13.3.1B.R Evacuation Time Estimate (ETE) Analysis

The William States Lee Nuclear Station Emergency Response Plan (Lee Emergency Plan) includes an analysis of the time required to evacuate the plume exposure pathway emergency planning zone (EPZ) and for taking other protective actions for various sectors and distances within the plume exposure pathway EPZ (EPZ) for transient, permanent, and special facility populations. The report titled " William S. Lee Nuclear Station Development of Evacuation Time Estimates," dated September 2007, (the ETE Report) is summarized in Appendix 4 to the Lee Emergency Plan; the full report is provided as supplemental information in the COL application. The ETE Report and the associated RAI responses provide the basis for the following discussion and analyses.

The staff reviewed the ETE Report against current requirements and guidance and for consistency with other parts of the COL Application, including the Final Safety Analysis report (FSAR). Citations in the report were verified by comparison to the cited document text. General descriptions of the Bellefonte Nuclear Station region, population, and highways were verified using internet searches and aerial photographs.

13.3.1B.R.1 Regulatory Basis for the ETE Analysis

The staff considered the following regulatory requirements and guidance in the review of the evacuation time estimate analysis:

[10 CFR 52.79(a)(21) refers to 10 CFR 50, Appendix E] Section IV, "Content of Emergency Plans," of Appendix E to 10 CFR 50 requires that the nuclear power reactor operating license applicant provide an analysis of the time required to evacuate and for taking other protective actions for various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations.

The NRC staff evaluated the ETE Report against Appendix 4, "Evacuation Time Estimates within the Plume Exposure Pathway Emergency Planning Zone," to NUREG-0654/FEMA-REP-1. Appendix 4 includes detailed guidance that the staff considered in determining whether the ETE analysis meets the applicable regulatory requirements in Appendix E to 10 CFR 50.

13.3.1B.R.2 Introductory Materials [10 CFR 50, Appendix E.IV and NUREG-0654, Appendix 4.I]

13.3.1B.R.2.1 Technical Information in Introductory Materials

Section 1, "Introduction," of the ETE Report provides basic description of the process used for estimating evacuation times. A description, including a map (Figure 1-1, "Lee Nuclear Station Site Location"), of the EPZ and surrounding area was provided. Additional information concerning small communities in the Lee Nuclear Station vicinity was requested in **RAI 13.03-4** and topographical features in **RAI 13.03-5**. In response, the applicant provided an updated Figure 1.1 identifying small unincorporated areas.

The major assumptions of the ETE are provided in Section 2, "Study Estimates and Assumptions." Population estimates are based upon 2000 census data, projected to 2007 using county-specific linear regression analysis. Estimates of employees who commute into the EPZ to work are based upon the state "Journey to Work Database for 2000," and projected to 2007 using US Department of Labor job growth rates. Population estimates at special facilities are based on available data from county emergency management offices. Roadway capacity estimates are based on field surveys and application of Highway Capacity Manual published by the Transportation

Research Board of the National Research Council (Highway Capacity Manual). Population mobilization times are based on a statistical analysis of data acquired from a telephone survey, as is the relationship between resident population and evacuating vehicles (vehicle occupancy factors). Those without access to private vehicles will be transported in waves to reception centers by busses, with 50% sharing rides with family, neighbors, and friends. Voluntary (shadow) evacuation is assumed to occur at percentages that diminish with distance out to 15 miles. Additional assumptions regarding the development of population estimates, including pass-through populations and regional employees, are provided in Section 3, "Demand Estimation," and Appendix E, "Special Facility Data." Assumptions regarding transit-dependent and special populations are in Section 8, "Transit-dependent and Special Facility Evacuation Time Estimates." Development of trip generation times from survey responses is described in Section 5, "Estimation of Trip Generation Times."

Additional information concerning the use of data from field surveys with the default capacity rates of the Highway Capacity Manual was requested in **RAI 13.03-39.** The applicant's response clarified that highway characteristics (posted speed, number of lanes, shoulder conditions, free flow speed, terrain, traffic control devices, etc.) found during the survey were documented in Geographic Information System shapefiles, which were used in the development of the link-node analysis network. The capacity of each link was estimated using the procedures outlined in the HCM and the data from the shapefiles.

