOQDOQ atmospheric dispersion computer codes and a staff-generated JFD from the hourly database provided by the applicant shows that the two JFDs are similar.

To further check the validity and accuracy of the onsite meteorology data, the staff compared hourly data from the VEGP application to concurrent data obtained from the NCDC integrated hourly surface observations for Augusta. SER Table 2.3.3-2 compares 1998–2002 annual temperature, atmospheric moisture, wind speed, and wind direction statistics between the VEGP onsite data and the Augusta NWS data. The comparison of the 1998–2002 onsite temperature, atmospheric moisture, wind speed, and wind direction data with similar data recorded at Augusta for the same period of record shows that the Vogtle onsite data are reasonable.

Because of the reasonable correlation between the Augusta and Vogtle data, long-term temperature and atmospheric moisture data from Augusta are appropriate for determining the ambient air temperature and humidity site characteristics presented in SSAR Section 2.3.1. The Augusta annual maximum and minimum temperatures tend to be slightly more extreme than the Vogtle data. This implies that using Augusta data to characterize the extreme temperatures expected onsite is a conservative approach.

Based on an independent analysis of the onsite meteorological data and a comparison with hourly data from the Augusta NWS station, the staff accepts the 5 years of onsite data provided by the applicant as being representative of the site and an acceptable basis for estimating atmospheric dispersion for DBA and routine releases in SSAR Sections 2.3.4 and 2.3.5.

2.3.3.4 Conclusion

The NRC staff evaluated the relevant sections of the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007, pursuant to the acceptance criteria of RS-002 Section 2.3.3 and applicable regulatory requirements of 10 CFR Part 52 and 10 CFR Part 100. Based on the preceding discussion, the staff concludes that the applicant has successfully implemented an appropriate onsite meteorological measurements program and that data from this program provide an acceptable basis for estimating atmospheric dispersion for DBA and routine releases from a nuclear power plant of the type specified by the applicant. Therefore, the staff finds that the applicant has provided the information required to address 10 CFR 52.17(a)(1), 10 CFR 100.20(c), and 10 CFR 100.21(d). The staff also finds that analysis and conclusions regarding the site-specific adequacy of onsite meteorological instrumentation are sufficient to support the staff's evaluation of the applicant's proposed emergency plan, in SER Chapter 13, per 10 CFR 50.47 and 10 CFR Part 50, Appendix E.

Table 2.3.3-1 - Onsite Meteorological Monitoring Program Specifications

PARAMETER	RANGE	SYSTEM ACCURACY
Wind speed	0–100 mi/h	± 0.5 mi/h
Wind Direction	0°–360°	± 5°
Ambient Temperature	−10°–120 °F	± 0.9 °F
Differential Temperature	−5°–10 °F	± 0.27 °F

Table 2.3.3-2 - Comparison of Augusta NWS and Vogtle Meteorology Observations

	ANNUAL AVERAGE TEMPERATURE		EXTREME MAXIMUM ANNUAL TEMPERATURE		EXTREME MINIMUM ANNUAL TEMPERATURE	
	AUGUSTA	VOGTLE	AUGUSTA	VOGTLE	AUGUSTA	VOGTLE
1998	65 °F	66 °F	103 °F	102 °F	19 °F	25 °F
1999	64 °F	65 °F	107 °F	104 °F	13 °F	17 °F
2000	63 °F	63 °F	101 °F	98 °F	13 °F	17 °F
2001	64 °F	64 °F	97 °F	94 °F	12 °F	20 °F
2002	64 °F	65 °F	101 °F	96 °F	16 °F	17 °F
	ANNUAL AVERAGE DEWPOINT		ANNUAL AVERAGE Wind speed		ANNUAL PREVAILING WIND DIRECTION	
	AUGUSTA	VOGTLE	AUGUSTA	VOGTLE	AUGUSTA	VOGTLE
1998	53 °F	53 °F	4.9 mi/h	5.1 mi/h	WSW	WSW
1999	51 °F	50 °F	5.3 mi/h	5.1 mi/h	WSW	SW
2000	52 °F	49 °F	5.1 mi/h	5.3 mi/h	WSW	SW
2001	52 °F	50 °F	5.1 mi/h	5.5 mi/h	WSW	W
2002	53 °F	51 °F	5.3 mi/h	5.2 mi/h	WSW	W

