

### **13.3.1B.R Evacuation Time Estimate (ETE) Analysis**

The Virgil C. Summer Nuclear Station Emergency Response Plan (VCSNS 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 for transient and permanent populations. The report titled "Virgil C. Summer Nuclear Station Development of Evacuation Time Estimates," dated August 2007, (ETE Report) was provided as a separate document in the COL application, but it is considered to be part of the VCSNS Emergency Plan and is incorporated into the VCSNS Emergency Plan by reference as Appendix 5, "Evacuation Time Estimate Study." 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 NRC requirements and guidance for consistency with other parts of the COL Application, including the FSAR. Citations in the report were verified by comparison to the cited document text. General descriptions of the VCSNS region, population, and highways were verified using internet searches and aerial photographs. *The designated evacuation routes were driven to observe any impediments to evacuation, shoulder and lane width, and general road condition.*

#### **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 Appendix E to 10 CFR 50]** 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 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 contains detailed guidance that the staff used 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," provides a basic description of the process used to estimate evacuation times. A simple description, with map (Figure 1-1, "VC Summer Nuclear Station Site Location"), of the EPZ and surrounding area is provided. Additional information regarding the lack of elevations, surrounding communities, and political boundaries on the map was requested in **RAI 13.03-03**. In a response letter dated January 6, 2009, the applicant provided a revised Figure 1-1 that includes labels for the lakes, rivers, and communities in the area. The applicant also provided a revised Figure 1-2 in a larger scale that includes sector, quadrant, and county boundaries. Major roadways, communities, lakes, and rivers have also been labeled. Figures 3-1 and 6-1 were also revised to include county boundaries.

Section 2, "Study Estimates and Assumptions," provides the basis for the population data estimates used in the ETE. Population estimates are based on the 2000 census

using the ArcGIS Software and the block centroid method. Additional information was requested in **RAI 13.03-02 (A)** to resolve differences in population estimates between the ETE Report, the Environmental Report (ER), and the Final Safety Evaluation Report (FSAR). In a response letter dated January 6, 2009, the applicant stated that ER section 2.5.1.1 uses a 10-mile radius centered at proposed new Units 2 and 3 to estimate its population. The ETE Report uses a 10-mile radius centered at the existing Unit 1. The EPZ also excludes some areas of the 10-mile zone while including others. These two factors account for the differences in population estimates between the ETE and the ER.

Estimates of employee and special facility populations are based on data provided by county emergency management officials. Auto occupancy factors are based on a statistical analysis of data acquired from a telephone survey. 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 about transit-dependent and special populations are provided in Section 8, "Transit-Dependent and Special Facility Evacuation Time Estimates," and Appendix E. Development of trip generation times from survey responses is described in Section 5, "Estimation of Trip Generation Times."

Twelve study assumptions used as the basis for the ETE are provided in Section 2.3, "Study Assumptions." The study assumes that everyone will evacuate according to assigned routes. Schools are to be notified in advance of the general population and are given priority for use of transportation resources. Additional information was requested in **RAI 13.03-04(A)** with regard to the notification of schools. In a response letter dated January 6, 2009, the applicant stated that Assumption #3 does not influence the calculation or results for the ETE and is not feasible under the ETE planning basis. This assumption will be removed in future revisions of the ETE Report. This section will now read:

67 percent of households in the EPZ have at least one commuter, 78 percent of which await the return of a commuter before beginning their evacuation trip, based on the telephone survey results.

Buses not being used for school evacuation will be used to transport those without access to private vehicles. Fifty-percent of these people are assumed to ride-share with neighbors or friends. Traffic control points and access control points will be established to aid the flow of traffic out of the plume exposure pathway EPZ. Additional information was requested in **RAI 13.03-04 (B)(C)** to determine what effect traffic control will have on evacuation time. In a response letter dated January 6, 2009, the applicant stated that ETE calculations do not rely on any of the traffic control measures identified in Appendix G. The estimates of capacity (Appendix K), which are used by the IDYNEV model, are based on the factors described in Section 4 and observations made during the road survey. Capacity estimates are not enhanced nor compromised by the establishment of a Traffic Control Points (TCPs) at an intersection. The TCPs are to facilitate evacuating traffic movements and discourage travelers from moving closer to the VCSNS. Personnel will also serve a surveillance function to inform the Emergency Operations Center (EOC) of any problems. Figure 1 of the ETE shows evacuation is dictated by the mobilization time. The short travel times indicate there is not pronounced traffic congestion within the EPZ. The establishment of TCPs to manage traffic congestion is not necessary; but recommended. There would be no effect on ETE if traffic control

points were not established. Thus, no changes to the ETE are needed due to lack of resources or the regions being evacuated.

Adverse weather is also considered as part of this study. Additional information on the effect of adverse weather was requested in **RAI 13.03-04 (D)**. In a response letter dated January 6, 2009, the applicant stated that the "No Effect" in the table on page 2-5 refers to the mobilization time for the general population. The name of the final column will be changed to "Mobilization Time of the General Population" for clarification. The only portion of this mobilization that involves driving is the time to return home. This occurs prior to the onset of congestion. Reduction in free speed due to weather would not increase travel time. The mobilization times discussed in Section 8 are for transit-dependent persons, schoolchildren, special facility populations, and those without private vehicle. The majority of this time is spent driving; as a result, the reductions of 10% in capacity and in speed for rain are assumed to add a total of 10 minutes to the mobilization time, as discussed on page 8-5.

An outline of the approach to estimating the ETE is presented; with a link-node map [Figure 1-2, "V.C. Summer Link-Node Analysis Network" (page 1-7)] of the highway network developed through the use of GIS mapping software and field observations. Details of the link-node map are presented in Appendix K, "Evacuation Roadway Network Characteristics." The IDYNEV System was used to analyze the highway network to determine routes used for evacuation and estimate evacuation times. A description of the IDYNEV System and associated sub-models is provided in Section 1.3, "Preliminary Activities." The IDYNEV System consists of several submodels - 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 integrates an equilibrium assignment model with a trip distribution algorithm to compute origin-destination volumes and paths of travel designed to minimize travel time. A discussion of algorithms used is provided in detail in Section 4, "Estimation of Highway Capacity." Additional information on algorithms used in the estimations was requested in **RAIs 13.03-5(A)(B)(C) and 13.03-11(C)**. In **RAI 13.03-5 (A)** the staff requested additional information related to algorithms used by the traffic models. In a response letter dated January 6, 2009, the applicant stated that information related to models is provided on page 1-6 under the "Analytical Tools" sub-heading, and in Appendices B through D of the ETE Report. Further detail of the PC-DYNEV simulation model is found in NUREG/CR-4873, "Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code," and NUREG/CR- 4874, "The Sensitivity of Evacuation Time Estimates to Changes in Input Parameters for the I-DYNEV Computer Code." Additional references to papers describing other algorithms are provided as a footnote on page 4-2.

