From: Christian Araguas
To: "Michelle Hart" <MLH3@nrc.gov>,"Joshua McGuire" <JNM@nrc.gov>
Date: 3/20/2007 9:53:06 AM
Subject: Fwd: RAI Letter # 3 Responses

Below are the RAI responses. Some I didn't see that they contained the response to your question and therefore left you off of the initial email. I just received them yesterday. Let me know if you have any questions. Thanks.

Christian

>>> Christian Araguas 03/20/2007 8:08 AM >>>
Rao/Jean-Claude/Steve,

Attached are the responses to your RAIs. A CD with the GASPAR and LADTAP computers is also included in the responses but I have not received it yet. I will make sure to bring it by when I get it. Who should get the CD, Steve or Jean-Claude? Let me know. Thanks.

Christian

>>> "Davis, James T." <JTDAVIS@southernco.com> 03/19/2007 6:36 PM >>>
<<RAI #3 Response AR-07-0401 Part 1 of 2.pdf>>

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Subject: Fwd: RAI Letter # 3 Responses
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From: Christian Araguas

Created By: CJA2@nrc.gov

Recipients
"Michelle Hart" <MLH3@nrc.gov>
"Joshua McGuire" <JNM@nrc.gov>

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Options
Priority: Standard
Reply Requested: No
Return Notification: None
None

Concealed Subject: No
Security: Standard

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SOUTHERN COMPANY
Energy to Serve Your World℠

MAR 16 2007

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AR-07-0401

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

Southern Nuclear Operating Company
Vogtle Early Site Permit Application
Response to Requests for Additional Information Letter No. 3

Ladies and Gentlemen:

By letter dated February 16, 2007, the U.S. Nuclear Regulatory Commission (NRC) provided Southern Nuclear Operating Company (SNC) with requests for additional information (RAIs) on the Vogtle Early Site Permit (ESP) application. The RAIs pertain to ESP application Part 2, Site Safety Analysis Report (SSAR), Chapters 2, 3 and 15; and Part 3, Environmental Report (ER), Sections 5.4 and 6.2. SNC's response to the RAIs is provided in the Enclosures to this letter. Proposed revisions to SSAR Section 2.1, *Geography and Demography*, SSAR Section 2.2, *Identification of Potential Hazards in Site Vicinity*, and ER Section 5.4, *Radiological Impacts of Normal Operations*, are enclosed, and incorporate additional RAI detail and changes as appropriate. These proposed revisions will be integrated into the next revision of the ESP application. In addition, Enclosure 6 is a compact disc (CD) containing input and output data files for GASPAR and LADTAP II computer codes utilized in analyses described in revised ER Section 5.4.

The SNC contact for this RAI response letter is J. T. Davis at (205) 992-7692.

Mr. J. A. (Buzz) Miller states he is a Vice President of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

J. A. Miller

Joseph A. (Buzz) Miller

Sworn to and subscripted before me this 16th *day of* March *, 2007*

Glori W. Buie
Notary Public

My commission expires: 05/06/08

JAM/BJS/dmw

Enclosures:

1. Response to February 16, 2007 RAI Letter No. 3 for the Vogtle ESP Application
2. Proposed Revision to SSAR Section 2.1
3. Proposed Revision to SSAR Section 2.2
4. Proposed Revision to ER Section 5.4
5. Westinghouse Document LTR-CRA-06-21
6. GASPAR and LADTAP II Computer Code Input and Output Data Files

cc: Southern Nuclear Operating Company
Mr. J. B. Beasley, Jr., President and CEO (w/o enclosures)
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File AR.01.01.06

Nuclear Regulatory Commission
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Mr. C. J. Araguas, Project Manager of New Reactors
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Mr. G. J. McCoy, Senior Resident Inspector of VEGP (w/o enclosures)

Georgia Power Company
Mr. O. C. Harper, Vice President, Resource Planning and Nuclear Development (w/o enclosure)

Oglethorpe Power Corporation
Mr. M. W. Price, Chief Operating Officer (w/o enclosure)

Municipal Electric Authority of Georgia
Mr. C. B. Manning, Senior Vice President and Chief Operating Officer (w/o enclosure)

Dalton Utilities
Mr. D. Cope, President and Chief Executive Officer (w/o enclosure)

Bechtel Power Corporation
Mr. J. S. Prebula, Project Engineer (w/o enclosures)
Mr. R. W. Prunty, Licensing Engineer (w/o enclosures)

Tetra Tech NUS, Inc.
Ms. K. K. Patterson, Project Manager (w/o enclosures)

Southern Nuclear Operating Company

AR-07-0401

Enclosure 1

Response to February 16, 2007 RAI Letter No. 3

For the

Vogtle ESP Application

Section 2.1 Site Location

2.1.1-1 Table 1-2, "Regulatory Compliance Matrix," presents the NRC regulations that are applicable and addressed in corresponding SSAR chapters and sections of the Vogtle Early Site Permit Application. However, there are noticeable discrepancies between the regulations cited and the corresponding chapter or section. Please review and update Table 1-2, to make all chapters and sections of SSAR consistent with the applicable regulatory requirements.

Response:

SNC has performed a preliminary review of SSAR Table 1-2, *Regulatory Compliance Matrix*, against Review Standard RS-002, *Processing Applications for Early Site Permits*, and agrees with the NRC that this table may contain some discrepancies. A more thorough review of the table is planned to positively correlate applicable regulatory requirement with associated SSAR chapters and sections. In addition, this table requires updating to incorporate new SSAR Chapter 11 requirements. Therefore, SNC will provide a revised SSAR Table 1-2 in the next revision to the ESP application.

2.1.1-2 The planned location of the proposed Units 3 and 4 has been changed since the SSAR was submitted. Please provide updated UTM coordinates for the proposed units. Also provide the latitude and longitude of the proposed new reactor site.

Response:

The proposed VEGP Units 3 & 4 UTM coordinates were already updated. Geographic latitude/longitude data has been added in the proposed revision to SSAR Section 2.1 (Enclosure 2) as follows:

Unit	Georgia East Coordinates (NAD27) 1001 – Georgia East (US ft)		UTM Coordinates (NAD83) Zone 17 – 84W to 78W (m)		Latitude/Longitude (NAD83) (Deg/Min/Sec)	
3	N	1,142,600	N	3,667,170	N	33 08 27
	E	621,800	E	428,320	E	81 46 07
4	N	1,142,600	N	3,667,170	N	33 08 27
	E	621,000	E	428,070	E	81 46 16

2.1.1-3 SSAR Figure 1-4, "Site Layout - New Development", shows a map of the proposed units, the site boundary, and the exclusion area boundary (EAB) without a scale on the map. Please provide an updated SSAR Figure 1-4 that contains a scale for that Figure.

Response:

SSAR Figure 1-4 has been revised to show a scale for the new development map. This revised figure is included for your review and will be incorporated into the next revision to the ESP application.

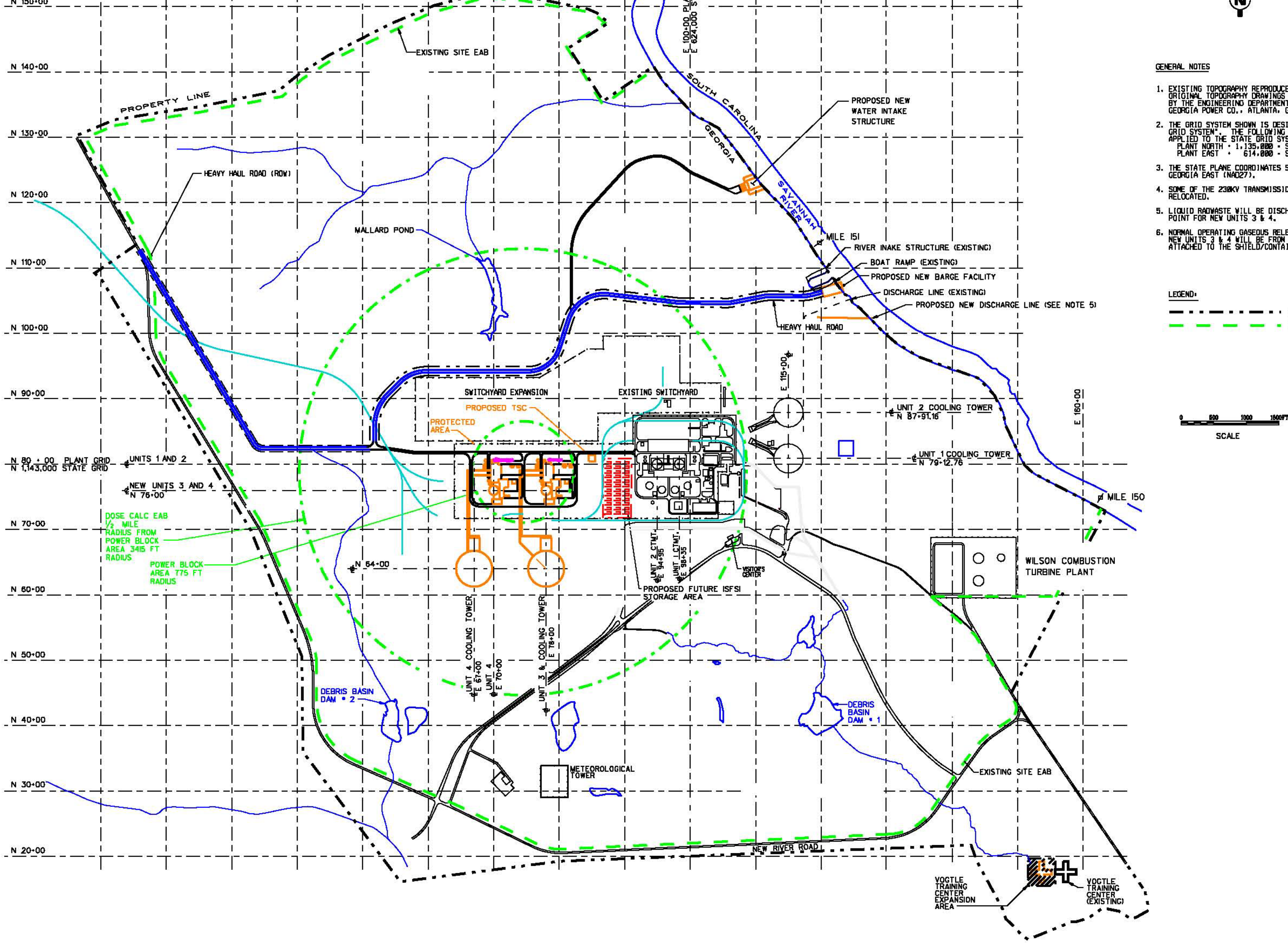


Figure 1-4 Site Layout – New Development

2.1.2-1 Please provide the number of people who will be working at Plant Wilson and the following details about their working hours: how many days per week they will work and the number of hours expected per shift. Please also provide the number of people who will be working at the visitor center and the same details regarding their working hours. This information will help assist the determination of whether individuals can be evacuated prior to receiving doses that exceed the dose limits.

Response:

Plant Wilson is staffed by VEGP personnel and the staff consists of seven full time individuals. The Wilson staff works Monday through Friday typically 7:00 am to 3:30 pm, with on call duty for the weekend. The Visitor Center is staffed by VEGP personnel and the staff consists of two full time individuals. The Visitor Center staff works Monday through Friday typically 7:00 am to 4:00 pm. Evacuation of the Visitors Center and Plant Wilson is addressed by SSAR Section 13.3 and the referenced ESP application Part 5, *Emergency Plan*.

2.1.2-2 Provide more details regarding the location of the visitor center, including a site map that shows the location of it.

Response:

SSAR Figure 1-4 has been revised to show the visitors center. Refer to the Response to RAI 2.1.1-3 for this revised Figure.

2.1.2-3 Provide the estimated evacuation time for the EAB, which would include visitor center and Plant Wilson.

Response:

Evacuation times are addressed in SSAR Section 13.3 and in the referenced ESP application Part 5 *Emergency Plan*. A statement has been included in the proposed revision to SSAR Section 2.1, provided in Enclosure 2 to this letter, that indicates evacuation of the Visitors Center and Plant Wilson is addressed by the Emergency Plan.

2.1.3-1 In Section 2.1.3.2 (page 2.1-5), the citation of figure numbers in the text appears to be incorrect. The cited figure number in the second sentence should be Figure 2.1-9 instead of Figure 2.1-10, and the cited figure number in the second sentence of the second paragraph should be Figure 2.1-11 instead of Figure 2.1-10. Please confirm and provide corrected citations.

Response:

The Figure listed in the first sentence the first paragraph of Section 2.1.3.2 has been changed to be Figure 2.1-9. The text of the second paragraph has been changed to reflect Figure 2.1-10 through Figure 2.1-15 titles. The revised Section 2.1.3.2 is shown in Enclosure 2.

2.1.3-2 In Section 2.1.3, Figures 2.1-10 through 2.1-15 contain population distributions from 10-50 miles (population within 10 miles is not included), but the figures are labeled as 50-mile Resident Population Distribution, thereby implying that the population distribution presented is from 0-50 miles. Please change the title of the figures to represent the 10-50 miles Resident Population Distribution.

Response:

The titles for Figures 2.1-10 through 2.1-15 have been revised to show them as 10 – 50 Mile Resident Population Distribution. These revised Figures are included in Enclosure 2.

2.1.3-3 Please provide a pointer to the section of the ESP application that contains a description of appropriate protective measures that would be taken on behalf of the populace in the low population zone in the event of a radiological emergency.

Response:

A statement has been incorporated into the proposed revision to SSAR Section 2.1 which refers to SSAR Section 13.3 and the referenced ESP application Part 5, *Emergency Plan*, as providing appropriate protective measures to be taken on behalf of the populace in the low population zone in the event of a radiological emergency.

2.1.3-4 Provide a scaled map of the low population zone that includes topographic features, highways, railways, waterways, and any other transportation routes. Also, provide a scaled map of the location of all facilities within the LPZ.

Response:

A Figure 2.1-17 has been created to show the LPZ with topographic features that include highways, railways, waterways, and other transportation routes, as well as facilities within the LPZ. It is included in Enclosure 2.

2.1.3-5 On page 2.1-7, the application states that "Given an approved ESP period of 20 years, a conservative start up date of 2025, and an operational period of 40 years, operations could extend until 2065." This information would have been correct if the ESP approval had been obtained in 2005. It may properly be accounted if modified to state "Given an ESP approval date of 2010, a conservative startup date of 2030, an assumed startup at the end of an ESP approval period of 20 years, and an operational period of 40 years, operations could extend until 2070."

Response:

Section 2.1.3.6, second sentence, has been revised to read:

"Given an ESP approval date of 2010, a conservative startup date of 2030 (at the end of an ESP approval period of 20 years), and an operational period of 40 years, operations could extend until 2070."

The revised SSAR section 2.1.3.6 has been included in Enclosure 2.

2.1.3-6 Please include the 0-50 mile total population for the base year 2000 in the text on page 2.1-5.

Response:

The population tables on page 2.1-5 have been revised to show data for the year 2000. The associated text and the associated tables have been changed to reflect this data and are included in Enclosure 2.

Section 2.2 Identification of Potential Hazards in Site Vicinity

2.2.2-1 The onsite chemicals for proposed Units 3 and 4 (AP1000) presented in Table 2.2-6 do not provide estimated quantities for chemicals listed. Please provide these details such that Table 2.2-6 will be consistent with Table 2.2-5.

Response:

Table 2.2-5 in the SSAR is based on information for the existing units for which the specific locations and quantities of the chemicals are known. Table 2.2-6 in the SSAR is based on the information provided in AP1000 DCD, Section 6 Engineered Safety Features, Chapter 6.4 Habitability Systems, Table 6.4-1 "ONSITE CHEMICALS". Westinghouse has not yet determined the specific locations and quantities of chemicals associated with the AP1000 design.

2.2.2-2 An onsite railroad spur, with the potential for transport of chemicals, was observed to have a tank car on it during the site visit conducted November 1-3, 2006. Please clarify whether or not chemicals are brought in using this railroad spur, and discuss the potential for any related hazards.

Response:

The use of chemicals at VEGP is governed by the site Chemical Control Procedure (00262-C, *Control of Chemicals/Fluids*). This procedure evaluates the chemical hazards including control room habitability concerns, use restrictions, concerns with corrosion or other reactions with site equipment or piping, and proper management and disposal of waste. Chemicals are used at VEGP for a variety of purposes, including water treatment and are sometimes supplied in bulk. Normally, bulk shipments are delivered by tanker truck or in large tote bins. Recently, VEGP conducted chemical cleaning of the steam generators for both units. In support of that process, one chemical that was required in large quantity was delivered by rail. The chemical, EDTA, was evaluated in accordance with the VEGP Chemical Control procedure and determined to be acceptable. The rail car of EDTA was observed during the NRC site visit and prompted this question.

Chemical use is carefully managed at VEGP and the Chemical Control procedure is strictly applied to all uses of chemicals onsite. Bulk shipments are generally limited to water treatment chemicals and fuel oil. Fire hazards associated with bulk fuel delivery have been evaluated in support of the ESP application (see response to RAI 2.2.3-2). Gaseous chlorine, anhydrous ammonia, and sulfur dioxide are no longer used at VEGP. The majority of water treatment chemicals are relatively low hazard and all have been evaluated. Any new chemicals are evaluated prior to being allowed onsite.

The use of rail transport for chemicals rarely occurs at VEGP and any chemical transported by rail or other means is evaluated per the Chemical Control procedure and determined to be acceptable prior to allowing the material onsite.

2.2.3-1 SSAR Section 2.2.3.1.1 addressed truck-borne hazards from six chemicals. Please provide the basis for the selection of these six chemicals used for the truck-borne hazards analysis. In addition, state whether any new chemicals have been identified since the analysis for Units 1 and 2 was performed, and state whether any new chemicals will be addressed for the proposed Units 3 and 4. Please address these details with the analysis cited in item 1 of the response to information needs letter AR-06-2720, dated December 15, 2006.

Response:

The six chemicals identified in the analysis of truck traffic were obtained from the original design basis analysis for Units 1 and 2 and were based on a 1975 study performed by the Georgia Institute of Technology for Georgia Power Company. The original study is no longer available, and these chemicals have been re-evaluated as described below.

SNC has obtained the EPA Tier II reports for Burke and Richmond Counties in Georgia, identifying those facilities in the vicinity of the plant which have permits for storing hazardous materials. These reports, along with the EPA Landview6 database, were used to confirm and/or update the list of chemicals for analysis.

A traffic corridor evaluation has been performed to determine whether there are any new or additional chemicals transported by truck within 5 miles of the site related to the facilities described above. The evaluation shows that even fewer chemicals pass by the site now than assumed in the previous analysis performed for the existing units.

There exist only two EPA regulated sites that would likely use State Route 23 as a route for transporting materials and equipment. These sites are construction-related sites and are located 7 to 10 miles south of the Vogtle site. Neither of these sites currently uses any of the previously identified chemicals nor have they been identified to use or cause the transport of any hazardous chemicals other than fuel oil or gasoline. The remaining sites are all outside of the 5 mile corridor and are likely to transport their materials and equipment via other, more direct, routes, rather than along State Route 23. These remaining sites therefore do not warrant further analysis. New Figure 2.2-4 (Attachment 10 to this enclosure), Corridor Analysis, is attached and will be included in Revision 2 of the ESP Application.

The use of bulk anhydrous ammonia has been discontinued at the plant site. Since there are not any other users of this chemical in the vicinity of this site, the issue of transportation of this chemical along the roadways or to the site will not require further analysis. (Anhydrous ammonia is still being transported by rail car, and is evaluated in SSAR Section 2.2.3.1.4).

The original analysis (performed for Units 1 & 2) had determined that SRS had the potential to utilize chlorine and ammonia at the D-Area, which is approximately 4.5 miles distant from Units 1 & 2. The proposed Units 3 & 4 are approximately the same distance from the D-Area as Units 1 & 2. However, the 2004 Tier II EPA report for this site, and recent communications with SRS management, have indicated that ammonia and chlorine are no longer in use at D-Area. The area has been remediated and nearly all the facilities have been removed. The only chemicals used at the site, according to the recent Tier II report, are chlorine softener chemicals, and biocide, which are used in the waste treatment process to eliminate the bacteria in the water. There were no chemicals identified which would be hazardous to the Vogtle site or would require further evaluation.

Thus, the only remaining hazardous chemicals transported by truck in the vicinity of the site are gasoline and diesel/fuel oil. Since stored or transported diesel/fuel oil is not flammable (see response to RAI 2.2.3-6), and it is much less volatile than gasoline, the gasoline truck analysis becomes bounding in the evaluation of truck-borne hazards.

2.2.3-2 In response 3 of letter AR-06-2720, you stated that an analysis of the potential formation of flammable vapor clouds from a gasoline truck is currently being performed. Please provide the results of this analysis, as well as a description of the input parameters and methodology used.

Response:

For an 8,500-gallon truck on State Road 23 at the closest approach distance of approximately 4.2 miles (22,000 ft), the following calculations were performed:

- TNT equivalent safe distance for an explosion of a gasoline vapor cloud,
- TNT equivalent safe distance for an explosion of gasoline vapor in a truck

For an explosion from a flammable vapor cloud, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi has been calculated to be1,279 feet.

For the explosion from a truck, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi has been calculated to be1,723 feet.

The gasoline truck analysis for the vapor cloud explosion uses the industry standard program DEGADIS to calculate the distance from the site of the spill to the boundaries of the upper and lower flammability limits and to obtain the flammable mass within the vapor plume. The concentrations are compared to the lower flammability limits for the respective chemical to determine the maximum distance for the flammable vapor cloud. The input parameters are:

- Quantity of Gasoline in the truck (50,000 lbs per RG 1.91 1978 – 50,700 lbs TNT equivalent)
- Physical property data:
  - molecular weight 95 g/mole;
  - diffusion coefficient 0.05 cm^2/sec;
  - vapor pressure 300 mm Hg,
  - boiling point temperature 130^{o}C, and

  - specific gravity 0.732.
- The meteorological conditions assumed are:
  - F (stable) stability class and
  - wind speeds of 1 m/s up to 2.5 m/s.

The size of gasoline delivery trucks on State Road 23 range from 4,000 to 8,500 gallons so the assumption of an 8,500-gallon truck in the analysis is conservative and bounding.

In addition to road transit, gasoline is delivered to the site by a tank wagon (10-wheel truck) containing a maximum volume of 4,000 gallons. The closest distance from the site delivery route to the power block circle is approximately 2,000 feet. As discussed above, since the 1-psi blast pressure distances for the vapor cloud and truck explosions are 1,279 feet and 1,723 feet, respectively, the 8,500-gallon truck analysis remains bounding for the tank wagon.

2.2.3-3 Please clarify whether an 8500 gallon gas truck with a TNT equivalent of 50,700 lbs is considered bounding for the truck traffic explosion and flammable vapor cloud analysis in SSAR Section 2.2.3.1.1. Additionally, the critical distance resulting in a peak overpressure of 1 pound-per-square-inch (psi) for a TNT equivalent of 50,700 lbs calculated based on the equation kW1/3 from Regulatory Guide (RG) 1.91 is about 1700 ft. In SSAR section 2.2.3.1.1 this critical distance is reported as 1900 ft. Please explain the discrepancy between the RG 1.91 calculation and what is reported in the SSAR.

Response:

As discussed in the response to RAI 2.2.3-2, the 8,500-gallon gasoline truck analysis, with a TNT equivalent of 50,700 lbs, is considered bounding for the truck traffic explosion and flammable vapor cloud analysis.

The critical distance reported in SSAR section 2.2.3.1.1 (1,900 ft) was originally estimated using a TNT equivalent of 50,700 lbs., TNT equivalent mass and reading the distance from RG 1.91, Figure 1, "Radius to Peak Incident Pressure of 1 PSI,". This was a conservative approximation. The 50,700 lbs of TNT equivalent was based on the information contained in NUREG-1835 (Safety Evaluation Report for Early Site Permit (ESP) at the North Anna ESP Site, September 2005). In a new analysis performed specifically for the Vogtle ESP Application, the TNT equivalent for 8,500 gallons/50,000 pounds of gasoline is 56,165 lbs. The critical distance for this TNT equivalent has been verified to be 1,723 ft using the equation $kW^{1/3}$. This new analysis will be reflected in the next revision of the ESP application.

2.2.3-4 The concentrations provided in response 4 of letter AR-06-2720 are the concentrations at the control room intake rather than the concentrations calculated for a flammable vapor cloud. Please provide the concentrations generated from the vapor cloud analysis to confirm the following conclusion presented in SSAR Section 2.2.3.1.1: "The analysis demonstrated that truck-borne substances transported within a 5-mile radius of the VEGP Units 1 and 2, as well as explosions and flammable vapor clouds induced by these chemicals, will not adversely affect safe operation of the units."

Response:

The concentrations provided in response 4 of letter AR-06-2720 were intended to show that the concentrations were all well below the lower flammability limits (LFL) listed below, which means the clouds are not flammable at the control room. As described in response to RAI 2.2.3-1, only diesel/fuel oil and gasoline remain as truck-borne hazardous chemicals of concern. The table below shows, for each chemical transported by truck, the key input parameters and the results of the evaluation.

Chemical	Quantity	Distance to Control Room	TNT Equivalent Distance	Distance to Lower Flammability Limit	Lower Flammability Limit
#2 Diesel	6,000 gal	4.2 mi (22,000 ft)	Not Applicable	Not Applicable	13,000 ppm
#2 Diesel	4,000 gal	2,000 ft	Not Applicable	Not Applicable	13,000 ppm
Gasoline	50,000 lb 8,500 gal	4.2 mi (22,000 ft)	1,723 ft	1,200 ft	14,000 ppm
Gasoline	23,530 lb 4,000 gal	2,000 ft	< 1,723 ft	< 1,200 ft	14,000 ppm

2.2.3-5 For clarification regarding the chemicals considered in SSAR Section 2.2.3.1.1, please provide the quantity of each chemical, the distance to the control room, wind speed, stability, and calculated concentration along with the compared limiting concentration. A similar approach is suggested for SSAR Sections 2.2.3.2 and 2.2.3.3.

Response:

The table below shows, for each chemical transported by truck, the key input parameters and the results of the evaluation. Bechtel's Standard Computer Program TOXDISP was run to determine the concentrations of these chemicals from an accidental spill. A table containing this information is included in the revision to SSAR Section 2.2.3.1, as reflected in Enclosure 3.

Chemical	Quantity	Distance to Control Room	Wind Speed	Stability	Control Room Concentration	Toxicity Limit
#2 Diesel	6,000 gal	4.2 mi (22,000 ft)	0.5 m/s	G	0.057 ppm	300 ppm
#2 Diesel	4,000 gal	2,000 ft	1 m/s	F	bounded by gasoline	300 ppm
Gasoline	50,000 lb 8,500 gal	4.2 mi (22,000 ft)	1 m/s	F	35.5 ppm	300 ppm
Gasoline	23,530 lb 4,000 gal	2,000 ft	1 m/s	F	115 ppm	300 ppm

2.2.3-6 Section 2.2.3.1.3 of Revision 0-S1 of the SSAR states that an analysis for VEGP Units 1 and 2 determined that the concentration of flammable material in the vapor-space of the tanks carrying the fuel oil is below the lower limit of flammability. Additionally, response 5 of letter AR-06-2720 states that the concentration inside any of the three 3-million-gallon fuel tanks is lower than the lower flammability limit of #2 diesel fuel. Please provide details of the analyses performed to determine that the concentration of fuel oil in the vapor space of tanks carrying fuel oil on a barge and in the Plant Wilson storage tanks is below the lower limit of flammability.

Response:

The following formula was used for determining the concentration of fuel oil in a tank vapor space:

X = molar concentration of fuel oil
P_{vapor} = saturated vapor pressure (psi) of fuel oil = 0.065 psi @ 85^{o}F
P = atmospheric pressure (psi) (14.7 psi)

X = P_{vapor}/P= 0.065/14.7 = 0.004422 = 0.44% @ 85°F

As shown in the table in response to RAI 2.2.3-5, the lower flammability limit (LFL) for diesel or fuel oil is 13,000 ppm (1.3%) in the vapor space above the liquid. Since the concentration of fuel oil in the vapor space is 0.44 %, the vapors are not flammable.

2.2.3-7 Response 5 of letter AR-06-2720 states that for fuel oil, Plant Wilson is bounding for explosion and flammable vapor cloud formation and that for vapor cloud toxicity, a fuel barge is limiting. Please provide the basis for your determination that a 3 million gallon fuel tank at Plant Wilson is bounding for explosion hazard and flammable vapor formation, but not for vapor cloud toxicity, compared to a lower volume of fuel oil on a barge. Please provide the details of the analysis, along with input parameters and assumptions pertaining to waterway traffic addressed in SSAR Section 2.2.3.1.3. Provide a brief discussion of the release scenario (i.e., leak or spill) from the Plant Wilson storage tank and the barge, as well as all other parameters used in performing the vapor cloud toxicity analysis.

Response:

Previously, the U.S. Army Corps of Engineers, in Waterborne Commerce of the United States (IWR-WCUS-04-1), had identified that barge traffic on the Savannah River below Augusta carrying fuel oil was less than 500 tons. Subsequently, it has been determined that fuel oil is no longer transported by barge past the Vogtle plant site, and the barge hazard has been eliminated from additional consideration as described below.

The Savannah River above the Vogtle site (River Mile 151) is primarily used for recreational purposes since 1979, with the closing of the New Savannah Bluff Lock and Dam (River Mile 187) to commercial traffic (USACE 2000). There are no commercial facilities or barge slips/docks which are visible on satellite imagery between the Vogtle site and the New Savannah Bluff Lock and Dam. This section of the river is primarily forested and otherwise undeveloped land to the river's edge.

Downstream of the Vogtle site, barge traffic may be present closer to the Port of Savannah (River Mile 21). In 2005 no barge traffic was reported to the Army Corp of Engineers Waterborne Commerce Statistics Center in New Orleans, Louisiana (USACE 2007). In 2004, only 13 commercial vessels were recorded (IWR 2004). These vessels were reported to contain a total of less than 500 tons of non-explosive residual fuel oil (less than a full barge load).

Therefore, the current use of the river and the lack of commercial facilities and barge slips/docks upstream of the plant indicate that there is no current or projected barge traffic on the Savannah River past the Vogtle site. Based on the above information, SNC has determined that evaluation of hazardous shipments by barge is not necessary for VEGP Units 3 and 4.

Regarding Plant Wilson, the Bechtel Standard Computer Program TOXDISP was run to determine the concentration of fuel oil at the air intake for the new units from a spill of fuel oil from one of the large storage tanks at Plant Wilson. The maximum concentration of fuel oil is:

	Quantity	Wind Speed	Stability	Distance to Control Room	Concentration of Vapor at Control Room Air Intake
Fuel Oil	3,000,000 gallons	1 m/s	F	Approximately 5,500 ft	< 50 ppm

As discussed in the RAI 2.2.3-6 response, the vapor pressure of fuel oil is sufficiently low that evaluation of the explosion of fuel oil at Plant Wilson is not required. This additional information will be reflected in the next revision of SSAR Section 2.2 as indicted in Enclosure 3.

2.2.3-8 Section 2.2.3.1.3 of Revision 1 of the SSAR states that "This substance is neither a solid explosive material, nor is it a hydrocarbon which has been liquefied under pressure. Therefore, in accordance with RG 1.91, this material is not required to be evaluated for explosion." However, this is inconsistent with RG 1.91. RG 1.91 states that the regulatory guide is limited to solid explosives and hydrocarbons liquified under pressure, and is not applicable to cryogenically liquefied hydrocarbons such as liquefied natural gas (LNG). This regulatory guide does not state that hazardous materials other than solid explosives and hydrocarbons liquefied under pressure do not need to be evaluated. Please clarify and provide the basis for not evaluating fuel oil for explosion.