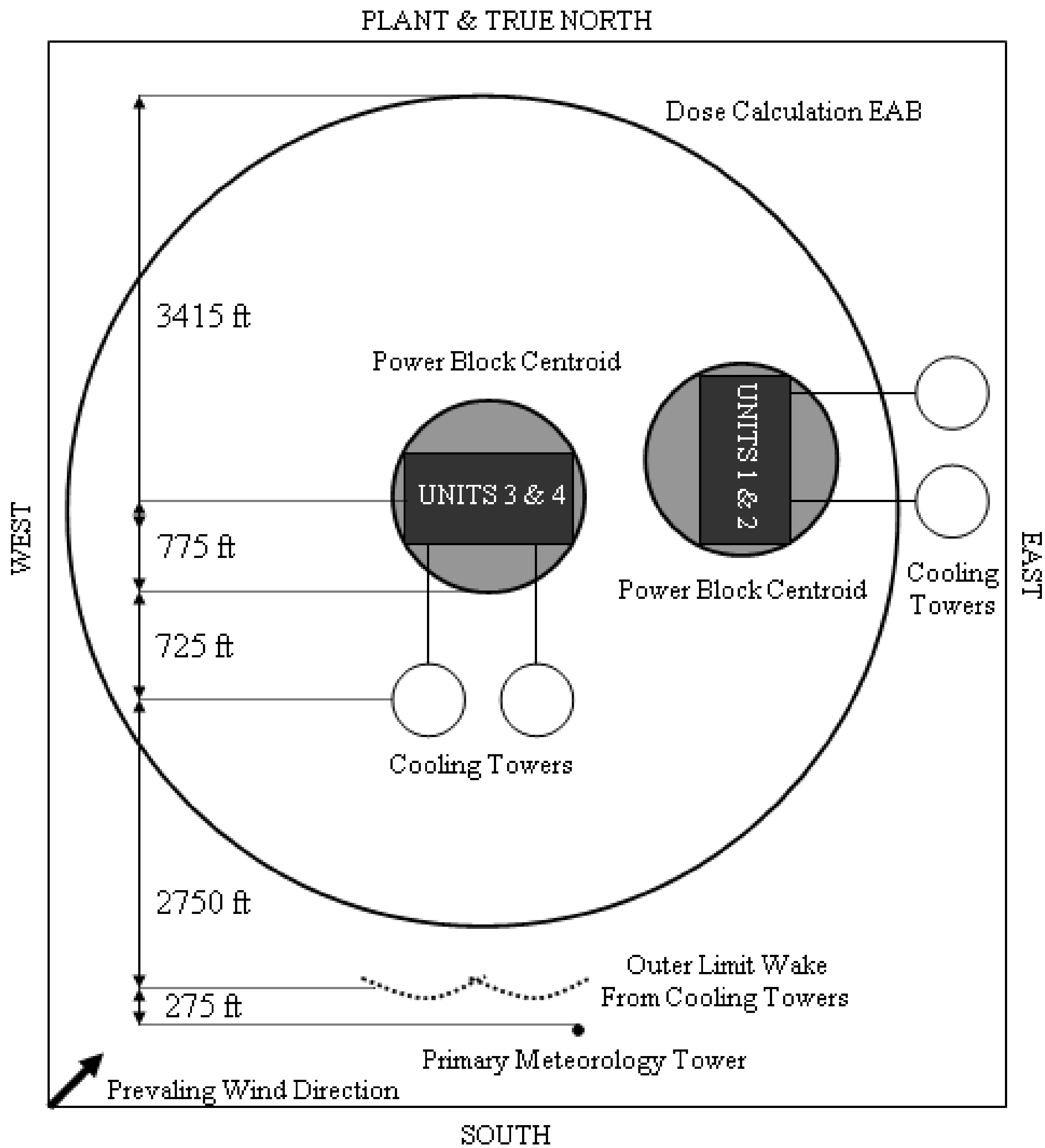

Figure 2.3.3-1 - Proposed Layout for VEGP Site

2.3.4 Short-Term Diffusion Estimates

2.3.4.1 Introduction

In Section 2.3.4 of the SSAR, the applicant presented information on atmospheric dispersion estimates for postulated accidental airborne releases of radioactive effluents to the EAB and the outer boundary of the LPZ. The applicant provided the following specific information:

- Atmospheric transport and diffusion models to calculate dispersion estimates (atmospheric dispersion factors, relative concentrations, or χ/Q values) for postulated accidental radioactive releases.

- Meteorological data summaries used as input to dispersion models

- Diffusion parameters

- Determination of χ/Q values used for assessment of consequences of postulated radioactive atmospheric releases from design-basis and other accidents.

This section verifies that the applicant has used appropriate atmospheric dispersion models and meteorological data to calculate relative concentration at appropriate distances and directions from postulated release points for the evaluation of accidental airborne releases of radioactive material.

2.3.4.2 Regulatory Basis

The acceptance criteria for calculating atmospheric dispersion estimates for postulated accidental airborne releases of radioactive effluents are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The staff considered the following regulatory requirements in reviewing the applicant's calculation of atmospheric dispersion estimates for postulated accidental airborne releases of radioactive effluents

- 10 CFR 100.20(c), which requires that the meteorological characteristics of the site, necessary for safety analysis or that may have an impact on plant design, be identified and characterized as part of the NRC's review of the acceptability of a site.