In **RAI 13.03-5 (B)** the staff requested the applicant provide a discussion of the "various known factors," mentioned on page 4-2. In a response letter dated January 6, 2009, the applicant provided a discussion of the process used to determine the value of variables described in Section 4. In short the applicant stated that "The values of the variables in the intersection algorithm in Section 4 were derived by applying the I-DYNEV System as an analysis tool rather than as a single "pass-through" calculation of an ETE. This tool was used to identify points of congestion and locations where TCPs could be helpful to the evacuating public. Simulation results were analyzed to identify locations where the green time was specified to realistically service the competing traffic volumes under

evacuation conditions. The model was executed iteratively to provide assurance that the allocation of "effective green time" appropriately represents the operating conditions of an evacuation. The mean queue discharge headway in seconds per vehicle is equal to 3600 sec/hr - saturation flow rate, expressed in vehicles per hour. Saturation flow rates are presented in Appendix K, based on the field survey and the HCM [Highway Capacity Manual] guidance." Examination of Appendix K shows that some of the highway links have a saturation flow rate of 1895 vehicles per hour per lane, exceeding the 1700 vehicles per hour per lane suggested by the HCM 2000. A sensitivity study was run reducing the capacity of these links to 1700 vehicles per hour per lane. The attached Figure 1 attached to this response indicates that the ETE is unaffected by this change. Chapters 10, 16, 17, and 31 of the 2000 HCM were also sighted as a reference for additional information.

In **RAI 13.03-5 (C)** the staff requested additional information related to an intersection equation used in the ETE Report. In a response letter dated January 6, 2009, the applicant stated that the equation presented on page 4-1 of the report applies to signalized and to manually-controlled intersections. No allowance is made for TCP operations. Figure 1, submitted with the response to **RAI 13.03-04 and 13.03-03 (Part B)**, shows that the mobilization time distribution, not congestion or traffic control, dictates evacuation time. When there are competing traffic movements at an intersection or juncture, the space must be time shared in order to afford safe passage. This process is implemented in the simulation model by the analyst determining the allocation of effective green. Competing traffic flows may be delayed at the intersection influencing the travel time. Figure 7-4 submitted with the RAI response, illustrates the resulting queuing that can take place as a result of this process when the traffic demand exceeds intersection capacity.

In **RAI 13.03-11(C)** the staff requested the applicant provide information related to the reduction factor, "R," used in an equation. In a response letter dated January 6, 2009, the applicant provided a reference to a study performed by Zhang and Levinson. The reference indicates that the variation of queue discharge flow (QDF) at a location is generally in the range of +/- 5% about the average QDF. The lower tail of this distribution would be equivalent to a capacity reduction factor of  $0.90 - 0.05 = 0.85$  which is the figure applied by the DYNEV System. The ETE Report takes a conservative view in estimating the capacity at bottlenecks when congestion develops by applying a factor of 0.85 only when flow breaks down, as determined by the simulation model. The applicant has provided a revision to page 4-4 that includes a reference to the Zhang and Levinson study.

Further details on the use of traffic models are provided in Appendix C, "Traffic Simulation Model: PC-DYNEV," and Appendix D, "Description of Study Procedure." Because this ETE study supersedes an earlier study performed in 1981 for the existing reactor at the VCSNS site, a list of differences in the approaches is provided in Section 1.4, "Comparison with Prior ETE Study."

### **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 evacuation model was provided including the assumptions used in the evacuation time estimate analysis.

The staff finds the clarifications and additional information submitted in response to **RAIs 13.03-02 (A), 13.03-04(B)(C), and 13.03-05(A)** to be acceptable and therefore resolved.

The staff finds the additional information and textual revisions submitted in response to **RAIs 13.03-03, 13.03-04(A), 13.03-04(D), 13.03-05(B), and 13.03-11(C)** to be acceptable. The following Confirmatory Action NRC Items have been created to track proposed revisions the applicant has committed to include in a future revision of the ETE Report:

- In response to **RAI 13.03-03** the applicant has provided revised Figures 1-1, 3-1 and 6-1. **Confirmatory Action NRC Items 13.03-01, 13.03-02, and 13.03-03** have been created to track the proposed revisions.
- In response to **RAI 13.03-04(A)** the applicant has committed to remove Assumption #3 from Section 2.3 and revise the text accordingly. **Confirmatory Action NRC Item 13.03-04** has been created to track this proposed revision.
- In response to **RAI 13.03-04(D)** the applicant has revised the final column in the table on page 2-5 to "Mobilization Time of the General Population" for clarification. **Confirmatory Action NRC Item 13.03-05** was created to track this proposed revision.
- In response to **RAI 13.03-05(B)** the applicant has committed to change Saturation flow rates in Appendix K from 1895 to 1714. **Confirmatory Action NRC Item 13.03-06** was created to track this proposed revision.
- In response to **RAI 13.03-11(C)** the applicant has committed to add a reference to the Zhang and Levinson study to page 4-4. **Confirmatory Action NRC Item 13.03-07** was created to track this proposed revision.

In response to **RAI 13.03-5 (C)** the applicant provided a discussion of the variables for the intersection algorithm in Section 4, "Estimation of Highway Capacity," which states that the model was executed iteratively to provide assurance that the allocation of effective green time appropriately represents the operating conditions. The response to **13.03-5(C)** discusses that this iterative procedure represents a reasonably efficient operation under evacuation conditions. This approach is appropriate, if the traffic control is in place to support a reasonably efficient operation under evacuation conditions. However, in the ETE Section 13, "Recommendations," states that the traffic management plan "should be" reviewed by state and county emergency planners with local and state police to reconcile resources with current assets. This indicates that the plan is not currently approved. Clarify whether the traffic management plan has been approved by state and county emergency planners. Discuss the appropriateness of this modeling approach and whether actual signal cycle timing should be used if the traffic

management plan is not implemented. These issues will be tracked as **Open Items 13.03-01 and 13.03-02.**

**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," provides an estimate of demand expressed in terms of people and vehicles. The Permanent resident population was projected out to 2007 by comparing the 2005 census with the 2000 census to obtain growth rates for each county. Additional information was requested in **RAI 13.03-02 (C)** to resolve differences in population growth rates between the ETE Report and the U.S. Census. In a response letter dated January 6, 2009, the applicant stated that data was obtained from the U.S. Census Bureau website at <http://quickfacts.census.gov> on November 1, 2006, and December 12, 2008. Annual growth rates calculated for each county were based on these population estimates. Comparisons with estimates in the ER show that they are in agreement.

Based on information obtained in a telephone survey, the permanent resident average household size is estimated at 2.68 persons per household with 1.49 vehicles per household. Estimates of the permanent resident population and their vehicles are presented for each Protective Action Zone (PAZ) in Table 3-2, "Permanent Resident Population and Vehicles by PAZ," and by polar coordinate representation in Figures 3-2, "Permanent Resident by Sector," (page 3-6) and Figure 3-3, "Permanent Resident Vehicles by Sector" (page 3-7). In **RAI 13.03-02 (D)(1-4)** the staff requested the applicant explain differences in population estimates between the ETE Report and State and local plans. In a response letter dated January 6, 2009, the applicant stated that populations in the ETE Report use the 2000 U.S. Census "blockpop" Geographical Information System (GIS) point shapefile. A description for the use of this system in estimating the 2007 PAZ populations was provided. Data used in the Richland County and Lexington County Emergency Response Plans are based on the estimates made in 1993 based on the 1990 census data. The ETE Report is based on 2007 estimates. The applicant also stated that there is no source for the data used in Annex Q to the Fairfield County Emergency Operations Plan, "Fixed Nuclear Facility Radiological Response Plan," but those numbers are similar to those found in the 1993 ETE Report. The applicant further stated that the numbers in Attachment 4 to Annex Q, "Population Distribution Map, 10-Mile EPZ, VC Summer Nuclear Station," are not consistent with those found in Section L.5.a, "Evacuation," of the Lexington County Radiological Emergency Response Plan or the numbers provided in the 1993 ETE Report.