Clarification of the assumptions regarding shadow evacuation was requested in **RAI 13.03-7a** for partial and **13.03-7b** for full EPZ evacuations. The applicant's response clarified that 35% of individuals in areas within the EPZ but not advised to evacuate may do so voluntarily; and that 30 percent of the population in the Shadow region beyond the EPZ that extends a distance of 15 miles from the Lee site will also elect to evacuate. Definition of the basis of future projections numbers of vehicles involved in shadow evacuation was requested in **RAI 13.03-14**; the applicant provided revised information for the year 2011 and proposed textual revisions and updated tables in response. Additional information related to shadow evacuation was requested in **RAI 13.03-42.** The applicant's responses to RAI 13.03-42(a) and (c) describe how trip generation times for the shadow evacuation were developed. The response to RAI 13.03-42(b) describes the population values for the percent shadow evacuation used in the sensitivity analyses of Appendix I to the ETE Report. The response to 13.03-42(d) provides the basis for the population used to calculate the shadow evacuation vehicles; it was assumed that the demographics in the shadow region are similar to those in the EPZ. In the applicant's response to **RAI 13.03-44**, which requested information differentiating "volunteer" evacuation from "shadow" evacuation, it is clarified that these two terms have the same meaning.

An outline of the approach for estimating the time to evacuate is presented, with a link-node map (Figure 1-2, "Lee Link-node Analysis Network") of the evacuation routes that was developed for the analyses. Further details on the methodology are provided in Section 3, Section 4, "Estimation of Highway Capacity," Section 5, and Section 6, "Demand Estimation for Evacuation Scenarios," as well as in Appendix C, "Traffic Simulation Model: PC-DYNEV," and Appendix D, "Detailed Description of Study Procedures." Details of the link-node map are presented in Appendix K, "Evacuation Roadway Network Characteristics."

A total of 12 "evacuation scenarios" representing different seasons, time of day, day of week and weather are considered. One of the 12 scenarios is the special scenario including construction of one of the Lee site plants.

13.3.1B.R.2.2 Technical Evaluation of Introductory Materials

The ETE Report includes a map showing the proposed site and plume exposure pathway EPZ, as well as transportation networks, topographical features, and political boundaries. The boundaries of the EPZ, in addition to the evacuation subareas within the EPZ, are based on factors such as current and projected demography, topography, land characteristics, access routes, and jurisdictional boundaries.

The ETE Report describes the method of analyzing the evacuation times. A general description of the IDYNEV modeling system was provided. The IDYNEV system consists of several sub-models such as a macroscopic traffic simulation model, an intersection capacity model, and a dynamic, node-centric routing model that adjusts the "base" routing in the event of an imbalance in the levels of congestion on the outbound links. Another model of the IDYNEV system is the traffic assignment and distribution model, which model integrates an equilibrium assignment model with a trip distribution algorithm to compute origin-destination volumes and paths of travel designed to minimize travel time.

The ETE Report describes the method of analyzing the evacuation times. A general description of the evacuation model was provided including the assumptions used in the evacuation time estimate analysis.

The staff finds the clarifications provided by the applicant in response to **RAIs 13.03-5, 13.03-7(a)** and **(b),** and **13.03-39** to be acceptable. The information and revisions provided in response to **RAIs 13.03-4, 13.03-14, 13.03-42,** and **13.03-44** are acceptable but require confirmation that they have been included in future revisions to the ETE Report.

13.3.1B.R.3 Demand Estimation [10 CFR 50, Appendix E.IV and NUREG-0654, Appendix 4.II]

13.3.1B.R.3.1 Technical Information Related to Demand Estimation

Section 3, "Demand Estimation," of the ETE Report provides an estimate of the number of people who could need to be evacuated (the "demand estimation"). Population estimates are provided in the ETE Report, based on the 2000 Census. The ETE Report states that census data showed that the local population increased 7.4% between 2000 and 2007. Population estimates are provided for permanent residents, transients, and employees of local businesses. Additional information was requested in **RAI 13.03-1** regarding the assumptions related to the population estimates during plant construction, and their consistency with projections in other COL documents. In its response to RAI 13.03-1, the applicant clarified the methods use to project populations. Clarification regarding the plant construction population itself was requested in **RAI 13.03-22**; the applicant's response clarified that while the number of employees peaks at 1000, only about 750 are assumed to be on-site at any one time.

A separate analysis for people without personal vehicles is provided in Section 8, "Transit-dependent and Special Facility Evacuation Time Estimates," of the ETE Report.

Other transient groups include visitors to local recreational areas, boat launches, and parks. Additional information was requested in **RAI 13.03-23** regarding how transients and employees are factored into needing transit service. The response indicated that because there is no mass transit to bring employees and transients into the area, the report assumes that employees and transients will evacuate via the same transportation method used to enter the evacuation area and do not require transit resources for evacuation. RAI **13.03-29** requested clarification of information regarding special facility transit demand; the applicant's response indicated that contributions for one of the Medical Centers were not included in the total and a revised Table 8-4 was provided.