- 10 CFR 100.21(c)(2), which requires that site atmospheric dispersion characteristics be evaluated and dispersion parameters established such that radiological dose consequences of postulated accidents shall meet the criteria set forth in 10 CFR 50.34(a)(1) for the type of facility proposed to be located at the site.

The applicant also originally identified Appendix E to 10 CFR Part 50 as applicable SSAR Section 2.3.4. In RAI 2.3.4-2, the staff asked the applicant to explain how Appendix E applies to the development of the short-term (accidental release) atmospheric dispersion estimates presented in SSAR Section 2.3.4. The applicant responded by deleting the reference to Appendix E to 10 CFR Part 50 in SSAR Section 2.3.4.

RS-002, Section 2.3.4 specifies that an application meets the above requirements, if the application provides the following information:

- 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. The models should be 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.

- 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.

- The variation of atmospheric diffusion parameters used to characterize lateral and vertical plume spread as a function of distance, topography, and atmospheric conditions, as related to measured meteorological parameters. The methodology for establishing these relationships should be appropriate for estimating the consequences of accidents within the range of distances which are of interest with respect to site characteristics and established regulatory criteria.

- Cumulative probability distributions of relative concentrations (χ/Q values) describing the probabilities of these χ/Q values being exceeded. These cumulative probability distributions should be presented for appropriate distances and time periods as specified in Section 2.3.4.2 of RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." The methods of generating these distributions should be adequately described.

- Relative concentrations used for assessment of consequences of atmospheric radioactive releases from design basis and other accidents.

To the extent applicable to the above-outlined acceptance criteria, the applicant applied the NRC-endorsed analytical methodologies, models and parameters found in the following:

- RG 1.23, which provides criteria for an acceptable onsite meteorological measurements program, data from which are used as input to atmospheric dispersion models.

- RG 1.70, which states that the SSAR should provide atmospheric estimates at the EAB and outer boundary of the LPZ for appropriate time periods up to 30 days after an accident based on the most representative meteorological data and potential impacts of topography on atmospheric dispersion site characteristics.

- RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," which provides acceptable methods for characterizing annual average atmospheric transport and diffusion conditions for evaluating the consequences of radiological releases at the EAB and outer boundary of the LPZ.

- RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," which provides acceptable methods for characterizing atmospheric dispersion conditions for appropriate time periods up to 30 days for evaluating the consequences of DBA radiological releases to the EAB and outer boundary of the LPZ.

- RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," which provides criteria on the use of alternative radiological source terms for evaluating the consequences of DBAs.

- RG 4.7, which provides criteria on the amount of meteorological data necessary to ensure the generation of representative atmospheric dispersion site characteristics.

The applicant originally identified RG 1.78 as applicable to SSAR Section 2.3.4. In RAI 2.3.4-3, the staff asked the applicant to explain how RG 1.78 applies to the development of the short-term (accidental release) atmospheric dispersion site characteristics presented in SSAR Section 2.3.4. The applicant responded by deleting the reference to RG 1.78 for SSAR Section 2.3.4.

When independently assessing the veracity of the information presented by the applicant in SSAR Chapter 2.3.4, the NRC Staff applied the same above-cited methodologies, models and parameters.

2.3.4.3 Technical Evaluation

Using the approaches and analytic methodologies described in RS-002 Section 2.3.4, the NRC staff reviewed the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007. In reviewing and evaluating the applicant's short-term atmospheric dispersion estimates, the staff used (or relied on) only the elevation of the post-accident release point from the design parameters and site interface values presented by the applicant in SSAR Section 1.3.

2.3.4.3.1 Atmospheric Dispersion Model

The applicant used the computer code PAVAN (NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design-Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations,") to estimate χ/Q values at the EAB and at the outer boundary of the LPZ for potential accidental releases of radioactive material. The PAVAN model implements the methodology outlined in RG 1.145.

The PAVAN code estimates χ/Q values for various time-average periods ranging from 2 hours to 30 days. The meteorological input to PAVAN consists of a joint frequency distribution (JFD) of hourly values of wind speed and wind direction by atmospheric stability class. In response to RAI 2.3.4-5, the applicant provided a copy of the input file used to compute the χ/Q values listed in SSAR Section 2.3.4. The staff used this input file, as well as the hourly meteorological data, to verify the χ/Q values presented by the applicant, as discussed in SER Section 2.3.4.3.4.

The χ/Q values calculated through PAVAN are based on the theoretical assumption that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. A straight-line trajectory is assumed between the point of release and all distances for which χ/Q values are calculated.