The transient population estimate is based on data provided by South Carolina Department of Parks, Recreation, and Tourism (SCDPRT). It is estimated that 320 people could be recreating within the VCSNS plume exposure pathway EPZ on a peak day. Of these, 90% are residents and 10% transients. A conservative value of 20% was applied to the transient population with an increase of 12 persons to account for rounding. The resultant transient population is 76 persons. Individual activity vehicle occupancy factors were used to estimate average vehicle occupancy of 2.14 transient per vehicle. Estimates of the transient population and their vehicles are presented by polar coordinate representation in Figures 3-4, "Transient Population by Sector," (page 3-9) and Figure 3-5, "Transient Vehicles by Sector" (page 3-10). In **RAI 13.03-07 (A)** the staff requested additional information on increases in the transient populations due to

local holiday celebrations. In a response letter dated January 6, 2009, the applicant stated that a sensitivity study was conducted to assess the impact on ETE of the influx of transients for the Chapin Labor Day Festival. There are 10,000 people present during peak times at the festival of which 20% are transients. The results of the sensitivity study indicate that the ETE for the entire EPZ (Region R03) is not affected by the influx of transients for the festival. The results of this study were included in a draft of the revised Appendix I. The applicant has committed to including the new results in a future revision of the ETE Report.

Employees who commute to jobs within the plume exposure pathway EPZ are assumed to evacuate along with the permanent resident and transient populations. Only two major employers, Virgil C. Summer Nuclear Station and Ellett Brothers-Sporting Goods Equipment Distributors, are within the plume exposure pathway EPZ. Vehicle occupancy of 1.01 is used for the employee population. Estimates of the employee vehicles are presented by polar coordinate representation in Figures 3-7, "Employee Vehicles by Sector" (page 3-13). In **RAI 13.03-07 (B)** the staff requested the applicant provide Figure 3-6, "Employee Population by Sector," for page 3-12 which was omitted. In a response letter dated January 6, 2009, the applicant stated that Figure 3-6 will be replaced in a future revision of the ETE Report with the version attached to this response, which identifies the employee population by sector.

One special event scenario, Scenario 12, is included. Scenario 12 represents the peak construction period for Units 2 and 3 during a typical summer, midweek, midday, under good weather conditions. The peak construction period is estimated by South Carolina Electric & Gas to begin in the year 2014. Population estimates for permanent residents and transients were extrapolated out to 2014, based on county growth rates. An estimated 3,600 workers and their vehicles were also included in Scenario 12. Additional information regarding population projections for the construction period was requested in **RAI 13.03-02 (B)**. In a response letter dated January 6, 2009, the applicant stated that only the permanent resident and shadow populations were extrapolated to 2014. It is assumed that no major transient attractions or major employers would be introduced between 2007 and 2014, so these population estimates were not extrapolated. The 2014 permanent resident populations are estimated to be 12, 470 using county-specific growth rates. The estimated shadow population would be 44, 096.

Permanent residents, transients, and employees make up the general population. Vehicles traveling through the plume exposure pathway EPZ (external-external trips) are assumed to continue to enter during the first 60 minutes following an accident. Subsequently, none enter and those remaining will evacuate with the general population. Population estimates for special facilities and people without personal vehicles are provided in Section 8: "Transit-Dependent and Special Facility Evacuation Time Estimates." There are seven pre-schools, five elementary schools, two middle schools and three high schools within the plume exposure pathway EPZ. In **RAI 13.03-08(A)** the staff requested the applicant explain the use of pre-schools in the ETE. In a response letter dated January 6, 2009, the applicant stated that vehicles used to pick up these children were included. The mobilization time estimates also include picking up children at day care centers. Table 1 summarizes the transportation assets for each day care center, based on a survey of these facilities. Some of the larger day care centers have vans or buses that can be used to evacuate children not picked up in a timely manner. Adding these vehicles will not impact the ETE of the general population. The applicant

has committed to including a discussion of day care facilities in Section 8.3 in a future revision of the ETE Report. This section will include the following paragraph:

Day-care centers are neighborhood facilities that service local children that are dropped off in the morning and picked up subsequently by parents or designees. Since the estimated resident vehicle population is based on household size and on vehicles per household, the vehicles used to pick up these children for evacuation have already been included in the estimate of evacuating vehicles. The mobilization time estimates (Section 5) are based on the telephone survey which reflects the daily activities of EPZ residents, including the picking up of children. Therefore, separate ETE are not provided for day-care centers. A survey of day-care centers within the EPZ was conducted; some of the larger day-care centers have vans or buses. While this transport is not capable of servicing all children at these facilities, they can be used to evacuate any children not picked up in a timely manner.

There is only one special care facility, Generations of Chapin Nursing Home, within the 10-mile plume exposure pathway EPZ. There are no hospitals or jails located within the EPZ. The staff requested additional information on special-needs individuals in the area in **RAI 13.03-08 (C)**. In a response letter dated January 6, 2009, the applicant stated that recent communication with the counties has yielded data concerning registered homebound special needs population within the VCSNS EPZ. Based on capacities, the applicant identified transportation resources necessary to evacuate the homebound special needs population. The EPZ counties are parties to the South Carolina state-wide mutual aid agreement which outlines procedures and policies regarding the delivery of ambulances, wheelchair vans and buses. If a county lacks sufficient resources, they will be provided through this state-wide agreement. The applicant submitted additional information related to the evacuation of special needs persons that will be included in a new section 8.4, "Special Needs Population," added to page 8-8.

A Separate map is provided indicating recreational areas in Appendix E, "Special Facility Data." In **RAI 13.03-08 (B)** the staff requested that the locations of special facilities be added to this map. In response letter dated January 6, 2009, the applicant stated that the figure on page E-8 of the ETE Report will be renamed "Figure E-1, "Recreational Areas within the VCSNS EPZ." The figure has been updated to include the names of the recreational areas and was enclosed with this response. Figure E-2, "Schools within the VCSNS EPZ," and Figure E-3, "Major Employers, Medical Facilities and Day Care Centers within the VCSNS EPZ," were also included and will be added to Appendix E pages E-9 and E-10 respectively, in a future revision of the ETE Report. Figures E-1, E-2 and E-3 collectively provide the locations of all special facilities relative to the location of the VCSNS site.

Telephone survey results (reported in Appendix F, "Telephone Survey") are used to estimate the portion of the population requiring transit service. The transit-dependent population includes persons in households without vehicles and persons in households whose vehicles are unavailable at the time of evacuation due to commuter use. In **RAI 13.03-06** the staff requested additional information to clarify the inconsistent use of the percentage of households with commuters. In a response letter dated January 6, 2009, the applicant stated that the results of the telephone survey indicate that 67% of households have at least one commuter. The value of 33% is the number of households

that do not have a commuter, as indicated in column 3 of Table 6-3. The telephone survey further indicates that 78% of those households with a commuter will await the return of the commuter prior to evacuating. The number of households with a commuter who will not await the return of the commuter is 22%. This value was used to estimate the number of transit-dependent persons in the EPZ, as shown in the formula on Section 8. The applicant plans to revise Section 2.3 to read:

it is further assumed that 67 percent of households in the EPZ have at least one commuter, 78 percent of which await the return of a commuter before beginning their evacuation trip, based on the telephone survey results.