Special populations are discussed in detail in Appendix E, "Special Facility Data." Within the EPZ, there are 20 schools in Cherokee County, one school in York County, and one school in Cleveland County with a combined enrollment of over 10,200 students and 635 staff. There are ten day care centers in Cherokee County and one in York County, with over 750 enrolled and about 120 employees. Three medical facilities and nursing homes with inpatient services are found within the EPZ with capacity of over 640 residents and 725 staff. Additional information about the definition of staff for these facilities was requested in **RAI 13.03-52**; the applicant's response clarifies that "staff" includes faculty, but does not include administrative, custodial, food service and adult volunteers. There are two state parks and overnight camps with a capacity of over 2500 persons, and 8 hotels and motels with a capacity of almost 1000 persons. Additional information regarding the adequacy of numbers of school buses for a single-wave of evacuation was requested in **RAI 13.03-28(a) and (b)**. The applicant responded that there were an insufficient number of school buses in Cherokee County for a single wave of relocation. Evacuation of schools and transit-dependent individuals with the existing inventory of school buses available in Cherokee County would require additional trips resulting in an associated increase in the ETE. An analysis to quantify the effect of these multiple trips on the ETE has not been performed, pending the identification of additional resources or implementation of alternate methods (e.g., mutual aid agreements) that will allow for single wave evacuation. This is being tracked as **OPEN ITEM- 13.03-01**.

Additional information was requested in **RAI 13.03-20** concerning transient populations in small parks, recreation areas, and campgrounds not listed in the ETE Report. The applicant's response indicates that these small facilities are assumed to be used by local residents who are already accounted for in the general population estimates. There is one correctional facility within the EPZ. Additional information regarding evacuation of correctional center inmates was requested in **RAI 13.03-25(a)** and **(b)**; the applicant responded that the Cherokee County Detention Center maintains emergency plans that cover facility evacuation and any such evacuation would require only 4 buses, which would not impact the ETE. Additional information regarding evacuation of day care centers was requested in **RAI 13.03-25(a)** and **(c)**; the applicant's response indicated that to evacuate children not picked up by parents during the 90 minute mobilization period, day care centers can transport children to the nearest public elementary school where they can evacuate with the school children or day care centers requiring transportation support can contact the County EMA who would dispatch buses to the day care center when they become available following evacuation of the school children. This particular response (13.03-25(c)) highlights needed additions to the Cherokee County Emergency Plan. RAI **13.03-25(d)** requested additional information about evacuation of Limestone College students; the response indicated that half of the students are campus residents included in the general population and 80% of the remainder are local residents also counted - therefore only about 74 students are in the

same category as "employee commuters". This accounting resulted in a minor change to the ETE Report.

Evacuation routes are described and times are estimated for transit-dependent and special facilities in Section 8, "Transit-dependent and Special Facility Evacuation Time Estimates." Additional information provided by the applicant in response to **RAI 13.03-27** clarifies that medical facility residents are all assumed to be evacuated by bus.

Vehicles traveling through the EPZ (external-external trips) at the time of an accident are assumed to continue to enter the EPZ during the first 90 minutes. Thereafter, none are assumed to enter and those remaining also evacuate with the residents and other transients. Clarification of the number of vehicles passing through the EPA was requested in **RAI 13.03-41**. In the response to RAI 13.03-41(a), additional information about individual highway segments is provided. In the response to RAI 13.03-41(b), it is clarified that Floyd Baker Boulevard (State Route 11) is also called Chesnee Highway. In the response to RAI 13.03-41(c), the applicant makes a revision to Table 6-4 (which is also discussed in the response to RAI 13.03-14).

Additional information regarding possible additional special populations was requested in **RAI 13.03-6, 13.03-26, and 13.03-30.** The applicant's response to RAI 13.03-6 indicated that up to 7 additional medical facilities could be operating within the EPZ and that contact would be made with these facilities to verify that they are operational and to obtain population data – these contacts are described in the responses to 13.03-26 and 13.03-30. The responses to 13.03-26 and 13.03-30 indicate that minor revisions will be made in the ETE Report to include these facilities but that each has its own transportation, resulting in no impact to the ETE. **RAI 13.03-32** requested maps showing locations of these facilities; the applicant's response provided additional maps for the ETE Report.