For each of the 16 downwind direction sectors (e.g., N, NNE, NE, ENE), PAVAN calculates χ/Q values for each combination of wind speed and atmospheric stability at the appropriate downwind distance (i.e., the EAB and the outer boundary of the LPZ). The χ/Q values calculated for each sector are then ordered from greatest to smallest and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speed and stabilities for each sector. The smallest χ/Q value in a distribution will have a corresponding cumulative frequency equal to the wind direction frequency for that particular sector. PAVAN determines for each sector an upper envelope curve based on the derived data (plotted as χ/Q versus probability of being exceeded), such that no plotted point is above the curve. From this upper envelope, the χ/Q value, which is equaled or exceeded 0.5 percent of the total time, is obtained. The maximum 0.5 percent χ/Q value from the 16 sectors becomes the 0–2 hour “maximum sector χ/Q value.”

Using the same approach, PAVAN also combines all χ/Q values independent of wind direction into a cumulative frequency distribution for the entire site. An upper envelope curve is determined, and the program selects the χ/Q value which is equaled or exceeded 5.0 percent of the total time. This is known as the 0–2 hour “5-percent overall site χ/Q value.”

The larger of the two χ/Q values, either the 0.5-percent maximum sector value or the 5-percent overall site value, is selected to represent the χ/Q value for the 0–2 hour time interval (note that this resulting χ/Q value is based on 1-hour averaged data but is conservatively assumed to apply for 2 hours).

To determine χ/Q values for longer time periods (i.e., 0–8 hour, 8–24 hour, 1–4 days, and 4–30 days), PAVAN performs a logarithmic interpolation between the 0–2 hour χ/Q values and the annual average (8760-hour) χ/Q values for each of the 16 sectors and overall site. For each time period, the highest among the 16 sector and overall site χ/Q values is identified and becomes the short-term site characteristic χ/Q value for that time period.

2.3.4.3.2 Meteorological Data Input

The meteorological input to PAVAN used by the applicant consisted of a JFD of wind speed, wind direction, and atmospheric stability based on hourly onsite data from January 1998 through December 2002. The wind data were obtained from the 10-meter level of the onsite meteorological tower, and the stability data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 60-meter and 10-meter levels on the onsite meteorological tower.

As discussed in SER Section 2.3.3, the staff considers the 1998–2002 onsite meteorological database suitable for input to the PAVAN model.

2.3.4.3.3 Diffusion Parameters

The applicant chose to implement the diffusion parameter assumptions outlined in RG 1.145, as a function of atmospheric stability, for its PAVAN model runs. The staff evaluated the applicability of the PAVAN diffusion parameters and concluded that no unique topographic features (such as rough terrain, restricted flow conditions, or coastal or desert areas) preclude the use of the PAVAN model for the VEGP site. Therefore, the staff finds that the applicant's use of diffusion parameter assumptions, as outlined in RG 1.145 was acceptable.

2.3.4.3.4 Relative Concentration for Accident Consequences Analysis

The applicant modeled one ground-level release point and did not take credit for building wake effects. Ignoring building wake effects for a ground-level release decreases the amount of atmospheric turbulence assumed to be in the vicinity of the release point, resulting in higher (more conservative) χ/Q values. A ground-level release assumption is therefore acceptable to the staff.

The applicant defined a "dose calculation" EAB as a circle that extends 0.5 mile beyond the power block area.[6] Consequently, the applicant executed PAVAN using a distance from release point to the dose calculation EAB of 0.5 mile (800 meters) for all downwind sectors. The applicant stated that because the dose calculation EAB is circumscribed the "true" (actual) EAB for the site, any χ/Q values produced by PAVAN will be conservative estimates. The staff verified that the dose calculation EAB is within the true EAB for the site and is therefore acceptable to the staff.

The outer boundary of the LPZ for the proposed facility is a 2-mile-radius circle centered on the existing power block. The applicant chose to use a downwind distance of 1.4 miles (2304 meters) for all direction sectors for calculating LPZ χ/Q values because this is the shortest distance in any direction from the proposed power block area boundary to the predefined LPZ. The use of the shortest distance results in higher (more conservative) χ/Q values and is therefore acceptable to the staff.

SER Table 2.3.4-1 lists the short-term atmospheric dispersion estimates for the dose calculation EAB and the outer boundary of the LPZ that the applicant derived from its PAVAN modeling run results. The applicant identified these χ/Q values as site characteristics in SSAR Table 1-1 because these are the atmospheric dispersion site characteristics used by the applicant to demonstrate compliance with the terms of 10 CFR 100.21(c)(2) for the radiological dose consequences of postulated accidents.

The applicant originally identified the 0.5-percent maximum sector EAB χ/Q value as being larger than the 5-percent overall site EAB χ/Q value. In contrast, by way of confirmatory analysis, the staff found the 5-percent overall site χ/Q value to be the larger of the two values. In RAI 2.3.4-4, the staff asked the applicant to confirm which of the two χ/Q values is more limiting for the site. The applicant responded that a new PAVAN run, using the revised

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6. Because the power block area is defined as being within a 775-foot-radius circle centered on a point between the two proposed AP1000 units, the dose calculation EAB can also be defined as a circle with a radius of 3,415 feet from the proposed power block centroid.

meteorological database discussed in SER Section 2.3.3, verified the staff's results: the 5-percentile overall site EAB χ/Q value did indeed bound the 0.5-percentile maximum sector EAB χ/Q value.