It is assumed that half of the 444 estimated people without transportation would ride-share with friends or neighbors, but that a residual 222 persons would require assistance to evacuate. Additional information regarding the estimation of this population group was requested in **RAI 13.03-08(D)(E)**. In **RAI 13.03-08(D)** the staff requested the applicant clarify whether employees and transients were considered in the transit-dependent population estimate as stated in the text. In a response letter dated January 6, 2009, the applicant stated that the study assumes all transients and employees will have private vehicles available for evacuation due to the lack of mass transit services. Therefore, employees and transients will not require transit resources for evacuation. The first paragraph of Section 8 will be revised to reflect this assumption

In **RAI 13.03-08(D)** the staff requested the applicant clarify the value used to represent the number of households with two vehicles. In a response letter dated January 6, 2009, the applicant stated that the data in Table 8-1 showing that 38.5% of households have two vehicles are accurate. The 58% shown in the calculation on page 8-3 is a typographical error. However, the results of the calculations shown in the second and third lines of the equation are correct. The applicant has revised the equation and text on page 8-3 to reflect the correct value of 38.5%.

The total number of people expected to evacuate for each scenario and vehicles to be used is discussed in Section 6, "Demand Estimation for Evacuation Scenarios." The VCSNS plume exposure pathway EPZ contains 13 Protective Action Zones (PAZs) with boundaries along major roads or rivers. The boundary definitions are provided in Appendix L, "Protective Action Zone Boundaries." Evacuation will be performed by regions that include multiple PAZs. These regions approximate (by radius/area): two-miles/four 90 degree sectors, five miles/four 90-degree sectors, 10-miles (EPZ)/four 90-degree sectors, and 10-miles (EPZ)/entire EPZ. A description of the evacuation regions and their associated PAZs can be found in Table 6-1, "Description of Evacuation Regions" (page 6-2).

A description of the evacuation scenarios used for this study can be found in Table 6-2, "Evacuation Scenario Definitions" (page 6-4). The percentages of population groups expected to evacuate for each scenario are described in Table 6-3, "Percentage of Population Groups for Various Scenarios" (page 6-5). Additional information on Table 6-3 was requested in **RAI 13.03-09(B)**. In a response letter dated January 6, 2009, the applicant stated that the numbers presented in Table 6-4 are for evacuation of the full EPZ. Voluntary evacuation percentages are not applied in obtaining the numbers in Table 6-4 because all PAZs evacuate 100%. The vehicle totals represent the upper bound of vehicles evacuating for a given scenario. The applicant has provided table H-

1, which identifies the voluntary evacuation percentages for each PAZ for each Regional configuration. This table will be added to Appendix H.

### **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 tourist volumes and employment data. Estimates for special facility populations are also provided.

The subareas, for which evacuation time estimates were determined, encompass the entire area within the plume exposure 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 submitted in response to **RAI 13.03-02(C) (D)(1)(2)(3)** to be acceptable and therefore resolved.

The staff finds the additional information and textual revisions submitted in response to **RAIs 13.03-06, 13.03-07(A)(B), 13.03-08(A)(B)(C)(D)(E), and 13.03-09(B)** to be acceptable. The following Confirmatory Action NRC Items have been created to track proposed revisions the applicant has committed to include in a future revision of the ETE Report.

- In response to **RAI 13.03-07(A)** the applicant provided a revision to Appendix I to include an analysis of the effect of transient influx due to the Chapin Festival. The applicant also provided a new Figure I-1 and Table I-3. **Confirmatory Action NRC Items 13.03-08, 13.03-09, and 13.03-10** were created to track these proposed revisions.
- In response to **RAI 13.03-07(B)** the applicant provided Figure 3-6, which was omitted from the ETE Report. **Confirmatory Action NRC Item 13.03-11** was created to track this proposed revision.
- In response to **RAI 13.03-08(A)** the applicant provided revised text for Section 8.3 to discuss the evacuation of day-care centers. **Confirmatory Action NRC Item 13.03-12** was created to track this proposed revision.
- In response to **RAI 13.03-08(C)** the applicant provided revised text for Section 8 to discuss the evacuation of special needs individuals that will be included in a new Section 8.4 - "Special Needs Population" on page 8-8. **Confirmatory Action NRC Item 13.03-13** was created to track this proposed revision.

- In response to **RAI 13.03-08(B)** the applicant provided revised Figure E-1 and new Figures E-2 and E-3 to identify special facilities in the EPZ. **Confirmatory Action NRC Items 13.03-14, 13.03-15, and 13.03-16** were created to track these proposed revisions.
- In response to **RAI 13.03-06** the applicant provided a revision to the text in Section 2.3 to address the number of households that have commuters. **Confirmatory Action NRC Item 13.03-17** was created to track this proposed revision.
- In response to **RAI 13.03-08 (D)** the applicant provided a revision to the first paragraph in Section 8 to omit the statement about the use of transit resources by transients and employees. **Confirmatory Action NRC Item 13.03-18** was created to track this proposed revision.
- In response to **RAI 13.03-08 (D)** the applicant provided a revision to the text and equation on page 8-3 that incorrectly identified a value of 58% instead of 38.5%. **Confirmatory Action NRC Items 13.03-19** was created to track this proposed revision.
- In response to **RAI 13.03-09 (B)** the applicant provided a new table H-1 which identifies the voluntary evacuation percentages for each PAZ for each Regional configuration. **Confirmatory Action NRC Item 13.03-20** was created to track this proposed revision.

In response to **RAI 13.03-02 (B)** the applicant stated that the ETE Report assumes that no major transient attractions or major employers would be introduced between 2007 and 2014, so these population estimates were not extrapolated. The applicant also provided the permanent resident and shadow estimated populations for 2014. The staff has requested that these assumptions and population estimates be included in the ETE Report. This issue will be tracked as **Open Item 13.03-03**.

#### **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," describes the process used to determine vehicle capacities for roadways in the transportation network. The methods used are generally taken from the HCM published by the Transportation Research Board of the National Research Council. Appendix K, "Evacuation Roadway Network Characteristics," identifies all evacuation route segments and their characteristics, including capacity. A map of the transportation network is provided in Figure 1-2, "North Anna Link-Node Analysis Network." Additional information describing the road network used for evacuation routes was requested in **RAI 13.03-10(A)**. In a response letter dated January 6, 2009, the applicant has provided a 48-inch by 36-inch PDF file of Figure 1-2 that contains the node numbers from Appendix K, sector, quadrant and county boundaries.

The ETE Report states that the characteristics of each section of the highway were recorded during field surveys. These included unusual characteristics, such as narrow bridges, sharp curves, poor pavement, flood warning signs, inadequate delineations, etc.

These areas were not identified in the report. In **RAIs 13.03-11(A)(B)** the staff requested additional information regarding unusual roadway characteristic and highway lane widths. In a response letter dated January 6, 2009, the applicant stated that the term "full lanes" is used to identify the number of lanes that extend over the entire length of the roadway segment or link. Many network links are widened with additional lanes near the downstream intersection and are all properly represented in the input stream for the I-DYNEV system. The estimation of capacity is based on the narrowest section of the roadway segment. The free-flow speed (Appendix K) is based on observation of traffic movements during the field survey. Lane widths were observed but not measured during the field survey. The number of bridges, sharp curves, narrow shoulders and other capacity-reducing features on the evacuation network were observed and considered in estimating capacity. The applicant also provided a discussion for how the model uses roadway characteristics to adjust traffic flow. In any case mobilization time dictates the ETE. There is excess capacity within the EPZ, and the reduced capacities on the narrowest road segments have no effect on ETE.