Response:

As discussed in response to RAI Question 2.2.3-6, the LFL is not exceeded, therefore, an explosion of the fuel oil is not possible. The fuel oil content of the vapor from a fuel oil storage tank is approximately 0.44% which is below the lower flammability limit of 1.3%. Therefore, vapor clouds induced by the release of fuel oil will not be flammable, and the potential for hazards from explosions or flammable vapor clouds is negligible. The safe operation of the new units is not affected. This explanation has been reflected in the revision to Section 2.2.3.1.3 (Enclosure 3) and the two sentences quoted in the question above have been deleted.

2.2.3-9 Please provide a justification for the selection of chemicals for the railroad traffic analyses in SSAR Section 2.2.3.1.4. In addition, there appears to be an incorrect citation on pages 2.2-12 and 2.2-13, since toxic vapor concentrations are based on RG 1.78 rather than RG 1.91.

Response:

Per communications with the CSX Director of Infrastructure Security (Murta), the percent of total 2005 bulk shipments that contained qualified DOT hazardous materials were:

64% - Cyclohexane;

9% - anhydrous ammonia;

3% - carbon monoxide;

3% - Elevated Temperature Materials Liquid (ETML)

Section 2.2.3.1.4 has been revised to include the above percentiles and to correct the reference from RG 1.91 to RG 1.78 (see Enclosure 3).

Accidental spills of carbon monoxide or ETMLs are not expected to create an explosion or vapor hazard for the site. Carbon monoxide, which can cause affixation, will quickly vaporize and dissipate prior to coming close to the Vogtle plant limits. ETMLs, also referred to as elevated temperature goods, are not necessarily flammable. ETMLs are DOT Class 9 materials and the main hazard they present is the potential to cause burns due to contact with the high temperature materials. Therefore, no adverse impact to the Vogtle ESP site is expected from the accidental release of these hazardous materials.

Cyclohexane (used in the manufacture of nylon, paint, resin, etc.) is a hazardous chemical which, according to CSX (Murta), is frequently shipped by rail past the site. Cyclohexane was not previously considered in the Unit 1& 2 analyses so a new analysis for this chemical has been performed for Units 3 & 4.

CSX also noted that ammonia is another of the chemicals frequently shipped by rail past the site. Ammonia is toxic and has the potential for a long transport distance. This chemical was previously evaluated in the Unit 1 & 2 analysis. The results of that evaluation have been extended, as appropriate, for the new units.

2.2.3-10 Please provide in tabular form the amount of each chemical analyzed and the calculated concentration in SSAR Section 2.2.3.1.4 along with the input parameters (distance, stability, wind speed, etc.) for the model used. Please also discuss the methodology, including salient assumptions, used for the analyses.

Response:

For ammonia and cyclohexane the methodology used for emission estimate and dispersion analysis are based on NUREG-0570, "Toxic Vapor Concentration in the Control Room Following a Postulated Accidental Release," (Wing 1979). Bechtel's standard computer program, "TOXDISP," is based on this methodology, and was used for determining the concentration of cyclohexane at the control room air intake. The Bechtel Standard Computer Program "TOXGAS", which is also based on NUREG-0570, was used for determining the concentrations of ammonia at the control room air intake. The closest rail location to the proposed units is approximately 4.5 miles (23,750 ft), so this distance is used in the evaluations.

Compound	Quantity	Distance from RR to Control Room	Wind Speed	Stability Class	Concentration of compound at control room air intake, ppm
Ammonia	26 tons	4.5 miles	1 m/s	G	112 @ 2 mins
Cyclohexane	67 tons	4.5 miles	1 m/s	F	34.3

Section 2.2.3.1.4 has been revised to include the above tabular inset and description (see Enclosure 3).

2.2.3-11 SSAR Section 2.2.3.1.4 states that the critical distance that would yield an overpressure of 1 psi for railroad traffic is 2250 ft. Please provide the basis for the calculation of this critical distance.

Response:

The 2,250 ft distance represents the radius-to-peak incident pressure of 1 psi, as approximated from RG 1.91, Figure 1, for a railroad box car containing a load equivalent to 132,000 pounds of TNT. That approximation was used in the original Units 1 and 2 calculation to demonstrate that the explosion of a rail car containing 26 tons of ammonia, 4.5 miles from the plant, would not cause a peak incident pressure greater than 1 psi at any plant structure.

Using the equation:

$R = 45W^{1/3}$

(on which RG 1.91 Figure 1 was based) for 132,000 pounds of TNT equivalent, the critical distance is calculated to be approximately 2,291 ft.

Given the 4.5-mile distance from the plant, the conclusion of the original analysis - that an explosion of the 26 ton container of ammonia would not cause a peak incident pressure of 1 psi on a plant structure - remains valid. Section 2.2.3.1.4 has been revised to correct the distance cited and to restate the conclusion that the critical distance is much less than the distance from the railroad line to the new units (see Enclosure 3).

2.2.3-12 In the analysis of the potential explosion hazard from a railcar containing cyclohexane in Section 2.2.3.1.4, the TNT equivalent mass is calculated based on the mass of cyclohexane that would be present in a railcar filled with cyclohexane vapor. However, in the analyses done for the potential explosion hazards from truck-borne hazards, the TNT equivalent mass is calculated based on a truck filled with the total amount shipped. Please explain why a different approach was used for cyclohexane than for the other chemicals.

Response:

The two methods used for calculating the TNT equivalent mass are both technically correct, although the method used for gasoline truck-borne hazards (total truck mass times a yield factor) yields more conservative results than the method used for TNT equivalent mass for cyclohexane (vapor mass only). The more conservative approach was chosen for gasoline since gasoline has a higher vapor pressure and is more flammable than cyclohexane.

Section 2.2.3.1.4 has been revised (see Enclosure 3 to this letter) to reflect the additional details.

2.2.3-13 The analysis of an explosion of a railcar containing cyclohexane presented in Section 2.2.3.1.4 of Revision 1 of the SSAR states that a TNT equivalent mass of 117.5 lbs of cyclohexane would produce a peak overpressure of 1 psi at a distance of 1026 ft from the railroad. This distance is not consistent with the critical distance calculated using kW1/3. Please clarify.

Response:

The maximum amount of cyclohexane vapor in a railcar was calculated to be 48.8 pounds. This was based on an air-vapor mixture at the upper flammability limit for cyclohexane. Using the ratio of the heats of combustion of cyclohexane and TNT, and a conservative yield factor of 100%, this mass of cyclohexane is calculated to be equivalent to 117.5 pounds of TNT. Using the equation $kW^{1/3}$ from RG 1.91, the radius to a peak incident pressure of 1 psi for a TNT equivalent mass of 117.5 lbs is 220 ft.

In a second scenario, a railcar leak was also considered. In this case, the liquid that leaks from the railcar is assumed to form a pool. A vapor cloud, based on the evaporation from that pool, is calculated and the flammable portion of the vapor cloud (the vapor mass of cyclohexane contained between the upper flammability limit and lower flammability limit) was estimated to be 1,868.1 lbs. The TNT equivalent of that mass (obtained by multiplying the mass by the ratio of heats of combustion and a yield factor of 6 %) is 1,007.3 lbs. The blast radius for a TNT equivalent mass of 1,007.3 lbs is 451 ft in accordance with equation $kW^{1/3}$. The outer edge of the lower flammable limit (LFL) of the flammable portion of the vapor cloud was calculated to be 575 ft downwind from the railroad line. If the blast occurs at the outer edge of the vapor cloud, which is a conservative assumption, then the maximum distance for which a peak incident pressure of 1 psi would occur is the sum of the two distances or 1,026 ft from the railroad. The distance between the closest point of the rail line and Units 3 & 4 is approximately 4.5 miles. This distance is far greater than either of the above calculated critical distances. Therefore, there will not be any impact on Units 3 or 4 from an explosion of cyclohexane from a railcar or vapor cloud.

Section 2.2.3.1.4 has been revised to include the additional details described above (see Enclosure 3).

2.2.3-14 Please clarify whether any analyses were done to evaluate the potential hazards from an explosion or flammable vapor cloud formation due to accidents associated with onsite storage tanks and nearby storage facilities, such as the fuel tanks at Plant Wilson. If these analyses were performed, please provide the details of these analyses, and if not, please provide an explanation for why these analyses were not performed.

Response:

Analysis of potential hazards from an explosion or flammable vapor cloud formation from onsite storage tanks and nearby storage facilities, such as at Plant Wilson, was performed for Units 1 & 2. This analysis showed that, for the chemicals stored onsite or at Plant Wilson, only fuel oil and gasoline were flammable. The concentration of fuel oil in the tank vapor space is less than the LFL, (see response to RAI 2.2.3-6 above), and so it has been eliminated from further consideration. Similarly, if there was a spill of fuel oil at Plant Wilson, the concentration of fuel oil vapor in the air would be further diluted in open atmosphere. Since these concentrations of fuel oil in the vapor are less than the lower flammability limit (1.3%), the formation of a vapor cloud or flammable mass was considered unlikely. The gasoline truck calculation, which is the bounding analysis for a vapor cloud explosion for Units 3 & 4, is discussed in response to RAI 2.2.3-2.

The evaluations of potential hazards to Units 1 and 2 from an explosion or flammable vapor cloud formation due to accidents associated with these storage facilities are bounding for Units 3 and 4 and therefore they are applied to all units.

2.2.3-15 Please identify and evaluate potential hazards, if any, associated with the existing Vogtle Units 1 and 2 (excluding severe accidents) that may affect the proposed Units 3 and 4 to be located at the ESP site.

Response:

From SSAR Table 2.2-5, "VEGP Units 1 & 2 Onsite Chemical Storage," the majority of the chemicals currently stored at VEGP are stored on the east side of Unit 1 (the most distant location with respect to proposed Units 3 and 4), or are stored within buildings. There are only two large storage tanks located on the west side of Unit 2. These are the two 80,000 gallon diesel storage tanks. These tanks are adjacent to Unit 2 and are greater than 1,000-2,000 ft from the proposed ESP units to the west. As stated in response to RAI 2.2.3-14 above, the envelope of potential hazards from an explosion or flammable vapor cloud formation due to accidents for Units 1 and 2 applies to proposed Units 3 and 4.

Other accidents, such as Design Basis Accidents, with radiological consequences, have been addressed in Section 2.2.3.4. In case of an event with potential radiological consequences, site communication systems would be used to notify all site personnel including those associated with proposed Units 3 and 4. In addition, the Control Room ventilation system for the AP1000 is designed with smoke and radiation detectors which will cause automatic isolation of the Control Room ventilation system in the event of fire or accident at Units 1 or 2. These automatic features provide further assurance that an event at Unit 1 or 2 will not affect the safe operation or the ability to shutdown proposed Unit 3 or 4.

2.2.3-16 SSAR Section 2.2.3.2.3 states that the potential hazard due to ammonia and hydrazine from onsite storage tanks will be addressed at the COL stage. Responses 16 and 17 in letter AR-06-2720 discuss analyses for the potential hazard due to onsite storage of hydrazine, methoxypropylamine, and phosphoric acid. Please explain why ammonia was not similarly analyzed in these responses, and clarify whether the potential hazard from onsite storage of ammonia will be addressed at the COL stage.

Response:

Ammonia was not addressed in letter AR-06-2720 16 and 17 responses because the questions did not address ammonia.

In the original on site hazard analysis, ammonia and hydrazine releases were evaluated as potentially exceeding the control room long term toxicity limit. However, Unit 1 and 2 no longer store large volumes of ammonia onsite. Therefore, it will no longer need to be addressed in the COL stage. Section 2.2.3.2.3 has been revised accordingly to remove the commitment to perform this analysis (see Enclosure 3).

Section 3.5.1.6 Aircraft Hazards

3.5.1.6-1 Please provide the assumptions and methodology used in determining the effective areas and assumed fractions for the general aviation, air taxi and commercial, air carrier, and military aircrafts addressed in SSAR Section 3.5.1.6.2 (page 3.5-3), which were used to calculate the weighted effective plant area.

Response:

The effective area depends on length, width, and height of the facility, as well as on the aircraft's wingspan, angle of impact and the length of its skid. Governing equations for effective area are given in **DOE 1996**. They are as follows:

$A_{eff} = A_f + A_s$
$A_f = (WS + R)H\cot\Phi + (2L \times W \times WS) / R + L \times W$
$A_s = (WS + R) \times S$

A_f = effective fly-in area; A_s = effective skid area
WS = aircraft wingspan; R = length of the diagonal of the facility = $(L^2 + W^2)^{0.5}$
H = facility height; $\cot\Phi$ = mean of the cotangent of the aircraft impact angle
L = length of facility; W = width of facility
S = aircraft skid distance (mean value)

Wingspan, impact angle and skid distances for the different types of aviation are given in **DOE 1996**. Facility height, length, width and diagonal were derived from AP1000 design drawings provided in **Westinghouse 2001**. The fractions for aviation types were assumed to be the same as the closest airport (Bush Field). Forecasted annual aircraft operations were obtained from **APO 2006** and simple mathematics was used to determine the fractions of flights for general aviation, air taxi & commuter, air carrier and military operations.

The fractions (f) of aircraft type were calculated by dividing the number of each type of aircraft by the total number of aircraft for the year 2025 from Table 3.5-1 in the SSAR. The effective area (A_{eff}) for each type of aircraft was calculated using the above equation. The table on the next page summarizes the calculation of the effective area for each type of aircraft. The average weighted area for the site was then calculated by multiplying each aircraft's effective area by its fraction, and then summing each of these calculated numbers, as shown in the following table:

Aircraft Type	Fraction	Effective Area for Each Type of Aircraft, sq. mi.	Weighted Average Effective Area
General Aviation	0.529	0.025	0.0132
Air Taxi & commuter	0.293	0.061	0.0179
Air Carrier	0.128	0.073	0.0093
Military	0.05	0.086	0.0043
TOTAL for Site	1.00		0.0447 (0.045 was used in the calculation)

AP1000	Bldg W (ft)	Bldg L (ft)	Bldg Diagonal, R (ft)	Bldg. H (ft)	Wing Span (ft)	Skid Dist. (ft)	CotΦ	Eff. Fly-In Area, A_f (ft^2)	Eff. Skid Area, A_s (ft^2)	Total Eff. Area (ft^2)	Total Eff. Area (mi^2)	Aircraft Operation for 2025
Gen. Aviation Reactor Bldg	130	130	183.85	203.5	50	60	8.2	416314	14031	430345		
Aux Bldg A	66	90	111.61	80	50	60	8.2	117276	9696	126972		
Aux Bldg B	44	116	124.06	80	50	60	8.2	123404	10444	133848		
									Total	691165	0.025	19023
Air Carrier Reactor Bldg	130	130	183.85	203.5	98	1440	10.2	619948	405861	1025809		
Aux Bldg A	66	90	111.61	80	98	1440	10.2	187411	301833	489244		
Aux Bldg B	44	116	124.06	80	98	1440	10.2	194372	319773	514145		
									Total	2029198	0.073	4585
Air Taxi Reactor Bldg	130	130	183.85	203.5	59	1440	10.2	531826	349701	881527		
Aux Bldg A	66	90	111.61	80	59	1440	10.2	151435	245673	397108		
Aux Bldg B	44	116	124.06	80	59	1440	10.2	159339	263613	422952		
									Total	1701587	0.061	10538
Military Reactor Bldg	130	130	183.85	203.5	223	780	10.4	918951	317341	1236292		
Aux Bldg A	66	90	111.61	80	223	780	10.4	308070	260993	569063		
Aux Bldg B	44	116	124.06	80	223	780	10.4	312210	270710	582920		
									Total	2388275	0.086	1799

3.5.1.6 Response References:

(APO 2006) *APO Terminal Area Forecast Summary Report*, Federal Aviation Administration, http://www.apo.data.faa.gov/wtaf/, issued February 2006, accessed 5/2/2006.

(DOE 1996) *Accident Analysis for Aircraft Crash into Hazardous Facilities*, DOE Standard, DOE-STD-3014-96, US Department of Transportation, October 1996.

(Westinghouse 2001) *Nuclear Island General Arrangement, AP1000 Advanced Passive Light Water Reactor*, Rev. 0, Section B-B, DCD Number APP 1000 P2 902, Westinghouse Electric Company, 08/06/2001.

Chapter 11 Radioactive Waste Management

11-1 Section 5.4 of the ER presents an assessment of radiation exposures and doses due to liquid and gaseous effluents based on models, assumptions, and site-specific data described in two key documents. They are:

- **Southern Nuclear Operating Company, Offsite Dose Calculation Manual for Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Ver. 22, June 25, 2004 (ODCM).**
- **Southern Nuclear Operating Company, Vogtle Electric Generating Plant - Units 1 and 2, Annual Radioactive Effluent Release Report for January 1, 2003 to December 31, 2003.**

A review of ER Section 5.4 and cited references indicates that Section 5.4 does not provide information used to model exposure pathways, and does not include a list of all input parameters used to derive dose estimates to members of the public. In its evaluation, NRC Staff will be using the GASPAR II and LADTAP II computer codes, and will not rely on the ODCM method described in the application for the purpose of assessing doses to members of the public from liquid and gaseous effluents.

Accordingly, update ER Section 5.4 to include descriptions of all required model assumptions and include input parameters necessary to run the GASPAR II and LADTAP II computer codes. Without this information, the staff cannot perform an independent evaluation and conclude, with reasonable assurance, that the application demonstrates compliance with 10 CFR Part 50, Appendix I dose objectives.

Response:

ER Section 5.4 has been revised to use the GASPAR and LADTAP II computer codes with site-specific parameters. The data input and output files used for these analyses are provided on compact disc (CD) in Enclosure 6 to this letter. Current ER Section 5.4 is no longer valid. A revised Section 5.4 is included as Enclosure 4 to this letter, and will be part of Revision 2 of the ESP application.

11-2 A review of ER Section 5.4 indicates that the dose assessment excludes potential exposure pathways (for liquid and gaseous effluents), with no basis provided for their omissions. In particular, ER Tables 5.4-2 and 5.4-4 exclude boating, shoreline activity, crop and pasture irrigation, livestock watering, and goat milk production. Given that the assessment relies on information presented in the 2004 ODCM and 1988 results of the land-use census (see Ref. 14 in the ODCM, p. ix), confirm that the results of the most current land-use census will be used in determining whether all potential exposure pathways have been considered in assessing doses to members of the public.

Similarly, a review of the Vogtle Electric Generating Plant Annual Radiological Environmental Operating Report for 2005 indicates that for gaseous effluent releases, there are several other nearby residences that are closer to the plant than the one considered in the ER analysis (as described in Section 5.4, Table 5.4-5). For example, ER Section 5.4 assumes that the maximally exposed individual is located 4.7 miles away in the SSW sector. However, a review of the land-use census results presented in the 2005 operating report (Table 4.1-1, p.4-5) indicates that there are residences that are located in closer proximity to the plant, ranging from 1.2 to 4.6 miles. ER Section 5.4 does not acknowledge this fact and does not provide justification for excluding residences that are closer to the proposed plant site.

Accordingly, update ER Section 5.4 to identify and justify the selection of the most appropriate location of the nearest residence and maximally exposed individual, include all applicable exposure pathways using the results of the most current land-use census, and provide the rationale for excluding specific ones. Identify and provide full citations for all applicable references forming the basis of all updated assumptions. Without this information, the staff cannot perform an independent evaluation and conclude, with reasonable assurance, that the application demonstrates compliance with 10 CFR Part 50, Appendix I dose objectives.

Response:

As discussed in the response to RAI 11-1, ER Section 5.4 has been revised to use the GASPAR and LADTAP II computer codes with site-specific parameters (see Enclosure 4).

The distance to the nearest residence (1,071 m) identified in the VEGP Annual Radiological Environmental Operating Report was conservatively used in all directional sectors for all types of sensitive receptors (meat animal, vegetable garden, and residence). X/Qs and D/Qs at the Unit 4 reactor area due to routine releases from the Unit 3 reactor were also assessed in order to estimate dispersion and deposition at the Unit 4 area when Unit 3 is operating and Unit 4 is still under construction.

11-3 Pursuant to 10 CFR Part 52.18, applications are reviewed against the applicable standards of 10 CFR Part 50 and its appendices and 10 CFR Part 100. A review of SSAR Part 1, Chapter 2, (Section 2.1) and SSAR Part 2, Chapter 1 (Section 1.8) indicates that there is no information in the SSAR demonstrating compliance with the following:

a. 10 CFR Part 52.17(a)(1) as it relates to a characterization of liquid radiological effluents associated with normal plant operations and demonstration of compliance with Section II.A of Appendix I to Part 10 CFR Part 50 as part of the description and assessment of the site on which the facility is to be located.

b. 10 CFR Part 100.21(c)(1) as it relates to a characterization of gaseous radiological effluents associated with normal plant operations and demonstration of compliance with Sections II.B and II.C of Appendix I to Part 10 CFR Part 50 for any individual located offsite.

Accordingly, update the appropriate section(s) of the SSAR to include the information specified by the above NRC regulations. Without this information, the staff cannot complete its evaluation and conclude, with reasonable assurance, that the application demonstrates compliance the applicable requirements of 10 CFR Part 52 and 10 CFR Part 100.

Response:

Revision 2 of the ESP Application will include new SSAR Sections 11.2 .3 and 11.3.3 to address liquid and gaseous effluent releases respectively. These sections will be consistent in content and analysis methodology with proposed revision to ER Section 5.4 (see Enclosure 4). Section 11.2.3 will demonstrate compliance with 10 CFR 50, Appendix I, Section II.A, as it pertains to total body and organ doses from liquid effluents. Section 11.3.3 will demonstrate compliance with 10 CFR 50, Appendix I, Sections II.B and IIC, regarding exposure to gamma and beta radiation and total body, skin, and organ doses from gaseous effluents.

11-4 A review of ER Sections 3.5 and 5.4 indicates the radiological effluent source term is based on the AP1000 Design Control Document (Rev. 15, November 2005). A comparison between radionuclides and associated liquid and gaseous effluent source terms was made between the data presented in ER Section 3.5 and in the AP1000 DCD (Table 11.2-7). The review indicates that for one nuclide, a different isotope (Na-24 vs Na-22) was used in ER Table 3.5-1 for liquid effluents. NRC staff recommends that the data presented in ER Tables 3.5-1 be reviewed against that of the AP1000 DCD and be updated accordingly.

Response:

All data in ER Table 3.5-1 has been reviewed against the AP-1000 DCD. ER Table 3.5-1 has been revised to correct a typographical error: the table now lists “Na-24” instead of “Na-22” to match the AP-1000 DCD Table 11.2-7. This correction will be updated in the next revision to the ESP Application.

11-5 The staff's review of ER Section 5.4 and supporting sections of the ER and SSAR identified a number of internal inconsistencies in referencing information and parameters used in calculating doses to members of the public. NRC staff requests that the following items be reviewed and corrected or clarified, as needed. They are:

a. The basis for the dilution factor applied to liquid effluents - A review of ER Section 5.4.1.1 and Table 5.4-1 indicates that the stated dilution factor is not qualified as to the location of the receptor. In addition, Table 5.4-1 characterizes the effluent discharge rate of 1.3 gpm being diluted in a cooling tower blowdown flow rate of 6,000 gallons per minute (gpm) (assumed to be for one plant), as compared to ER Table 3.0-1 which lists a dilution flow rate of 4,650 gpm (one plant). Also, ER Table 3.1-1 cites a dilution flow rate of 9,300 gpm and a discharge rate of 3 gpm, but ER Figure 3.3-1 gives a dilution flow rate of 9,605 gpm and a discharge rate of 3 gpm, taken to be from two plants.

Response:

ER Section 5.4.1.1 and Table 5.4-1 have been revise to reflect a liquid effluent analysis dose developed using the NRC endorsed LADTAP II computer program (NRC, 1986). Table 5.4-1 no longer contains a discharge rate of 1.3 gpm and a cooling tower blowdown rate of 6,000 gpm. This methodology was revised as a result of NRC review of the ER and efforts to develop a consistent SSAR Chapter 11 analysis.

There is no ER Table 3.1-1; however, SNC assumes the question refers to Table 3.3-1 "Plant Water Use." Table 3.3-1 is used to describe plant water use and contributing system flows as illustrated in Figure 3.3-1 "Water Use Diagram Summary." The 9,300 gpm number cited in Table 3.3-1 is the CWS Cooling Tower blowdown rate is not the only effluent stream that contributes to the blowdown discharge sump flow of 9,605 gpm. The 3 gpm liquid rad-waste flow rate was a rounded 2 Unit rate and is included in the 9,608 gpm total discharge value down stream of the discharge sump flow as illustrated in Figure 3.3-1. Section 3.3 flow rates are averaged normal plant flow rates and were used to evaluate consumptive water use, not illustrate dilution flow rates for rad-waste. These site specific flow rates were developed by Bechtel as a result of conceptual cooling tower design and integrated with the AP1000 DCD values. The 1.3 gpm liquid rad-waste effluent and 6,000 gpm numbers previously used in the ER Section 5.4.1 evaluation were obtained from the AP1000 DCD Chapter 11.

b. Basis for atmospheric dispersion data - A review indicates that the bases of the atmospheric dispersion factors between SSAR Section 2.3.5 and ER Section 2.7.6 are different than those cited in ER Section 5.4. ER Section 5.4.1.2 and ER Tables 5.4-3 and 5.4-5 are based on ODCM data for the existing plants, while SSAR Section 2.3.5 presents atmospheric dispersion data derived from the XOQDOQ computer code.

Response:

Section 5.4 has been revised to use the GASPAR and LADTAP II computer codes with site-specific parameters. As part of this new modeling effort, all parameters and assumptions in ER Section 5.4 are consistent with SSAR Section 2.3.5, including atmospheric dispersion data, and designations of wind sectors and distances for offsite receptors. The GASPAR and LADTAP II input and output data files are provided on CD in Enclosure 6 to this letter.

c. Designations of wind sectors and distances for the maximally exposed individual and nearest site boundary - A review of ER Section 5.4.1.2 and ER Tables 5.4-3 and 5.4-5 indicates that designations of wind sectors and distances for the maximally exposed individual and nearest site boundary for gaseous effluents differ from those set forth in ER Section 2.7.6 and SSAR Section 2.3.5. ER Tables 5.4-3 and 5.4-5 are based on ODCM data for existing plants, while SSAR Section 2.3.5 presents atmospheric dispersion data derived anew for the application.

Response:

ER Section 5.4 has been revised (see Enclosure 4 to this letter) to use the GASPAR and LADTAP II computer codes with site-specific parameters. As part of this new modeling effort, all parameters and assumptions in ER Section 5.4 are consistent with SSAR Section 2.3.5, including atmospheric dispersion data, and designations of wind sectors and distances for offsite receptors.

d. The basis for total population within the 50-mile radius - A review of ER Section 5.4.3 and Table 5.4-10 reveals an inconsistency in the size of the total population within the 50-mile radius used in assessing collective doses between ER Section 2.5.1 (Table 2.5.1-1) and ER Section 5.4. ER Section 2.5.1 cites a population of 674,102 and ER Table 5.4-10 states 667,092, while referencing ER Table 2.5.1-1 as the basis of this value. Also, note that ER Section 2.9, Table 2.9-1 gives a value of 670,000 for the total population.

Response:

The total population for year 2000 in ER Table 2.5.1-1 will be revised to correct an error. The corrected total is 674,101. This correction will be reflected in the next revision to the ESP application. ER Table 5.4-10 has been revised to list a 50-mile radius population of 674,101 to be consistent with ER Table 2.5.1-1. ER Revision 1 Table 5.4-10 (now Table 5.4-9 in the proposed ER revision to Section 5.4 [see Enclosure 4 to this letter]) referenced an earlier population analysis that was subsequently revised without updating the footnote in Table 5.4-10.

The value for the 50-mile populations (rounded to two significant digits) in ER Table 2.9-1 is also in error and will be corrected in the next revision to the ESP application to be consistent with ER Table 2.5.1-1 and (Revision 1) ER Table 5.4-10.

e. The operational radiological monitoring program of onsite groundwater wells - SSAR Section 2.4.12 states that onsite groundwater wells will be used as a source of potable water as well as supplying plant systems. In light of the information presented in ER Sections 2.3.3, 6.2.3, and 6.3.3, and SSAR Section 2.4.12, describe how groundwater from onsite wells will be monitored for the presence of radioactivity generated by plant operations. Note that ER Section 6.2, Table 6.2-1 refers to "surface water" and "drinking water," but does not identify water from onsite groundwater wells. Finally, a review of the 2004 ODCM (Rev. 22) indicates that the current REMP only considers the analysis of river water samples collected downstream from the plant.

Accordingly, revise the relevant ER and SSAR Sections in light of the above observations, and provide the information, references, rationale, etc., in support of any proposed revisions. Without this information, the staff cannot perform an independent evaluation and conclude, with reasonable assurance, that the application demonstrates compliance with (a) 10 CFR Part 50, Appendix I dose objectives, (b) compliance with the EPA drinking water standards of 40 CFR Part 141 for man-made radionuclides.

Response:

10 CFR Part 50 Appendix I addresses normal and expected effluents due to plant operations. There are no effluent discharges from normal operations to the groundwater. Liquid effluent discharges are made to the Savannah River through the discharge structure. Analysis of accidental discharge of contaminated liquid to the groundwater is analyzed in section 2.4.13. SSAR Section 2.4.13 evaluates contamination resulting from a severe accident to the unconfined water table aquifer and the flow of groundwater to Mallard Pond and eventually to the Savannah River.

Groundwater use at Plant Vogtle involves two aquifers. The unconfined or water table aquifer is utilized only for irrigation and non-potable purposes. Drinking water for the Vogtle site is obtained from the confined Cretaceous and tertiary aquifer which is isolated from the Water Table aquifer by the Blue Bluff Marl formation which serves as an aquaclude. Spills or leaks of radioactive material at the Vogtle site would be isolated from the source of drinking water. The Vogtle drinking water wells are sampled periodically for radioactivity in accordance with EPA/state requirements. Authority to judge compliance or initiate enforcement actions to EPA drinking water standards, (40 CFR 141.25 (c)) is a state authority. Plant Vogtle drinking water wells are regulated by the State of Georgia Department of Natural Resources (GADNR). All onsite drinking water wells are considered Non-Community Systems and are regulated by GADNR.

NUREG-1301, ODCM Guidance: Standard Radiological Effluent Controls for PWRs, states "groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination." As stated previously, wells in the Water Table aquifer are used only for ornamental vegetation and grass irrigation and not for potable water. The water table aquifer does not receive recharge onsite from outcroppings or other potentially vulnerable features. There is no connectivity between the confined and Water Table aquifers on the Vogtle site and drinking water sources would not be impacted by spills into the Water Table aquifer.

11-6 The staff's review of ER Section 6.2 indicates that there is no discussion about whether the current REMP program would be augmented in light of the NEI and nuclear utility initiative in response to the NRC's Liquid Radioactive Release Lessons Learned Task Force Report on contamination of ground and surface water (ADAMS Accession No. ML062650312). Provide descriptions of how facility design and operational procedures would minimize, to the extent practicable, contamination of site facilities, surface and groundwater, and prevent uncontrolled and unmonitored releases of radioactive materials in the environment.

Accordingly, update ER Section 6.2 and provide a discussion describing how the scope of the existing radiological environmental monitoring program information might be augmented to address the recommendations of the NEI and nuclear utility initiative in light of the issues identified in the NRC's Liquid Radioactive Release Lessons Learned Task Force Report on contamination of ground and surface water.

