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<<RAI #3 Response AR-07-0401 Part 2 of 2.pdf>>

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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 jet-

engine 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°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 °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	0.50×10^6 ft^3 (7/1/04-6/30/05) 0.45×10^6 ft^3 (7/1/05-6/30/06) 0.40×10^6 ft^3 (7/1/06-6/30/07) 0.35×10^6 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

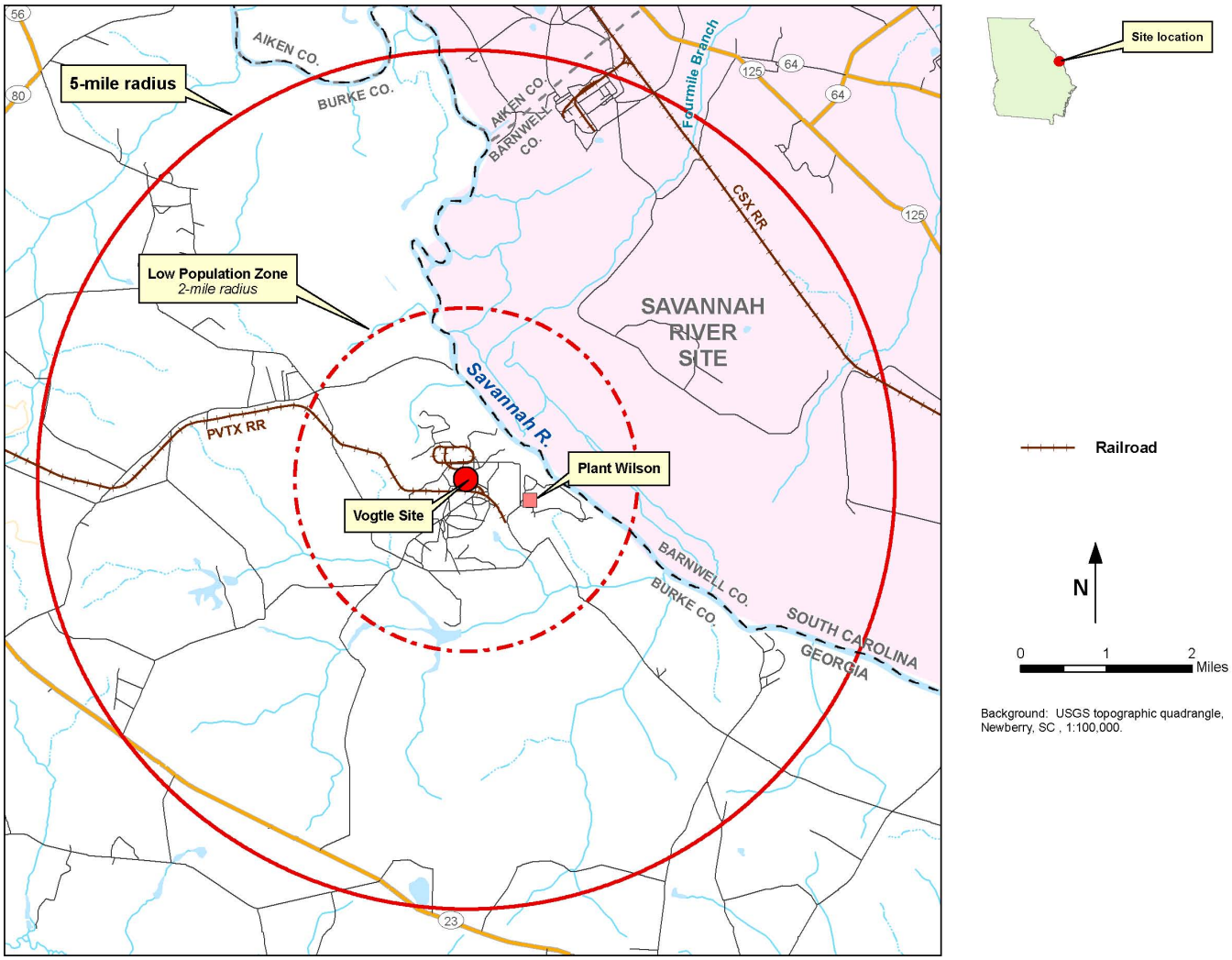

Figure 2.2-1 Site Vicinity Map

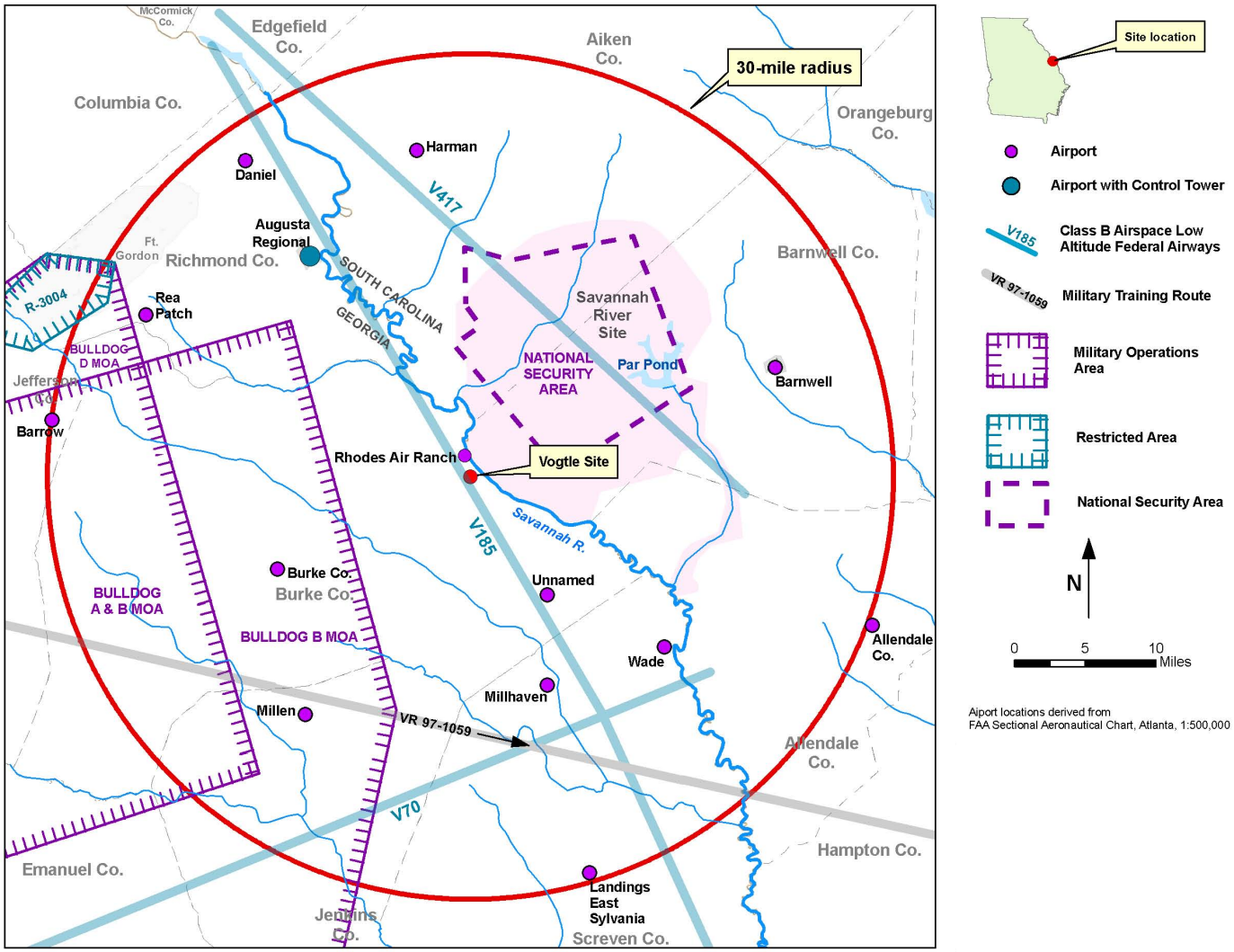

Figure 2.2-2 Airports within 30 miles of VEGP

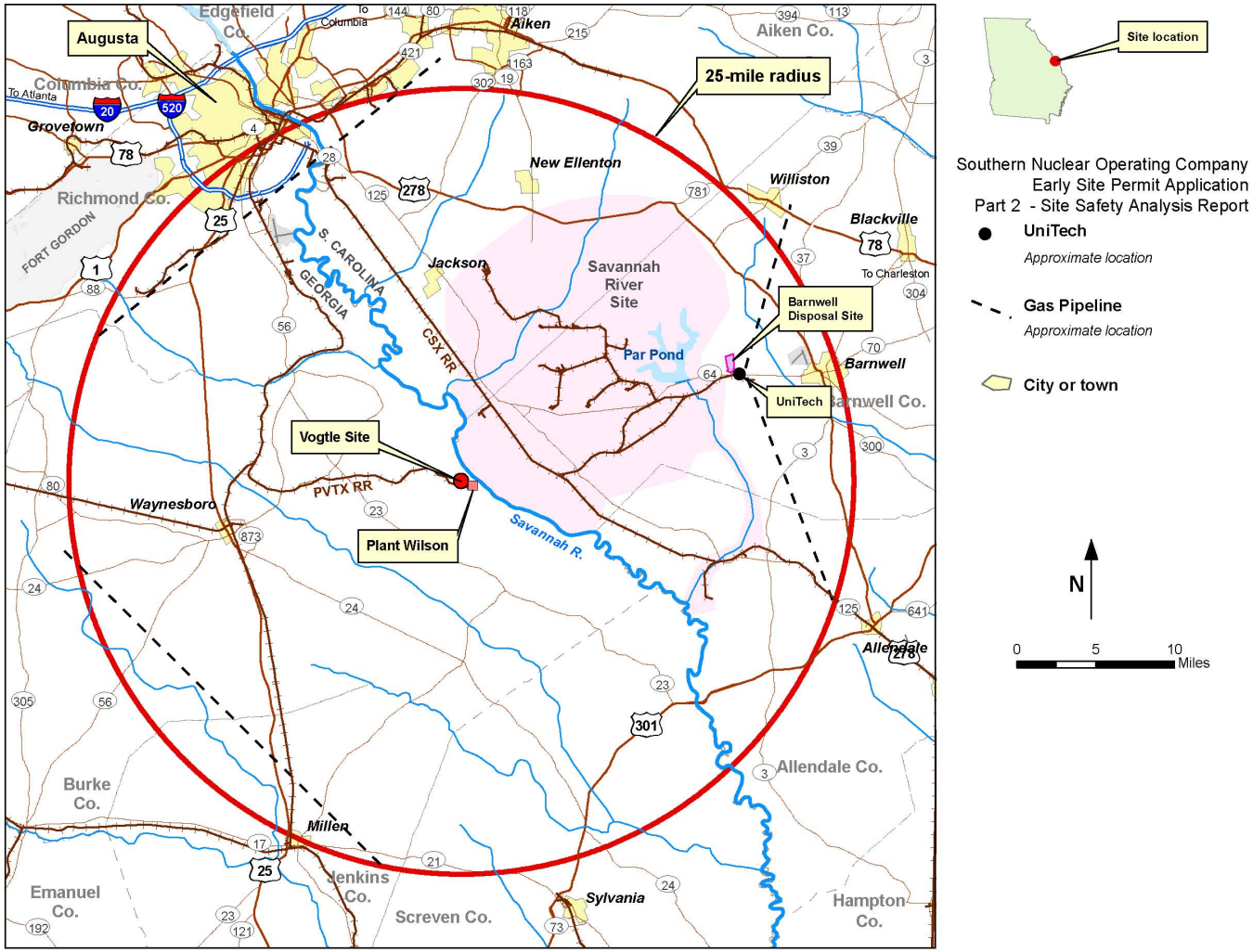

Figure 2.2-3 Industrial Facilities within 25 miles of VEGP