The staff confirmed the applicant's atmospheric dispersion estimates by running the PAVAN computer model and obtaining similar results (i.e., plus or minus 4 percent).

In light of the foregoing, the staff accepts the short-term χ/Q values presented by the applicant. The staff will include the short-term χ/Q s listed in SER Table 2.3.4-1 as site characteristics in any ESP that the NRC may issue for the VEGP site.

2.3.4.4 Conclusion

The NRC staff has evaluated the relevant sections of the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007, pursuant to the acceptance criteria described in RS-002 Section 2.3.4 and the applicable regulatory requirements of 10 CFR Part 52 and 10 CFR Part 100. As discussed above, the applicant provided meteorological data and an atmospheric dispersion model that are appropriate for the characteristics of the site. Therefore, the staff concludes that representative atmospheric transport and diffusion conditions have been calculated at the EAB and the outer boundary of the LPZ, and, thus, that the applicant has provided the information required to comply with the applicable provisions of 10 CFR Part 52 and 10 CFR 100.21(c)(2).

Table 2.3.4-1 - Short-Term (Accidental Release) Atmospheric Dispersion Site Characteristics

SITE CHARACTERISTIC	VALUE	DEFINITION
0–2 hr χ/Q value @ EAB	3.49×10^{-4} s/m^3	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accidental airborne releases.
0–8 hr χ/Q value @ LPZ outer boundary	7.04×10^{-5} s/m^3	
4 hr χ/Q value @ LPZ outer boundary	5.25×10^{-5} s/m^3	
1–4 day χ/Q value @ LPZ outer boundary	2.77×10^{-5} s/m^3	
–30 day χ/Q value @ LPZ outer boundary	1.11×10^{-5} s/m^3	

2.3.5 Long-Term Diffusion Estimates

2.3.5.1 Introduction

In Section 2.3.5 of the SSAR, the applicant presented its atmospheric dispersion estimates for routine releases of radiological effluents to the atmosphere. Specifically, the applicant provided the following information:

- 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.

- 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.

- meteorological data used as input to dispersion models.

- diffusion parameters

- felative concentration factors (χ/Q values) and relative deposition factors (D/Q values) used to assess the consequences of routine airborne radioactive releases.

This section verifies that the applicant has used appropriate atmospheric dispersion models and meteorological data to calculate relative concentration and relative deposition at appropriate distances and directions from postulated release points for the evaluation of routine airborne releases of radioactive material.

2.3.5.2 Regulatory Basis

The acceptance criteria for calculating atmospheric dispersion estimates for routine releases of radiological effluents are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The staff considered the following regulatory requirements in reviewing the applicant's calculation of atmospheric dispersion estimates for routine releases of radiological effluents:

- 10 CFR 100.20(c), which requires that the meteorological characteristics of the site, necessary for safety analysis or that may have an impact on plant design, be identified and characterized as part of the NRC's review of the acceptability of a site.

- 10 CFR 100.21(c)(1), which requires that site atmospheric dispersion characteristics be evaluated and dispersion parameters established such that radiological effluent release limits associated with normal operation from the type of facility to be located at the site can be met for any individual located offsite.

Characterization of atmospheric transport and diffusion conditions is necessary for estimating the radiological consequences of routine releases of radioactive materials to the atmosphere, so as to demonstrate compliance, at the COL stage, with the numerical guides for doses contained in 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and limiting

Conditions for Operation to Meet the Criterion ‘As Low as Reasonable Achievable’ for Radioactive material in Light-Water-Cooled Nuclear Power Reactor Effluents.”

The applicant originally identified in its application Appendix E to 10 CFR Part 50 as applicable to SSAR Section 2.3.5. In RAI 2.3.5-3, the staff asked the applicant to explain how Appendix E applies to the development of the long-term (routine release) atmospheric dispersion estimates presented in SSAR Section 2.3.5. The applicant responded by deleting the reference to Appendix E to 10 CFR Part 50 in SSAR Section 2.3.5.

RS-002, Section 2.3.5 specifies that an application meets the above requirements, if the application provides the following information:

- 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.

- A discussion of the relationship between atmospheric diffusion parameters, such as vertical plume spread, and measured meteorological parameters. Use of these parameters should be substantiated as to their appropriateness for use in estimating the consequences of routine releases from the site boundary to a radius of 50 miles from the plant site.

- 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.

- Relative concentration (χ/Q) and relative deposition (D/Q) values used for assessment of consequences of routine radioactive gas 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.