Additional information regarding special needs populations in **RAI 13.03-15.** In response to **RAI 13.03-15,** the applicant provided additional information regarding estimates of homebound disabled individuals who are transit dependent and proposed new text for the ETE Report. **RAI 13.03-21(a)** requested additional information regarding transient populations at special events routinely held in the region. In response, the applicant provided a revision to Section 3 of the ETE Report describing the construction peak scenario and a sensitivity study related to inclusion of the Ed Brown Rodeo in the ETE estimates. **RAI 13.03-21(b)** requested additional information regarding peak tourist populations; the applicant's response clarified that peak tourist populations are included in the recreational areas, shopping, and lodging estimates.

Figures summarizing the various population groups are provided in the ETE Report in the format suggested in Appendix 4, "Evacuation Time Estimates within the Plume Exposure Pathway Emergency Planning Zone," of NUREG-0654/FEMA-REP-1. The figures include: Figure 3-2, "Permanent Residents by Sector," Figure 3-3, "Permanent Resident Vehicles by Sector," Figure 3-4, "Transient Population by Sector," and Figure 3-5, "Transient Vehicles by Sector," and Figure 3-6, "Employee Population by Sector," and Figure 3-7, "Employee Vehicles by Sector." Clarification of the nomenclature in Figures 3.3 and 3.4 was requested in **RAI 13.03-12**; the applicant defined the notation in response. Additional information regarding number of vehicles estimated per scenario was requested in **RAI 13.03-11**; the applicant clarified the relationship of the scenarios to the vehicle estimates in these figures.

13.3.1B.R.3.2 Technical Evaluation of Information Related to Demand Estimation

The ETE Report provides an estimate of the number of people who may need to evacuate. Three population segments are considered: permanent residents, transients, and persons in special facilities. The permanent population is adjusted for growth, and the population data is translated into two groups: those using automobiles and those without automobiles. The number of vehicles used by permanent residents is estimated using an appropriate automobile occupancy factor. In addition, evacuation time estimates for simultaneous evacuation of the entire plume exposure pathway EPZ were determined.

Estimates of transient populations are developed using local data including peak volumes during the summer tourist season and employment data. Estimates for special facility populations (schools, medical care, and day care) are also provided.

The subareas, for which evacuation time estimates were determined, encompass the entire area within the plume exposure pathway EPZ. The maps are generally adequate for the purpose, and the level of detail is approximately the same as United States Geological Survey (USGS) quadrant maps. The assumptions on evacuation are based on simultaneous evacuation of inner and outer sectors.

The staff finds the clarifications provided by the applicant in response to **RAIs 13.03-1, 13.03-11, 13.03-12(a) and (b), 13.03-20, 13.03-21(b), 13.03-22, 13.03-27, 13.03-41(a) and (b),** and **13.03-52** to be acceptable. The information and revisions provided in response to **RAIs 13.03-6, 13.03-12(b), 13.03-15, 13.03-21(a), 13.03-23, 13.03-25(a), (b), (c),** and **(d), 13.03-26** (and also **13.03-30** which is similar),**13.03-29**, **13.03-32,** and **13.03-41** are acceptable but require confirmation that they have been included in future revisions to the ETE Report. **RAI 13.03-28(a)** and **(b)** is being tracked as an **OPEN ITEM.**

13.3.1B.R.4 Traffic Capacity [10 CFR 50, Appendix E.IV and NUREG-0654, Appendix 4.III]

13.3.1B.R.4.1 Technical Information Related to Traffic Capacity

Section 4, "Estimation of Highway Capacity," of the ETE Report describes estimation of highway capacity. The methods used are generally taken from the Highway Capacity Manual. Appendix K, "Evacuation Roadway Network Characteristics," identifies all evacuation route segments and their characteristics, including capacity. Additional information describing the road network used for evacuation routes was requested in **RAI 13.03-39**, specifically, information regarding highway lane widths. The response to RAI 13.03-39 clarified the assumptions on lane widths.