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. Appendix G, "Traffic Management," provides a description of Traffic control Points (TCPs) and Access control Points (ACPs) and provides maps of their location within the plume exposure pathway EPZ [Figure #G-1, "North Anna Power Station Traffic Control Points" (page G-2) and Figure #G-2, "North Anna Power Station Access Control Points" (pageG-37)]. Additional information regarding the use of the traffic management strategy was requested in **RAIs 13.03-10(B-C)**. In **13.03-10(B)** the staff requested the applicant explain the use of TCPs and ACPs. In a response letter dated January 6, 2009, the applicant stated that ETE calculations do not rely on any of the traffic control measures identified in Appendix G. The estimates of capacity, which are used by the IDYNEV model and are documented in Appendix K, are based on the factors described in Section 4 and on the observations made during the road survey. The applicant further stated that TCPs could be used to facilitate evacuating traffic movements and discourage travelers from moving closer to the VCSNS. Personnel manning TCPs will also serve a surveillance function to inform the EOC of any problems. As illustrated in Figure 1, the ETE for the VCSNS EPZ is dictated by the mobilization time. The short travel times indicate there is not pronounced traffic congestion within the EPZ delaying the departure of evacuees from the EPZ. The establishment of TCPs to manage traffic congestion is not necessary, but recommended to provide guidance, reassurance, fixed point surveillance. There would be no effect on ETE if traffic control points were not established.

In **13.03-10(C)** the staff requested the applicant explain the effect or reentry on the ETE. In a response letter dated January 6, 2009, the applicant stated that Assumption #6 IN Section 2.3 indicates that ACPs are staffed one to two hours after the advisory to evacuate (ATE). The inputs to the model indicate that traffic stops entering the EPZ at 90 minutes after the ATE. Figure F-10 indicates that approximately 99% of the EPZ population could travel home from work in 90 minutes or less, justifying the use of 90 minutes. The assumed 90 minute timeframe for allowing entry into the EPZ was reviewed by the EPZ counties as they were presented with the ETE Report prior to COLA submittal. The applicant has revised Assumptions #6 on page 2-4 and the footnote on page 6-5 to eliminate the reference estimate of one to two hours following

notification and replaced it with the correct estimate of 90 minutes. A revision to Assumption #7 on page 2-4 was also provided.

Section 10, "Evacuation Routes," illustrates the emergency evacuation routes for the four counties surrounding the VCSNS site. Evacuation routes provide for evacuation first to the EPZ boundary and then to reception centers. The TRAD model was used to determine routes that would minimize exposure to risk by balancing traffic demand relative to road capacity. Evacuation routes were also developed to minimize travel outside the EPZ and relate traffic volume to reception center capacity. Section 7.2, "Patterns of Congestion," identifies areas of traffic congestion that arise for the case when the entire EPZ (Region R3) is advised to evacuate during the summer, weekend, and midday period under good weather, in Figure 7-3, "Congestion Patterns at 2 Hours after the Order to Evacuate (Scenario 1)," (page 7-14) and Figure 7-4, "Congestion Patterns at 2 Hours after the Order to Evacuate (Scenario 12)" (page 7-15). Additional information regarding travel times and delay durations was requested in **RAI 13.03-15 and 13.03-8(E)(1-3)**. In **RAI 13.03-09 (E)(1)** the staff requested the applicant provide maps that include queuing locations and estimated delay times. In a response letter dated January 6, 2009, the applicant stated that there is no significant traffic congestion during evacuation for all Year 2007 Scenarios (1 through 11). There is congestion for the Construction Scenario (Scenario 12) due to the large influx of vehicles transporting workers for the construction of Units 2 and 3. The applicant has revised the second paragraph on page 7-3 of the ETE Report to read:

There is no significant congestion within the EPZ for all Year 2007 cases (Scenarios 1 through 11); consequently the ETE reflects the mobilization activities of the EPZ population. There is congestion under Scenario 12 conditions (peak construction - Year 2014); however all congestion within the EPZ is clear by 3 hours and 20 minutes after the advisory to evacuate. Therefore, the 100th percentile ETE for Scenario 12 is also dictated by mobilization time. Specifically, as detailed in Table 7-1 D, the ETE for 100% of the population approximates the time required for those relatively few persons who need up to 4 hours to mobilize for the evacuation trip. Any decrease in this mobilization time will translate to a commensurate reduction in ETE. The recommendations in Section 13 address this issue.

In **RAI 13.03-09 (E)(2)** the staff requested the applicant clarify how potential congestion will be managed. In a response letter dated January 6, 2009, the applicant stated that congestion within the EPZ clears by three hours and 20 minutes after the advisory to evacuate for Scenario 12; therefore, the ETE for the 100th percentile is still dictated by the mobilization time of four hours. The applicant has provided additional information to describe the buildup of congestion points and the use of ACPs and TCPs to reduce congestion. Implementation of these ACPs and TCPs will help manage congestion during construction, but the ETE is not dependent on them being established.

In **RAI 13.03-09 (E)(3)** the staff requested the applicant clarify the effect congestion will have on the ETE. In a response letter dated January 6, 2009, the applicant stated that congestion under Scenario 12 conditions increases the ETE by 15 and 10 minutes for the 50th and 90th percentiles of EPZ population, respectively. The ETE for the 95th percentile is 10-minutes less for Scenario 12 than it is for Scenario 1. Therefore, the ETE for the 95th and 100th percentiles are not affected by the congestion caused by construction worker vehicles. Following review of output files, the applicant determined

that the 95th percentile ETE for Scenario 12, Region R03 should be 3:20. The applicant has provided revised Tables 7-1 D and J-1 D to reflect this correction.

In **RAI 13.03-15** the staff requested the applicant provide maps that include queuing locations and estimated delay times. In a response letter dated January 6, 2009, the applicant stated that Figures 7-3 and 7-4 have been revised and will be included in a future revision of the ETE report. The major roads in the study area have been identified on the map. The major congestion points in the study area have been labeled with an identification number. Table 7-3 provides a description of each congestion point and the link from Figure 1-2 corresponding to that area of congestion. Estimates of the average delay in minutes per vehicle are provided in the Table 7-3 for each of the congestion points. The delay presented is over the previous 10 minutes of simulation. For example, Figure 7-4 shows the congestion patterns at 2 hours after the Advisory to Evacuate for Scenario 12. The average delay for each link provided in the table (column 6) applies to the 10 minute time interval from 110 to 120 minutes after the Advisory to Evacuate. Therefore, the vehicles occupying the link from node 168 to node 8 experience an average delay of 1.8 minutes during this 10-minute interval. Table 7-3 will also be added to page 7-16 of the revised ETE Report.

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

The ETE Report provides a complete review of the evacuation road network. 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 applicant also analyzed travel times and potential locations for serious congestion along the evacuation routes.

The staff finds the additional information submitted in response to **RAIs 13.03-09(E)(2), 13.03-10(A), 13.03-11(A)** to be acceptable and therefore resolved.