To the extent applicable to the above-outlined acceptance criteria, the applicant applied the NRC-endorsed analytical methodologies, models and parameters found in the following:

- RG 1.23, which provides criteria for an acceptable onsite meteorological measurements program, data from which are used as input to atmospheric dispersion models.

- RG 1.70, which states that the SSAR should provide realistic estimates of annual average atmospheric transport and diffusion characteristics out 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 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,” which presents identification criteria to be used for specific receptors of interest.

- RG 1.111, which provides acceptable methods for characterizing atmospheric transport and diffusion conditions for evaluating the consequences of routine effluent releases.

- RG 1.112, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors,” which provides criteria for identifying release points and release characteristics.

When independently assessing the veracity of the information presented by the applicant in SSAR Chapter 2.3.5, the NRC Staff applied the same above-cited methodologies, models and parameters.

2.3.5.3 Technical Evaluation

Using the approaches and analytic methodologies described in RS-001 Section 2.3.5, the NRC staff reviewed the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007. In reviewing and evaluating the applicant’s long-term atmospheric dispersion estimates, the staff used (or relied on) none of the applicant’s proposed design parameters and site interface values presented in SSAR Section 1.3, but did rely on the containment building minimum cross-sectional area and the equivalent structural height values presented by the applicant in SSAR Section 2.3.5.

2.3.5.3.1 Atmospheric Dispersion Model

The applicant used the NRC-sponsored computer code XOQDOQ (described in NUREG/CR-2919, “XOQDOQ Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,”) to estimate χ/Q and D/Q values resulting from routine releases. The XOQDOQ model implements the methodology outlined in RG 1.111.

The XOQDOQ model is a straight-line Gaussian plume model based on the theoretical assumption that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. In predictions of χ/Q and D/Q values for long time periods (i.e., annual averages), the plume’s horizontal distribution is assumed to be evenly distributed within the downwind direction sector (e.g., “sector averaging”).

Because geographic features such as hills, valleys, and large bodies of water can potentially influence dispersion and airflow patterns, terrain recirculation factors can be used to adjust the results of a straight-line trajectory model such as XOQDOQ to account for terrain-induced flows, recirculation, or stagnation. In RAI 2.3.5-5, the staff asked the applicant to explain why it did not use terrain recirculation factors, which were used in Chapter 8 of Revision 21 of the VEGP Offsite Dose Calculation Manual (ODCM, dated October 1, 2003), in developing the long-term χ/Q s presented in the VEGP SSAR. The applicant responded that the topographic features in the site vicinity do not require the use of terrain recirculation factors and that the analyses reported in the Unit 1/Unit 2 FSAR did not use these factors. The applicant also stated that most terrain recirculation factors used in the ODCM for ground-level releases are about 1. Based on SSAR Figure 2.3-15, topographical descriptions in SSAR Section 2.3.1, and a site audit conducted on December 6, 2006, the staff agrees with the applicant that the site can be characterized as having open terrain with gently rolling hills. Thus, the staff concludes that XOQDOQ modeling results are applicable to the site and no unique topographic features (such as valley, desert, or overall water trajectories) preclude the use of the model for the proposed VEGP site.

2.3.5.3.2 Release Characteristics and Receptors

The applicant modeled one ground-level release point, assuming a minimum building cross-sectional area of 2,926 square meters and a containment "equivalent" structure height of 65.6 meters. The staff asked the applicant in RAI 2.3.5-1 to provide the basis for the calculation of the containment building minimum cross-sectional area and equivalent structural height. In its response, the applicant stated that the equivalent structure height was determined by dividing the building cross-sectional area by the width of the proposed reactor containment at the bottom.

A ground-level release is a conservative assumption resulting in higher χ/Q and D/Q values when compared to a mixed-mode (e.g., part-time ground, part-time elevated) release or a 100-percent elevated release, as discussed in RG 1.111. A ground-level release assumption is therefore acceptable to the staff.

The applicant executed XOQDOQ using a distance from the release point to the dose calculation EAB of 0.5 mile (800 meters) for all downwind sectors as discussed in SSAR Section 2.3.4.3. The applicant also placed receptors of interest (i.e., resident, meat animal, and vegetable garden) in all compass directions at a downwind distance of 1,071 meters. This distance is based on the closest of these receptors (the nearest resident in the west-southwest sector), as identified in the VEGP "Annual Radiological Environmental Operating Report (AREOP) for 2004," produced by Southern Company (ADAMS Accession No. ML051380059). This is a conservative assumption and is therefore acceptable to the staff. SER Table 2.3.5-1 compares the AREOP distances and the distances used as input to the XOQDOQ model.