Response:

All SNC plants will participate in the Nuclear Energy Institute (NEI) Groundwater Protection Initiative which includes developing a monitoring plan and reporting mechanism for communicating radiological releases (leaks and spills). This initiative was designed for the purpose of early leak detection. The proposed Southern Nuclear Groundwater Protection Initiative Action Plan (monitoring plan) includes monitoring for tritium, gamma isotopic and gross alpha/beta activity in the direct vicinity of the underground structures with the potential to release radiological materials (rad waste building, discharge piping, etc.). The plan for the VEGP site will focus on sampling in the Unconfined Aquifer (water table aquifer) and Confined Tertiary Aquifers. As part of the monitoring plan, samples may also be collected from the on site existing plant makeup and drinking water wells which are supplied by the Cretaceous Aquifer. In the event tritium, or any other radioisotope analyzed, is detected at levels greater than background, the extent and source of the release will be delineated. As mentioned above, the proposed monitoring plan is currently being developed, including an evaluation of the site hydrology to determine if new monitoring wells are needed to satisfy the groundwater monitoring initiative. The groundwater monitoring evaluation is expected to be completed in June 2007 and SNC intends to implement the action plan/program in December 2007.

Chapter 15 Accident Analysis

15-1 Please provide the Chapter 15 reference (Westinghouse 2006b) Westinghouse Document No. LTR-CRA-06-21, AP1000 Accident Releases and Doses as Function of Time, Westinghouse Electric Company, February 1, 2006, and explain the methodology used to determine the time-dependent activity releases for each design basis accident.

Response:

Westinghouse document LTR-CRA-06-21 is provided in Enclosure 5 to this letter. The Westinghouse *AP1000 Design Control Document* (DCD) is a reference for Chapter 15. The methodology used to determine the time-dependent activity releases for each design basis accident is provided in the AP1000 DCD, as noted in Section 15.2, *Evaluation Methodology*. In addition, Section 15.3 goes on to specify that the design basis accident source terms in the AP1000 DCD are calculated in accordance with NRC Regulatory Guide 1.183, *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*.

Southern Nuclear Operating Company

AR-07-0401

Enclosure 2

Proposed Revision to SSAR Section 2.1, Geography and Demography

NOTE: This enclosure consists of a 25-page proposed ESP application section.

2.0 Site Characteristics

Chapter 2 describes the characteristics of the Vogtle Electric Generating Plant (VEGP) site. The site location and description are provided in sufficient detail to support a safety assessment. The chapter is divided into five sections:

- Geography and demography (Section 2.1)
- Nearby industrial, transportation, and military facilities (Section 2.2)
- Meteorology (Section 2.3)
- Hydrology (Section 2.4)
- Geology and seismology (Section 2.5)

2.1 Geography and Demography

2.1.1 Site Location and Description

2.1.1.1 Site Location

The proposed Units 3 and 4 will be built on the existing VEGP site. The 3,169-acre VEGP site is located on a coastal plain bluff on the southwest side 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 (River Miles 150.0 to 151.7). The property boundary entirely encompasses the EAB and extends beyond River Road in some areas. The site is approximately 30 river miles above the US 301 bridge and directly across the river from the Department of Energy's (DOE's) Savannah River Site (SRS) (Barnwell County, South Carolina). The VEGP site is approximately 15 mi east-northeast of Waynesboro, Georgia, and 26 mi southeast of Augusta, Georgia, the nearest population center (i.e., having more than 25,000 residents). It is also about 100 mi from Savannah, Georgia, and 150 river miles from the mouth of the Savannah River.

The VEGP site is situated within three major resource areas: the Southern Piedmont, the Carolina and Georgia Sand Hills, and 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.

Burke County includes five incorporated towns: Waynesboro, Girard, Keysville, Midville, and Sardis. Of these five towns, only the town of Girard is within 10 mi of the VEGP site. According to the 2000 Census survey, Girard, which has a population of 227, is the largest community within 10 mi of the VEGP site **(USCB 2000b)**. Figure 2.1-1 shows Girard and its location with respect to the VEGP site Access to the site is by River Road via US Route 25, Georgia Routes 56, 80, 24, and 23. A railroad spur connects the site to the Norfolk Southern Savannah-to-Augusta track.

Figure 2.1-2 shows highways, railways and airports located in the 50 mi surrounding area. The nearest highway, Interstate 20 (I-20), passing through Augusta and connecting Columbia, South Carolina, with Atlanta, Georgia, is located approximately 29 mi north of the VEGP site.

2.1.1.2 Site Description

VEGP Units 3 and 4 (Westinghouse Electric Company, LLC [Westinghouse] AP1000 certified reactor design plants) will be located in the power block area shown in Figure 1-4. The centerline of the proposed VEGP Unit 3 will be located approximately 1,700 ft west and 400 ft south of the center of the existing VEGP Unit 2 containment building. The proposed VEGP Unit 4 will be approximately 800 ft west of proposed VEGP Unit 3. The coordinates of the center of the containment building for VEGP Units 3 and 4 are as follows:

Unit	Georgia East Coordinates (NAD27) 1001 – Georgia East (US ft)		UTM Coordinates (NAD83) Zone 17 – 84W to 78W (m)		Latitude/Longitude (NAD83) (Deg/Min/Sec)	
3	N	1,142,600	N	3,667,170	N	33 08 27
	E	621,800	E	428,320	E	81 46 07
4	N	1,142,600	N	3,667,170	N	33 08 27
	E	621,000	E	428,070	E	81 46 16

No commercial, industrial, institutional, recreational, or residential structures are located within the site area, with the exception of Plant Wilson, the Georgia Power Company (GPC) combustion turbine plant. The nearest point to the exclusion area boundary (EAB) is located approximately 3,400 ft southwest of the proposed VEGP Units 3 and 4 power block area.

2.1.1.3 Boundary for Establishing Effluent Release Limits

VEGP Units 3 and 4 will be located within the power block area, which is the perimeter of a 775-ft-radius circle with the centroid at a point between the two AP1000 units. The EAB as described previously, will be the same as the exclusion area boundary for the existing VEGP units. There are no residents in this exclusion area. No unrestricted areas within the site boundary are accessible to members of the public. Access within the property boundary is controlled as discussed in Section 2.1.2. Detailed discussion of effluent release points is provided in Section 2.3.5.

All areas outside the exclusion area will be unrestricted areas in the context of 10 CFR 20. Additionally, the guidelines provided in 10 CFR 50, Appendix I, for radiation exposures to meet the criterion “as low as is reasonably achievable” would be applied at the EAB.

2.1.2 Exclusion Area Authority and Control

The EAB is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River (River Miles 150.0 to 151.7) as shown in Figure 1-4.

2.1.2.1 Authority

Ownership general information required by 10 CFR 50.33 is described in Part 1, Chapter 3 of the ESP application. The co-owners own the entire plant exclusion area in fee simple including mineral rights. Pursuant to the VEGP owner's agreement, GPC, for itself and as agent for the co-owners, has delegated to Southern Nuclear Operating Company, Inc. (SNC) complete authority to regulate any and all access and activity within the entire plant exclusion area.

The perimeter of the VEGP EAB is adequately posted with "No Trespassing" signs on land and with signs along the Savannah River, and indicate the actions to be taken in the event of emergency conditions at the plant.

2.1.2.2 Control of Activities Unrelated to Plant Operation

There are only two facilities within the EAB that have authorized activities unrelated to nuclear plant operations, the visitor's center and the GPC combustion turbine plant, Plant Wilson.

The exclusion area outside the controlled area fence will be posted and will be closed to persons who have not received permission to enter the property.

The access route to the visitor's center is from River Road along the main plant access road to the road leading to the visitor's center. Access to the visitor's center is controlled by security at the pavilion (access control point) on the plant entrance road. Normally, only a few administrative personnel are located at the visitor's center. Because of the remote location of the site, the number of visitors at the center is minimal. However, approved persons visiting the center will occupy the center and the area and parking lot immediately adjacent to the center. In the event of emergency conditions at the plant, the emergency plan provides for notification of visitors to the center concerning the proper actions to be taken and evacuation instructions.

Plant Wilson is controlled and operated by VEGP staff. Access to the facility from New River Road is limited by locked gates. The emergency plan also provides for notification and evacuation of VEGP personnel at Plant Wilson.

SNC normally will not control passage or use of the Savannah River along the exclusion area boundary. "No trespassing" signs are posted near the river indicating the actions to be taken in the event of emergency conditions at the plant.

2.1.2.3 Arrangements for Traffic Control

No state or county roads, railways, or waterways traverse the VEGP exclusion area. SNC has made arrangements with the Burke County Sheriff for control of traffic nearby in the event of an emergency. Evacuation of the EAB including the Visitors Center and Plant Wilson is addressed in Section 13.3 and the Emergency Plan (Part 5 of the ESP application).

2.1.3 Population Distribution

The population distribution surrounding the VEGP site, up to a 50-mi (80 km) radius, was estimated based on the year 2000 US Census Bureau decennial census data **(NRC 2003)**. The population distribution is estimated in 10 concentric bands at 0 to 1 mi, 1 to 2 mi, 2 to 3 mi, 3 to 4 mi, 4 to 5 mi, 5 to 10 mi, 10 to 20 mi, 20 to 30 mi, 30 to 40 mi, and 40 to 50 mi from the center of the power block area (generating facilities and switchyard), shown in Figure 1-4 and 16 directional sectors, each direction consisting of 22.5 degrees. The population projections for 2010, 2020, 2030, 2040, and 2070 have been estimated by calculating an annualized growth rate using the 1980 and 2000 census data (by county) as the base **(USCB 1990a, 2000a)**.

2.1.3.1 Resident Population Within 10 Mi

Figure 2.1-1 shows the general locations of the municipalities and other features within 10 mi (16 km) of the VEGP site. According to the 2000 Census, Girard, with a population of 227, is the largest community within 10 mi of the site (USCB 2000b). The population of Girard showed an increase of 16.4 percent in the last decade from a population of 195 in 1990 to a population of 227 in 2000 **(USCB 1990b)**.

The population distribution within 10 mi of the site was computed by overlaying the 2000 Census block points data (the smallest unit of census data) on the grid shown in Figure 2.1-1 and summing the population of the census block points within each sector. SNC used SECPOP 2000, a code developed for the NRC by Sandia National Laboratories, to calculate population by emergency planning zone sectors **(NRC 2003)**. SECPOP uses 2000 block data from the US Census Bureau and overlays it into the sectors in the annuli prescribed by the user. The 1980 and 2000 population distributions for each county considered in Georgia and South Carolina were obtained from the U.S Census Bureau and used to calculate a growth rate over 20 years **(USCB 1990a, 2000a)**. Each county growth rate was annualized and used to project future populations within each sector, taking into account the percentage of each sector that each county occupied.

The population distributions and related information were collected and the results tabulated for all distances of interest in all 16 directions. All the north-northeast to east sectors in South Carolina are occupied by the SRS, which has no residents. SRS transients are accounted for in the SRS Emergency Plan and, therefore, are not included in the VEGP Emergency Plan. The SRS will remain a government-controlled facility in perpetuity. The SECPOP 2000 results show that in 2000, the combined resident and transient populations within 5 mi and 10 mi of the VEGP site were 687 and 3,560 persons, respectively. The resident and transient 10-mi population for 2000 and projections for 2010 through 2070 are shown in Figures 2.1-3 through 2.1-8, with the total population listed in the table below.

Year	2000	2010	2020	2030	2040	2070
Population 0-10 miles	3,560	3,823	4,105	4,409	4,736	5,875

2.1.3.2 Resident Population Between 10 and 50 Mi

The 50-mi (80-km) radius centered at the VEGP site includes all, or parts of, 16 counties in Georgia, and 12 counties in South Carolina (Figure 2.1-9). Augusta, Georgia, approximately 26 mi northwest of the VEGP site, had a population of 195,182 in year 2000. Estimates of the year 2000 resident population between 10 and 50 mi from the VEGP site were computed using the same methodology used to develop the 10-mi population distribution.

The population grid to 50 mi is shown in Figure 2.1-9, and the 10 - 50-mi population for 2000 and projections for 2010 through 2070 are shown in Figures 2.1-10 through Figure 2.1-15, with the total population listed in the table below.

Year	2000	2010	2020	2030	2040	2070
Population 0-50 miles	674,101	770,241	893,950	1,056,016	1,272,090	2,530,357

2.1.3.3 Transient Population

2.1.3.3.1 Transient Population Within 10 Miles

Information concerning transient population for the 10-mi radius was obtained from the VEGP Emergency Plan. The transient population includes hunters and fishermen at recreational areas along the Savannah River. Up to 200 hunters and fishermen may be located along the Savannah River on any weekend day during the hunting season **(SNC 2004)**. Although most hunters and fishermen likely reside in the area, this information is not definitive. Therefore, all hunters and fishermen were included as transient population. The construction workforce for VEGP Units 3 and 4 and the existing staff at VEGP were not included as transient population within 10 mi of the plant because they are counted as residents within the 10–50 mi radius area.

Portions of the SRS fall within 10 mi of the VEGP site. However, SRS workers are not counted as transient population in the VEGP Emergency Plan because SRS is responsible for its own evacuation plan. **(SNC 2004)**

2.1.3.3.2 Transient Population Between 10 and 50 Miles

Colleges, schools, hospitals, a military base, and the SRS are between 10 and 50 mi from the VEGP site. In addition, thousands of people visit Augusta and the surrounding area out to the 50-mi limit annually during the week of the Masters Tournament and for other annual events within a 50-mi radius. However, compared to the resident population within a 50-mi radius, the transient population is expected to be very small.

2.1.3.4 Low Population Zone

The low population zone (LPZ) for VEGP Units 3 and 4 is the same as the LPZ for the existing VEGP units and consists of the area falling within a 2-mi radius of the midpoint between the VEGP Unit 1 and Unit 2 containment buildings. The resident and transient population distribution within the LPZ is indicated in Figures 2.1-3 through 2.1-8, based on the 2000 Census and projections through 2070. The LPZ population projections are also shown in the table below.

Year	2000	2010	2020	2030	2040	2070
Population	93	100	109	116	126	157

There are no schools in the LPZ. One private school is located approximately 9 mi west of the site, Lord's House of Praise Christian School, with an enrollment of approximately 50 students. S.G.A. Elementary School is the nearest public school and is located in the town of Sardis approximately 11 mi from the VEGP site **(BCS 2006)**. As stated in the previous section, the only significant transient population within 10 mi is hunters and fishermen along the banks of the Savannah River. Approximately 50 hunters and fishermen could be considered transient population within the LPZ. River Road is the only road within the LPZ. No towns, recreational facilities, hospitals, schools, prisons, or beaches are within the LPZ **(SNC 2004)**. Design basis accidents are evaluated in Chapter 15 to demonstrate that doses at the LPZ will be within the dose limits of 10 CFR 100.21(c) and 10 CFR 50.34(a)(1)(ii). Evacuation of the LPZ is addressed in SSAR Section 13.3 and the referenced Emergency Plan (Part 5 of the ESP application).

2.1.3.5 Population Center

The nearest population center to the VEGP site with more than 25,000 residents is the City of Augusta, Georgia, with a 2000 population of 195,182 **(USCB 2000b)**. Augusta is approximately 26 miles north-northwest of the VEGP site.

2.1.3.6 Population Density

Regulatory Position C.4 of Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Plants*, Revision 2, April 1998 (RG 4.7) and NRC Review Standard RS-002, *Processing Applications for Early Site Permits*, May 3, 2004 (RS-002) provide guidance on suitable population densities. Given an ESP approval date of 2010, a conservative startup date of 2030, an assumed startup at the end of an ESP approval period of 20 years, and an operational period of 40 years, operations could extend until 2070. Figure 2.1-16 is a plot of population density to radial distance from the plant. Three VEGP site curves, one actual and two projected, were plotted to illustrate that the VEGP site vicinity population density is well below the regulatory guidance for population density. The three VEGP curves show the cumulative population in 2000 within 20 mi of the site and projected cumulative populations in 2040 and 2070. On the same figure, spanning the same radial distances, regulatory guidance population curves are plotted for hypothetical densities of 500 persons per square mile and 1,000 persons per square mile. Based on these projections, population densities, averaged over any radial distance out to 20 mi, are expected to be less than 500 persons per square mile over the lifetime of the new units.