The staff finds the additional information and textual revisions submitted in response to **RAIs 13.03-09(E)(1)(3), 13.03-10(C), and 13.03-15** to be acceptable. The following Confirmatory Action NRC Items have been created to track proposed revisions the applicant has committed to include in a future revision of the ETE Report.

- In response to **RAI 13.03-10(C)** the applicant revised Assumptions #6 on page 2-4 and the footnote on page 6-5 to eliminate estimate of one to two hours following notification and replaced it with the correct estimate of 90 minutes. A revised Assumption #7 on page 2-4 was also provided. **Confirmatory Action NRC Items 13.03-21, 13.03-22, and 13.03-23** have been created to track these proposed revisions.
- In response to **RAI 13.03-09(E)(1)** the applicant revised the second paragraph on page 7-3 to discuss congestion in Scenario 12. **Confirmatory Action NRC Item 13.03-24** was created to track this proposed revision.

- In response to **RAI 13.03-09(E)(3)** the applicant determined that the 95th percentile ETE for Scenario 12, Region R03 should be 3:20. The applicant has provided revised Tables 7-1 D and J-1 D to reflect this correction. **Confirmatory Action NRC Items 13.03-25 and 13.03-26** were created to track these proposed revisions.
- In response to **RAI 13.03-15** the applicant has revised Figures 7-3 and 7-4 to include congestion point labels to match Table 7-3 and identify major roads. Table 7-3 will also be added to page 7-16. **Confirmatory Action NRC Items 13.03-27, 13.03-28, and 13.03-29** were created to track these proposed revisions.

In **RAI 13.03-11(B)** the staff asked for clarification of road characteristics. A detailed discussion is provided on the application of field data into the calculation and states that bridges are treated as Links in the network. The inclusion of the large scale nodal map supports review of the integration of highway characteristics and some bridges are clearly defined as links in the roadway network. However, there is a bridge located between nodes 185 and 186 and there are two bridges between nodes 171 and 172. The discussion in the response to **RAI 13.03-11 (B)** indicates that these bridges should be identified as separate links in the system to account for their unique characteristics. Discuss the criteria by which links are established at bridges or other narrow roadway segments. This issue will be tracked as **Open Item 13.03-04**.

In **RAI 13.03-10(B)** the staff asked for clarification regarding how the ETE model addressed the movement of vehicles through traffic control intersections and how the traffic management strategy affected ETE calculations. However, the response to **RAI 13.03-5(C)** would indicate that the ETE does, to some extent, rely on traffic control being in place to represent reasonably efficient operation under evacuation conditions. Refer to the **Open Items 13.03-01 and 13.03-02**

### **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, "Estimation of Highway Capacity," describes how data collected during field surveys of the transportation network were combined with methods suggested in the 2000 HCM. Section 5, "Estimation of Trip generation Time," provides estimates of the four different distributions of elapsed times associated with mobilization activities undertaken by the public to prepare for the evacuation trip. The elapsed time associated with each activity is represented as a statistical distribution reflecting differences between members of the public. Additional information regarding evacuation activity distributions was requested in **RAIs 13.03-07(C)(D), 13.03-13(B), 13.03-14(A)(D)**. In **RAI 13.03-7(C)** the staff requested additional information related to the logistics for evacuating the reservoir. In a response letter dated January 6, 2009, the applicant identified three major boat ramps located on the Monticello Reservoir. Page 3-8 of the report states the South Carolina Department of Parks, Recreation and Tourism (SCDPRT) estimated that approximately 90% of the people at recreational areas are residents and 10% are transients. Thus, the majority of the people are familiar with the evacuation procedures through public information distribution. Brochures provide information related to evacuation procedures as described on page D-19 of the Fairfield

County Emergency Operations Plan. Table 6-3 of the report shows the majority of residents are home during summer weekends when peak populations on the reservoir are expected. Thus, Distribution D of Table 5-1 is applicable; this distribution extends over four hours. It is reasonable to assume that boaters on the reservoir will be able to return to boat launch sites, trailer their boats and begin to evacuate the area within this time frame.

In **RAI 13.03-7(D)** the staff requested additional information related to transient mobilization activities depicted in Figure 5-1. In a response letter dated January 6, 2009, the applicant stated that the mobilization distribution for transients extends over a period of 2-½ hours, as shown in Table 5-1. Those who elect to return to collect their belongings will be able to do so and then evacuate. The existing Figure 5-1 has been reviewed; the diagrams for scenarios (b) and (d) do not include those households with employees who work during the evening or on weekends. The applicant revised Figure 5-1 to clarify its meaning. The final paragraph on page 5-3 will also be revised to read:

A household within the EPZ that has one or more commuters at work, and will await their return before beginning the evacuation trip, will follow the first sequence of Figure 5-1 (a). A household within the EPZ that has no commuters at work, or that will not await the return of any commuters, will follow the second sequence of Figure 5-1 (a), regardless of day of week or time of day. Note that event 5, "Leave to evacuate the area," is conditional either on event 2 or on event 4. For this study, we adopt the conservative posture that all activities will occur in sequence. Households with no commuters on weekends or in the evening/night-time will follow the applicable sequence in Figure 5-1 (b). Transients will always follow one of the sequences of Figure 5-1 (b). Some transients away from their residence could elect to evacuate immediately without returning to the residence, as indicated in the second sequence.

In **RAI 13.03-13(B)** staff requested that the applicant explain how data was normalized to distribute the "don't know" response. In a response letter dated January 6, 2009, the applicant stated that a review of the survey instrument reveals that several questions have a "don't know" or "refused" entry for a response. It is accepted practice to accept these answers for a few questions. To address this issue, the practice is to assume that the distribution of these responses is the same as the underlying distribution of the positive responses. In effect, the "don't know" responses are ignored and the distributions are based on the positive data that is acquired.

In **RAI 13.03-14(A)** the staff requested the applicant to provide the basis for the statement that 85% of the population within the EPZ will be aware of the accident within 30 minutes. In a response letter dated January 6, 2009, the applicant stated that the notification distribution is assumed based on the presence of the siren alert system. The discussion of Distribution #1 on page 5-4 will be revised to indicate that the distribution is assumed. Page Q-8 of the Fairfield County Emergency Operations Plan provides a design objective for warning the population in the EPZ. This design objective is in agreement with the assumed notification distribution provided on page 5-4 of the ETE Report.

In **RAI 13.03-14(D)** the staff requested the applicant discuss whether the curves in Figure 5-3 are intended to approach 100%, or whether the elapsed time axis should be extended. In a response letter dated January 6, 2009, the applicant stated that the

response to **RAI 13.03-9(C)** identifies that the curves in Figure 5-2 and Figure 5-3 do not reflect the results of this procedure discussed in the response whereby the trip generation of the stragglers is advanced. The applicant has provided revised figures in response to **RAI 13.03-9(C)**.

The quantification of activity-based distributions in Section 5 relies largely on the results of a telephone survey contained in Appendix F, "Telephone Survey." In **RAI 13.03-14(C)** the staff requested the applicant explain how the data in Figure F-11 were used in the development of the ETE. In a response letter dated January 6, 2009, the applicant stated that as noted in the response to **RAI 13.03-9(C)**, Distribution # 4 on page 5-8 of the ETE Report will be revised to reflect the results of the trip generation truncation procedure identified in the response. The distribution was input correctly to the simulation model, however the distribution was not properly documented in the ETE Report.