2.3.5.3.3 Meteorological Data Input

The meteorological input to XOQDOQ consists of a JFD of wind speed, wind direction, and atmospheric stability based on hourly onsite data from January 1998 through December 2002. The wind data were obtained from the 10-meter level of the onsite meteorological tower, and the stability data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 60-meter and 10-meter levels on the onsite meteorological tower.

As discussed in SER Section 2.3.3, the staff considers the 1998–2002 onsite meteorological database suitable for input to the XOQDOQ model.

2.3.5.3.4 Diffusion Parameters

The applicant chose to implement the diffusion parameter assumptions outlined in RG 1.111, as a function of atmospheric stability, for its XOQDOQ model runs. The staff evaluated the applicability of the XOQDOQ diffusion parameters and concluded that no unique topographic features (such as valley, desert, or over water trajectories) preclude the use of the PAVAN model for the VEGP site. Therefore, the staff finds that the applicant's use of diffusion parameter assumptions, as outlined in RG 1.111 was acceptable.

2.3.5.3.5 Resulting Relative Concentration and Relative Deposition Factors

SER Table 2.3.5-2 lists the long-term atmospheric dispersion and deposition estimates for the dose calculation EAB and special receptors of interest that the applicant derived from its XOQDOQ modeling results. The applicant identified these χ/Q and D/Q values as site characteristics in SSAR Table 1-1 because these are the atmospheric dispersion site characteristics used by the applicant to demonstrate compliance with the terms of 10 CFR 100.21(c)(1) for the radiological dose consequences related to routine operation.

In response to RAI 2.3.5-6, the applicant provided long-term atmospheric dispersion and deposition estimates for all 16 radial sectors from the site boundary, to a distance of 50 miles from the proposed facility, in SSAR Table 2.3-18. The COL applicant will need to use this information to show that the proposed plant's gaseous radiological waste systems include all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can, for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor, in accordance with the requirements of Section II.D of Appendix I to 10 CFR Part 50.

The χ/Q values presented in SER Table 2.3.5-2 reflect several plume radioactive decay and deposition scenarios. Section C.3 of RG 1.111 states that radioactive decay and dry deposition should be considered in radiological impact evaluations of potential annual radiation doses to the public, resulting from routine releases of radioactive materials in gaseous effluents. Section C.3.a of RG 1.111 states that an overall half-life of 2.26 days is acceptable for evaluating the radioactive decay of short-lived noble gases and an overall half-life of 8 days is acceptable for evaluating the radioactive decay for all iodines released to the atmosphere.

Definitions for the χ/Q categories listed in the headings of SER Table 2.3.5-2 are as follows:

- Undepleted/No Decay χ/Q values are χ/Q s used to evaluate ground-level concentrations of long-lived noble gases, tritium, and carbon-14. The plume is assumed to travel downwind, without undergoing dry deposition or radioactive decay.

- Undepleted/2.26-Day Decay χ/Q values are χ/Q s used to evaluate ground-level concentrations of short-lived noble gases. The plume is assumed to travel downwind, without undergoing dry deposition, but is decayed, assuming a half-life of 2.26 days, based on the half-life of xenon-133m.

- Depleted/8.00-Day Decay χ/Q values are χ/Q s used to evaluate ground-level concentrations of radioiodine and particulates. The plume is assumed to travel downwind, with dry deposition, and is decayed, assuming a half-life of 8.00 days, based on the half-life of iodine-131.

The applicant provided a copy of its XOQDOQ input file in response to RAI 2.3.5-4. Using this information as well as the updated meteorological data provided by the applicant in its March 30, 2007 letter, the staff confirmed the applicant's χ/Q and D/Q values by running the XOQDOQ computer code and obtaining the same results.

In light of the foregoing, the staff accepts the long-term χ/Q and D/Q values presented by the applicant. The staff will include the long-term atmospheric dispersion and deposition factors listed in SER Table 2.3.5-2 as site characteristics in any ESP that the NRC might issue for the VEGP site.

2.3.5.4 Conclusion

The NRC staff evaluated the relevant sections of the application, as supplemented by letters dated January 30, 2007, March 26, 2007, and March 30, 2007, pursuant to the acceptance criteria of RS-002 Section 2.3.5 and applicable regulatory requirements of 10 CFR Part 52 and 10 CFR Part 100. As discussed above, the applicant has provided meteorological data and an atmospheric dispersion model that are appropriate for the characteristics of the site and release points. Therefore, the staff concludes that the applicant has calculated representative atmospheric transport and diffusion conditions for 16 radial sectors from the site boundary to a distance of 50 miles and for the specific receptor locations. Therefore, the applicant has provided the information required to address 10 CFR 52.17(a), 10 CFR 100.20, and 10 CFR 100.21(c)(1). The staff also concludes that the applicant's characterization of long-term atmospheric transport and diffusion conditions would be appropriate, at the COL stage, for use in demonstrating compliance with the numerical guides for doses contained in Appendix I to 10 CFR Part 50.