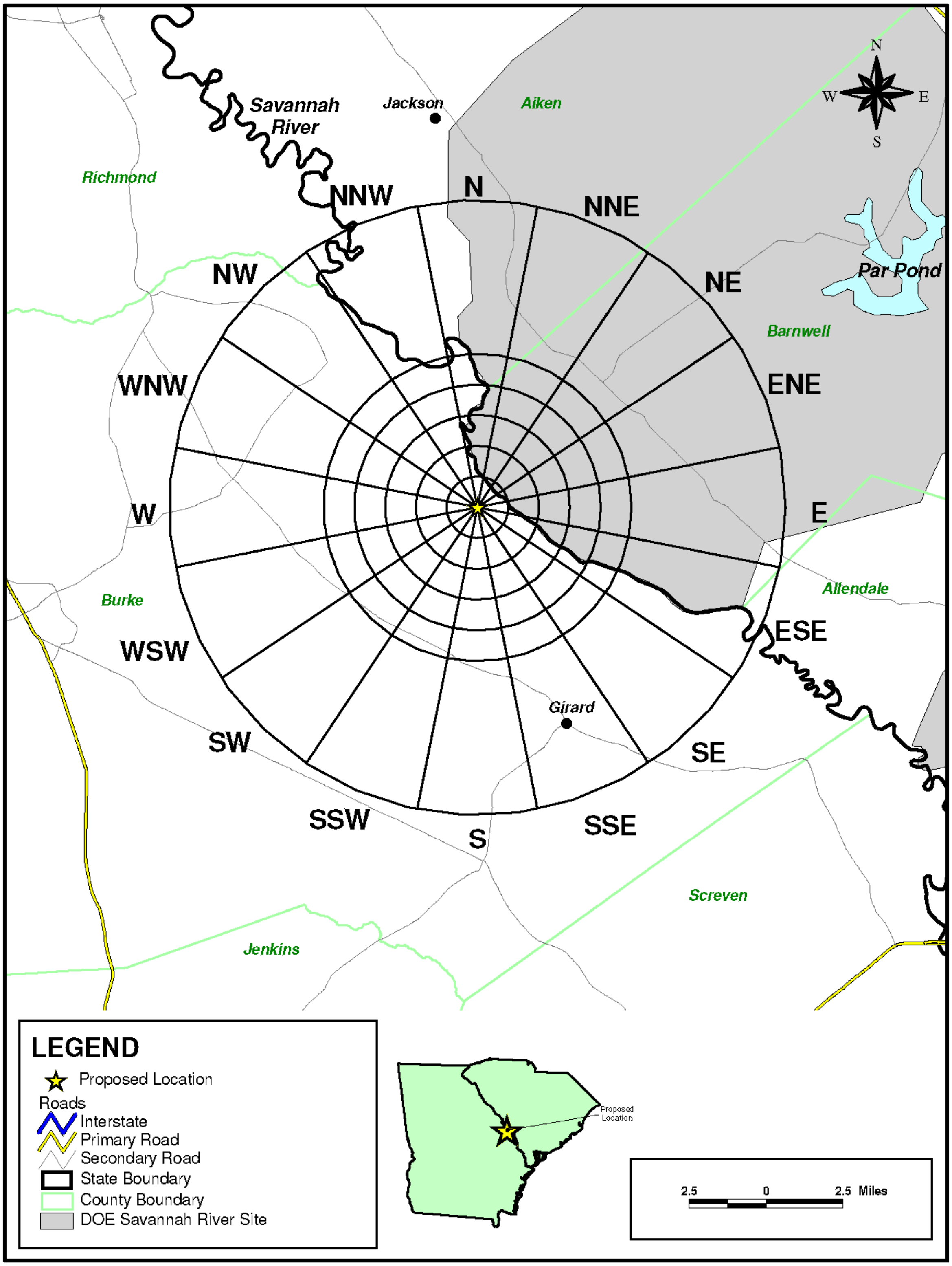


Figure 2.1-1 10-Mile Surrounding Area

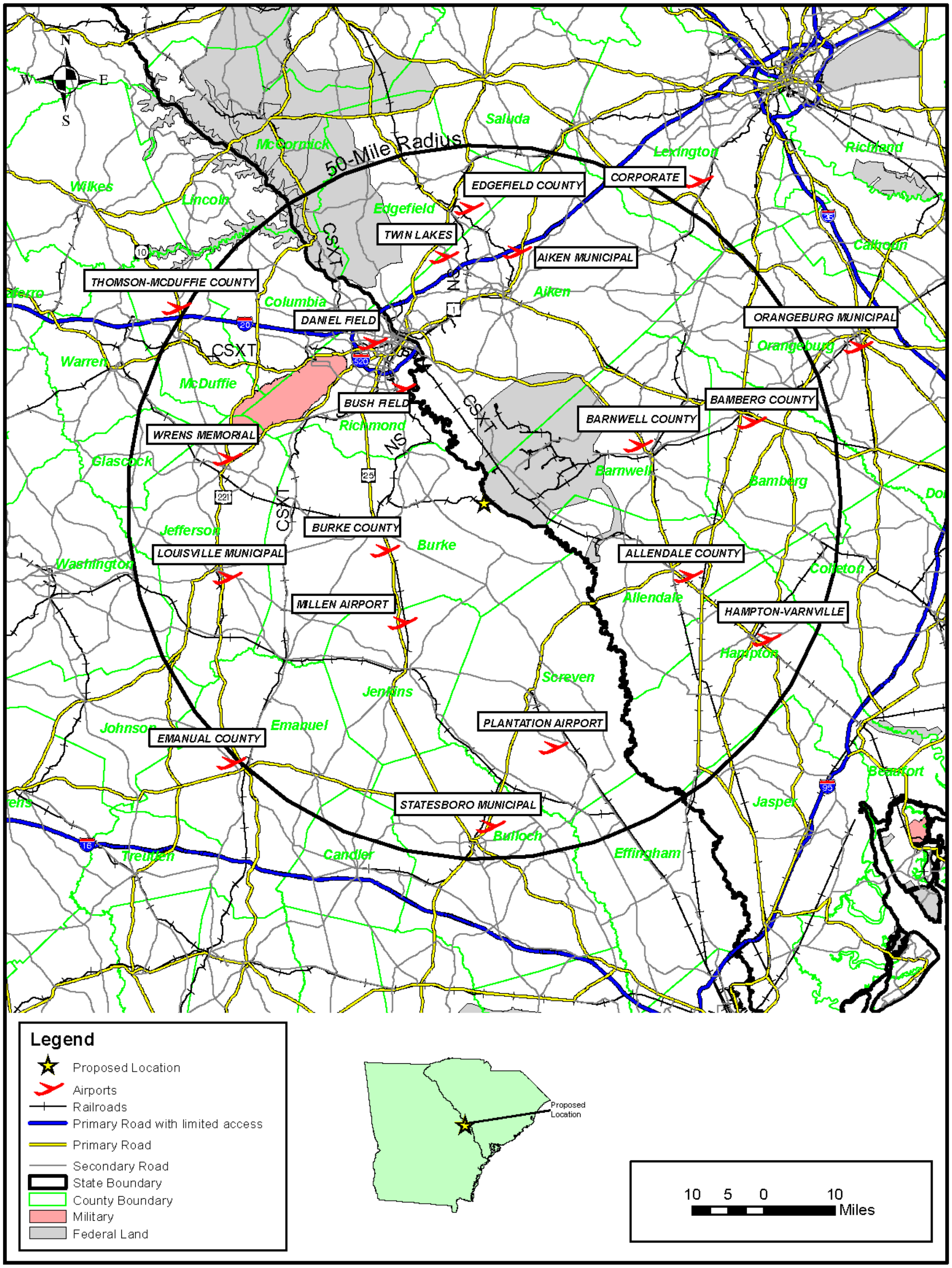


Figure 2.1-2 50-Mile Surrounding Area

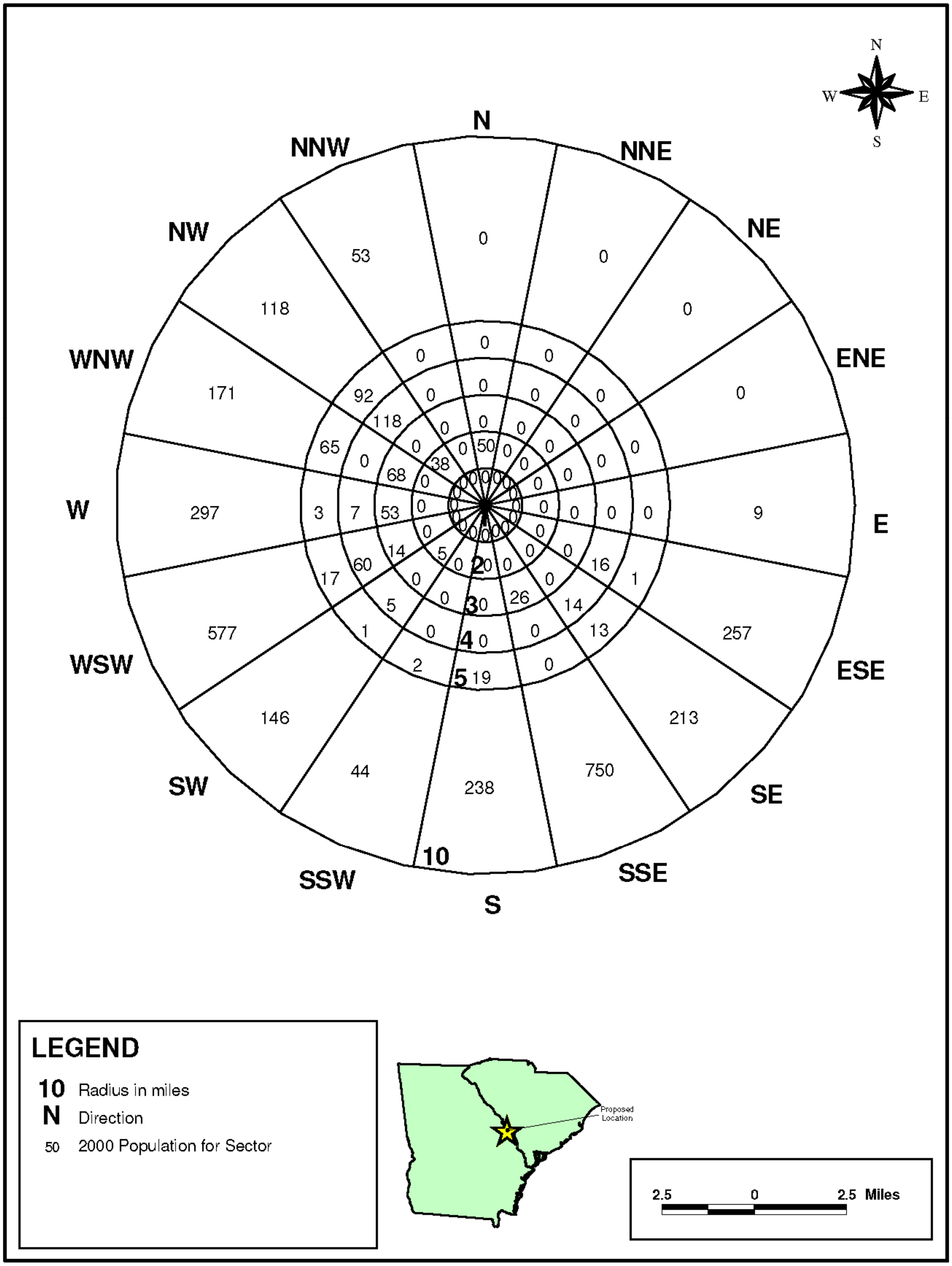


Figure 2.1-3 10-Mile Resident and Transient Population Distribution – 2000

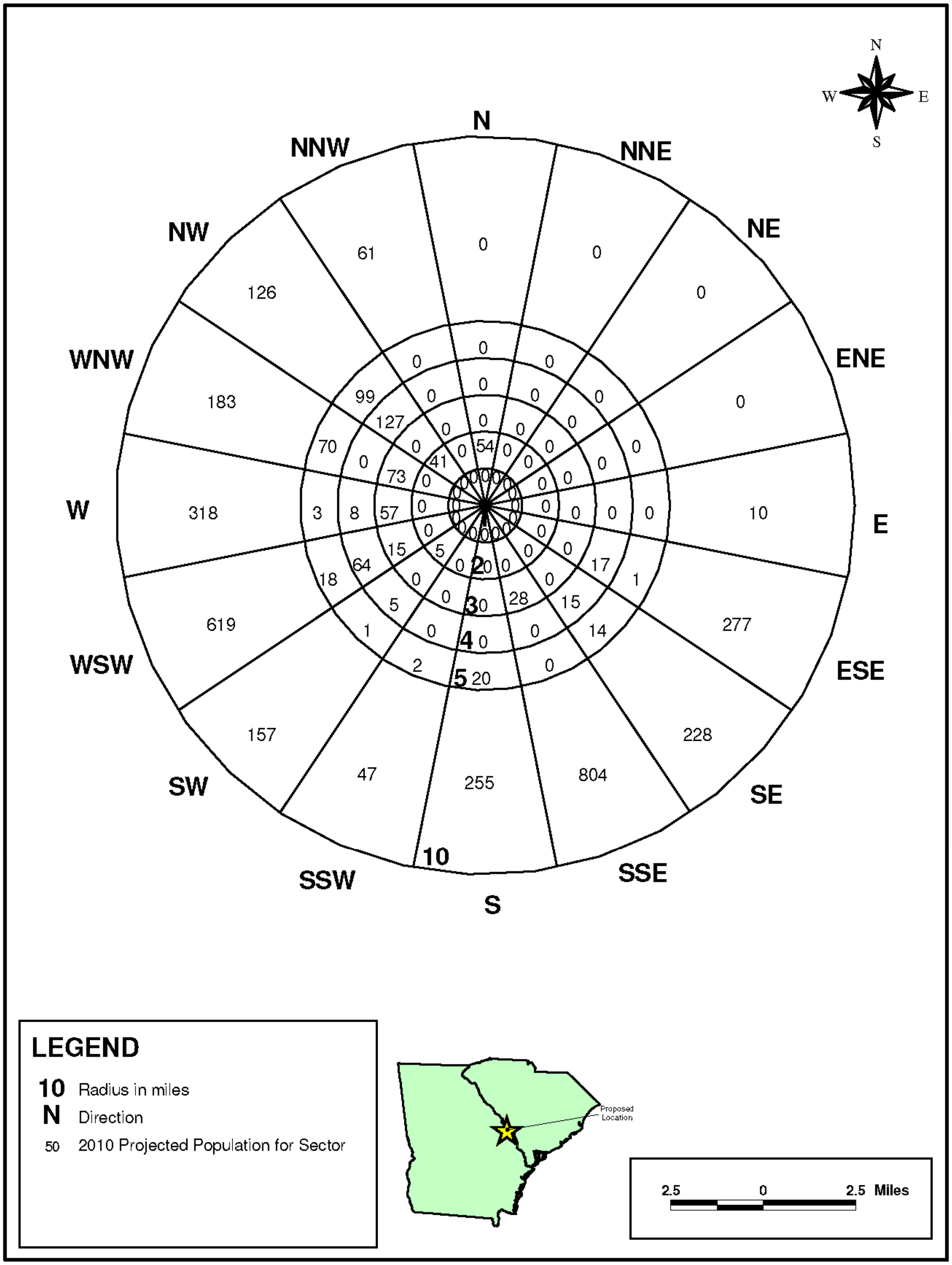


Figure 2.1-4 10-Mile Resident and Transient Population Distribution – 2010

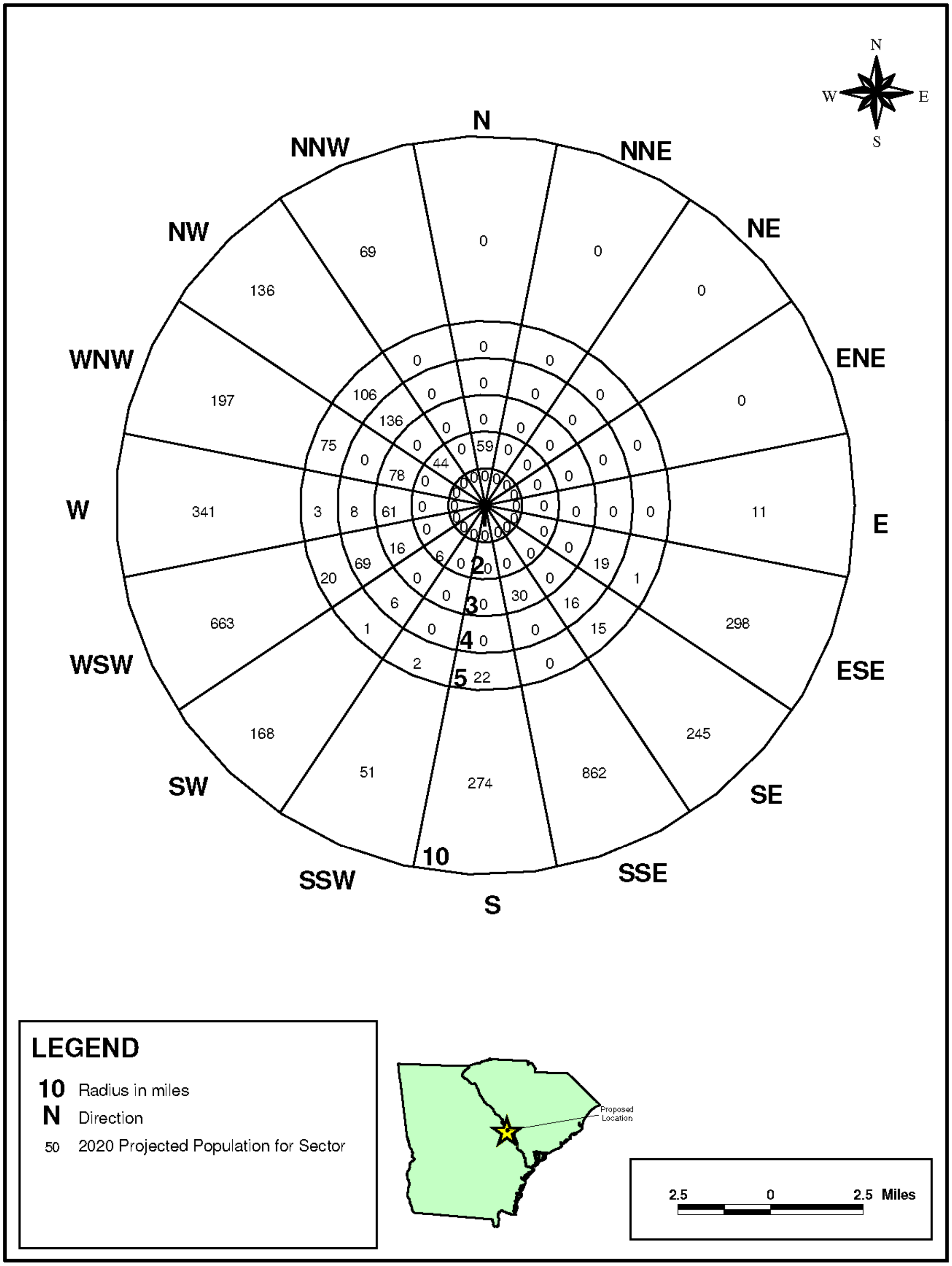


Figure 2.1-5 10-Mile Resident and Transient Population Distribution – 2020

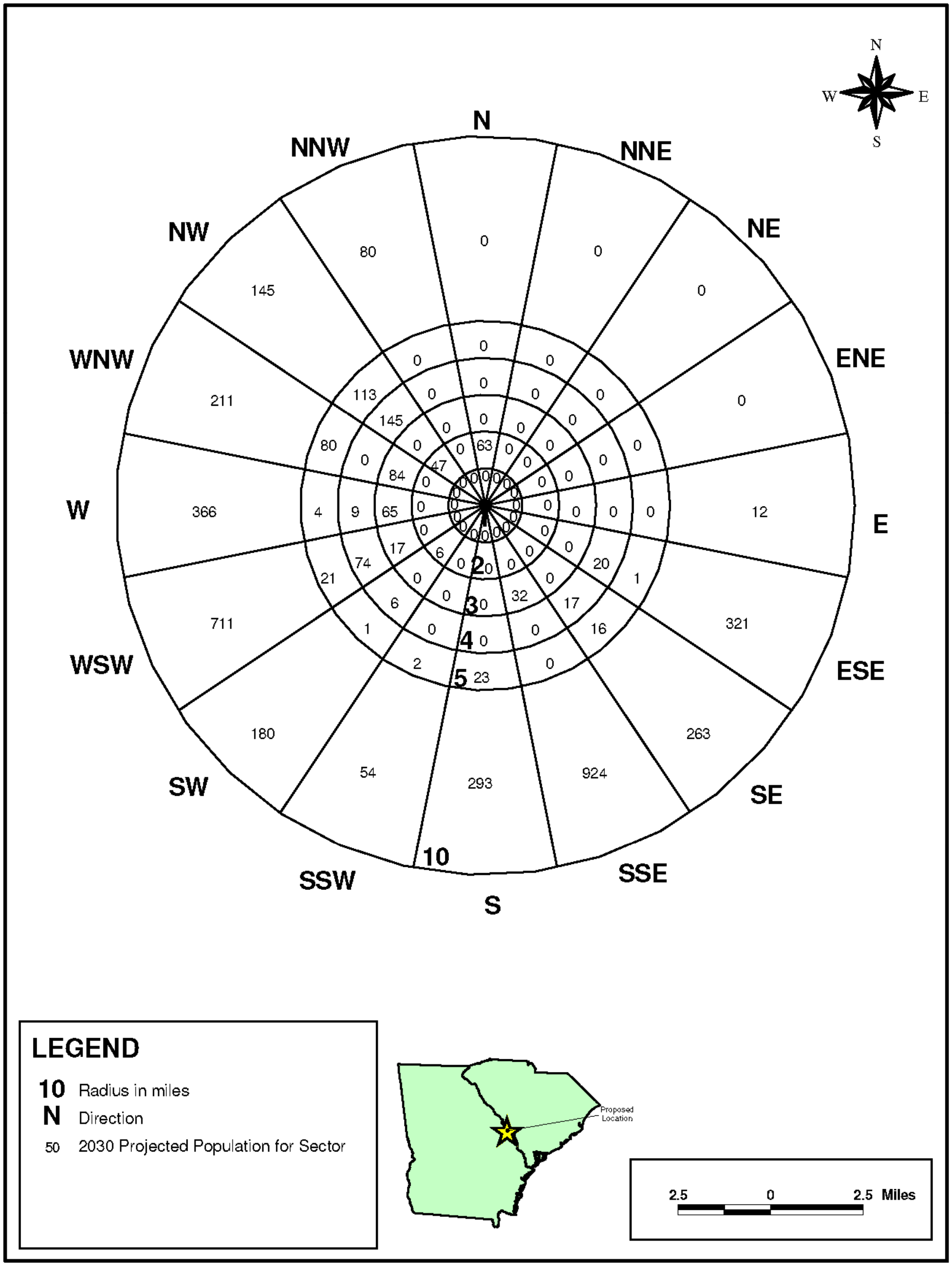


Figure 2.1-6 10-Mile Resident and Transient Population Distribution – 2030

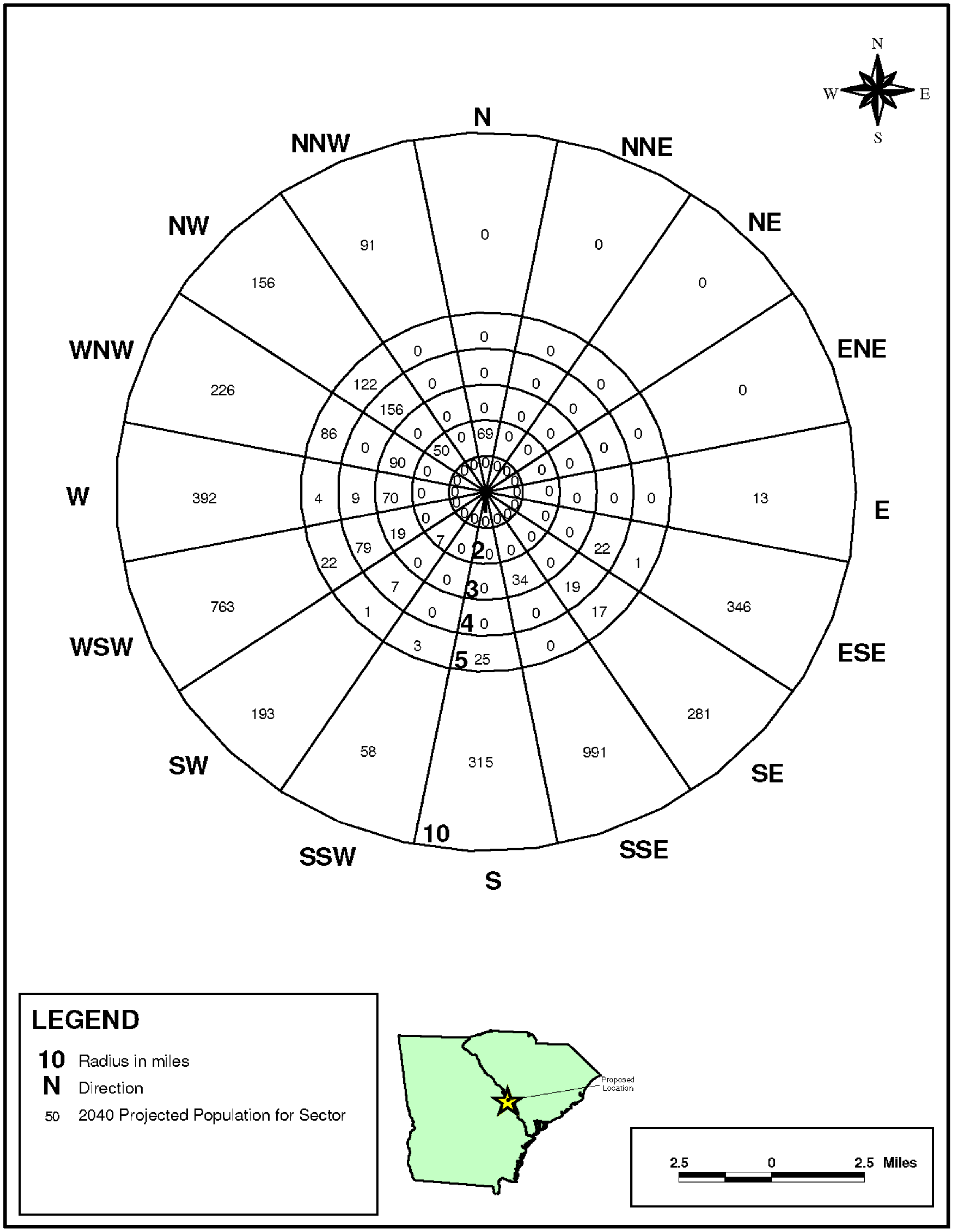


Figure 2.1-7 10-Mile Resident and Transient Population Distribution – 2040

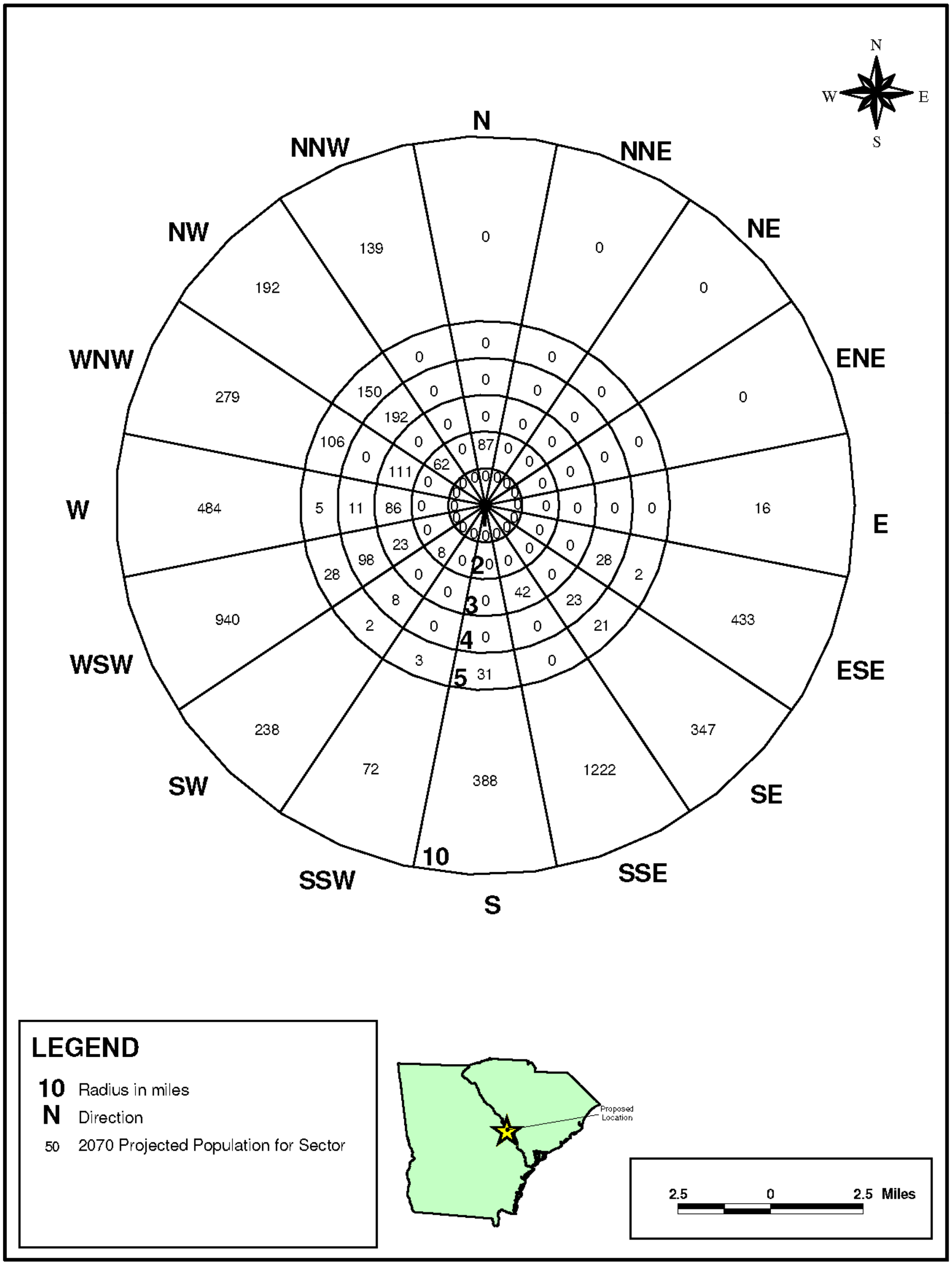


Figure 2.1-8 10-Mile Resident and Transient Population Distribution – 2070

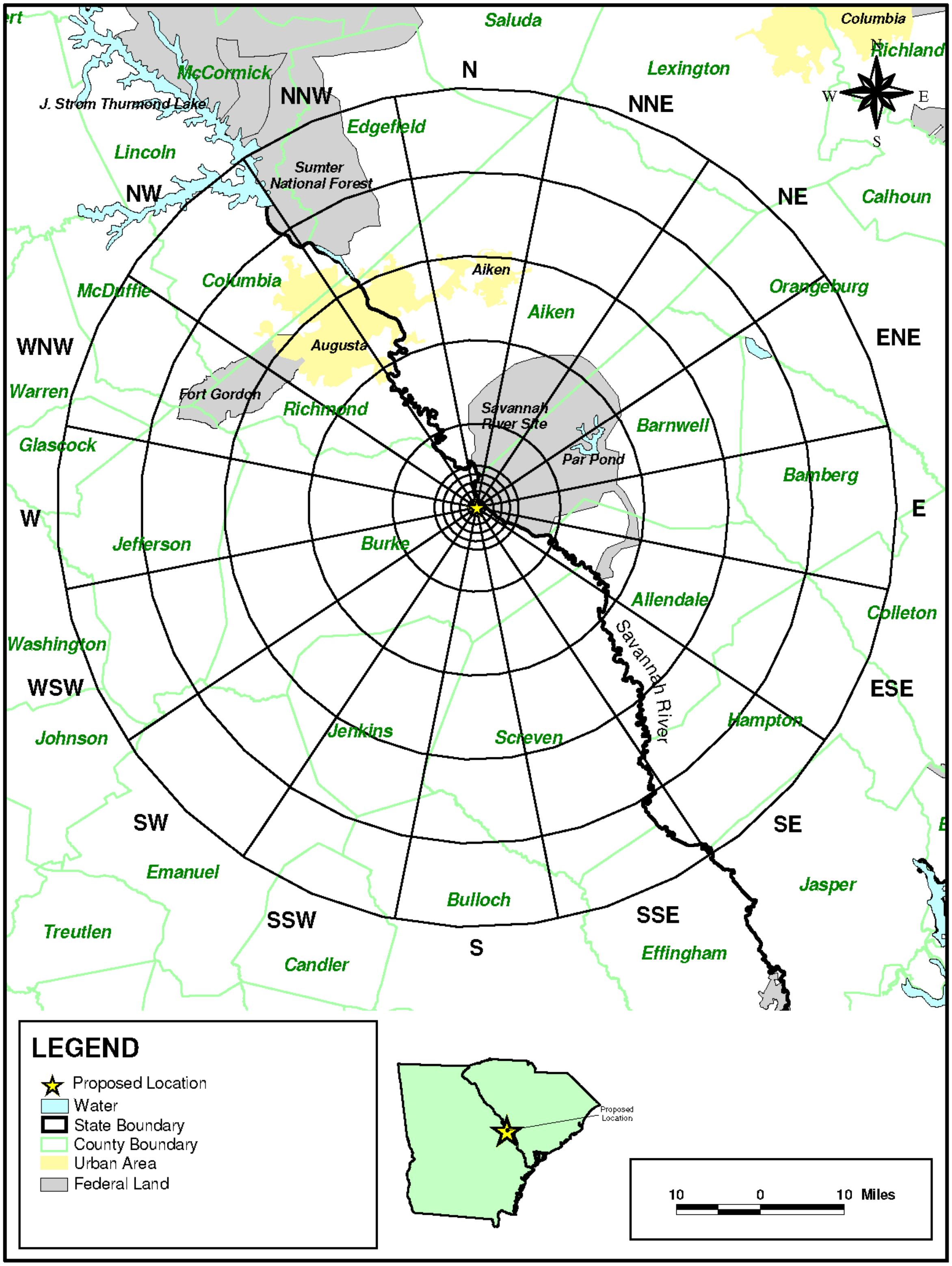


Figure 2.1-9 Population Grid Out to 50 Miles

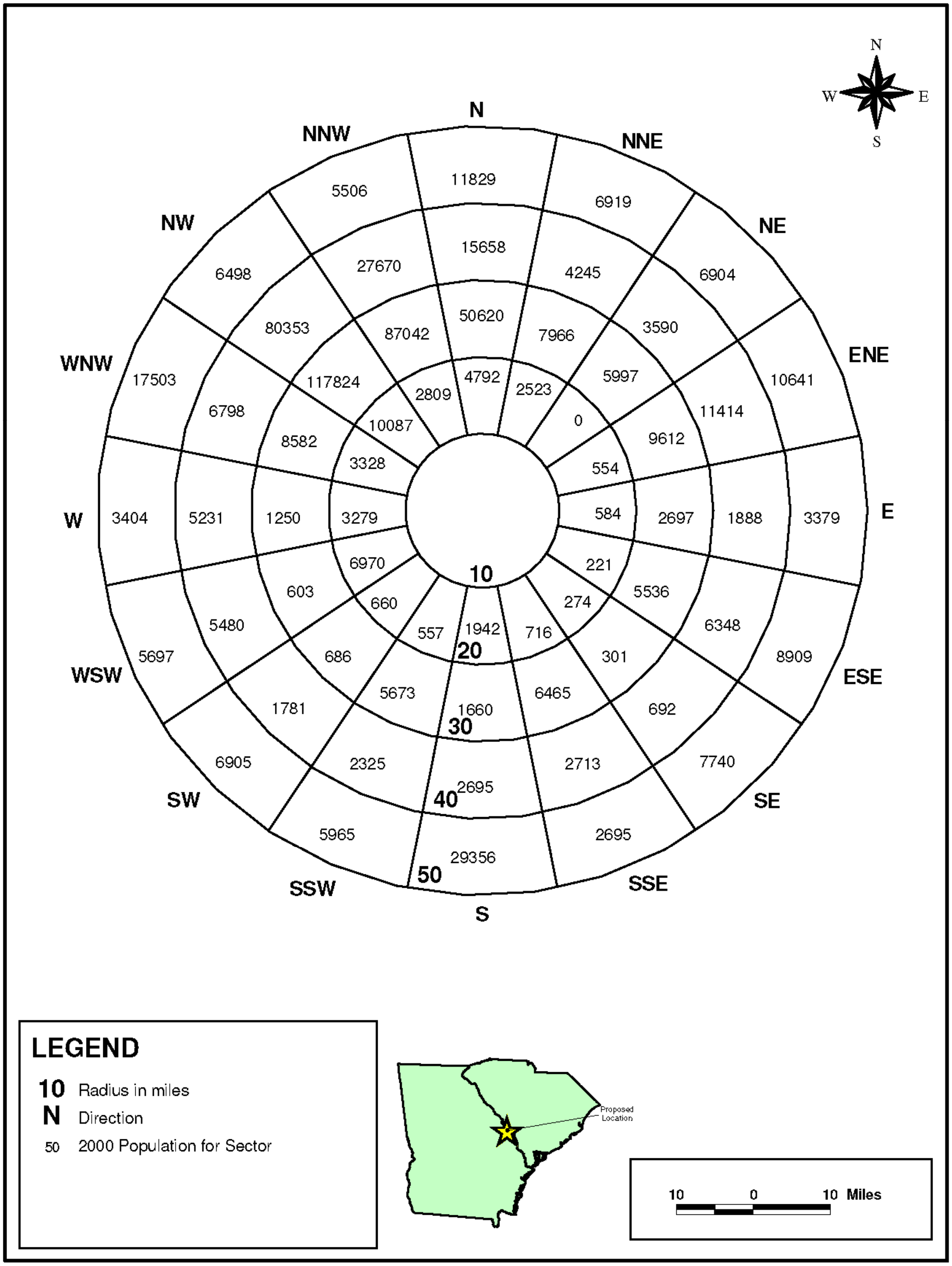


Figure 2.1-10 10 to 50-Mile Resident Population Distribution 2000

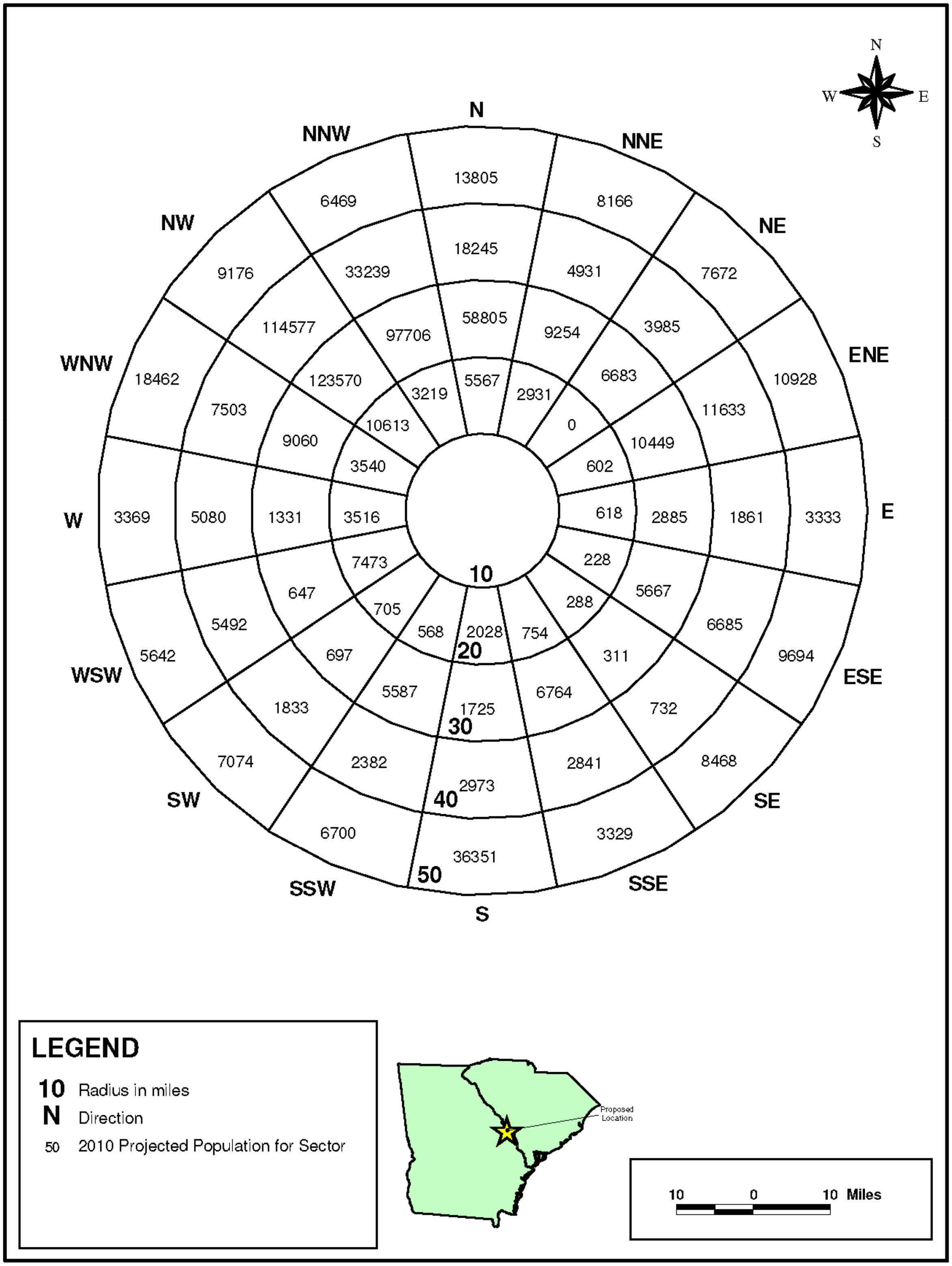


Figure 2.1-11 10 to 50-Mile Resident Population Distribution 2010

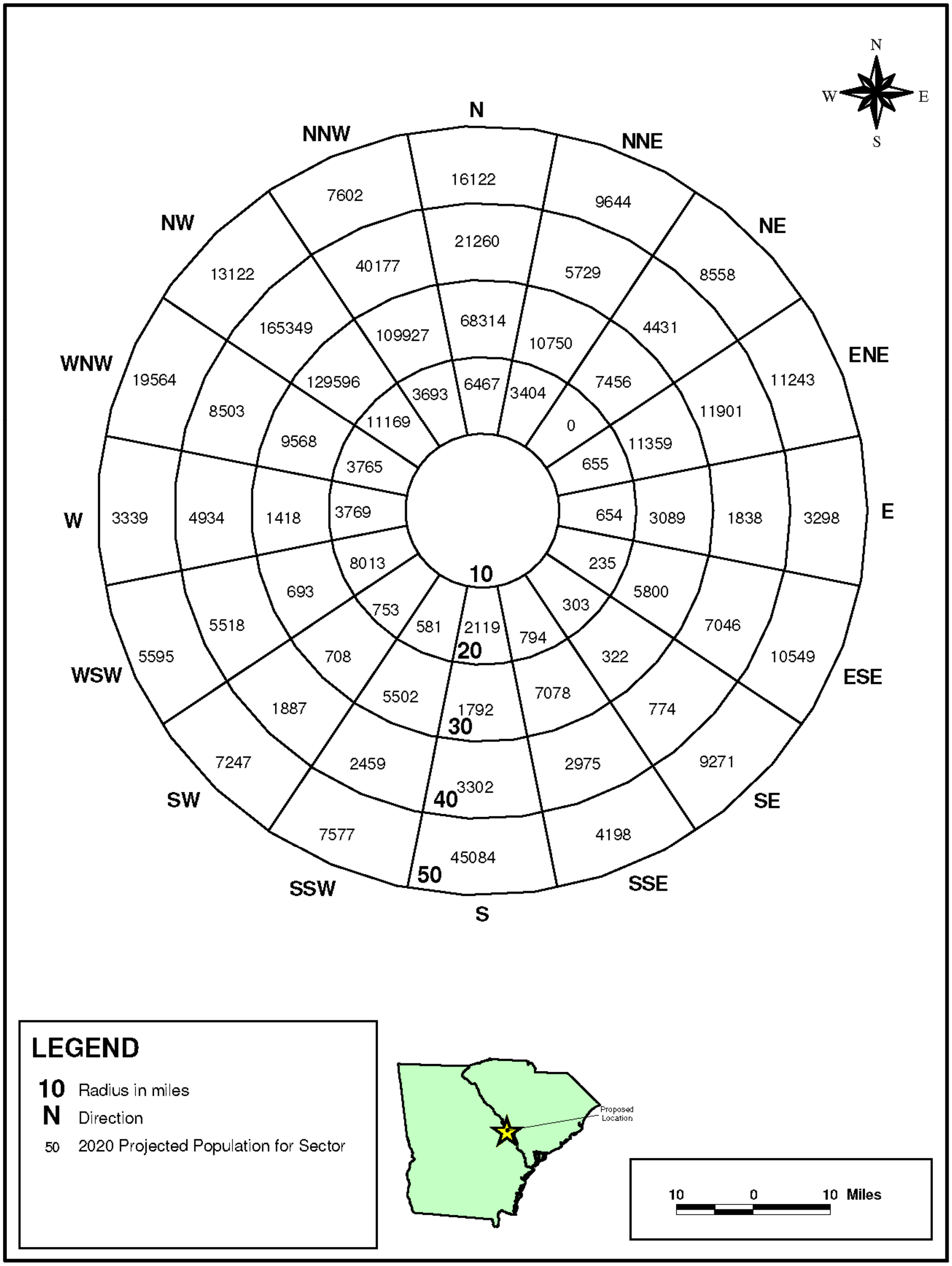


Figure 2.1-12 10 to 50-Mile Resident Population Distribution 2020

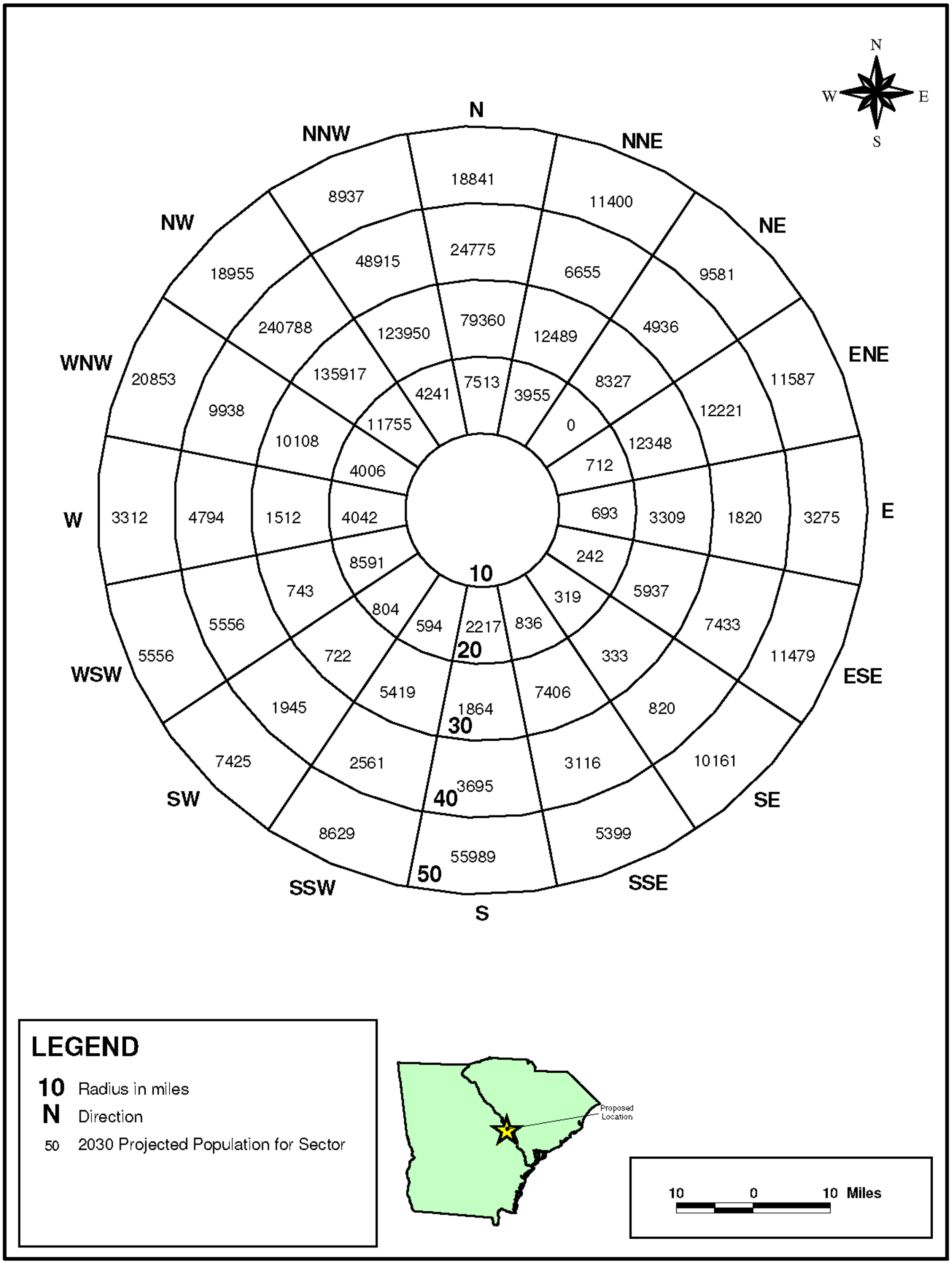


Figure 2.1-13 10 to 50-Mile Resident Population Distribution 2030

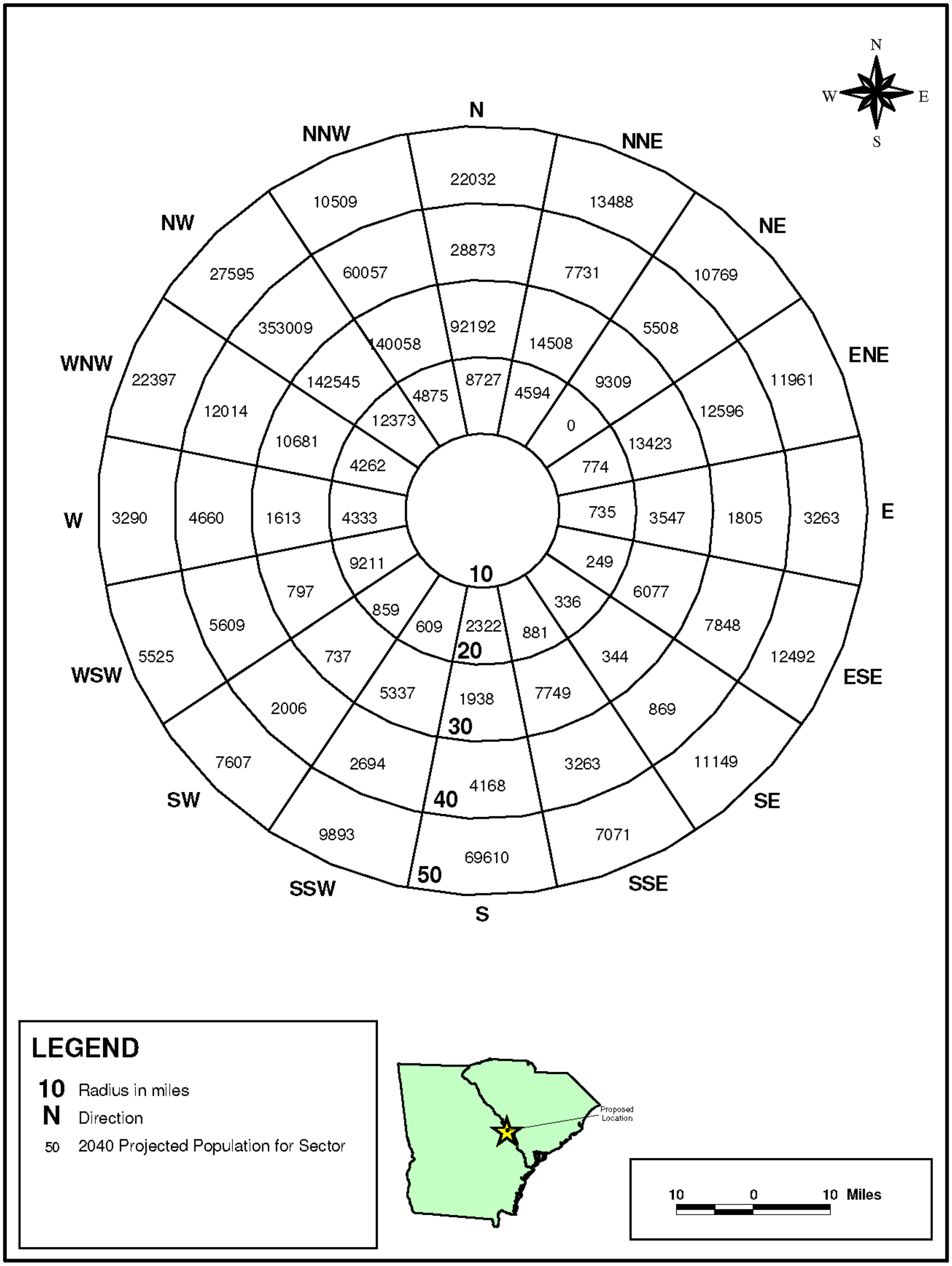


Figure 2.1-14 10 to 50-Mile Resident Population Distribution 2040

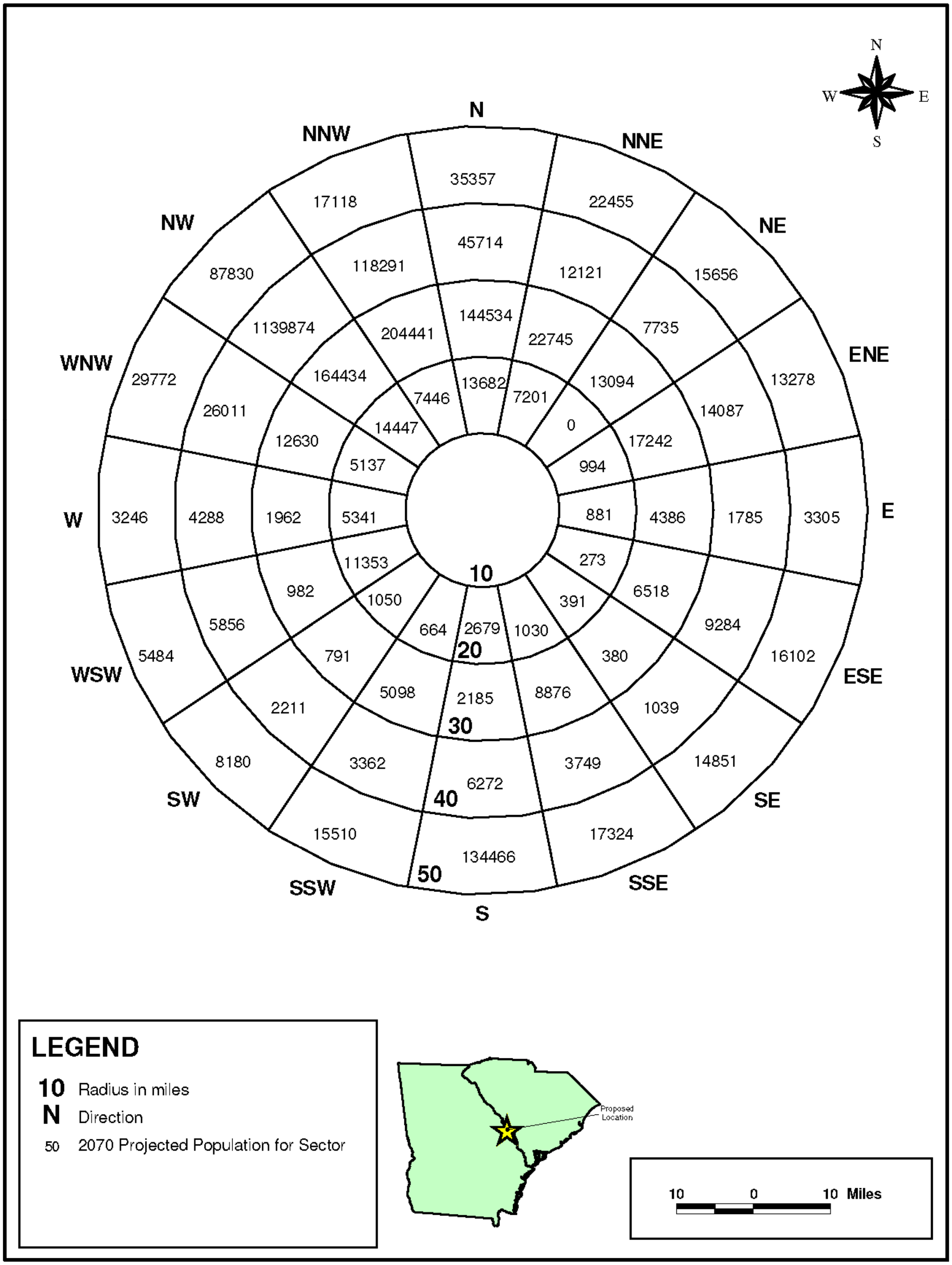


Figure 2.1-15 10 to 50-Mile Resident Population Distribution 2070

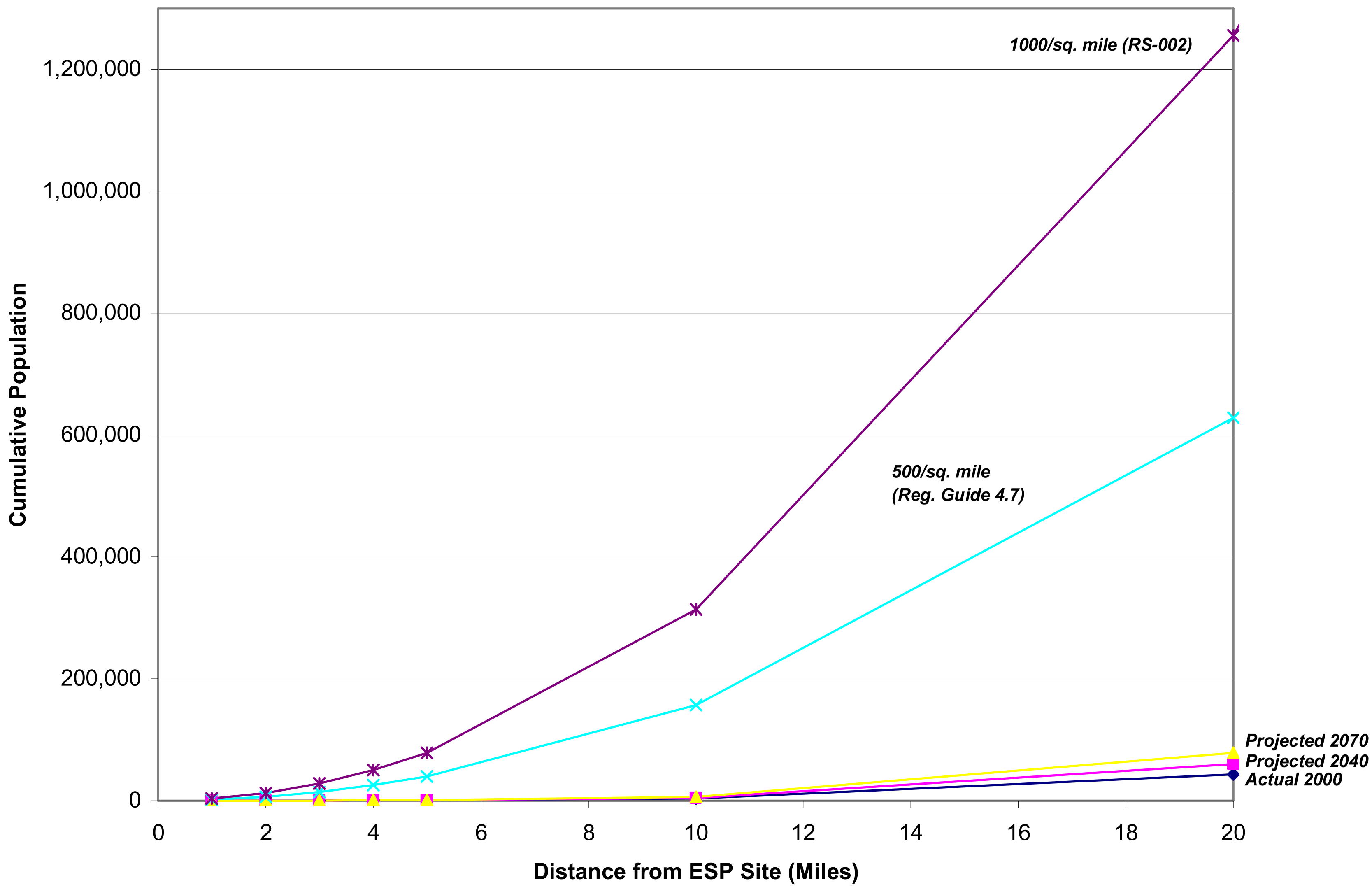
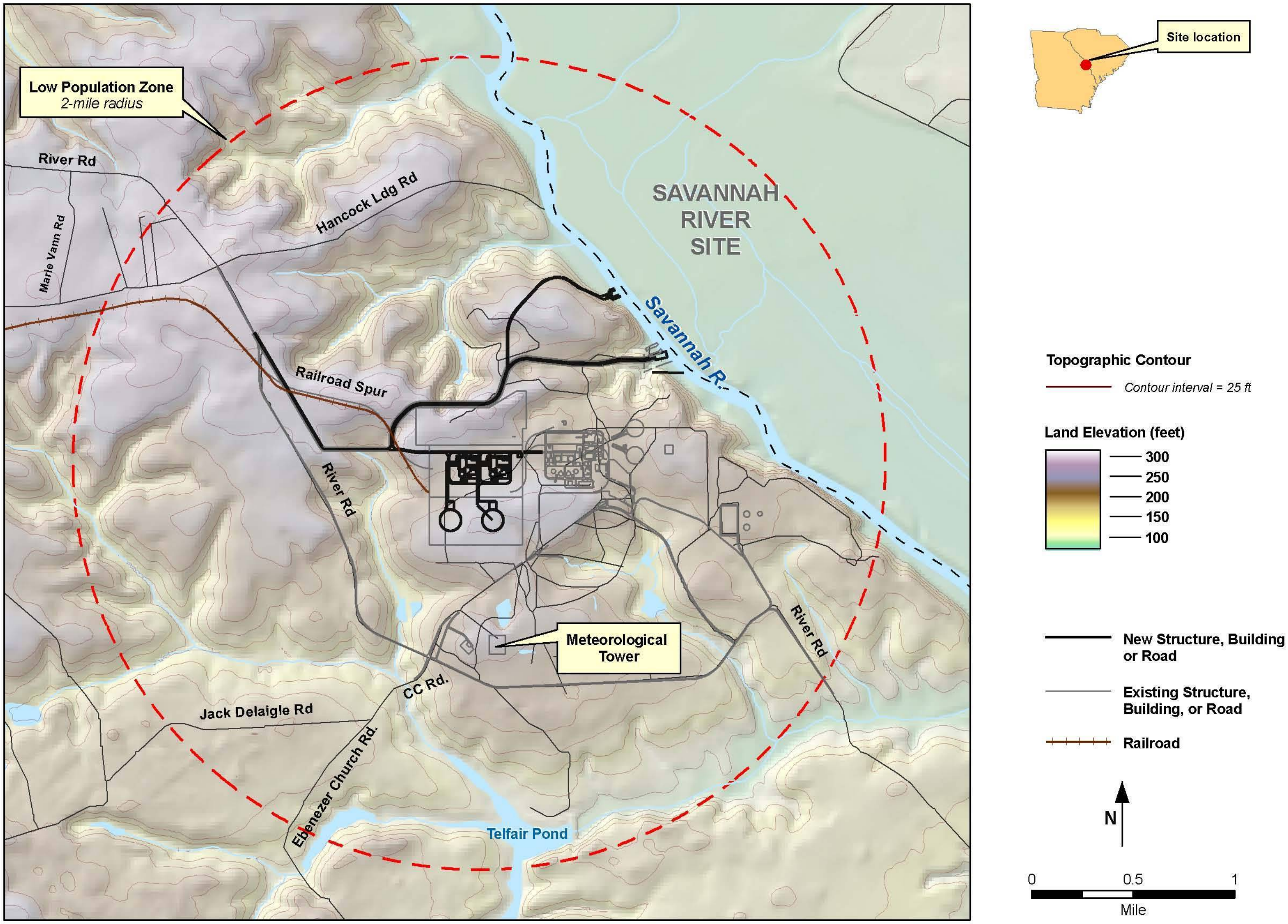


Figure 2.1-16 Population Compared to NRC Siting Criteria



Source data: ESRI, Data & Maps and StreetMap USA, 2005. USGS, seamless data distribution, NED shaded relief.
Vogtle Project Drawing No. 0-C2-00 10-00001.

Figure 2.1-17 Low Population Zone

Section 2.1 References

(BCS 2006) *Burke County Schools,* BCS, 2006, available online at: http://www.burke.k12.ga.us, accessed April 5, 2006.

(NRC 2003) *SECPOP 2000: Sector Population, Land Fraction, and Economic Estimation Program*, Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission, Washington, D.C., August 2003.

(SNC 2004) *Vogtle Electric Generating Plant Emergency Plan*, Revision 29, Southern Nuclear Operating Company, Inc., 2004.

(USCB 1990a) CPH-2-1. *1990 Census of Population and Housing, Population and Housing Unit Counts, United States, Table 30: Population and Housing Units: 1940 to 1990*, US Census Bureau, available online at: http://www.census.gov/population/www/censusdata/hiscendata.html, accessed June 1, 2005.

(USCB 1990b) *DP-1. General Population and Housing Characteristics*: 1990, US Census Bureau, Available online at http://factfinder.census.gov/, accessed June 3, 2005.

(USCB 2000a) *Census 2000 PHC-T-4. Ranking Tables for Counties;* 1990 and 2000, US Census Bureau, available online at http://www.census.gov, accessed June 2, 2005.

(USCB 2000b) *GCT-PH1. Population, Housing Units, Area, and Density*: 2000, US Census Bureau, available online at http://factfinder.census.gov, accessed June 3, 2005.

Southern Nuclear Operating Company

AR-07-0401

Enclosure 3

Proposed Revision to SSAR Section 2.2, Identification of Potential Hazards in Site Vicinity

NOTE: This enclosure consists of a 30-page proposed ESP application section.

2.2 Identification of Potential Hazards in Site Vicinity

2.2.1 Location of Nearby Industrial, Transportation, and Military Facilities

Within a 5-mile vicinity of the VEGP site, there are several major industrial facilities, one railroad, and one highway with commercial traffic. Specifically, the following transportation routes and facilities are shown on the indicated figures:

- Plant Wilson (see Figure 2.2-1)
- Savannah River Site (see Figure 2.2-2)
- Georgia State Highway 23 (see Figure 2.2-3)
- CSX Railroad (see Figure 2.2-1)
- A coal-fired steam plant operated by Washington Savannah River Company in D-Area of the SRS
- VEGP Unit 1 and Unit 2

Figures 2.2-2 and 2.2-3 shows the location of major industrial facilities, military bases, highway transportation routes, airports, railroads, and pipelines within a 25-mile radius of the site. In addition, Figure 2.2-2 shows nearby airways and military operation areas.

Items illustrated on the maps are described in Section 2.2.2. The only military facility within a 50-mile radius is Fort Gordon. The Fort Gordon U.S. Army Signal Corps training facility is barely within 25 miles of the VEGP site. The only major storage facility within 25 miles of the VEGP site, other than those at the SRS and at Chem-Nuclear Systems, is a group of oil storage tanks associated with the existing combustion turbine generators for Plant Wilson on the VEGP site.

2.2.2 Descriptions

2.2.2.1 Industrial Facilities

The Burke County Comprehensive Plan: 2010, Part 1 **(Burke 1991)** shows a relatively slow, stable population growth pattern for the county. This is indicative that the nearby industries have not experienced much growth.

The Comprehensive Plan also reveals that services and manufacturing industries dominate the top 10 employers in the county. Southern Nuclear and Samson Manufacturing Company (curtains and draperies) are the largest Burke County employers. Nearby industries also include the Chem-Nuclear Systems radioactive waste disposal site (18 miles away in South Carolina) operated by Duratek; Unitech Services Group nuclear laundry facility (21 miles away in South Carolina); and the facilities of the SRS (also in South Carolina). Table 2.2-1 lists the largest employers for the three-county region, based on recent data obtained for Burke County **(Burke 2005)** in Georgia, and nearby Aiken and Barnwell counties in South Carolina **(Aiken 2005; Barnwell 2005)**.

There currently are no projected major increases to industrial, military, or transportation facilities within a 25-mile radius of the VEGP site except for the development of the site for VEGP Units 3 and 4.

2.2.2.1.1 Savannah River Site

The SRS borders the Savannah River for approximately 17 miles opposite the VEGP site. It occupies an approximately circular area of 310 square miles (198,344 acres) encompassing parts of Aiken, Barnwell, and Allendale counties in South Carolina **(WSRC 2006)**. The SRS is owned by the DOE and operated by an integrated team led by Washington Savannah River Company (WSRC). The site is a closed government reservation except for through traffic on South Carolina Highway 125 (Savannah River Site Road A) and the CSX Railroad.

The SRS processes and stores nuclear materials in support of the national defense and U. S. non-proliferation efforts. The site also develops and deploys technologies to improve the environment and treat nuclear and hazardous wastes left from the Cold War. **(WSRC 2006)**

The following is a list of current and near-term operating facilities at the SRS and the activities conducted at these facilities **(WSRC 2006; DOE 2006)**:

- Separations facilities for processing irradiated materials (H Area).
- Waste management facilities that process, dispose or ship solid radioactive waste, hazardous waste, mixed waste, transuranic waste, and sanitary waste (E Area).
- The Defense Waste Processing Facility is processing high-level radioactive waste into stable borosilicate glass for disposal (S Area).
- The Savannah River National Laboratory (a process development laboratory to support production operations and containing two test reactors) and administrative facilities (A Area).
- The L Area Disassembly Basin which provides receipt and interim storage of research reactor fuel (L Area).
- Tritium Extraction Facility to extract tritium from fuel rods irradiated at TVA's reactors and to load the extracted tritium into canisters for shipment to the Department of Defense.

Expected to begin operation in fiscal year 2007.

- Replenishment of tritium – recycling, purifying, and reloading nuclear weapons reservoirs.
- MOX Fuel Fabrication Facility (to be constructed) to manage and convert excess weapons-grade plutonium to a form that can be used in commercial nuclear power plants.
- Stabilization, management, and storage of plutonium materials (K Area).
- Salt waste Processing Facility to remove radioactive constituents from high-level waste (under construction).
- A variety of non-nuclear facilities necessary for plant operations.

Five nuclear production reactors and several small test reactors are deactivated and are awaiting decommissioning and decontamination.

The major waste storage areas for high-level waste are adjacent to the two separations areas and consist of two tank farms linked to the separations areas and to each other by pipelines with secondary containment. In addition, the SRS uses engineered concrete vaults and engineered trenches for the permanent disposal of solid low-level radioactive waste **(WSRC 2006)**. The deactivated reactors, separations areas, and waste storage areas are at least 4 miles from the nearest VEGP site boundary.