Section 6, "Demand Estimation for Evacuation Scenarios," 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 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 as a grouping of contiguous evacuation PAZs, which forms either a "keyhole" sector-based area, or a circular area within the plume exposure pathway EPZ, that must be evacuated in response to a radiological emergency. Reception centers are shown on maps in Section 10, "Evacuation Routes." The assumptions on evacuation are based on simultaneous evacuation of inner and outer sectors.

A summary of the ETE is provided in Section 7, "General Population Evacuation Time Estimates (ETE)." These results cover 21 regions within the VCSNS EPZ and the 12 evacuation scenarios discussed in Section 6. The evacuation times are presented for 21 evacuation regions and 12 scenarios in Appendix J, "Evacuation Time Estimates for All Evacuation Regions and Scenarios and Evacuation Time Graphs for Region R03, for all Scenarios." Results are presented for 50%, 90%, 95%, and 100% of vehicles. Additional information on evacuation times was requested in **RAIs 13.03-9(C), 13.03-14(B)**. In **RAI 13.03-9(C)** the staff requested that the applicant explain how the distribution in Section 5 was derived using the telephone survey information. In a response letter dated January 6, 2009, the applicant stated that Figure F-11 shows about 99% of respondents complete the home preparation within 4 hours, with the remaining stragglers requiring another two hours. It is important to accurately represent the ETE at the 90th and 95th percentiles and avoid bias resulting from the stragglers. Truncating the cited distribution at four hours ensures that these ETE of interest (i.e., 90th and 95th percentiles) are based on a conservative estimate of traffic demand. Advancing the departures of the stragglers to four hours provides assurance that the traffic demand includes all evacuees over that time frame when congested conditions could arise. Since traffic flow is generally a first-in-first-out (FIFO) process, any "tail truncation" that occurs well after the 90th and 95th percentile ETE does not influence these values. The applicant cited NUREG/CR-6953, Vol. 2 (page 27), as a reference. The applicant also provided, "Procedure for Estimating Mobilization Curve Based on Survey Data," which discusses the methodology for advancing the trip generation times of those persons who take longer to mobilize.

In **RAI 13.03-14(B)** the staff requested that the applicant explain the factors that cause the ETE for Scenario 5, in Table 7-1C, to be longer than all other summer scenarios including Scenario 2. In a response letter dated January 6, 2009, the applicant stated that as indicated in the response to **RAI 13.03-4(B)**, the ETEs for all cases are reflective of mobilization time. Table 1 (attached) presents the mobilization time of the evacuating vehicles for each time period for Scenarios 3, 4 and 5. The "Cumulative Vehicles Mobilized" are calculated using the vehicle totals and the trip generation rates provided in Table 5-1. Figure 1 presents the time distribution of mobilized vehicles. The mobilization curve for Scenarios 3 and 4 is significantly steeper than that for Scenario 5. This difference reflects the fact that the majority of the vehicles evacuating in Scenario 5 are resident vehicles with longer mobilization times than employees and transients. Scenario 5 has 199 evacuating vehicles, 137(69%) of which are residents. Scenarios 3 and 4 have 607 evacuating vehicles, 137(23%) of which are residents. Therefore, the ETE time distribution for Scenario 5, which tracks that of the mobilization time, is longer at the 50th, 90th and 95th percentiles than that for Scenarios 3 and 4.

Results are provided for good and adverse conditions. Additional information concerning the possible impacts on evacuation time caused by adverse weather conditions was requested in **RAI 13.03-12(A)(B)(C)**. In **RAI 13.03-12 (A)** the staff requested that the applicant explain why icy conditions were not included in the evaluation. In a response letter dated January 6, 2009, the applicant stated that the ice weekend/evening scenario not being included was an oversight. Scenarios 11 and 12 will be renumbered as Scenarios 12 and 13 and a new Scenario 11 (winter weekend/evening with ice), will be added. Scenarios 9, 10 and 11 (all winter, weekend scenarios) will appear in adjoining columns in the ETE tables (7-1A through D) so that a rapid assessment of the effect of rain and ice on the ETE can be made. The applicant added that rain is estimated to reduce the free speed and capacity of all links in the analysis network by 10%, while ice reduces the free speed and capacity by 20%. The only difference between the weekday and weekend rain scenarios is the number of people evacuating, as shown in Table 6-4. The weekend and the evening scenarios are similar in that most commuters are home, as shown in Table 6-3. The applicant will revise the table on page 2-2, Table 6-2 "Evacuation Scenario Definitions," Tables 7-1 A through D, and the table on page 2-5 to reflect this change. All references to "12 scenarios" will also be changed to "13 scenarios."

In **RAI 13.03-12(B)** the staff requested that the applicant explain why only Regions 12 and 13 are affected by ice when evacuating 50% and 90% of the population. In a response letter dated January 6, 2009, the applicant stated that the input files were reviewed, and the capacity reduction used was actually 20%, not 15%. Rain and ice do not influence the ETE because the volume of traffic following the Advisory to Evacuate never attains a level where capacity is a factor in influencing travel time even when reduced by inclement weather. The applicant cited various sections of the ETE Report and provided an explanation of the PC-DYNEV model to support this statement. Revised Tables 7-1A, 7-1B, and 7-1D were also provided.

In **RAI 13.03-12 (C)** the staff requested that the applicant explain why icy conditions were not considered in the estimates provided for schools and transit dependent people in Tables 8-5A/B and 8-6 A/B. In a response letter dated January 6, 2009, the applicant stated that travel speed was reduced by 10% for rain scenarios and will be reduced 20% for ice scenarios. A 10-minute increase in mobilization time was assumed for rain conditions to allow for slower travel speeds as the bus driver drives to the depot to pick

up the bus and then drives from the depot to the school. A 20-minute increase will be added to the base mobilization time for ice scenarios. The loading time was increased by five minutes for rain scenarios to account for students who may be carrying umbrellas who have to close the umbrella before boarding the bus. It is assumed that this loading time is also adequate for ice scenarios. The ETE for ice will assume 10 additional minutes of route travel time and of passenger pickup time. The applicant has revised Table 8-5C, "School Evacuation Time Estimates – Ice" and Table 8-6C, "Transit Dependent Evacuation Time Estimates – Ice," to reflect these changes. The text in Section 8.4 was also revised to reflect these changes.

The methodology for the general population uses distribution functions. Figures describing the time distribution of evacuating vehicles follow the format of NUREG-0654, App. 4, Figure 4. In **RAI 13.03-13(A)** the staff requested that the applicant explain why separate estimates were not made for transients and permanent residents. In a response letter dated January 6, 2009, the applicant stated that NUREG-0654 does not specify that separate ETE be provided for residents and transients. The applicant further stated that all of the data requested in Table 2 on page 4-16 of NUREG-0654 are presented in various sections of the ETE Report.