Clarification was requested on several traffic capacity questions in **RAI 13.03-12**. In its response to RAI 13.03-12(a) the applicant provided clarification that the ETE developed for school in session does include consideration that the same buses will be used to evacuate transit-dependent individuals. In its response to RAI 13.03-12(b) concerning the effect this "second wave" had on the transit-dependent individual ETE, the applicant responded that after dropping off school children at the reception centers, the buses return to the EPZ to perform a "second-wave" evacuation of transit-dependent persons; a minor adjustment to the ETE was also made to account for the response to **RAI 13.03-31** which adjusted assumed bus speeds. The response to RAI 13.03-12(c) indicates

that the bus routes pass schools and that that some transit-dependent individuals will walk to the bus route and be picked up as the buses traverse these routes; others will walk to a school to await the arrival of a bus. In its response to RAI 13.03-12(d) concerning the use of school buses on weekends and in summer, the applicant stated that some buses were assumed to be in use during these periods, but that the ETE calculations were not altered by this assumption. An explanation of inbound travel speed and time was requested in RAI 13.03-12(e). The applicant responded that transit bus speeds would be 45 mph in good weather and 40 minutes in adverse weather, conditional on the assumption that Traffic Control Points would not hinder the movement of inbound buses. In response to RAI 13.03-12(f), the applicant provided the basis for the estimate for pickup time that each bus will, on average, contain 30 passengers, each picked up individually, with a delay associated with each stop of 1 minute.

Additional information regarding use of empirical modifiers to the Highway Capacity Manual queue discharge flow (QDF) rates was requested in **RAI 13.03-40.** The applicant's response defended a conservative view in estimating the capacity at bottlenecks when congestion develops, so a QDF factor of 0.85, when flow breaks down as determined by the simulation model, was applied.

The modeling described in Section 4 relies upon the simulation model PC-DYNEV. In **RAI 13.03-10a,** clarification was requested regarding the modeling of traffic through intersections; the applicant clarified that application of Traffic Control Points was not considered and the modeling used the equations presented in Section 4 exclusively (this information was repeated in the response to the similar **RAI 13.03-43**). **RAI 13.03-10b** requested a discussion of use of field observations to determine allocation of characteristics to the modeled highway segments. The applicant supplied additional information regarding the use of data characteristics includeing number and estimated width of lanes, shoulder type and estimated width, intersection configuration, lane channelization, roadway geometrics; posted speed; actual free speed; abutting land use; traffic control devices; street parking; and signage. **RAI 13.03-10c** requested clarification of the use of several factors from the Highway Capacity Manual in estimating flow rates of vehicles turning through intersections; the applicant's response provided additional information regarding the definition of these parameters.

Section 9, "Traffic Management Strategy," presents a traffic control and management strategy that is designed to expedite the movement of evacuating traffic. The traffic management strategy is based on a field survey of critical locations and consultation with emergency management and enforcement personnel. Clarification was requested in **RAI 13.03-3** whether local officials concurred with the selection of traffic control points. In the response to RAI 13.03-3, the applicant explained the iterative process through which the Traffic Management Plan had been arrived at with county and state authorities. IN RAI **13.03-34** and **13.03-35**, clarification was requested of how the traffic management strategy was integrated into the ETE calculations; the applicant's responses indicated that the calculations do not rely upon any of the traffic control measures described and that their use would improve the ETE.

Section 10,"Evacuation Routes," discusses the emergency evacuation routes. In **RAI 13.03-38**, the staff also requested details regarding the link-node map presented in Appendix K, "Evacuation Roadway Network Characteristics." The response to RAI 13.03-38 included a CD that contained a revised copy of Figure 1-2, "Lee Link-node Analysis Network." In **RAI 13.03-36**, clarification is requested between the link-node

map and the evacuation routes of Figures 10-2 through 10-5. The applicant's response clarifies that there is no implication that evacuees are restricted to the major evacuation routes shown. The evacuation network includes many other minor roads that are capable of servicing evacuating traffic. Information about funneling of traffic into the reception centers outside of the EPZ was requested in **RAI 13.03-37**; the response indicates that the Reception Centers will be located several miles beyond the EPZ boundary and that congestion in the vicinity of the relocation/reception centers is unlikely to impact the ETE.

13.3.1B.R.4.2 Technical Evaluation of Information Related to Traffic Capacity

Analyses are made of travel times and potential locations for congestion. The evacuation time estimates are not dependent on the establishment of traffic control points and access control points. Therefore, manpower and equipment shortages have no effect on the evacuation time estimate calculations. In addition, all evacuation route segments and their characteristics, including capacity are described.

A traffic control and management strategy that is designed to expedite the movement of evacuating traffic is described. The traffic management strategy is based on a field survey of critical locations and consultation with emergency management and enforcement personnel.

The ETE Report included assumptions for determining the number of vehicles needed, as well as the methodology, for determining the transport-dependent population. The applicant also analyzed travel times and potential locations for serious congestion along the evacuation routes. Because the maps provided in the ETE Report illustrated areas for which congestion was predicted, but not the duration of that congestion, additional information regarding duration of congestion was requested in **RAI 13.03-48.** The applicant's response included updated figures with congested links identified that can be cross-referenced to a new table containing related information.