2.2.2.1.2 Unitech Services Nuclear Laundry Facility

Although not located within 5 miles of the VEGP site, the Unitech Services Nuclear Laundry Facility, located in the Barnwell County Industrial Park, is described due to its relative proximity to and association with the SRS (Figure 2.2-3). It was constructed by Unitech Service Group to provide radiological laundry, decontamination and respirator services. The facility has about 50 employees as of May 2006 **(Unitech 2006)**.

2.2.2.1.3 Chem-Nuclear Systems

Chem-Nuclear Systems developed, constructed, and operates the largest radioactive waste disposal site in the country near Barnwell, South Carolina (Figure 2.2-3). This site contains 308 acres, of which 235 have been deeded to the State of South Carolina as a designated exclusion area. Waste receipts are in the form of solids only; no liquids are accepted. Since the disposal facility began operation in 1971, about 28 million cubic feet, or 90 percent of the available disposal volume, have been used **(Chem-Nuclear 2006)**. The facility handles approximately 400 shipments of low-level spent fuel per year. The products and materials associated with Chem-Nuclear Systems are described in Table 2.2-2 **(Still 2005)**.

2.2.2.1.4 Georgia Power Company's Plant Wilson

Plant Wilson is located approximately 6,000 feet east-southeast from the proposed VEGP Units 3 & 4 footprint. The existing combustion turbine plant is an electrical peaking power station of Georgia Power Company. The plant consists of six combustion turbines with a total rated capacity of 351.6 MW. The storage capacity of the fuel storage tanks is 9,000,000 gallons.

2.2.2.1.5 VEGP Units 1 and 2

The existing VEGP Units 1 and 2 reactors are located about 3,600 ft and 3,900 ft, respectively west of the Savannah River. For these units, the exclusion area is the same as that for the proposed units and it is defined as an irregular shaped area which generally conforms to the site's boundary lines. There are no residents within the exclusion area, and there are no highways, railways, or waterways crossing the area. Besides the activities at Plant Wilson, the only other activities that may occur within the exclusion area that are unrelated to plant operations 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.

2.2.2.2 Mining Activities

There are no mining activities within 5 miles of the VEGP site.

2.2.2.3 Roads

The nearest highway with commercial traffic is Georgia State Highway 23 (Figure 2.2-3). Segments of Georgia State Highways 23, 80, and 56 Spur are located within a 5-mile radius of the site. Other than traffic volumes, the Georgia Department of Transportation does not maintain data on the products and materials carried over these roads. However, major commercial traffic occurs only on State Highway 23, which serves as a major link between Augusta and Savannah. The heaviest truck traffic along State Highway 23 near the site consists primarily of timber and wood products and materials. State Highways 80 and 56 Spur serve primarily as minor transportation routes for local traffic. Available statistical data on personal injury accidents on these roads between 1999 and 2003 are presented in Table 2.2-3 **(GDT 2005)**.

2.2.2.4 Railroads

CSX is the nearest railroad with commercial traffic and is approximately 4.5 miles northeast of the VEGP site. CSX runs through and services the SRS. Major chemical substances identified as being carried by the CSX Railroad include cyclohexane, anhydrous ammonia, carbon monoxide, and elevated temperature material liquids (ETML). **(Murta 2006)**

Burke County has two local Norfolk Southern rail lines, one through Waynesboro and one through Midville. These are approximately 12 miles west of the VEGP site.

2.2.2.5 Waterways

The Savannah River above the Vogtle site (River Mile 151) is primarily used for recreational purposes since 1979, with the closing of the New Savannah Bluff Lock and Dam (River Mile 187) to commercial traffic **(USACE 2000)**. There are no commercial facilities or barge slips/docks which are visible on satellite imagery between the Vogtle site and the New Savannah Bluff Lock and Dam. This section of the river is primarily forested and otherwise undeveloped land to the river's edge.

Downstream of the Vogtle site, barge traffic may be present closer to the Port of Savannah (River Mile 21). In 2005 no barge traffic was reported to the Army Corp of Engineers Waterborne Commerce Statistics Center in New Orleans, Louisiana **(USACE 2007)**. In 2004, only 13 commercial vessels were recorded **(IWR 2004)**. These vessels were reported to contain a total of less than 500 tons of non-explosive residual fuel oil (less than a full barge load).

Therefore, the current use of the river and the lack of commercial facilities and barge slips/docks upstream of the plant indicate that there is no current or projected barge traffic on the Savannah River past the Vogtle site. Based on the above information, SNC has determined that evaluation of hazardous shipments by barge is not necessary for VEGP Units 3 and 4.

2.2.2.6 Airports, Airways, and Military Training Routes

2.2.2.6.1 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 VEGP site. It has a 4,035-foot asphalt runway oriented 250° WSW – 70° ENE. The airport, which has a non-directional radio beacon for runway approach, is used by single-engine private aircraft and by crop-dusting operations. There are only two multi-engine and five single-engine aircraft based at the field. The average number of operations (landings and takeoffs are counted separately) is about 57 per week. Most operations are transient general aviation; only about 33 percent are local general aviation **(Burke Airport 2006)**.

The closest commercial airport is Augusta Regional Airport at Bush Field, which is located approximately 17 miles north-northwest of the VEGP site. It has an 8,000-foot primary runway oriented 170° SSE – 350° NNW and a 6,000-foot crosswind runway oriented 80° ENE – 260° WSW. FAA information effective April 13, 2006 indicates that 17 aircraft are based on the field. Ten of these are single-engine airplanes, four are multi-engines airplanes, and three are jetengine airplanes. The average number of operations is about 91 per day. Most (40 percent) are general transient aviation, 24 percent are air taxi, 12 percent are local general aviation, 14 percent are commercial, and 10 percent are military **(FAA 2006)**. Based on the historical flight data recorded prior to 2005, projections for air traffic at Bush Field up to fiscal year 2025 are given in Table 2.2-4 **(APO 2006)**. 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 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 more than 1.4 mile from the power block of the new units. This privately owned and operated airstrip has a 1,650-foot turf runway oriented 80° East – 260° West. Thus take-offs and landings are tangential to the site property and oriented away from the plant. While no FAA traffic information is available for this airstrip, informal communication with the owner/operator revealed that the airstrip is for personal use and the associated traffic consists only of small single-engine aircraft **(Rhodes 2006)**. 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 emergency. The traffic associated with either of these facilities may be characterized as sporadic. Therefore, due to the small amount and the nature of the traffic, these facilities do not present a safety hazard to the VEGP site.

2.2.2.6.2 Airways

The centerline of Airway V185 is approximately 1.5 miles west of the VEGP site (Figure 2.2-2). Additionally, Airway V417 is about 12 miles northeast of the VEGP site, and Airway V70 is approximately 20 miles south of the VEGP site (Figure 2.2-2) **(FAA 2005)**. Due to its close proximity to the VEGP site, an evaluation of hazards from air traffic along the V185 airway is presented in Section 3.5.1.6. That evaluation shows that the presence of Airway V185 is not a safety concern for the VEGP site.

2.2.2.6.3 Military Training Routes

In August 2005, Shaw Air Force Base (AFB), South Carolina, issued a draft Environmental Impact Statement (EIS) **(Shaw 2005)** regarding implementing airspace modifications to the Gamecock and Poinsett Military Operation Areas (MOAs) in South Carolina and the Bulldog MOAs in Georgia. The west edge of the Poinsett MOA is about 75 miles east-northeast of the VEGP site. The Gamecock MOAs are east of the Poinsett MOA. The proposed Gamecock E MOA would be created to form a “bridge,” allowing maneuvering and training between the Gamecock MOAs and the Poinsett MOA. The east edge of the Bulldog MOAs is about 11 miles west of the VEGP site (see Figure 2.2-2). Because of the relatively long distances between the

VEGP site and these MOAs, and their related training routes, no aircraft accident analysis is required for flight activities associated with these MOAs and their related training routes.