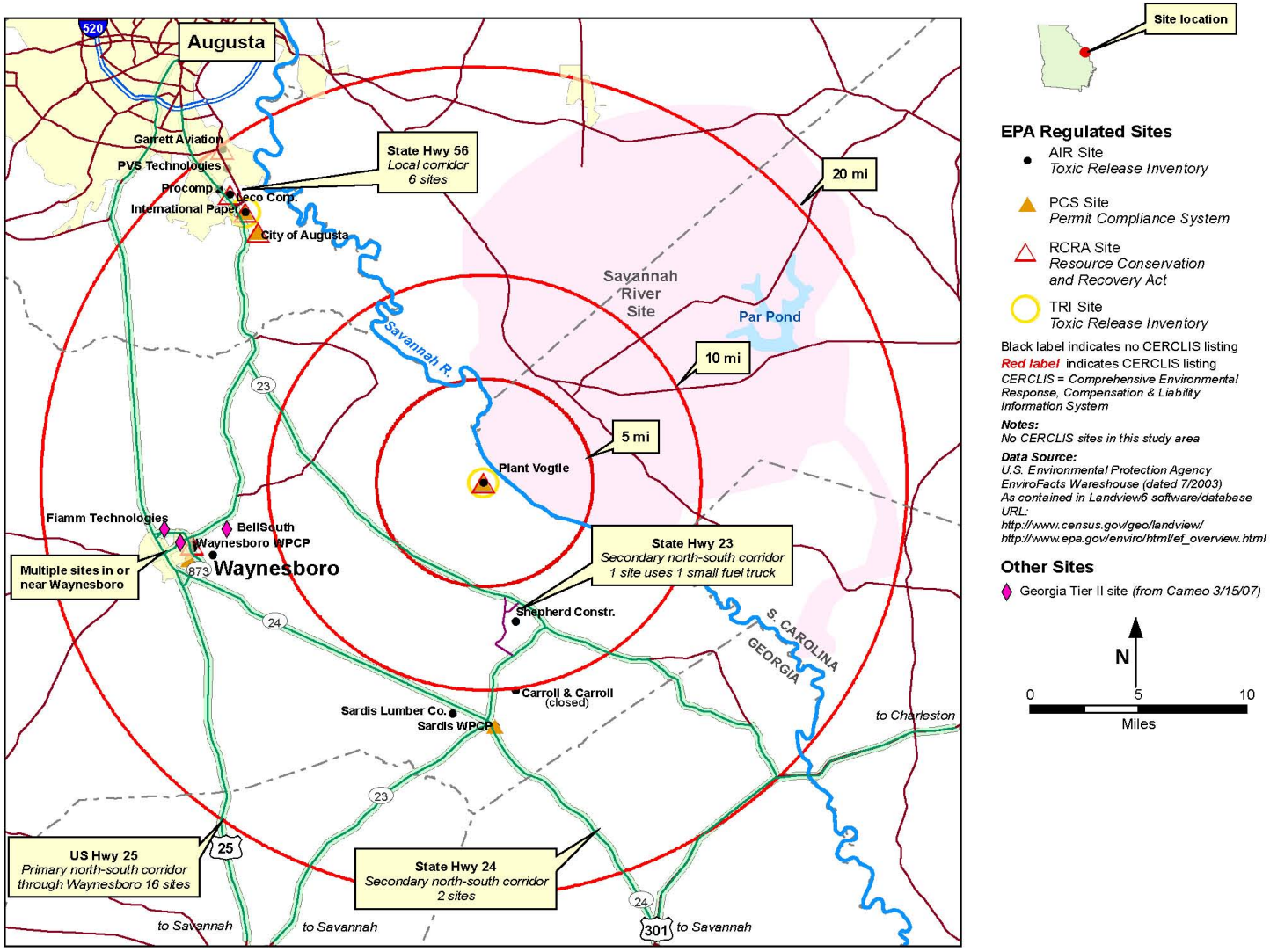

Figure 2.2-4 Corridor Analysis Study

Section 2.2 References

(Aiken 2005) Aiken County Top Employers, http://www.sces.org/lmi/data/top/aiken.htm, accessed August 8, 2005.

(APO 2006) *APO Terminal Area Forecast Summary Report*, Forecast issued February 2006, Federal Aviation Administration Augusta Regional Airport at Bush Field, Augusta, Georgia, http://www.apo.data.faa.gov/, accessed at May 2, 2006.

(FAA 2006) FAA airnav.com information on Augusta Regional Airport at Bush Field, Augusta, Georgia (effective April 13, 2006), http://www.airnav.com/airport/AGS, accessed April 21, 2006.

(Barnwell 2005) Barnwell County Top Employers, http://www.sces.org/lmi/data/top/barnwell.htm, accessed August 25, 2005.

(Burke 1991) Burke County Comprehensive Plan: 2010, Part 1: *Inventory and Assessment*, 1991.