Table 2.3.5-1 - Distances between the Proposed Units 3 and 4 Power Block and Receptors of Interest[1]

RECEPTOR	DOWNWIND DIRECTION SECTOR	DISTANCE COMPILED FROM THE AREOP	DISTANCE USED
Nearest Resident	N	2032 m	1071 m
	NNE	>8045 m	1071 m
	NE	>8045 m	1071 m
	ENE	>8045 m	1071 m
	E	>8045 m	1071 m
	ESE	7118 m	1071 m
	SE	7327 m	1071 m
	SSE	7410 m	1071 m
	S	6835 m	1071 m
	SSW	7068 m	1071 m
	SW	3633 m	1071 m
	WSW	1071 m	1071 m
	W	5024 m	1071 m
	WNW	2069 m	1071 m
	NW	>8045 m	1071 m
	NNW	1946 m	1071 m
Meat Animal	N	>8045 m	1071 m
	NNE	>8045 m	1071 m
	NE	>8045 m	1071 m
	ENE	>8045 m	1071 m
	E	>8045 m	1071 m
	ESE	>8045 m	1071 m
	SE	>8045 m	1071 m
	SSE	7414 m	1071 m
	S	>8045 m	1071 m
	SSW	6736 m	1071 m
	SW	7155 m	1071 m
	WSW	6366 m	1071 m
	W	6170 m	1071 m
	WNW	>8045 m	1071 m
	NW	2400 m	1071 m

RECEPTOR	DOWNWIND DIRECTION SECTOR	DISTANCE COMPILED FROM THE AREOP	DISTANCE USED
	NNW	>8045 m	1071 m
Vegetable Garden	N	>8045 m	1071 m
	NNE	>8045 m	1071 m
	NE	>8045 m	1071 m
	ENE	>8045 m	1071 m
	E	>8045 m	1071 m
	ESE	>8045 m	1071 m
	SE	>8045 m	1071 m
	SSE	>8045 m	1071 m
	S	>8045 m	1071 m
	SSW	>8045 m	1071 m
	SW	>8045 m	1071 m
	WSW	4273 m	1071 m
	W	>8045 m	1071 m
	WNW	4458 m	1071 m
	NW	5899 m	1071 m
	NNW	>8045 m	1071 m

[1] Note that 2004 AREOP did not report any milk-giving animals (either cows or milk) within a 5-mile radius of the proposed VEGP site.

Table 2.3.5-2 - Long-Term (Routine Release) Atmospheric Dispersion Site Characteristics

SITE CHARACTERISTIC	VALUE	DEFINITION
Annual Average Undepleted/No Decay χ/Q Value @ EAB, northeast, 0.5 mile	5.5×10^{-6} s/m^3	The maximum annual average EAB undepleted/no decay atmospheric dispersion factor (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, northeast, 0.5 mile	5.5×10^{-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, northeast, 0.5 mile	5.0×10^{-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, northeast and east-northeast, 0.5 mile	1.7×10^{-8} 1/m^2	The maximum annual average EAB relative deposition factor (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, northeast, 0.67 mile	3.4×10^{-6} s/m^3	The maximum annual average resident undepleted/no decay atmospheric dispersion factor (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, northeast, 0.67 mile	3.4×10^{-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, northeast, 0.67 mile	3.0×10^{-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.
Annual Average D/Q Value @ Nearest Resident, northeast, east-northeast, and east, 0.67 mile	1.0×10^{-8} 1/m^2	The maximum annual average resident relative deposition factor (D/Q) value for use in determining gaseous pathway doses to the maximally exposed individual.

SITE CHARACTERISTIC	VALUE	DEFINITION
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Meat Animal, northeast, 0.67 mile	3.4×10^{-6} s/m^3	The maximum annual average meat animal undepleted/no decay atmospheric dispersion factor (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, northeast, 0.67 mile	3.4×10^{-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, northeast, 0.67 mile	3.0×10^{-6} 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, northeast, east-northeast, and east, 0.67 mile	1.0×10^{-8} 1/m^2	The maximum annual average meat animal relative deposition factor (D/Q) value for use in determining gaseous pathway doses to the maximally exposed individual.
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Vegetable Garden, northeast, 0.67 mile	3.4×10^{-6} s/m^3	The maximum annual average vegetable garden undepleted/no decay atmospheric dispersion factor (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 Vegetable Garden, northeast, 0.67 mile	3.4×10^{-6}s/m^3	The maximum annual average vegetable 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 Vegetable Garden, northeast, 0.67 mile	3.0×10^{-6} s/m^3	The maximum annual average vegetable 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 Vegetable Garden, northeast, east-northeast, and east, 0.67 mile	1.0×10^{-8} 1/m^2	The maximum annual average vegetable garden relative deposition factor (D/Q) value for use in determining gaseous pathway doses to the maximally exposed individual.