Under the proposed action, the airspace structure at Bulldog A MOA would be expanded to the east under the Bulldog B "shelf" to match the boundary of the existing Bulldog B. Mainly, the current 500-foot msl floor as allowed at Bulldog A would be laterally expanded into Bulldog B. Because the current Bulldog B floor is 10,000 feet msl, this lateral expansion would increase the airspace volume in the Bulldog MOAs. The overall distance from the MOA boundary to the VEGP site is unchanged.

Military aircraft in the Bulldog MOAs are expected to come mainly from Shaw AFB (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 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 (Figure 2.2-2). The maximum route width of VR97-1059 is 20 nautical miles (NM); therefore, the width on either side of the route centerline is assumed to be 10 NM (11.5 miles). The VEGP site is located more than 6 miles from the edge of this training route. Additionally, the total number of military aircraft using route VR97-1059 is approximately 833 per year **(Shaw 2005)**.

According to RS-002, *Processing Applications for Early Site Permits*, May 2004 (RS-002), the aircraft accident probability for military training routes is considered to be less than 10^{-7} per year if the distance from the site is at least 5 statute miles from the edge of military training routes, including low-level training routes, except for those associated with a usage greater than 1,000 flights per year, or where activities may create an unusual stress situation.

In summary, the MOA use is projected to remain relatively unchanged and no modifications are proposed to the military routes. The VEGP site is located more than 5 statute miles from the edge of VR97-1059, and the total military flights using the same route is less than 1,000 per year; therefore, no aircraft accident analysis is required for flights using VR97-1059 **(Shaw 2005)**.

2.2.2.7 Natural Gas or Petroleum Pipelines

Three pipelines are within 25 miles of the VEGP site (Figure 2.2-3); however, none are located within 10 miles of the VEGP site.

Pipeline 1, located approximately 21 miles northeast of the VEGP site, is an 8-inch-diameter line constructed in 1959. It operates at a maximum pressure of 750 psi; is buried 3 feet deep; has 8-inch Rockwell isolation valves at 25-mile intervals; and carries natural gas. It is not used for storage.

Pipeline 2, located approximately 19 miles southwest of the VEGP site, has a 14-inch-diameter line constructed in 1954 and a 20-inch-diameter line constructed in 1977. Both lines are buried 3-feet deep; operate at a maximum pressure of 1,250 psi; have buried Rockwell isolation valves every 8 to 9 miles; and carry natural gas. They are not used for storage.

Pipeline 3, located approximately 20 miles northwest of the VEGP site, has two 16-inch-diameter lines constructed in 1953 and 1957. Both operate at a maximum pressure of 1,250 psi; are buried 3 feet deep; have buried Rockwell isolation valves every 8 to 9 miles; and carry natural gas.

Because the pipelines identified are well over 10 miles from the VEGP site, there is no need to identify the locations of individual pipeline valves.

2.2.2.8 Military Facilities

There are no military facilities within 5 miles of the VEGP site.

2.2.2.9 VEGP Units 1 and 2 Storage Tanks / Chemicals

Chemicals currently stored at the VEGP site are presented in Table 2.2-5.

2.2.3 Evaluation of Potential Accidents

Analyses were performed in order to evaluate the impact on the proposed ESP Units following potential accidents resulting in an explosion or flammable cloud or toxic chemical releases within a 5-mile radius of the VEGP site. The postulated accidents which would result in an explosion or chemical release were analyzed at the following locations.

- Nearby transportation routes (Savannah River, Highway 23, and CSX Railroad)
- Nearby chemical and fuel storage facilities (Savannah River Site, Plant Wilson)
- Onsite chemical storage tanks
- Other nearby fire sources

The existing analysis of potential hazards to the Units 1 and 2 was reviewed for applicability to the Units 3 and 4. That analysis evaluated postulated releases of flammable materials and toxic gases transported or stored at industrial facilities within a 5-mile radius of the VEGP site. In addition, new chemicals, which have been identified as being associated with Units 1 and 2, were subsequently evaluated or analyzed for this ESP Application to determine their impact to Units 3 and 4. As described below, in each case, these analyses concluded that the potential for hazard is minimal and will not affect safe operation of Units 3 and 4.

2.2.3.1 Explosion and Flammable Vapor Clouds

The effects of explosion and formation of flammable vapor clouds from the nearby sources are evaluated below.

2.2.3.1.1 Truck Traffic

Segments of Georgia State Highways 23, 80, and 56 Spur are located within a 5-mile radius of the VEGP site. Major commercial traffic occurs only on State Highway 23, which serves as a major link between Augusta and Savannah, Georgia.

An analysis of truck-borne hazards that was performed for Units 1 and 2 identified that chlorine (1 ton), anhydrous ammonia (6 tons), liquid nitrogen (6,500 gallons), phosphoric acid (200 lb), nitric acid (5,000 gallons), and diesel oil (6,000 gallons) were transported on nearby Highway 23. At its nearest point, Highway 23 passes about 4.7 miles from the center point of the Units 1 and 2 control rooms. The allowable and actual distances of hazardous chemicals transported on highways were evaluated according to NRC Regulatory Guide 1.91, Revision 1, *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants* (RG 1.91). RG 1.91 cites 1 psi as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. The analysis demonstrated that truck-borne substances transported within a 5-mile radius of the VEGP Units 1 and 2, as well as explosions and flammable vapor clouds induced by these chemicals, would not adversely affect safe operation of the units.

The six chemicals identified above in the analysis of truck traffic were obtained from the original design basis analysis for Units 1 and 2 and were based on a 1975 study performed by the Georgia Institute of Technology for Georgia Power Company. The original study is no longer available, and these chemicals have been re-evaluated as described below.

SNC has obtained the EPA Tier II reports for Burke and Richmond Counties in Georgia, identifying those facilities in the vicinity of the plant which have permits for storing hazardous materials **(EPA 2006d)**. These reports, along with the EPA Landview 6 database, were used to confirm and/or update the list of chemicals for analysis. **(EPA 2003)** The sites identified from these sources containing chemicals within a 20 mile radius of the VEGP site are depicted on Figure 2.2-4.

A traffic corridor evaluation has been performed to determine whether there are any new or additional chemicals transported by truck within 5 miles of the site related to the facilities described above. The evaluation shows that even fewer chemicals pass by the site now than assumed in the previous analysis performed for the existing units.

There exist only two EPA regulated sites that would likely use State Route 23 as a route for transporting materials and equipment. These sites are construction-related sites and are located 7 to 10 miles south of the Vogtle site. Neither of these sites currently uses any of the previously identified chemicals nor have they been identified to use or cause the transport of any hazardous chemicals other than fuel oil or gasoline. The remaining sites are all outside of the 5 mile corridor and are likely to transport their materials and equipment via other, more direct, routes, rather than along State Route 23. These remaining sites therefore do not warrant further analysis.

The use of bulk anhydrous ammonia has been discontinued at the plant site. Since there are not any other users of this chemical in the vicinity of this site, the issue of transportation of this chemical along the roadways or to the site will not require further analysis. (Anhydrous ammonia is still being transported by rail car, and is evaluated in SSAR Section 2.2.3.1.4).

The conclusion of SNC's re-evaluation determined that the only remaining hazardous chemicals transported by truck in the vicinity of the site are gasoline and diesel/fuel oil.

For an 8,500 gallon truck on State Road 23 at the closest approach distance of approximately 4.2 miles (22,000 ft), the following calculations were performed in accordance with RG 1.91:

- TNT equivalent safe distance for an explosion of a gasoline vapor cloud,
- TNT equivalent safe distance for an explosion of gasoline vapor in a truck

The gasoline truck analysis for the vapor cloud explosion uses the industry standard program DEGADIS to calculate the distance from the site of the spill to the boundaries of the upper and lower flammability limits and to obtain the flammable mass within the vapor plume. The concentrations are compared to the lower flammability limits for the respective chemical to determine the maximum distance for the flammable vapor cloud. The input parameters are:

- Quantity of Gasoline in the truck = 50,000 lbs (56,165 lbs TNT equivalent)
- Physical property data:
  - molecular weight 95 g/mole;
  - diffusion coefficient 0.05 cm^2/sec
  - vapor pressure 300 mm Hg,
  - boiling point temperature 130^{o}C, and
  - specific gravity 0.732.
- The meteorological conditions assumed are:
  - F (stable) stability class and
  - wind speeds of 1 m/s up to 2.5 m/s.

For an explosion from a flammable vapor cloud, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi has been calculated to be1,279 feet.

For the explosion from a truck, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi has been calculated to be1,723 feet.

The distance between State Road 23 and Units 3 & 4 is approximately 4.2 miles. This distance is far greater than either of the above calculated critical distances. Therefore, there will not be any impact on Units 3 or 4 from an explosion of gasoline from a truck or vapor cloud.

The size of gasoline delivery trucks on State Road 23 range from 4,000 to 8,500 gallons so the assumption of an 8,500-gallon truck in the analysis is conservative and bounding.

In addition to road transit, gasoline is delivered to the site by a tank wagon (10-wheel truck) containing a maximum volume of 4,000 gallons. The closest distance from the site delivery route to the power block circle is approximately 2,000 feet. As discussed above, since the 1-psi blast pressure distances for the vapor cloud and truck explosions are 1,279 feet and 1,723 feet, respectively, the 8,500-gallon truck analysis remains bounding for the tank wagon.

Since transported diesel/fuel oil is not flammable, and it is much less volatile than gasoline, the gasoline truck analysis becomes bounding in the evaluation of truck-borne hazards.

The quantity of chemical (diesel and gasoline), wind speed and stability, concentration of chemicals and limiting conditions are shown below:

Chemical	Quantity	Distance to Units 3 and 4	TNT Equivalent Distance	Distance to Lower Flammability Limit	LFL
#2 Diesel	6,000 gal	4.2 mi (22,000 ft)	Not Applicable	Not Applicable	13,000 ppm
#2 Diesel	4,000 gal	2,000 ft	Not Applicable	Not Applicable	13,000 ppm
Gasoline	50,000 lb 8,500 gal	4.2 mi (22,000 ft)	1,723 ft	1,200 ft	14,000 ppm
Gasoline	23,530 lb 4,000 gal	2,000 ft	<1,723 ft	<1,200 ft	14,000 ppm

2.2.3.1.2 Pipelines and Mining Facilities

No natural gas pipeline or mining facilities are located within 10 miles of the VEGP site. No pipelines carrying potentially hazardous materials are located within 5 miles of the VEGP site. Therefore, the potential for hazards from these sources are minimal and will not adversely affect safe operation of the plant.

2.2.3.1.3 Waterway Traffic

As discussed in Section 2.2.2.5, there is no barge traffic past the Vogtle site. Therefore, there are no chemicals transported by barge which require evaluation.

2.2.3.1.4 Railroad Traffic

The only railroad within a 5-mile radius of the VEGP site is the CSX Railroad (approximately 4.5 miles northeast of the center point between Units 1 and 2), which runs through, and services, the SRS. A hazards analysis performed for VEGP Units 1 and 2 showed that explosions and flammable vapor clouds induced by chemicals carried by this rail line will not adversely affect safe operation of Units 1 and 2. The critical distance (given by $kW^{1/3}$ in Regulatory Guide 1.91) that could cause overpressures of 1 psi to safety-related structures is approximately 2,291 feet. This scenario is caused by the explosion of a 26-ton ammonia railroad tank car (assumed to contain 132,000 pounds TNT equivalent). Because of the relatively long distance (approximately 4.5 miles) between the railroad and the VEGP site, if an explosion occurred due to an accident involving an ammonia railroad tank car, it would occur at a distance great enough not to pose an overpressure hazard to the safety-related structures. Since the proposed VEGP Units 3 and 4 will be located farther away from the railroad line than Units 1 and 2, the possibility of adverse effects from explosions and flammable vapor clouds is even smaller for the new units.

More recent information obtained from CSX (Director of Infrastructure Security) **(Murta 2006)** indicates that the top four substances carried by CSX during 2005, which qualified as DOT hazardous chemicals, are cyclohexane (64%), anhydrous ammonia (9%), carbon monoxide (3%), elevated temperature material liquids (ETMLs) (3%).

Evaluations were made for each of the above chemicals. Some of the these chemicals were already analyzed in a previous analysis for effect on Units 1 and 2, and some were evaluated specifically for their potential effect on Units 3 and 4. In each case, the evaluations concluded that the potential hazard from the chemicals is minimal and will not affect the safe operation of the new units.

Accidental spills of carbon monoxide or ETMLs are not expected to create an explosion or vapor hazard for the site. Carbon monoxide, which can cause affixation, will quickly vaporize and dissipate prior to coming close to the Vogtle plant limits. ETMLs, also referred to as elevated temperature goods, are not necessarily flammable. ETMLs are DOT Class 9 materials, and the main hazard they present is the potential to cause contact burns due to the elevated temperature of the substance. Because of the long distance separation between the CSX Railroad and the new units, no direct contact with these substances is expected. Therefore, no adverse impact is expected from the accidental releases of the ETML substances.

Cyclohexane (used in the manufacture of nylon, paint, resin, etc.) is a hazardous chemical which was not previously considered in the Unit 1& 2 analyses, so a new analysis has been performed for Units 3 & 4.

For a 67 ton railcar at the closest approach distance of approximately 4.5 miles (23,760 ft), the following calculations were performed in accordance with RG 1.91:

- TNT equivalent safe distance for an explosion of cyclohexane vapor in a rail tank car
- TNT equivalent safe distance for an explosion of a cyclohexane vapor cloud,

The cyclohexane railcar analysis for the vapor cloud explosion uses the industry standard program DEGADIS to calculate the distance from the site of the spill to the boundaries of the upper and lower flammability limits and to obtain the flammable mass within the vapor plume. The concentrations are compared to the lower flammability limits for the respective chemical to determine the maximum distance for the flammable vapor cloud. The input parameters are:

- Quantity of cyclohexane vapor in the rail car = 48.8 lbs (117.5 lbs TNT equivalent)
- Physical property data:
  - molecular weight 84.16 g/mole;
  - diffusion coefficient 0.076 cm^2/sec
  - molecular volume 133.2
  - boiling point temperature 80.7 ^{o}C, and
  - specific gravity 0.779.
- The meteorological conditions assumed are:
  - F (stable) stability class and
  - wind speeds of 1 m/s up to 2.5 m/s.

For the explosion from a railcar, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi is 220 feet.

For an explosion from a flammable vapor cloud, the TNT equivalent safe distance beyond which the blast pressure would be less than 1 psi has been calculated to be 451 feet. The outer edge of the lower flammability limit (LFL) of the flammable portion of the cyclohexane vapor cloud is 575 ft downwind from the railroad line. If the blast occurs at the outer edge of the vapor cloud, which is a conservative assumption, then the maximum distance for which a peak incident of 1 psi would occur is the sum of the two distances or 1,026 ft from the railroad car.

The distance between the closest point of the rail line and Units 3 & 4 is approximately 4.5 miles. This distance is far greater than either of the above calculated critical distances. Therefore, there will not be any impact on Units 3 or 4 from an explosion of cyclohexane from a railcar or vapor cloud.

2.2.3.2 Hazardous Chemicals

Regulatory Guide 1.78 requires evaluation of control room habitability for a postulated release of chemicals stored within 5 miles of the control room. As described in Subsection 2.2.2, no manufacturing plants, chemical plants, storage facilities, or oil or gas pipelines are located within 5 miles of the VEGP site. Therefore, three scenarios were evaluated:

1. Potential hazards from chemicals transported on routes within a 5-mile radius of the site, at a frequency of 10 or more per year, and with weights outlined in RG 1.78
2. Potential hazards from major depots or storage areas
3. Potential hazards from onsite storage tanks

Each hazard is discussed and evaluated below. The VEGP Units 1 and 2 analysis was reviewed for applicability to Units 3 and 4 for the effects from each of these hazards. The review determined that the impact to the new units for each of these postulated events is bounded by the impact to Units 1 and 2.

2.2.3.2.1 Release of Hazardous Chemicals Due to a Transportation Accident

As previously discussed, three routes (Georgia State Highways 23, 80, and 56) pass within 5 miles of the VEGP site. Of these three routes, major commercial traffic occurs only on State Highway 23, which serves as a major link between Augusta and Savannah. In addition, rail traffic exists within the five mile radius of the plant.

As discussed in Section 2.2.2.5, there is no barge traffic past the Vogtle site. Therefore, there are no chemicals transported by barge which require evaluation.

The hazardous chemical sources due to a transportation accident were analyzed. The results of the analysis indicated that control rooms of VEGP Units 3 and 4 would remain habitable for all transported chemicals as discussed below.

In the analysis for truck traffic, methods specified in NUREG-0570 were used to estimate vapor emission rates and their dispersion. As discussed in Section 2.2.3.1.1, the only hazardous chemicals transported by truck in the vicinity of the VGEP site are gasoline and diesel/fuel oil.

The table below shows, for each chemical transported by truck, the key input parameters and the results of the evaluation using the methodology of NUREG-0570.

Chemical	Quantity	Distance to Control Room	Wind Speed	Stability	Control Room Concentration	Toxicity Limit
#2 Diesel	6,000 gal	4.2 mi (22,000 ft)	0.5 m/s	G	0.057 ppm	300 ppm
#2 Diesel	4,000 gal	2,000 ft	1 m/s	F	bounded by gasoline	300 ppm
Gasoline	50,000 lb 8,500 gal	4.2 mi (22,000 ft)	1 m/s	F	35.5 ppm	300 ppm
Gasoline	23,530 lb 4,000 gal	2,000 ft	1 m/s	F	115 ppm	300 ppm

Therefore, no adverse impact to VEGP Units 3 & 4 is expected from the accidental release of gasoline or diesel/fuel oil.

For a postulated accident on a rail line, cyclohexane and ammonia were evaluated. Potential adverse impact caused by accidental release of cyclohexane was analyzed for the ESP because it was not previously evaluated, it is flammable, and it has an established toxic threshold limit value (TLV). Using approaches specified in NUREG-0570, the analysis has concluded that the accidental release of cyclohexane from a railcar will not have adverse effects to the control room operators. The meteorological conditions used in the ESP analysis were based on guidance provided in RG 1.78. RG 1.78 describes a simplified procedure for calculating weights of hazardous chemicals for control room evaluations. In that simplified procedure, stable atmospheric stability (F stability) is used because it represents the worst 5% meteorology observed at the majority of nuclear plant sites per Regulatory Guide 1.78. Therefore, in the ESP analysis, stable atmospheric meteorological conditions (F stability with a wind speed of 1 m/s) were assumed.

The assumed railcar capacity (67 tons) is similar to that described in RG 1.91. With a control room air intake height about 60 ft above grade, the control room outside concentration was estimated to be 0.12 g/m^3 (34.3 ppm). The immediate danger to life and health (IDLH) value of cyclohexane is 1,300 ppm **(CHRIS 1999)**. Since the control room outside concentration was estimated to be only 34.3 ppm, the accidental release of the cyclohexane tank car will not cause adverse effects to the control room operators.

The evaluation of ammonia was originally performed for Units 1 and 2, and extended to Units 3 and 4. Assuming the release from a rail car containing 26 tons of anhydrous ammonia, the evaluation showed that Units 1 and 2 control room concentration at 2 minutes after odor detection is 112 ppm, without taking credit for control room isolation. This concentration is much lower than the IDLH value of 300 ppm. In accordance with Regulatory Guide 1.78, the evaluation assumed 2 minutes is sufficient time for a trained operator to put a self-contained breathing apparatus into operation, if they are to be used.

For ammonia and cyclohexane, the factors for estimating the concentration of each chemical at the control room air intake are:

Compound	Quantity	Distance from RR to Control Room	Wind Speed	Stability Class	Concentration of compound at control room air intake, ppm	IDLH Toxicity Limit, ppm
Ammonia	26 tons	4.5 miles	1 m/s	G	112 @ 2 min	300
Cyclohexane	67 tons	4.5 miles	1 m/s	F	34.3	1,300

In addition the AP1000 design provides manual actuation to initiate the emergency habitability system. Protective measures (including manual actuation of the main control room habitability system) required to be taken by the control room operators will be evaluated further at the time of the COL application in accordance with DCD COL Information Item 6.4-1.

Therefore, no adverse impact to VEGP Units 3 and 4 is expected from the accidental release of ammonia or cyclohexane.

2.2.3.2.2 Potential Hazard from Major Depots or Storage Areas

There are no major depots within 5 miles of the VEGP site. The only chemical storage areas within 5 miles of the VEGP site exist at the SRS and the Wilson combustion turbine plant.

The original analysis (performed for Units 1 & 2) had determined that SRS had the potential to utilize chlorine and ammonia at the D-Area, which is approximately 4.5 miles distant from Units 1 & 2. However, the 2004 Tier II EPA report for this site **(EPA 2006d)**, and recent communications with SRS management, have indicated that ammonia and chlorine are no longer in use at D-Area **(Vanpelt 2006)**. The area has been remediated and nearly all the facilities have been removed. The only chemicals used at the site, according to the recent Tier II report, are chlorine softener chemicals, and biocide, which are used in the waste treatment process to eliminate the bacteria in the water. There were no chemicals identified which would be hazardous to the Vogtle site or would require further evaluation.

The chemicals stored at the Plant Wilson combustion turbine plant (6,000 feet from the new AP1000 units' power block), consist of fuel oil, sulfuric acid, and several other chemicals kept in small quantities. These chemicals have low volatility and toxicity, and there would be no potential hazard to the new AP1000 unit control rooms habitability from these substances. The three No. 2 fuel oil tanks located at east of the Service Building for the combustion turbine plant have a capacity of 3,000,000 gallons each **(Wilson Plant 2006)**. The tanks are surrounded by a dike, which would prevent a fuel leak from spreading into a large spill area. An analysis, based on the methodology of NUREG-0570, has shown that a postulated release of fuel oil from an accidental spill at Plant Wilson will result in a concentration of less than 50 ppm at the air intake for the Control Rooms for Units 3 or 4:

	Quantity	Wind Speed	Stability	Distance to Control Room	Concentration of Vapor at Control Room Air Intake	Toxicity Limit
Fuel Oil	3,000,000 gallons	1 m/s	F	Approximately 5,500 ft	< 50 ppm	300 ppm

Therefore, the Plant Wilson fuel oil storage tanks do not pose a hazard to VEGP Units 3 and 4..

2.2.3.2.3 Potential Hazard from Onsite Storage Tanks

The storage facilities for VEGP Units 1 and 2 are listed in Table 2.2-5. Many of the chemicals listed in that table are excluded from further consideration due to their properties (e.g., low volatility or low toxicity) or due to the relatively small quantities that are stored. The guidelines and methodologies of NUREG-0570 were used to determine the release rates and concentrations of toxic gases at the control room air intake for existing VEGP Units 1 and 2. This analysis shows that the control room would remain habitable for most release scenarios without any operator action and that there would be sufficient time for control room operators to take emergency action (donning emergency breathing apparatus) for the remaining release scenarios. For all releases except hydrazine, the average concentration over an 8-hour period would never exceed the long-term toxicity limit. Where the long-term limit would be exceeded, it has been shown by calculation for VEGP Units 1 and 2 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 is stored northeast of the VEGP Unit 1 reactor, this chemical would be separated by a minimum of about 1,800-feet from Units 3 and 4. Therefore, the impact on the new Units 3 and 4 due to an accidental hydrazine release will be expected to be smaller than that for existing Units 1 and 2, and will be evaluated at the time of the COL in accordance with DCD COL Information Item 6.4-1.

As shown in Table 2.2-5, some chemicals previously used for Units 1 and 2 have recently been replaced. Phosphoric acid (Nalco 3DT177) is one of the new chemicals used for the existing Units 1 and 2 that was identified to be toxic. This material is stored in a 5050-gallon tank located between the two existing cooling towers at a distance of approximately 3,200 feet from the air intake for the Unit 3 control room (the closest of the new control rooms to the chemical source). An analysis has shown that under stable atmospheric conditions (F stability) the phosphoric acid concentration outside the new control room air intake would be 94 $\mu g/m^3$, which is much lower than the 8-hour TLV of 1 mg/m^3 and the short term exposure limit of 3 mg/m^3 **(CHRIS 1999)** following an accidental release. Since this material is not flammable, the explosion effect was not evaluated.

Table 2.2-6 lists chemicals which will be used in conjunction with the AP1000 Units 3 and 4. Section 6.4 of the Westinghouse AP1000 Design Control Document addresses habitability systems for the new AP1000 units and concludes that the DCD-listed sources of AP1000 onsite chemicals do not represent a toxic hazard to AP1000 control room personnel **(Westinghouse 2005)**.

2.2.3.3 Fires

In the vicinity of the VEGP site, the following potential fire hazards exist:

a. Fire due to a transportation accident

b. Forest fire

c. Fire due to an accident at offsite industrial storage facilities

d. Fire due to an onsite storage tank spill

An analysis was performed for VEGP Units 1 and 2 which evaluated the potential fire hazards identified above. Items a, c and d above have been addressed in previous sections. For each event, the analysis concluded that combustion products would not reach concentrations in the VEGP Unit 1 and 2 control room that approached toxicity limits.

An analysis of a postulated forest fire indicates that toxic chemicals (such as CO, NO_2 and CH_4) emitted from the forest fire, located approximately 1,800 feet from the Units 1 and 2 control room, produce negligible concentrations outside the Units 1 and 2 control room air intakes due to the relatively high buoyancy of the plume. In addition, due to the long distance separating the tree line from the control room, the analysis indicates that there would not be any adverse heat impact in the form of heat flux from the forest fire. The temperature rise for each event was calculated to be insignificant when compared with fuel oil fires for causing thermal damage to any safety-related structures at VEGP Units 1 and 2. For all of the fire events evaluated, the location of the new AP1000 units on the VEGP site is the same distance from the source of the fire as the existing VEGP Units 1 and 2, or is further removed, and therefore the same conclusions concerning impact may be made**.** In addition the design of the control room HVAC for the AP1000 includes smoke detectors. Any smoke detected from an onsite or offsite fire would initiate isolation of the control room HVAC prior to toxicity limits being exceeded. Other fire hazards for the AP1000 plant have been addressed in the Design Control Document **(Westinghouse 2005)**.

2.2.3.4 Radiological Hazards

The hazard due to the release of radioactive material from either VEGP Units 1 and 2 or the facilities at SRS, as a result of normal operations or an unanticipated event, would not threaten safety of the new units. Smoke detectors, radiation detectors, and associated control equipment are installed at various plant locations as necessary to provide the appropriate operation of the systems. Radiation monitoring of the main control room environment is provided by the radiation monitoring system (RMS). The habitability systems for the AP1000 are capable of maintaining the main control room environment suitable for prolong occupancy throughout the duration of the postulated accidents that require protection from external fire, smoke and airborne radioactivity. Automatic actuation of the individual systems that perform a habitability systems function is provided. In addition, safety related structures, systems, and components for the AP1000 have been designed to withstand the effects of radiological events and the consequential releases which would bound the contamination from a release from either of these potential sources. **(Westinghouse 2005)**

Table 2.2-1 Nearby Largest Employers

Burke County, GA	Aiken County, SC	Barnwell County, SC
Burke County Hospital	Westinghouse Savannah River	Dixie Narco Inc.
Kwikset Corporation	Aiken County Board of Education	Barnwell School District #45
Management Analysis & Utilization Inc.	Bechtel Savannah River Company	Ness Motley Loadholt Richardson
Samson Manufacturing Inc.	Avondale Mills Inc.	Sara Lee Sock Company Inc.
Southern Nuclear Operating Co. Inc.	Kimberly-Clark Corporation	Excel Comfort Systems Inc.

Table 2.2-2 Description of Products and Materials: Chem-Nuclear Systems, Inc.

Products or Materials	Status	Annual Amounts	Shipment
Isotopes – Including Co-60 (by far largest quantity),Fe-55, and Ni-63	Stored	0.50 x 10^6 ft^3 (7/1/04-6/30/05) 0.45 x 10^6 ft^3 (7/1/05-6/30/06) 0.40 x 10^6 ft^3 (7/1/06-6/30/07) 0.35 x 10^6 ft^3 (7/1/07-7/30/08)	400/year; average volume - 150 ft^3; largest volume for a single shipment - 8,000 ft^3

Note: The above materials are transported via highway.

Table 2.2-3 Burke County, Georgia Transportation Accident Data Within 5 Miles of the VEGP Site

	1999	2000	2001	2002	2003
State Route 80					
Accidents					
Injuries	5	0	10	3	3
Fatalities	0	0	0	0	0
State Route 23					
Accidents					
Injuries	14	3	9	15	12
Fatalities	3	0	0	0	0
State Route 56C					
Accidents					
Injuries	0	0	0	0	0
Fatalities	0	0	0	0	0

Table 2.2-4 Bush Field (Augusta) Terminal Area Forecast Fiscal Years 1990–2025 Total Flights

Year	Total[a]
1990	47981
1991	38455
1992	37682
1993	36246
1994	33057
1995	34008
1996	33346
1997	34459
1998	34428
1999	37631
2000	36961
2001	35222
2002	34617
2003	33916
2004	35561
2005	27917
2006	28330
2007	28753
2008	29184
2009	29625
2010	30074
2011	30532
2012	31001
2013	31479
2014	31967
2015	32305
2016	32647
2017	32995
2018	33347
2019	33703
2020	34065
2021	34430
2022	34801
2023	35178
2024	35558
2025	35945

[a] Itinerant Operations (air taxi & commercial + general aviation + military)

Table 2.2-5 VEGP Units 1 and 2 Onsite Chemical Storage

Material	Quantity	Location
Kitchen Grease	550 gallons	Underground tank east of service building
No. 2 Diesel Fuel	1,500 gallons	South of PESB
No. 2 Diesel Fuel	160,000 gallons*	East of U1 diesel generator building
No. 2 Diesel Fuel	160,000 gallons*	West of U2 diesel generator building
Hydrazine	6,000 gallons	East of turbine building
Methoxypropylamine	12,780 gallons	East of turbine building
Clean Lube Oil	30,000 gallons	East of turbine building
Dirty Lube Oil	30,000 gallons	East of turbine building
No. 2 Diesel Fuel	100,000 gallons	East of turbine building
No. 2 Diesel Fuel	560 gallons	Fire protection pumphouse
No. 2 Diesel Fuel	560 gallons	Fire protection pumphouse
Main Turbine Lube Oil	12,800 gallons	Turbine building
Main Turbine Lube Oil	12,800 gallons	Turbine building
SGFP Lube Oil	2,800 gallons	Turbine building
SGFP Lube Oil	2,800 gallons	Turbine building
EHC Fluid	1,600 gallons	Turbine building
EHC Fluid	1,600 gallons	Turbine building
No. 2 Diesel Fuel	1,250 gallons	U1 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U1 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U2 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U2 diesel generator building
Unleaded Gasoline	6,000 gallons	East of receiving warehouse
No. 2 Diesel Fuel	3,000 gallons	East of receiving warehouse
Sodium Hypochlorite	6,700 gallons	Main Cooling towers
Dispersant**	4,400 gallons	Main Cooling towers
MS Corrosion Inhibitor***	5,050 gallons	Main Cooling towers
Copper Corrosion Inhibitor****	2,200 gallons	Main Cooling towers
Kerosene	7,000 gallons	Fire training area
Sodium Hypochlorite	250 gallons	East of plant potable water storage tank
Boric Acid	46,000 gallons	U1 aux building
Boric Acid	46,000 gallons	U2 aux building
Used Oil	4,000 gallons	NW of admin support building
Used Oil	5,000 gallons	NW of admin support building
Sodium Bromide	4,000 gallons	Main Cooling towers
Nalco STABREX	6,700 gallons	Main Cooling towers
Sodium Hypochlorite	200 gallons	Plant potable water building
Sodium Phosphate, Tribasic	200 gallons	Plant potable water building
Copper Corrosion Inhibitor****	200 gallons	U1 NSCW tower chemical addition building
Copper Corrosion Inhibitor****	200 gallons	U2 NSCW tower chemical addition building
Ammonium Bisulfite	200 gallons	Circulating water dechlorination building

* Actually two 80,000 gallon tanks that are interconnected and function as one tank.
** Currently using Nalco 3DT102, swapping to Nalco 3DT190 during summer 2006.
*** Currently using Nalco 73297, swapping to Nalco 3DT177 during summer 2006.
**** Currently using Nalco 1336.