The staff finds the clarifications provided by the applicant in response to **RAIs 13.03-3, 13.03-10(a), (b),** and **(c), 13.03-12(a), (c), (d), (e)** and **(f), 13.03-34, 13.03-35, 13.03-36, 13.03-37, 13.03-39, 13.03-40,** and **13.03-43** to be acceptable. (The large PDF map provided in response to RAI **13.03-38** is acceptable but should also be incorporated into the ETE Report.) The information and revisions provided in response to **RAIs 13.03-12(b), 13.03-31,** and **13.03-48** are acceptable but require confirmation that they have been included in future revisions to the ETE Report.

13.3.1B.R.5 Analysis of Evacuation Times [10 CFR 50, Appendix E.IV and NUREG-0654, Appendix 4.IV]

13.3.1B.R.5.1 Technical Information Related to Analysis of Evacuation Times

Sections 4, 5 and 6 of the ETE Report describe the methods used to estimate the evacuation times. Section 4 describes estimation of highway capacity and is discussed in detail in Section 13.3.1B.R.4. Section 5 of the ETE Report provides estimates of the distributions of elapsed times associated with mobilization activities undertaken by the public to prepare for the evacuation trip (the "trip generation time"). The elapsed time associated with each activity is represented as a statistical distribution reflecting differences between members of the public. The quantification of these activity-based distributions relies largely on the results of a telephone survey. Additional information was requested in **RAI 13.03-24** regarding trip generation times for transients; the response clarified that the 2-hour mobilization time for transients is adequate for those

transients who return to their lodging facilities before evacuating. Additional information regarding use of truncated distributions of mobilization times was requested in **RAI 13.03-45(a)** through **(f).** For each question (a) through (f), it was acknowledged that distributions were shortened because the objective was to evaluate the evacuation times under circumstances of greatest highway loading, given the uncertainty about "laggards" who are reluctant to prepare to leave or unwilling to evacuate. The applicant stated that although a telephone survey had indicated that some people would require as much as 6 hours to prepare to evacuate, it had used a 4-hour preparation time in its ETE calculations.

Trip generation times are also the focus of **RAI 13.03-46** – for scenarios on weekends, additional information was requested to explain not having a 'prepare to leave activity' and 'travel home' sequence for these scenarios. The applicant's response was two-fold; revision to the sequence illustrations was provided, and an analysis was provided that indicated that the impact of the sequences on weekend scenarios was lost in rounding of the numbers of vehicles to the nearest 5 because of low numbers of vehicles involved.

Trip generation times were based on results from a telephone survey of the region. Additional information about normalization of the survey results to the "Don't Know" response was requested in **RAI 13.03-47**. The applicant's response clarified that it was assumed that the distribution of these responses is the same as the underlying distribution of the positive responses.

Section 6 defines the various evacuation cases for which time estimates were made; a case is a combination of a scenario and a region. A scenario is defined to be a combination of circumstances, including time of day, day of week, season, and weather conditions. Scenarios define the number of people in each of the affected population groups and their respective mobilization time distributions. A region is defined to be a grouping of contiguous evacuation zones, which forms either a "keyhole" sector-based area, or a circular area within the plume exposure pathway EPZ, that is evacuated in response to a radiological emergency. The Lee plume exposure pathway EPZ has been defined to contain 14 separate evacuation zones (which may be combined into regions), with boundaries along major roads or rivers. The boundary definitions are provided in Appendix L, "Zone Boundaries," of the ETE Report. These do not bisect any population centers. Also, these regions approximate (by radius/area) two miles/four 90 degree sectors, five miles/four 90 degree sectors, 10 miles/four 90 degree sectors, and 10 miles/entire plume exposure pathway EPZ.

Population information by permanent resident, transient, and employee, and the estimated number of vehicles associated with each, are provided. Assumed general population reception centers are shown on a map in Figure 10-1, "Assumed General Population Reception Centers," in Section 10, "Evacuation Routes."