(Burke 2005) Georgia Snapshots, Burke County, Community Profiles, http://www.dca.state.ga.us/snapshots/PDF/Burke.pdf, accessed August 26, 2005.

(Burke Airport 2006) Burke County Airport, Waynesboro, Georgia, http://www.airnav.com/airport/KBXG, accessed April 21, 2006.

(Chem-Nuclear 2006) Chem-Nuclear System, LLC, http://www.chemnuclear.com/disposal.html, accessed March 18, 2006.

(CHRIS 1999) Chemical Hazards Response Information System (CHRIS), U.S. Coast Guard, 1999.

(DOE 1999) *Savannah River Site Generic Safety Analysis Report* by Westinghouse Savannah River Company for the U. S. Department of Energy, 1999.

(DOE 2006) Characteristics of Spent Nuclear Fuel Management, U. S. Department of Energy, Office of Environmental management, Historical Document, http://web.em.doe.gov/eis/s27.html, accessed March 18, 2006.

(DOE 2007) DOE Savannah River Operations Office letter from Cindy M. Brizes (Emergency Management Program Manager) to Charles Pierce (SNC ESP Manager) regarding "Emergency Preparedness for Savannah River Site (SRS) Hazardous Materials," January 22, 2007.

(EPA 2003) Landview 6 DVD from U. S. Census Bureau depicting EPA regulated sites, July 2003.

(EPA 2006d) Georgia Tier II facilities CAMEO 1.1.3; December 1, 2006.

(FAA 2005) Atlanta Sectional Aeronautical Chart, Federal Aviation Administration, National Aeronautical Charting Office, 74th Edition, March 17, 2005.

(GDT 2005) Georgia Department of Transportation, "*Updates on Traffic Accidents – Burke Co. Georgia*", Email from D. Brantley, Office of Traffic Safety and Design to K. Patterson, Tetra Tech NUS, Inc., May 31, 2005.

(IWR 2004) Waterborne Commerce of the United States, Calendar Year 2004, Part 1 – Waterways and Harbors Atlantic Coast, Department of the Army, Corp of Engineers, Institute for Water Resources, IWR-WCUS-04-1, 2004.

(Murta 2006) Personal communication from T. Murta (CSX) to R. Kannor (Bechtel), May 24 2006.

(Plant Wilson 2006) Wilson Plant Emergency and Hazardous Chemical Inventory, February 2006.

(Rhodes 2006) 3GA7 Rhodes Air Ranch, http://www.fboweb.com/fb40/pu/ai/ad.aspx?adtident=3GA7, accessed 7/12/2006.

(Shaw 2005) Draft Environmental Impact Statement (EIS) for the Airspace Training Initiative, Shaw Air Force Base, South Carolina, August 2005.

(Still 2005) Letter from J. Still, Licensing Manager, Chem-Nuclear Systems, Inc. to K. Patterson, Project Manager, Tetra Tech NUS, Inc., June 8, 2005.

(Unitech 2006) Unitech Services Group, http://www.u1st.com , accessed May 16 2006

(USACE 2000) New Savannah River Bluff Lock and Dam Project, Savannah River, Georgia and South Carolina, Section 216, Disposition Study, Final Report, U. S. Army Corps of Engineers, September 2000.

(USACE 2007) Personal communication from A. Tujaque (USACE) to A. Farber (Bechtel), February 28, 2007

(Westinghouse 2005) AP1000 Document APP-GW-GL-700, *AP1000 Design Control Document*, Revision 15, Westinghouse Electric Company, LLC, 2005.

(WSRC 2006) Savannah River Site Fact Sheets, Washington Savannah River Company, January 2006.

(EPA 2003) Landview 6 DVD from U. S. Census Bureau depicting EPA regulated sites, July 2003.

(EPA 2006d) Georgia Tier II facilities CAMEO 1.1.3; December 1, 2006.

(Vanpelt 2006) Personal communication from R. Vanpelt (SRS) to R. Kannor (Bechtel), December 4, 2006.

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)	Annual Dose 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
Fax: 412-374-5099

Our ref: LTR-CRA-06-21

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

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

Official record electronically approved in EDMS

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 time dependent 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 DATE: December 21,2005

PE: John S Prebula DATE: December 21, 2005

RESPONSE INFORMATION

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

Official record electronically approved in EDMS

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

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

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

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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

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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

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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

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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)