Table 2.2-6 AP1000 (VEGP Units 3 and 4) Onsite Chemicals

Material	State	Location
Hydrogen	Gas	Gas storage
Nitrogen	Liquid	Turbine building
CO_2	Liquid	Turbine building
Oxygen Scavenger	Liquid	Turbine building
pH Addition	Liquid	Turbine building
Sulfuric Acid	Liquid	Turbine building
Sodium Hydroxide	Liquid	Turbine building
Dispersant[a]	Liquid	Turbine building
Fuel Oil	Liquid	DG fuel oil storage tank/DG building/ Turbine building/ Annex building
Corrosion Inhibitor	Liquid	Turbine building
Scale Inhibitor	Liquid	Turbine building
Biocide/Disinfectant	Liquid	Turbine building
Algaecide	Liquid	Turbine building

[a]Site specific, by Combined License applicant

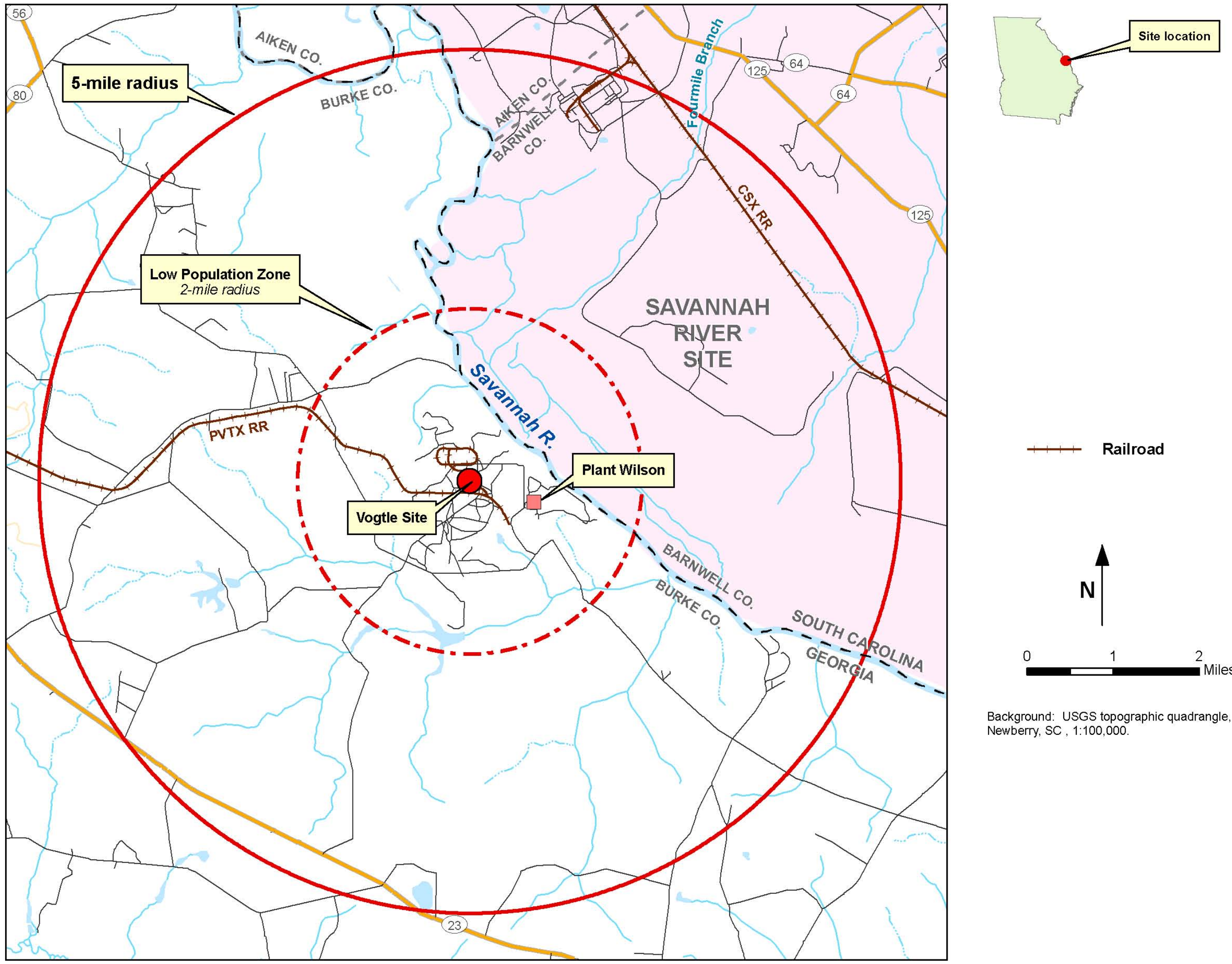


Figure 2.2-1 Site Vicinity Map

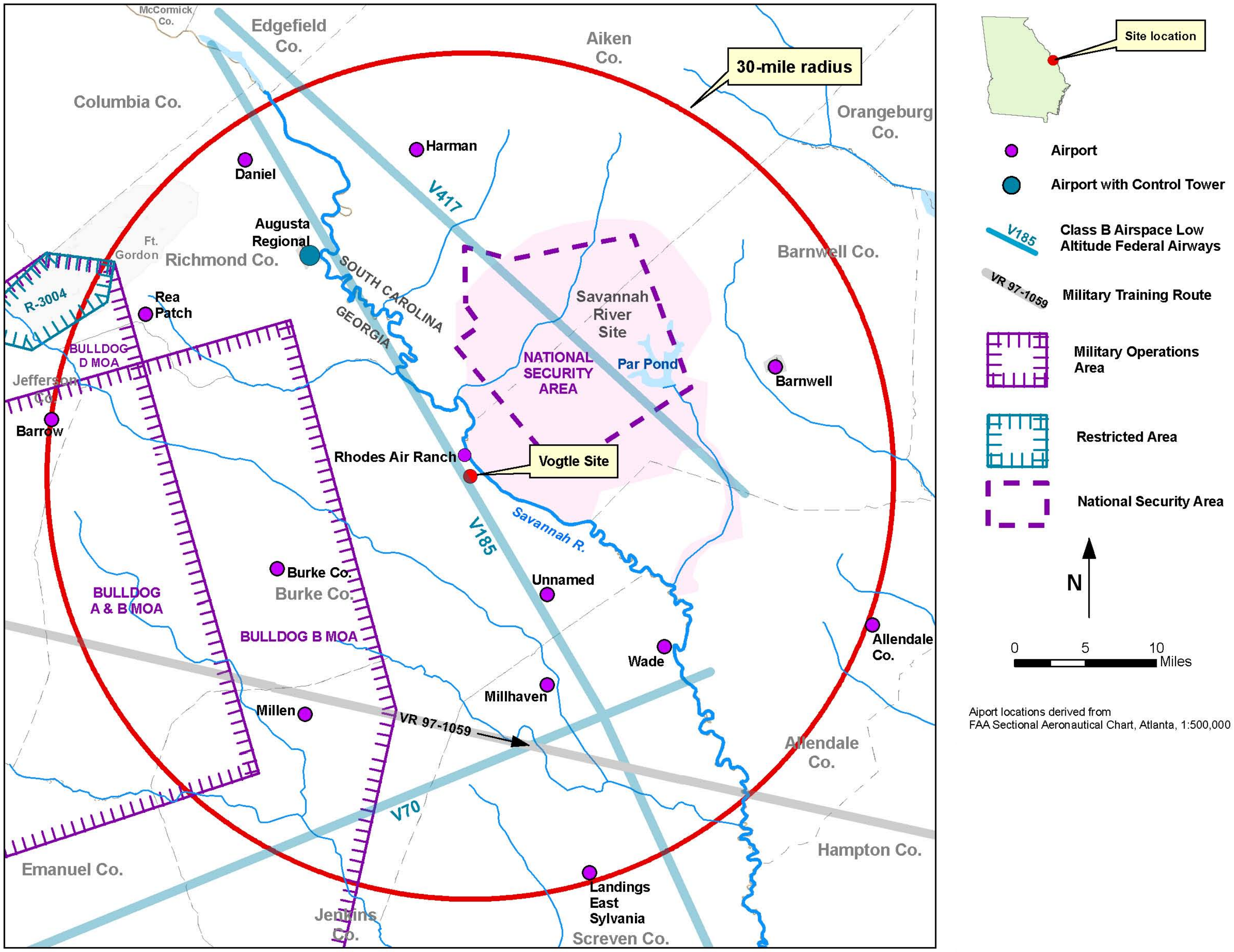


Figure 2.2-2 Airports within 30 miles of VEGP

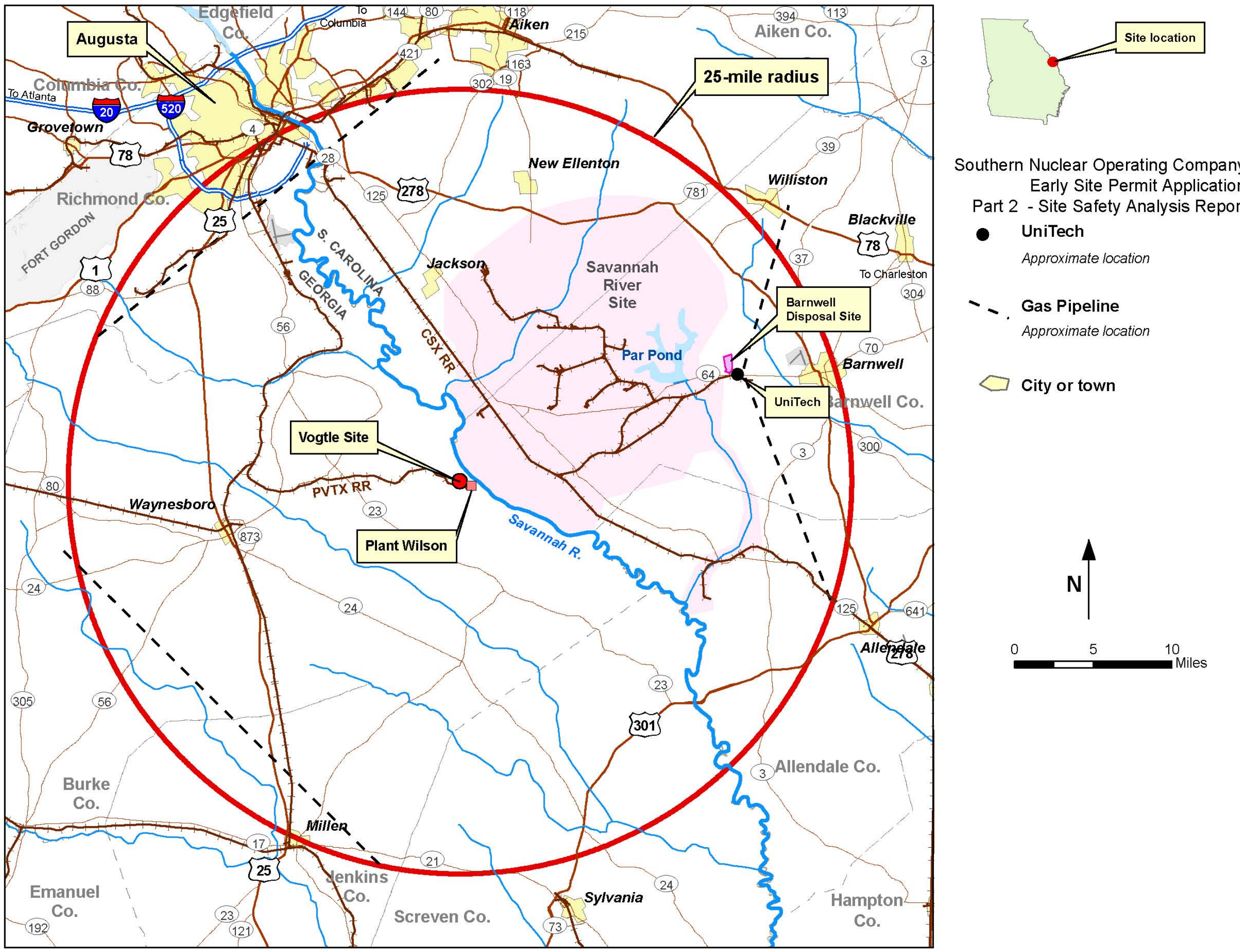


Figure 2.2-3 Industrial Facilities within 25 miles of VEGP

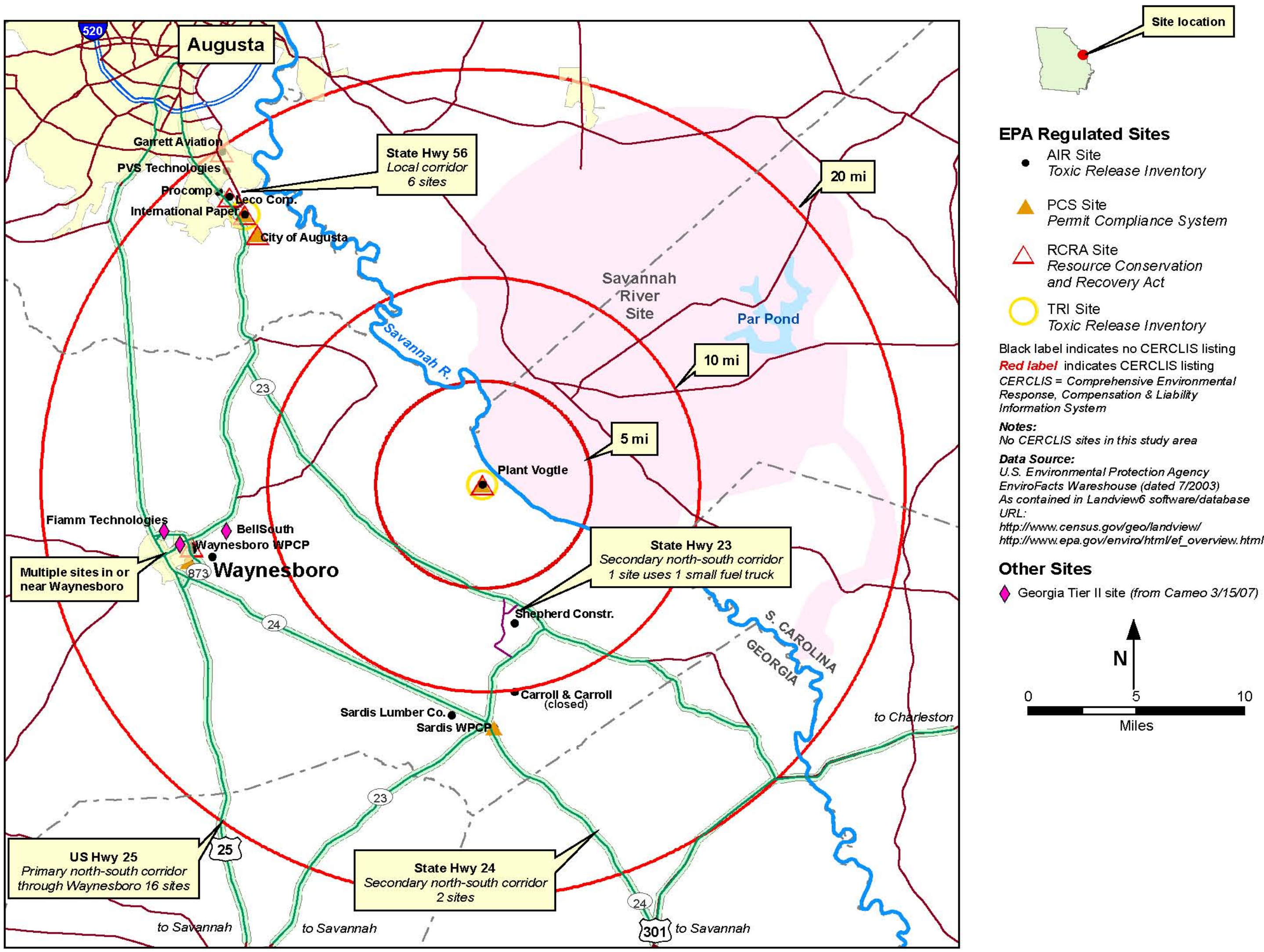


Figure 2.2-4 Corridor Analysis Study

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Southern Nuclear Operating Company

AR-07-0401

Enclosure 4

Proposed Revision to ER Section 5.4, Radiological Impacts of Normal Operation

NOTE: This enclosure consists of an 11-page ESP application section.

5.4 Radiological Impacts of Normal Operation

This section describes the radiological impacts of normal plant operation on members of the public, plant workers, and biota. Section 5.4.1 describes the exposure pathways by which radiation and radioactive effluents could be transmitted from Units 3 and 4 to organisms living near the plant. Section 5.4.2 estimates the maximum doses to the public from the operation of one new unit. Section 5.4.3 evaluates the impacts of these doses by comparing them to regulatory limits for one unit. In addition, the impact of two new units in conjunction with the existing units is compared to the corresponding regulatory limit. Section 5.4.4 considers the impact to non-human biota. Section 5.4.5 describes the radiation doses to plant workers from the new units.

5.4.1 Exposure Pathways

Small quantities of radioactive liquids and gases would be discharged to the environment during normal operation of Units 3 and 4. The impact of these releases and any direct radiation to individuals, population groups, and biota in the vicinity of the new units was evaluated by considering the most important pathways from the release to the receptors of interest. The major pathways are those that could yield the highest radiological doses for a given receptor. The relative importance of a pathway is based on the type and amount of radioactivity released, the environmental transport mechanism, and the consumption or usage factors of the receptor.

The exposure pathways considered and the analytical methods used to estimate doses to the maximally exposed individual (MEI) and to the population surrounding the new units are based on NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50*, Appendix I (Rev.1, October 1977) (RG 1.109) and NRC Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors (Revision 1, July 1977) (RG 1.111). An MEI is a member of the public located to receive the maximum possible calculated dose. The MEI allows dose comparisons with established criteria for the public.

5.4.1.1 Liquid Pathways

Units 3 and 4 would release effluents to the Savannah River. The NRC-endorsed LADTAP II computer program **(NRC 1986)** was used to calculate these doses, with parameters specific to the river and downstream locations. This program implements the radiological exposure models described in Reg. Guide 1.109 for radioactivity releases in liquid effluent. The following important exposure pathways are considered in LADTAP II:

- Ingestion of aquatic organisms as food
- Ingestion of drinking water

Although less important, the shoreline, swimming and boating exposure pathways are also considered in LADTAP II. The input parameters for the liquid pathway are presented in Tables 5.4-1. The discharge is assumed fully mixed with the river flow.

5.4.1.2 Gaseous Pathways

The GASPAR II computer program was used to calculate the doses to offsite receptors from the new units. This program implements the radiological exposure models described in NRC Reg. Guide 1.109 to estimate the doses resulting from radioactive releases in gaseous effluent. The atmospheric dispersion component of the analysis was calculated with the NRC-sponsored program, XOQDOQ **(NRC 1982)**. Dispersion and deposition factors, shown in Section 2.7, were calculated from onsite meteorological parameters (wind speed, wind direction, stability class) for 1998-2002.

The following exposure pathways are considered in GASPAR II:

- External exposure to contaminated ground
- External exposure to gases in air
- Inhalation of airborne activity
- Ingestion of contaminated meat and milk
- Ingestion of contaminated garden vegetables

The input parameters for the gaseous pathway are presented in Table 5.4-2, and the receptor locations of maximum exposure, determined from GASPAR calculations, are shown in Table 5.4-3.

5.4.1.3 Direct Radiation from Units 3 and 4

Contained sources of radiation at the new units will be shielded. The AP1000 is expected to provide shielding that is at least as effective as existing light water reactors (LWR). An evaluation of all operating plants by the NRC states that:

> *"…because the primary coolant of an LWR is contained in a heavily shielded area, dose rates in the vicinity of light water reactors are generally undetectable and are less than 1 mrem/year at the site boundary. Some plants [mostly BWRs] do not have completely shielded secondary systems and may contribute some measurable off-site dose." (NRC 1996 Section 4.6.1.2)*

Thus, the direct radiation from normal operation would result in small contributions at site boundaries. Therefore, direct dose contribution from the new units would be SMALL and would not warrant additional mitigation. No further consideration of direct radiation is provided.

5.4.2 Radiation Doses to Members of the Public

In this section, doses to MEIs from liquid and gaseous effluents from one new unit are estimated using the methodologies and parameters specified in Section 5.4.1.

5.4.2.1 Liquid Pathway Doses

Based on the parameters shown in Table 5.4-1, the LADTAP II computer program was used to calculate the important doses to the MEI via the following activities:

- Eating fish caught in the Savannah River
- Drinking water from the Savannah River

Doses from shoreline activities were also calculated but found to be much smaller than those from fish ingestion and drinking water. The liquid activity releases (source terms) for each radionuclide are shown in Table 3.5-1. The calculated annual doses to the total body, the thyroid, and the maximally exposed organ are presented in Table 5.4-5. The maximum annual organ dose from liquid releases of 0.021 millirem per unit would be to the liver of the maximally exposed child.

5.4.2.2 Gaseous Pathway Doses

Based on the parameters in Table 5.4-2 and Table 5.4-3, the GASPAR II computer program was used to calculate doses to the maximally exposed individual child (MEI), who represents the bounding age group for total body and all organs. The location of this individual is given in Table 5.4-4. This location was conservatively chosen as the distance to the nearest offsite receptor (0.67 miles) in the maximum exposure direction (chosen from among the 16 compass directions encircling the site). The gaseous activity releases (source terms) for each radionuclide are shown in Table 3.5-2. The calculated annual pathway components for the total body, thyroid, and other organ doses for this individual are presented (for two new units) in Table 5.4-6. The total body MEI (annual total body dose of 1.09 mrem per unit) is a nearby child resident that would be exposed through plume, ground, inhalation, and ingestion of locally grown meat and vegetables pathways; milk consumption was not considered because no milk animals are located within 5 miles of the plant. The maximum annual thyroid dose to this same individual is 5.97 mrem per unit. Based on experience at the existing unit, these calculations are conservative and do not represent actual doses to individuals near the Vogtle site.

5.4.3 Impacts to Members of the Public

In this section, the radiological impacts to individuals and population groups from liquid and gaseous effluents are presented using the methodologies and parameters specified in Section 5.4.1. Table 5.4-7 estimates the single-unit total body and organ doses to the MEI from liquid effluents and gaseous releases from the new units for analytical endpoints prescribed in 10 CFR 50, Appendix I. As the table indicates, the single-unit doses are below Appendix I limits.

The total liquid and gaseous effluent doses from existing Units 1 and 2 plus proposed Units 3 and 4 would be well within the regulatory limits of 40 CFR 190 (Table 5.4-8). As indicated in NUREG-1555, demonstration of compliance with the limits of 40 CFR 190 is considered to be in compliance with the 0.1 rem limit of 10 CFR 20.1301. Table 5.4-9 shows the collective total body dose to the population within 50 miles of the VCSNS site that would be attributable to the new units. Impacts to members of the public from operation of the new units would be SMALL and would not warrant additional mitigation.

5.4.4 Impacts to Biota Other than Members of the Public

Radiation exposure pathways to biota were examined to determine if the pathways could result in doses to biota significantly greater than those predicted for humans. This assessment used species that provide representative information about the various dose pathways potentially affecting broader classes of living organisms. The liquid pathway doses to these species are calculated by the LADTAP II computer program. The gaseous pathway doses were taken as equivalent to adult human doses for the inhalation, vegetation ingestion, plume, and twice the ground pathways; neither muskrats nor heron normally ingest terrestrial vegetation and that pathway was deleted for those species. The doubling of doses from ground deposition reflects the closer proximity of these organisms to the ground.

Doses to biota from liquid and gaseous effluents are shown in Table 5.4-10. The total body dose is taken as the sum of the internal and external dose. Annual doses to all of the surrogates meet the requirements of 40 CFR 190 (Table 5.4-10).

Use of exposure guidelines, such as 40 CFR 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The International Council on Radiation Protection states that "...if man is adequately protected then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation **(ICRP 1977, 1991)**. This assumption is appropriate in cases where humans and other biota inhabit the same environment and have common routes of exposure. It is less appropriate in cases where human access is restricted or pathways exist that are much more important for biota than for humans. Conversely, it is also known that biota with the same environment and exposure pathways as man can experience higher doses without adverse effects.

Species in most ecosystems experience dramatically higher mortality rates from natural causes than man. From an ecological viewpoint, population stability is considered more important to the survival of the species than the survival of individual organisms. Thus, higher dose limits could be permitted. In addition, no biota have been discovered that show significant changes in morbidity or mortality due to radiation exposures predicted from nuclear power plants.

An international consensus has been developing with respect to permissible dose exposures to biota. The International Atomic Energy Agency **(IAEA 1992)** evaluated available evidence including the *Recommendations of the International Commission on Radiological Protection* **(ICRP 1977)**. The IAEA found that appreciable effects in aquatic populations will not be expected at doses lower than 1 rad per day and that limiting the dose to the maximally exposed individual organisms to less than 1 rad per day will provide adequate protection of the population. The IAEA also concluded that chronic dose rates of 0.1 rad per day or less do not appear to cause observable changes in terrestrial animal populations. The assumed lower threshold occurs for terrestrial rather than for aquatic animals primarily because some species of mammals and reptiles are considered more radiosensitive than aquatic organisms. The permissible dose rates are considered screening levels and higher species-specific dose rates could be acceptable with additional study or data.

The calculated total body doses in Table 5.4-10 can be compared to the 1 rad per day dose criteria evaluated in the *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards* **(IAEA 1992)**. The biota doses meet the dose guidelines by a large margin. In these cases, the annual dose to biota is much less than the daily allowable doses to aquatic and terrestrial organisms. Impacts to biota other than members of the public from exposure to sources of radiation would be SMALL and would not warrant mitigation.

5.4.5 Occupational Radiation Doses

Based on the available data on the AP1000 design, the maximum annual occupational dose is estimated to be similar to or less than that for Units 1 and 2. For 2005, the collective radiation dose to workers at Units 1 and 2 was 151 person-rem **(NRC 2006)**. The total body dose to a Unit 4 construction worker from operation of proposed Unit 3, based on all releases being from ground level, would be less than 0.74 mrem/yr, with a maximum organ dose (to the skin) of less than 2.51 mrem/yr. The impacts to workers from occupational radiation doses would be SMALL and would not warrant additional mitigation.

Table 5.4-1 Liquid Pathway Parameters

Parameter	Value
Release source terms	Table 3.5-1
Discharge rate	9229 cubic feet per second[a]
Dilution factor for discharge	1[a]
Transit time to receptor	0.1 hours, 16 hours, 48 hours[b]
Impoundment reconcentration model	None[c]
Population distribution	Table 2.5.1-1
Fish Consumption	21 kilograms per year[d]
Drinking water consumption	730 liters per year[d]

[a] Assumed fully mixed with annual average river flow at Vogtle.
[b] 0.1 hours assumed for MEI. 16 hours is average transit time halfway down 50-mile stretch. 48 hours for downstream public drinking water facilities **(SNC 2004a)**
[c] Completely mixed model used for Savannah River.
[d] Adult MEI. 6.9 kilograms and 370 liters per year average (adult population) fish and drinking water consumption, respectively **(NRC 1986)**

Table 5.4-2 Gaseous Pathway Parameters

Parameter	Value
Release Source Terms	Table 3.5-2
Population distribution	Table 2.5.1-1

Table 5.4-3 Gaseous Pathway Consumption Factors for Maximally Exposed Individual

	Annual Rate			
Consumption Factor	**Infant**	**Child**	**Teen**	**Adult**
Milk consumption (l/yr)	330	330	400	310
Meat consumption (kg/yr)	0	41	65	110
Leafy vegetable consumption (kg/yr)	0	26	42	64
Vegetable consumption (kg/yr)	0	520	630	520

Source: NRC (1987). Leafy vegetables are assumed grown in the MEI's garden for 58% of the year; the garden is assumed to supply 76% of the other vegetables ingested annually. Average population consumption of milk, meat and vegetables is 131 l/yr, 81 kg/yr, and 197 kg/yr, respectively.

Table 5.4-4 Gaseous Pathway Receptor Locations

Receptor	Direction	Distance (miles)
Site boundary	NE	0.50
Maximally exposed individual (MEI)	NE	0.67

Table 5.4-5 Liquid Pathway Doses for Maximally Exposed Individual (1 Unit) (millirem per year)

Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
0.000073	0.012	0.021	0.017	0.015	0.012	0.0090	0.0086

GI-LLI = Gastrointestinal-lining of lower intestine. Child receptor, except total body is adult and skin is teen.

Table 5.4-6 Gaseous Pathway Doses for Total Body Maximally Exposed Individual - Two Units (millirem per year)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.30E-01	4.30E-01	4.30E-01	4.30E-01	4.30E-01	4.30E-01	4.57E-01	1.92E+00
GROUND	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	2.06E-01
VEGET								
ADULT	4.08E-01	4.15E-01	1.95E+00	4.09E-01	3.91E-01	3.90E+00	3.65E-01	3.61E-01
TEEN	6.07E-01	6.16E-01	3.08E+00	6.29E-01	6.01E-01	5.25E+00	5.62E-01	5.55E-01
CHILD	1.33E+00	1.30E+00	7.19E+00	1.38E+00	1.33E+00	1.02E+01	1.27E+00	1.25E+00
MEAT								
ADULT	1.25E-01	1.51E-01	5.41E-01	1.25E-01	1.22E-01	3.03E-01	1.20E-01	1.20E-01
TEEN	1.00E-01	1.15E-01	4.56E-01	1.02E-01	9.98E-02	2.30E-01	9.82E-02	9.78E-02
CHILD	1.81E-01	1.88E-01	8.55E-01	1.83E-01	1.81E-01	3.78E-01	1.79E-01	1.78E-01
COW MILK								
ADULT	1.83E-01	1.58E-01	6.44E-01	1.99E-01	1.88E-01	5.32E+00	1.52E-01	1.49E-01
TEEN	2.97E-01	2.68E-01	1.18E+00	3.44E-01	3.25E-01	8.45E+00	2.64E-01	2.56E-01
CHILD	6.41E-01	6.01E-01	2.87E+00	7.42E-01	7.06E-01	1.69E+01	6.03E-01	5.92E-01
INFANT	1.27E+00	1.21E+00	5.50E+00	1.51E+00	1.39E+00	4.07E+01	1.22E+00	1.20E+00
GOAT MILK								
ADULT	2.70E-01	1.94E-01	7.26E-01	3.05E-01	2.50E-01	6.39E+00	1.94E-01	1.83E-01
TEEN	3.93E-01	3.15E-01	1.31E+00	5.13E-01	4.19E-01	1.01E+01	3.23E-01	3.01E-01
CHILD	7.54E-01	6.74E-01	3.17E+00	1.02E+00	8.57E-01	2.02E+01	6.97E-01	6.63E-01
INFANT	1.42E+00	1.32E+00	5.94E+00	2.02E+00	1.63E+00	4.87E+01	1.37E+00	1.31E+00
INHAL								
ADULT	5.58E-02	5.65E-02	8.32E-03	5.71E-02	5.80E-02	5.10E-01	7.22E-02	5.42E-02
TEEN	5.65E-02	5.70E-02	1.01E-02	5.86E-02	6.00E-02	6.37E-01	8.18E-02	5.47E-02
CHILD	5.00E-02	4.93E-02	1.23E-02	5.21E-02	5.32E-02	7.43E-01	7.08E-02	4.83E-02
INFANT	2.89E-02	2.82E-02	6.20E-03	3.11E-02	3.10E-02	6.66E-01	4.34E-02	2.78E-02
SUM OF VIABLE PATHWAYS (CHILD)	**2.17E+00**	**2.14E+00**	**8.66E+00**	**2.22E+00**	**2.17E+00**	**1.19E+01**	**2.15E+00**	**3.60E+00**

Note: Maximally exposed individual is child resident. Adult, teen and infant doses are presented as additional information. Cow milk and goat milk pathway doses are hypothetical for this location and are presented as additional information only. Ground level releases assumed.