A summary of the evacuation time estimates are provided in Section 7, "General Population Evacuation Time Estimates," of the ETE Report. These results cover 22 regions within the Lee EPZ and the 12 evacuation scenarios discussed in Section 6. The evacuation times are presented for 22 evacuation regions and 12 Scenarios in Appendix J, "Evacuation Time Estimates for All Evacuation Regions and Evacuation Time Graphs for Region 3 (R3), for All Scenarios." Results are presented for 50%, 90%, 95%, and 100% of vehicles. Results are also provided for good and adverse (rainy) weather conditions. The maximum evacuation times are presented, as well as the times to achieve lower evacuation percentages. Evacuation times are reported separately for

the general population (Section 7 and Appendix J), schools (Section 8), and transit-dependent population (Section 8). The general population includes both permanent residents and transients. Figures J-1 through J-12, "Evacuation Time Estimates - Scenarios 1 through 12 for Region 3 (Entire EPZ)," describe the time distribution of evacuating vehicles. Clarification was requested in **RAI 13.03-2** regarding whether the results presented in Section 7 included schools, transit dependents, and special facilities. In the response to RAI 13.03-2, the applicant clarified that the Section 7 results include only the general population and the school, transient, and special facilities populations are reported separately. Clarification was requested in **RAI 13.03-17** regarding the use of rain as adverse conditions rather than icy conditions; the applicant's response indicated that the Counties considered icy conditions to be a low-probability event that was not seriously under-represented by rainy conditions. The apparent lack of impact of adverse weather on the calculated ETE values was questioned in RAI **13.03-49**; the applicant's response clarified that rain reduces the free travel speed somewhat, which is generally not sufficient by itself to increase the ETE, due to the relatively short trip lengths. Clarification was requested in **RAI 13.03-33** regarding the "long tail" of the traffic flow rates as a function of time; the applicant's response clarified the discussion.

A series of sensitivity tests are documented in Appendix I, "Evacuation Sensitivity Studies," regarding the sensitivity of the results to trip generation time (directly related to time-dependent traffic loading) and to the amount of shadow evacuation.

The ETE Report includes separate calculations for special populations of school children and transit-dependent individuals in Section 8, "Transit-Dependent and Special Facility Evacuation Time Estimates." Clarification of assumptions regarding mobilization of school buses was requested in **RAI 13.03-8**; the applicant responded that the county authorities had suggested 90 minutes for Cherokee County schools but that schools in York and Cleveland Counties required only 30 minutes because the buses for those schools remained at the schools. Telephone survey results, reported in Appendix F, "Telephone Survey," are used to estimate the portion of the population requiring transit service, including persons in households that do not have a vehicle available and persons in households that do have vehicles that would not be available at the time the evacuation is ordered. The ETE Report assumes that half of these people would ride-share with others. Section 8 and Table 8-6, "Summary of Transit Dependent Bus Routes for the Lee Nuclear Station," shows that a residual 2,539 persons would require approximately 42 bus runs on 11 routes. Operations for these buses are described in Section 8.

Proposed routes for transit-dependent and special facility populations are described in Figure 8-2, "Proposed Transit Dependent Bus Routes." Clarification of bus routes was requested in **RAI 13.03-16**; the applicant's response included a revised figure 8-2 outlining the assumed routing for buses. **RAI 13.03-18** requested clarification of travel times for bus service through congested areas of Gaffney; the applicant's response indicated that average speeds in congested areas include periods of higher speed outside of the congested zones. **RAI 13.03-19** requested explanation of the assumptions regarding bus return times for "second wave" evacuation. The response clarified that the travel times back to the EPZ for those buses performing a second wave evacuation of transit dependents are the average travel times based on assumed bus speeds of 45 mph and 40 mph for good weather and rain, respectively.

13.3.1B.R.5.2 Technical Evaluation of Information Related to Evacuation Times

A total of 264 evacuation time estimates are computed for the evacuation of the general public. Each evacuation time estimate quantifies the aggregate evacuation time estimated for the population within one of the 22 Evacuation Regions to completely evacuate from that Region, under the circumstances defined for one of twelve Evacuation Scenarios. Separate evacuation time estimates were calculated for transit-dependent evacuees, including school children. An acceptable variant of the NUREG-0654 format is used for the presentation of the evacuation times in Appendix J.

Distribution functions for notification of the various categories of evacuees were developed. The distribution functions for the action stages after notification predict what fraction of the population will complete a particular action within a given span of time. There are separate distributions for auto-owning households, school population, and transit-dependent populations. These times are combined to form the trip generation distributions.

On-road travel and delay times are calculated.

The staff finds the clarifications provided by the applicant in response to **RAIs 13.03-2, 13.03-8, 13.03-17, 13.03-18, 13.03-19, 13.03-24, 13.03-33, 13.03-45(a)-(f), 13.03-47,** and **13.03-49** to be acceptable. The information and revisions provided in response to **RAIs 13.03-16** and **13.03-46** are acceptable but require confirmation that they have been included in future revisions to the ETE Report.

13.3.1B.R.6 Other Requirements [10 CFR 50, Appendix E.IV and NUREG-0654, Appendix 4.V]

13.3.1B.R.6.1 Technical Information Related to Analysis of Other Requirements

Section 12, "Confirmation Times," of the ETE Report suggests a procedure to confirm that the evacuation process is effective in the sense that the public is complying with the advisory to evacuate. The suggested procedure employs a stratified random sample and a telephone survey. It is estimated that this process could be completed within approximately 3 - 4 hours of the advisory to evacuate. Clarification was requested in **RAI 13.03-50** regarding assumptions regarding telephone surveys and county agreements on methods of confirming evacuation. The applicant responded by identifying an advantage to the telephone based approach and suggested the approach could be reinforced with ground vehicles if decided at a later date. The use of a telephone survey is one approach suggested in NUREG 0654 and the response is acceptable.

Intelligent Transportation Systems (Dynamic Message Signs, Highway Advisory Radio, Automated Traveler Information Systems, etc.) are discussed in Section 9. Additional information about consideration of the use of such systems in the ETE analysis was requested in **RAI 13.03-51**. The applicant's response clarifies that were not credited in the development of the ETE and the results of the ETE are not dependent on their use.

The development of the ETE Report was coordinated with emergency planners from the State of South Carolina, and from Cherokee and York Counties which are involved in emergency response for the site. **RAI 13.03-3** requested information regarding the

review of the ETE Report by state and local organizations involved with emergency response. The applicant responded by describing its collaboration with State and local emergency management officials and law enforcement personnel in developing the ETE analysis and resolving their comments on the draft ETE Report. In addition, RAI 13.03-3 requested clarification regarding whether state and local organizations provided any comments, and if so, that the comments and their resolution be provided as additional information. The applicant responded to RAIs 13.03-3 by describing its collaboration with State and local emergency management officials and law enforcement personnel in developing the ETE analysis and resolving their comments on the draft ETE Report. Also, RAI 13.03-3 asked for specific clarification regarding whether the state and local emergency response agencies had concurred with Traffic Control Point and Access Control Point selection and arrangements. The applicant responded that State and local emergency response agencies concurred with the Traffic Control Points during the development of the Emergency Plan and ETE, and had signed letters of commitment to support the Emergency Plan and ETE. In response to **RAI 13.3-9,** which requested clarification of the use of Traffic Control Points in the ETE estimate, the applicant clarified that the functions of the Traffic Control Points were not assumed in the ETE estimation and would act to reduce the time if employed. It was noted in **RAI 13.03-53** that Table G-1 that summarized the Traffic Control Points was referred to but omitted from the ETE Report; the applicant's response rectified this omission.

13.3.1B.R.6.2 Technical Evaluation of Information Related to Other Requirements

The time required for confirmation of evacuation was estimated. In addition, the development of the ETE Report was coordinated with emergency planners from the state and counties which are involved in emergency response for the site.

The staff finds the clarifications provided by the applicant in response to **RAIs 13.03-3, 13.03-9, 13.03-50, 13.03-51,** and **13.03-52** to be acceptable. The information and revisions provided in response to **RAI 13.03-53** are acceptable but require confirmation that they have been included in future revisions to the ETE Report.

13.3.1B.R.7 Conclusion for the Lee ETE Report

On the basis of its review of the onsite emergency plan as described above, the NRC staff concludes that the information provided in the report titled " William S. Lee Nuclear Station Development of Evacuation Time Estimates," dated September 2007, (ETE Report) is not consistent with those portions of Section 13.3 of NUREG-0800 related to the evacuation time estimate analysis. The staff identified the following Open Item as needing to be resolved before concluding that the ETE Report meets applicable requirements:

- **RAI 13.03-28(a) and (b)**. The applicant responded that there were an insufficient number of school buses in Cherokee County for a single wave of relocation, which was an assumption made in the ETE Report. Evacuation of schools and transit-dependent individuals with the existing inventory of school buses available in Cherokee County would require additional trips resulting in an associated increase in the ETE. An analysis to quantify the effect of these multiple trips on the ETE has not been performed, pending the identification of additional resources or implementation of alternate methods (e.g., mutual aid agreements) that will allow for single wave evacuation. The staff will continue to track this as **OPEN ITEM 13.03-1.**

Therefore, the ETE Report is unacceptable and does not meet the applicable requirements of 10 CFR 50, Appendix E.IV.