Table 5.4-7 Comparison of Annual Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

Type of Dose	Location	Annual Dose AP1000 (per unit)	Limit
Liquid effluent[a]			
Total body (mrem)	Savannah River	0.017	3
Maximum organ – liver (mrem)	Savannah River	0.021	10
Gaseous effluent[b]			
Gamma air (mrad)	Site boundary	0.58	10
Beta air (mrad)	Site boundary	2.21	20
Total external body (mrem)	Site boundary	0.50	5
Skin (mrem)	Site boundary	1.78	15
Iodines and particulates (gaseous effluents)			
Maximum organ – thyroid (mrem)	MEI	5.01[c]	15

[a]Total body is adult using Savannah River. Liver is child using Savannah River.

[b]Northeast Site Boundary. Ground level releases assumed.

[c]Child eating home grown meat and vegetables. Difference between Table 5.4-7 and 5.4-8 thyroid dose is 0.43 millirem from noble gases in the plume and 1.48 millirem from H3 and C14 in vegetables, meat and inhaled air for two units.

Table 5.4-8 Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria – (millirem per year)

	Units 3 and 4			Units 1 and 2			Site Total	Regulatory Limit
	Liquid	Gaseous[a]	Total	Liquid[b]	Gaseous[b]	Total		
Total body	0.034	2.17	2.20	0.091	0.0017	0.092	2.30	25
Thyroid	0.027	11.93	11.96	0.061	0.0012	0.062	12.02	75
Other organ - bone	0.024[c]	8.66	8.68	0.054[d]	0.0017[e]	0.055	8.74	25

[a]Residence with meat animal and vegetable garden, dose to child, 0.67miles NE of new units (MEI).
[b]From doses due to 2001 releases (SNC, 2002), the year of maximum MEI total body dose of years 2001-2004. Air pathway receptor is child eating home grown meat and vegetables, 4.7 miles SSW of the existing units.
[c]Maximum other organ dose for Units 3 and 4 liquid pathway is 0.042 to the liver of a child.
[d]Maximum other organ dose for Units 1 and 2 liquid pathway is 0.15 to the GI-LLI.
[e]Maximum other organ doses for units 1 and 2 gaseous pathways are to the liver, kidney, lung, and GI/LLI.

Table 5.4-9 Collective Total Body Doses within 50 Miles (person-rem per year)

	Units 3 and 4		Units 1 and 2	
	Liquid	Gaseous	Liquid	Gaseous
Noble gases	0	0.51	0	0.001
Iodines and particulates	0.058	0.14	0.003	0.16
Tritium and C-14	0.68	1.09	0.65	0.049
Total	0.74	1.74	0.65	0.21
Natural background	2.42E5		2.42E5	

Note: Natural background dose is based on a dose rate of 360 mrem/person/yr and a population of 674,101 (Table 2.5.1-1).
Source: Unit 1 source terms from SNC (2003) for gaseous releases and SNC (2004b) for liquid releases.

Table 5.4-10 Doses to Biota from Liquid and Gaseous Effluents

Biota	Dose (millirad per yr)		
	Liquid effluents[a]	Gaseous effluents[b]	Total
Fish	0.16	0	0.16
Muskrat	0.47	1.38	1.85
Raccoon	0.19	2.05	2.24
Heron	2.15	1.38	3.53
Duck	0.45	2.05	2.50

[a]Using Savannah River water in vicinity of release.

[b]Assumed residing at site boundary. Adult pathway doses from GASPAR for plume, vegetation ingestion (except herons and muskrats) and inhalation; ground exposure taken as twice adult. RBE equal one.

Section 5.4 References

(IAEA 1992) International Atomic Energy Agency, 1992. Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards, Report Series No. 332.

(ICRP 1977) International Council on Radiation Protection, 1977. *Recommendations of the International Commission on Radiological Protection*, ICRP Publication 26.

(ICRP 1991) International Council on Radiation Protection 1991. *Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60.

(NRC 1982) U.S. Nuclear Regulatory Commission, 1982. *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations Final Report*, NUREG/CR-2919, Office of Nuclear Reactor Regulation, Washington D.C., September.

(NRC 1986) U.S. Nuclear Regulatory Commission, 1986. *LADTAP II Technical Reference and User Guide*, NUREG/CR-4013, Office of Nuclear Reactor Regulation, Washington D.C., April.

(NRC 1987) U.S. Nuclear Regulatory Commission, 1987. *GASPAR II Technical Reference and User Guide*, NUREG/CR-4653, Office of Nuclear Reactor Regulation, Washington D.C., March.

(NRC 1996) U.S. Nuclear Regulatory Commission, 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Vol.1, Office of Nuclear Regulatory Research, Washington D.C., May.

(NRC 2006) U.S. Nuclear Regulatory Commission, 2006. *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2005*, Thirty-Eighth Annual Report, NUREG-0713, Vol.27, Office of Nuclear Regulatory Research, Washington D.C., December.

(SNC 2002) Southern Nuclear Company, 2002. *Annual Radioactive Effluent Release Report for January 1, 2001 to December 31, 2001,* Undated.

(SNC 2003) Southern Nuclear Company, 2003. *Annual Radioactive Effluent Release Report for January 1, 2002 to December 31, 2002,* Undated.

(SNC 2004a) Southern Nuclear Company, 2004. *Offsite Dose Calculation Manual for Southern Nuclear Operating Company Vogtle Electric Generating Plant*, Version 22, June 25, 2004.

(SNC 2004b) Southern Nuclear Company, 2004a. *Annual Radioactive Effluent Release Report for January 1, 2003 to December 31, 2003,* Undated.

Southern Nuclear Operating Company

AR-07-0401

Enclosure 5

Westinghouse Document LTR-CRA-06-21

NOTE: This enclosure consists of a 14-page Westinghouse letter.

Westinghouse

To: J. L. Whiteman | Date: February 1,2006

From: Containment & Radiological Analysis
Ext: 412-374-5585 | Our ref: LTR-CRA-06-21
Fax: 412-374-5099
Ref: 1. Bechtel Request for Information RFI No. 25144-000-GRI-GEX-0021,12/14/2005
(a copy of page 1 of this document is attached)

Subject: **AP1000 Accident Releases and Doses as a Function of Time**

In response to Reference 1, the computer runs for the AP1000 accident radiological consequences analyses have been reviewed and the activity releases and doses have been extracted for the significant time intervals and are provided in the following pages. As requested, the accidents addressed are:

- Large break LOCA
- Main steam line break with accident-initiated iodine spike
- Main steam line break with pre-existing iodine spike
- Locked rotor with feedwater unavailable
- Locked rotor with feedwater available
- Rod ejection
- Steam generator tube rupture with accident-initiated iodine spike
- Steam generator tube rupture with pre-existing iodine spike
- Small line break outside containment
- Fuel handling accident

All the analyses, except for the LOCA, used the following atmospheric dispersion values for the LPZ:

EAB	8.0E-4 sec/m^3
LPZ (0-8 hr)	5.0E-4 sec/m^3
LPZ (8-24 hr)	3.0E-4 sec/m^3
LPZ (24-96 hr)	1.5E-4 sec/m^3
LPZ (96-720 hr)	8.0E-5 sec/m^3

The LOCA analysis was revised to address recalculated values for the activity removal coefficients and this required the definition of lower values for the atmospheric dispersion factors in order to obtain acceptable doses (the revised dispersion factors were not applied to the other events). The atmospheric dispersion factors for the LOCA are:

EAB	5.1E-4 sec/m^3
LPZ (0-8 hr)	2.2E-4 sec/m^3
LPZ (8-24 hr)	1.6E-4 sec/m^3
LPZ (24-96 hr)	1.0E-4 sec/m^3
LPZ (96-720 hr)	8.0E-5 sec/m^3

A BNFL Group company

Activity releases that are lower than 1.0E-10 Ci are reported as being zero. Note also that the doses provided here are the actual calculated doses and do not include the rounding-up that is reflected in the doses reported in the DCD.

J. L. Grover
Containment & Radiological Analysis

Verifier: S. T. Kinnas
Containment & Radiological Analysis

Approved: S. I. Dederer
Acting Manager
Containment & Radiological Analysis

REQUEST FOR INFORMATION (RFI)

RFI NUMBER: 25144-000-GRI-GEX-00021	DATE: December 14,2005
PROJECT NUMBER: 25144	PROJECT NAME: SNC ALWR ESP Project
PREPARED BY: S. Jha/D. Kemp **PHONE/FAX:** 301-228-6435/240-379-2842	DISCIPLINE: Nuclear
TO: C. Pierce	
REFERENCE **DRAWING(S)/DOCUMENT(S):** Westinghouse Doc. APP-0000-XI-001 AP1000 DCD	**REV.:** 3 14
SPECIFICATION(S): N/A	**REV.:**

INFORMATION REQUESTED:

Request for DCD Post Accident Doses (by Time Step) and DCD Source Terms (by Time Step)

For the Vogtle ESP. Bechtel intends to ratio the radiological dose consequences of design basis accidents based on the difference of the short-term atmospheric dispersion factors for Vogtle Site and those assumed in the DCD (but not reported in the DCD). In order to accomplish this effort, Bechtel also needs the DCD time-dependent low population zone (LPZ) doses for each accident which is analyzed for longer than 8 hrs. The DCD only provides the total dose at the LPZ.

The attached 3 emails were provided by Westinghouse for the Dominion Project, North Anna, for this same purpose. However, the DCD no longer agrees with the attached information (total doses have changed). Also, when the North Anna Application was prepared, Westinghouse did not have the activity releases for the Failure of Small Lines Carrying Primary Coolant Outside Containment (FSL).

Bechtel needs the following information for the Vogtle Analyses:

1. Provide the Westinghouse / DCD time-dependent LPZ doses for the following accidents: Loss of Coolant Accident (LOCA), Steam Generator Tube Rupture (SGTR) with Pre-Existing Iodine Spike, SGTR with Accident-Initiated Iodine Spike, Main Steam Line Break (MSLB) with Pre-Existing Iodine Spike, MSLB with Accident-Initiated Iodine Spike, and Rod Ejection. The 0 – 8 hr LPZ doses for the Locked Rotor and the Fuel Handling Accident (FHA) are in the DCD.

2. Provide the Westinghouse / DCD timedependent isotopic activity releases (gaseous source terms) for LOCA, SGTR with Pre-Existing Iodine Spike, SGTR with Accident-Initiated Iodine Spike, MSLB with Pre-Existing Iodine Spike, MSLB with Accident-Initiated Iodine Spike, FHA, Locked Rotor, and Rod Ejection.

3. Provide the Westinghouse / DCD time-dependent source terms for the FSL It is assumed that the LPZ dose provided in the DCD is for a single time step of 0 – 8 hr. If this is not the case, also provide the time-dependent LPZ doses for the FSL.

RESPONSE REQUIRED BY: February 1, 2006.

IMPACTS: The requested information will be used in the ESP application in Section 15 of the Safety Analysis Report and in Section 7.1 of the Environmental Report. If the information is nat received by the required date. the schedule for completing these sections may be delayed

APPROVED FOR ISSUANCE TO SNC:

EGS: DAK [signature] DATE: December 21,2005

PE: [signature] **DATE:** December 21, 2005

RESPONSE INFORMATION

TO: John Prebula / Robert Prunty	**FROM:** Charles R. Pierce
OF: Bechtel Power Corporation	OF: Southern Nuclear Operating Company

Summary of Releases and Doses

for the AP1000

Large Break Loss-of-Coolant Accident (LOCA)

		TEDE Dose (rem)
EAB	1.4-3.4 hr	2.43E+01
LPZ	0-8 hr	2.17E+01
	8-24 hr	7.69E-01
	24-96 hr	3.71E-01
	96-720 hr	8.70E-01

LOCA Activity Releases (Ci)					
	1.4-3.4 hr	0-8 hr	8-24 hr	24-96 hr	96-720 hr
I-130	5.637E+01	1.119E+02	5.373E+00	7.100E-01	1.270E-02
I-131	1.676E+03	3.485E+03	2.664E+02	2.386E+02	7.193E+02
I-132	1.232E+03	2.137E+03	1.637E+01	1.456E-02	0.000E+00
I-133	3.232E+03	6.541E+03	3.826E+02	1.042E+02	1.040E+01
I-134	6.599E+02	1.138E+03	2.964E-01	6.791E-08	0.000E+00
I-135	2.558E+03	4.894E+03	1.578E+02	6.085E+00	3.161E-03
Kr-85m	1.416E+03	3.771E+03	1.874E+03	8.559E+01	1.216E-03
Kr-85	8.306E+01	2.968E+02	7.055E+02	1.585E+03	1.360E+04
Kr-87	1.098E+03	1.945E+03	4.966E+01	4.053E-03	0.000E+00
Kr-88	3.111E+03	7.260E+03	1.697E+03	1.745E+01	4.087E-07
Xe-131m	8.257E+01	2.935E+02	6.787E+02	1.372E+03	5.570E+03
Xe-133m	4.431E+02	1.539E+03	3.153E+03	4.109E+03	2.582E+03
Xe-133	1.469E+04	5.187E+04	1.158E+05	2.056E+05	4.070E+05
Xe-135m	1.062E+01	3.594E+01	2.144E-07	0.000E+00	0.000E+00
Xe-135	3.150E+03	9.638E+03	1.011E+04	2.106E+03	8.682E+00
Xe-138	3.105E+01	1.204E+02	1.584E-07	0.000E+00	0.000E+00
Rb-86	3.039E+00	6.320E+00	2.985E-01	9.828E-02	5.128E-01
Cs-134	2.584E+02	5.381E+02	2.569E+01	9.112E+00	7.736E+01
Cs-136	7.328E+01	1.523E+02	7.159E+00	2.284E+00	9.877E+00
Cs-137	1.505E+02	3.134E+02	1.497E+01	5.319E+00	4.572E+01
Cs-138	1.498E+02	3.296E+02	2.183E-03	0.000E+00	0.000E+00
Sb-127	2.417E+01	4.801E+01	2.286E+00	5.674E-01	7.823E-01
Sb-129	5.104E+01	8.936E+01	1.505E+00	4.945E-03	4.903E-08
Te-127m	3.150E+00	6.304E+00	3.162E-01	1.109E-01	8.710E-01
Te-127	2.048E+01	3.827E+01	1.146E+00	2.745E-02	1.327E-04
Te-129m	1.072E+01	2.145E+01	1.071E+00	3.647E-01	2.355E+00
Te-129	1.879E+01	2.833E+01	2.689E-02	3.544E-08	0.000E+00
Te-131m	3.167E+01	6.196E+01	2.640E+00	3.345E-01	7.809E-02

Official record electronically approved in EDMS

LOCA Activity Releases (Ci)					
	1.4-3.4 hr	0-8 hr	8-24 hr	24-96 hr	96-720 hr
Te-132	3.228E+02	6.404E+02	3.019E+01	7.040E+00	7.831E+00
Sr-89	9.228E+01	1.846E+02	9.238E+00	3.190E+00	2.263E+01
Sr-90	7.948E+00	1.591E+01	7.993E-01	2.840E-01	2.442E+00
Sr-91	9.677E+01	1.810E+02	5.459E+00	1.348E-01	7.056E-04
Sr-92	6.830E+01	1.131E+02	1.014E+00	5.149E-04	0.000E+00
Ba-139	5.436E+01	8.302E+01	1.485E-01	9.906E-07	0.000E+00
Ba-140	1.627E+02	3.249E+02	1.606E+01	5.106E+00	2.166E+01
Mo-99	2.146E+01	4.252E+01	1.981E+00	4.288E-01	3.779E-01
Tc-99M	1.472E+01	2.662E+01	6.048E-01	5.265E-03	1.333E-06
Ru-103	1.731E+01	3.462E+01	1.730E+00	5.928E-01	3.985E+00
Ru-105	8.177E+00	1.436E+01	2.483E-01	8.864E-04	1.172E-08
Ru-106	5.702E+00	1.141E+01	5.731E-01	2.029E-01	1.698E+00
Rh-105	1.028E+01	2.018E+01	8.812E-01	1.287E-01	4.144E-02
Ce-141	3.890E+00	7.780E+00	3.884E-01	1.321E-01	8.451E-01
Ce-143	3.460E+00	6.784E+00	2.934E-01	4.047E-02	1.142E-02
Ce-144	2.941E+00	5.886E+00	2.955E-01	1.045E-01	8.677E-01
Pu-238	9.159E-03	1.834E-02	9.211E-04	3.272E-04	2.815E-03
Pu-239	8.059E-04	1.613E-03	8.104E-05	2.879E-05	2.478E-04
Pu-240	1.181E-03	2.365E-03	1.188E-04	4.221E-05	3.633E-04
Pu-241	2.655E-01	5.314E-01	2.670E-02	9.482E-03	8.143E-02
Np-239	4.484E+01	8.867E+01	4.078E+00	8.147E-01	5.702E-01
Y-90	8.078E-02	1.600E-01	7.437E-03	1.588E-03	1.345E-03
Y-91	1.185E+00	2.371E+00	1.187E-01	4.116E-02	2.995E-01
Y-92	7.894E-01	1.351E+00	1.795E-02	2.859E-05	0.000E+00
Y-93	1.214E+00	2.280E+00	7.084E-02	1.976E-03	1.422E-05
Nb-95	1.595E+00	3.190E+00	1.593E-01	5.435E-02	3.554E-01
Zr-95	1.586E+00	3.175E+00	1.590E-01	5.523E-02	4.077E-01
Zr-97	1.425E+00	2.742E+00	1.031E-01	6.733E-03	3.705E-04
La-140	1.672E+00	3.291E+00	1.462E-01	2.362E-02	9.620E-03
La-141	1.030E+00	1.785E+00	2.705E-02	6.411E-05	2.009E-10
La-142	5.379E-01	8.308E-01	2.091E-03	3.394E-08	0.000E+00
Nd-147	6.161E-01	1.230E+00	6.064E-02	1.895E-02	7.287E-02
Pr-143	1.390E+00	2.777E+00	1.374E-01	4.397E-02	1.940E-01
Am-241	1.196E-04	2.394E-04	1.203E-05	4.273E-06	3.677E-05
Cm-242	2.821E-02	5.647E-02	2.833E-03	9.978E-04	8.078E-03
Cm-244	3.463E-03	6.934E-03	3.483E-04	1.237E-04	1.063E-03

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Main Steam Line Break with Accident-Initiated Iodine Spike

Time Period	LPZ Dose (rem TEDE)
0-2 hr	5.06E-01
2-8 hr	5.18E-01
8-24 hr	3.77E-01
24-72 hr	5.36E-01

	Activity Releases (Ci)			
	(0-2 hr)	(2-8 hr)	(8-24 hr)	(24-72 hr)
Kr-85m	6.855E-02	1.141E-01	6.796E-02	6.177E-03
Kr-85	2.824E-01	8.462E-01	2.250E+00	6.686E+00
Kr-87	2.755E-02	1.342E-02	5.291E-04	8.602E-08
Kr-88	1.124E-01	1.372E-01	4.037E-02	8.269E-04
Xe-131m	1.277E-01	3.791E-01	9.810E-01	2.700E+00
Xe-133m	1.585E-01	4.506E-01	1.038E+00	2.054E+00
Xe-133	1.178E+01	3.454E+01	8.644E+01	2.161E+02
Xe-135m	3.043E-03	1.325E-05	0.000E+00	0.000E+00
Xe-135	3.098E-01	6.896E-01	8.351E-01	3.384E-01
Xe-138	3.985E-03	1.138E-05	0.000E+00	0.000E+00
I-130	4.198E-01	9.950E-01	1.583E+00	1.009E+00
I-131	2.600E+01	5.730E+01	1.558E+02	4.134E+02
I-132	4.617E+01	9.739E+01	2.238E+01	1.819E-01
I-133	4.908E+01	1.137E+02	2.269E+02	2.553E+02
I-134	1.343E+01	1.859E+01	2.651E-01	8.415E-07
I-135	3.235E+01	7.739E+01	7.828E+01	1.772E+01
Cs-134	1.898E+01	1.951E-01	5.185E-01	1.540E+00
Cs-136	2.822E+01	2.862E-01	7.428E-01	2.060E+00
Cs-137	1.366E+01	1.407E-01	3.739E-01	1.112E+00
Cs-138	1.012E+01	1.018E-03	4.424E-07	0.000E+00

Main Steam Line Break with Pre-Existing Iodine Spike

Time Period	LPZ Dose (rem TEDE)
0-2 hr	4.83E-01
2-8 hr	9.78E-02
8-24 hr	7.18E-02
24-72 hr	1.08E-01

	Activity Releases (Ci)			
	(0-2 hr)	(2-8 hr)	(8-24 hr)	(24-72 hr)
Kr-85m	6.855E-02	1.141E-01	6.796E-02	6.177E-03
Kr-85	2.824E-01	8.462E-01	2.250E+00	6.686E+00
Kr-87	2.755E-02	1.342E-02	5.291E-04	8.602E-08
Kr-88	1.124E-01	1.372E-01	4.037E-02	8.269E-04
Xe-131m	1.277E-01	3.791E-01	9.810E-01	2.700E+00
Xe-133m	1.585E-01	4.506E-01	1.038E+00	2.054E+00
Xe-133	1.178E+01	3.454E+01	8.644E+01	2.161E+02
Xe-135m	3.043E-03	1.325E-05	0.000E+00	0.000E+00
Xe-135	3.098E-01	6.896E-01	8.351E-01	3.384E-01
Xe-138	3.985E-03	1.138E-05	0.000E+00	0.000E+00
I-130	3.591E-01	1.417E-01	2.093E-01	1.334E-01
I-131	2.402E+01	1.211E+01	3.096E+01	8.216E+01
I-132	3.052E+01	4.142E+00	8.061E-01	6.552E-03
I-133	4.335E+01	1.898E+01	3.534E+01	3.976E+01
I-134	6.742E+00	1.633E-01	1.429E-03	4.535E-09
I-135	2.600E+01	8.156E+00	7.542E+00	1.707E+00
Cs-134	1.898E+01	1.951E-01	5.185E-01	1.540E+00
Cs-136	2.822E+01	2.862E-01	7.428E-01	2.060E+00
Cs-137	1.366E+01	1.407E-01	3.739E-01	1.112E+00
Cs-138	1.012E+01	1.018E-03	4.424E-07	0.000E+00

Locked Rotor Accident

Time Period	No Feedwater LPZ Dose (rem TEDE)
0-1.5 hr	3.89E-01

Time Period	Feedwater Available LPZ Dose (rem TEDE)
0-2 hr	1.29E-01
2-8 hr	6.65E-01

	No Feedwater		Feedwater Available		
	(0-1.5 hr)		(0-2 hr)	(2-8 hr)	(6-8 hr)
Kr-85m	8.158E+01		1.048E+02	1.744E+02	4.128E+01
Kr-85	7.576E+00		1.010E+01	3.026E+01	1.008E+01
Kr-87	1.204E+02		1.431E+02	6.965E+01	5.428E+00
Kr-88	2.078E+02		2.619E+02	3.197E+02	6.047E+01
Xe-131m	3.771E+00		5.026E+00	1.492E+01	4.945E+00
Xe-133m	2.021E+01		2.685E+01	7.636E+01	2.477E+01
Xe-133	6.664E+02		8.874E+02	2.601E+03	8.570E+02
Xe-135m	3.240E+01		3.282E+01	1.429E-01	2.677E-06
Xe-135	1.591E+02		2.082E+02	4.635E+02	1.315E+02
Xe-138	1.288E+02		1.301E+02	3.717E-01	3.009E-06
I-130	8.447E-01		1.171E-01	1.329E+00	5.652E-01
I-131	3.774E+01		5.394E+00	7.513E+01	3.459E+01
I-132	2.789E+01		3.450E+00	1.484E+01	3.950E+00
I-133	4.855E+01		6.862E+00	8.291E+01	3.644E+01
I-134	2.884E+01		2.760E+00	2.980E+00	2.091E-01
I-135	4.188E+01		5.679E+00	5.221E+01	2.045E+01
Cs-134	1.290E+00		1.822E-01	2.403E+00	1.110E+00
Cs-136	5.634E-01		8.451E-02	7.786E-01	3.465E-01
Cs-137	7.739E-01		1.099E-01	1.411E+00	6.506E-01
Cs-138	6.080E+00		7.291E-01	3.349E+00	1.127E+00
Rb-86	1.329E-02		1.828E-03	2.730E-02	1.272E-02

Note: The releases for the 6-8 hour period are identified because this is the limiting time period for the 2-hour site boundary dose.

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Rod Ejection

Time Period	LPZ Dose (rem TEDE)
0-2 hr	1.76E+00
2-8 hr	2.82E+00
8-24 hr	7.84E-01
24-96 hr	6.32E-02
96-720 hr	2.06E-02

	Activity Releases (Ci)				
	(0-2 hr)	(2-8 hr)	(8-24 hr)	(24-96 hr)	(96-720 hr)
Kr-85m	1.123E+02	6.480E+01	3.868E+01	1.767E+00	2.511E-05
Kr-85	5.012E+00	5.599E+00	1.492E+01	3.353E+01	2.877E+02
Kr-87	1.823E+02	2.596E+01	1.025E+00	8.366E-05	0.000E+00
Kr-88	2.912E+02	1.184E+02	3.491E+01	3.589E-01	8.407E-09
Xe-131m	4.938E+00	5.457E+00	1.416E+01	2.864E+01	1.162E+02
Xe-133m	2.666E+01	2.809E+01	6.485E+01	8.450E+01	5.311E+01
Xe-133	8.789E+02	9.581E+02	2.404E+03	4.267E+03	8.446E+03
Xe-135m	7.341E+01	5.304E-02	4.333E-09	0.000E+00	0.000E+00
Xe-135	2.148E+02	1.720E+02	2.088E+02	4.347E+01	1.793E-01
Xe-138	2.987E+02	1.378E-01	3.194E-09	0.000E+00	0.000E+00
I-130	4.897E+00	7.276E+00	4.321E+00	2.030E-01	2.946E-04
I-131	1.358E+02	2.452E+02	2.313E+02	3.101E+01	1.675E+01
I-132	1.528E+02	9.936E+01	9.852E+00	8.236E-03	0.000E+00
I-133	2.722E+02	4.396E+02	3.176E+02	2.280E+01	2.410E-01
I-134	1.663E+02	2.851E+01	1.367E-01	4.478E-08	0.000E+00
I-135	2.387E+02	2.974E+02	1.186E+02	2.393E+00	7.322E-05
Cs-134	3.082E+01	6.216E+01	6.030E+01	7.760E+00	5.164E+00
Cs-136	8.787E+00	1.751E+01	1.666E+01	2.049E+00	6.584E-01
Cs-137	1.793E+01	3.616E+01	3.509E+01	4.520E+00	3.051E+00
Cs-138	1.086E+02	7.046E+00	1.682E-03	0.000E+00	0.000E+00
Rb-86	3.623E-01	7.272E-01	6.956E-01	8.674E-02	3.417E-02

Small Line Break Outside Containment

LPZ Dose = 1.02 rem TEDE

	Activity Releases (Ci)
	(0-0.5 hr)
Kr-85m	1.241E+01
Kr-85	4.398E+01
Kr-87	7.047E+00
Kr-88	2.212E+01
Xe-131m	1.993E+01
Xe-133m	2.500E+01
Xe-133	1.843E+03
Xe-135m	2.588E+00
Xe-135	5.202E+01
Xe-138	3.645E+00
I-130	1.888E+00
I-131	9.256E+01
I-132	3.494E+02
I-133	2.007E+02
I-134	1.579E+02
I-135	1.680E+02
Cs-134	4.157E+00
Cs-136	6.163E+00
Cs-137	2.996E+00
Cs-138	2.214E+00

Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Time Period	LPZ Dose (rem TEDE)
0-2 hr	5.13E-01
2-8 hr	1.14E-01
8-24 hr	1.69E-01

	Activity Releases (Ci)		
	(0-2 hr)	(2-8 hr)	(8-24 hr)
Kr-85m	5.530E+01	1.929E+01	7.529E-03
Kr-85	2.204E+02	1.085E+02	1.339E-01
Kr-87	2.393E+01	3.612E+00	9.119E-05
Kr-88	9.222E+01	2.651E+01	5.429E-03
Xe-131m	9.961E+01	4.876E+01	5.909E-02
Xe-133m	1.238E+02	5.914E+01	6.609E-02
Xe-133	9.192E+03	4.468E+03	5.291E+00
Xe-135m	3.443E+00	5.862E-03	0.000E+00
Xe-135	2.455E+02	1.019E+02	7.101E-02
Xe-138	4.560E+00	5.068E-03	0.000E+00
I-130	8.870E-01	1.619E-01	8.238E-01
I-131	4.363E+01	1.142E+01	6.761E+01
I-132	1.472E+02	4.857E+00	1.291E+01
I-133	9.334E+01	1.996E+01	1.084E+02
I-134	5.587E+01	6.043E-02	5.942E-02
I-135	7.614E+01	9.880E+00	4.378E+01
Cs-134	1.626E+00	6.053E-02	2.163E-01
Cs-136	2.417E+00	8.860E-02	3.144E-01
Cs-137	1.173E+00	4.366E-02	1.560E-01
Cs-138	5.639E-01	2.914E-06	5.730E-07

Steam Generator Tube Rupture with Pre-Existing Iodine Spike

Time Period	LPZ Dose (rem TEDE)
0-2 hr	1.10E+00
2-8 hr	6.17E-02
8-24 hr	7.24E-02

	Activity Releases (Ci)		
	(0-2 hr)	(2-8 hr)	(8-24 hr)
Kr-85m	5.530E+01	1.929E+01	7.529E-03
Kr-85	2.204E+02	1.085E+02	1.339E-01
Kr-87	2.393E+01	3.612E+00	9.119E-05
Kr-88	9.222E+01	2.651E+01	5.429E-03
Xe-131m	9.961E+01	4.876E+01	5.909E-02
Xe-133m	1.238E+02	5.914E+01	6.609E-02
Xe-133	9.192E+03	4.468E+03	5.291E+00
Xe-135m	3.443E+00	5.862E-03	0.000E+00
Xe-135	2.455E+02	1.019E+02	7.101E-02
Xe-138	4.560E+00	5.068E-03	0.000E+00
I-130	1.794E+00	5.388E-02	2.680E-01
I-131	1.206E+02	5.267E+00	3.063E+01
I-132	1.416E+02	7.428E-01	1.923E+00
I-133	2.160E+02	7.634E+00	4.062E+01
I-134	2.741E+01	4.401E-03	4.227E-03
I-135	1.272E+02	2.696E+00	1.165E+01
Cs-134	1.626E+00	6.053E-02	2.163E-01
Cs-136	2.417E+00	8.860E-02	3.144E-01
Cs-137	1.173E+00	4.366E-02	1.560E-01
Cs-138	5.639E-01	2.914E-06	5.730E-07

Fuel Handling Accident

LPZ Dose = 3.44 rem TEDE

	Activity Releases (Ci)
	(0-2 hr)
Kr-85m	3.418E2
Kr-85	1.109E3
Kr-87	6.00E-2
Kr-88	1.070E2
Xe-131m	5.544E2
Xe-133m	2.801E3
Xe-133	9.657E4
Xe-135m	1.262E3
Xe-135	2.490E4
I-130	2.510E0
I-131	3.763E2
I-132	3.014E2
I-133	2.401E2
I-135	3.940E1

Southern Nuclear Operating Company

AR-07-0401

Enclosure 6

GASPAR and LADTAP II Computer Code Input and Output Data Files

on Compact Disc (CD)