Section 8, "Transit-Dependent and Special Facility Evacuation Time Estimates," discusses evacuation plans for schools, residents without vehicles, and special care facilities. These groups are expected to merge with general evacuation traffic following notification and mobilization. Separate estimates of population size and necessary transportation were made for schools, special facilities and the transit-dependent populations. Schools are given advanced notification, if possible, in order to determine transportation needs. The estimated students and their transportation needs, based on student to bus ratios, are provided in Table 8-2, "School Population Demand Estimates" (page 8-12). Additional information on school transportation needs was requested in **RAIs 13.03-8(J)(K)(M) and 13.03-8(D)**. In **RAI 13.03-8(J)(1)** the staff requested the applicant explain why Table 6-4, "Vehicle Estimates by Scenario," indicates that 200 buses are needed to support evacuation of the schools and not the 95 buses identified in Table 8-2, "School Population Demand Estimates." In a response letter dated January 6, 2009, the applicant stated that 100 buses are needed to evacuate all schoolchildren in the EPZ. The ETE Report indicates that one bus is equivalent to two passenger vehicles. Thus, Table 6-4 indicates that 200 vehicles (not buses) are modeled to represent 100 school buses in the simulation.

In **RAI 13.03-8(J)(2)** the staff requested the applicant clarify the column labeled, "Distance" in Table 8-2. In a response letter dated January 6, 2009, the applicant stated that the column is the radial distance of the school from the existing reactor (Unit 1) at the VCSNS site. The column heading will be revised to read "Distance from VCSNS (miles)."

In **RAI 13.03-8(K)** the staff requested the applicant explain why the number of children per bus is estimated differently for Mid-Carolina and Chapin Middle School. In a response letter dated January 6, 2009, the applicant stated that the number of buses required for Chapin Middle School in Table 8-2 is incorrectly identified as 13. The value should be 18, resulting in a total of 100 buses for Table 8-2. This error was only in documentation. The correct number of buses was input to the evacuation model. Table 8-2 has been revised to reflect this correction.

In **RAI 13.03-8(M)** the staff requested the applicant clarify the number of buses necessary to evacuate students from McCrorey-Liston Elementary School. In a response letter dated January 6, 2009, the applicant stated that Tab A to Appendix 9 to Annex Q of the Fairfield County Radiological Emergency Plan identifies an enrollment of 354 students. Tab B indicates that five buses are needed to evacuate the school. Internet searches indicate that the current enrollment for McCrorey-Liston Elementary is 250 students, which supports the data reported in the ETE Report. The use of four buses to evacuate McCrorey-Liston Elementary in the ETE Report is retained.

In **RAI 13.03-9(D)** the staff requested the applicant discuss the use of school buses in Scenarios 1 and 2 as described in Tables 6-3 and 6-4. In a response letter dated January 6, 2009, the applicant stated that the buses shown for Scenarios 1 and 2 in Tables 6-3 and 6-4 are evacuating summer school students. It is assumed that summer school enrollment is approximately 10% of enrollment for the regular school year.

Transportation resources should be adequate to evacuate schools in one wave, but additional resources can be requested from nearby cities if necessary. Additional information regarding evacuation resources was requested in **RAIs 13.03-7(F)(G)(L)**. In **RAI 13.03-08(F)(1)** the staff requested that the applicant provide information regarding the process used to request additional resources. In a response letter dated January 6, 2009, the applicant stated that the "Concept of Operations" section of Appendix L, "Transportation," to the Fairfield County Emergency Operations Plan indicates that transportation operations will be controlled from the County Emergency Operations Center. The Transportation Service Coordinator (TSC) will coordinate all transportation requirements. State and Federal support will be committed, as available, on a mission-type basis on request to the State. Requests for use of additional transportation resources will be made through the County EOC.

In **RAI 13.03-08(F)(2)** the staff requested that the applicant explain how the implementation of the resource request process could affect evacuation times. In a response letter dated January 6, 2009, the applicant stated that bus mobilization time is estimated to be 90 minutes but would most likely exceed 90 minutes if additional resources had to be brought in from other cities. However, this should not be necessary.

In **RAI 13.03-08(G)(1)** the staff requested that the applicant clarify whether a time difference associated with other inclement conditions, such as ice, has been considered in the estimate of travel time back to the EPZ. In a response letter dated January 6, 2009, the applicant stated that Table 8-6C, "Transit Dependent Evacuation Time Estimates – Ice," will be added to a future revision of the ETE Report. Additional information is provided in response to **RAI 13.03-12(C)**.

In **RAI 13.03-08(G)(2)** the staff requested that the applicant explain whether travel time includes transferring traffic control points. In a response letter dated January 6, 2009, the applicant states that primary objectives of traffic control points are to facilitate and guide the flow of evacuating traffic as discussed in the response to **RAI 13.03-4(B)**. It is especially critical that traffic control points facilitate the movements of transit resources (buses and ambulances) which are needed to evacuate the transit-dependent and special facility populations within the EPZ. Therefore, the inbound bus speed of 45 mph will be unaffected as buses traverse traffic control points. Appendix 9 to Annex Q (page Q-63) of the Fairfield County Radiological Emergency Plan states the following:

Once a bus driver has left the 10-mile EPZ, the bus will be permitted to re-enter the affected area only if driven by an adult driver. Adult bus drivers may re-enter the affected area on a voluntary basis, only if the bus has no student passengers. No buses will be permitted back into the EPZ unless multi-trips are necessary.

It is anticipated in the county plans that buses may have to re-enter the EPZ to evacuate others who need transportation assistance. The following statement will be added to the end of Section 9 of the ETE Report:

As discussed in Section 2.3, these TCPs are not expected to influence the ETE results. Access control points (ACP) are deployed near the periphery of the EPZ to divert "through" trips. The ETE calculations reflect the assumption that all "external-external" trips are interdicted after 90 minutes have elapsed after the advisory to evacuate (ATE). All transit trips and other responders entering the EPZ to support the evacuation are assumed to be unhindered by personnel manning TCPs. Study Assumptions 6 and 7 in Section 2.3 discuss ACP and TCP staffing schedules and operations.

In **RAI 13.03-08(L)** the staff requested that the applicant clarify that there are sufficient resources to evacuate the schools in a single wave. In a response letter dated January 6, 2009, the applicant provided an estimate of bus resources needed to evacuate schools in the EPZ and total enrollment by county. Estimates indicate that there are more than adequate transportation resources to evacuate the schools within the EPZ. The applicant submitted a revised Table 8-2 that includes this information.

The estimated time to evacuate schools within the plume exposure pathway EPZ is provided in Table 8-5A, "School Evacuation Time Estimates-Good Weather," and Table 8-5B, "School Evacuation Time Estimates-Adverse Weather" (pages 8-13/14). Evacuation of other special facilities, Generation of Chapin Nursing Home, is given the same consideration as schools with the exception of increased loading time. Mobilization of drivers and students has been built into the total evacuation times. The estimated population and necessary transportation resources can be found in Table 8-4, "Special Facility Transit-Demand Estimate" (page 8-12).

Remaining transportation resources and those that become available following the evacuation of schools will be used to evacuate the portion of the population without vehicles. The study estimates 222 people needing transportation can be evacuated in 8 bus runs. These individuals will be picked up along routes proposed in Section 8.4, "Evacuation Time Estimates for Transit-Dependent People," and depicted in Figure 8-2, "Proposed Transit Dependent Bus Routes." Additional information regarding evacuation of transit dependent people was requested in **RAIs 13.03-8(H)(I)**. In **RAI 13.03-08(H)** the staff requested that the applicant explain how transit-dependent individuals are expected to get from their residences to the bus routes, and whether this time was factored into the ETE. In a response letter dated January 6, 2009, the applicant stated that evacuees are assumed to walk to the nearest route and "flag" down a bus traversing the route. Based on route design, the walking distance should be less than one mile. The 2000 HCM recommends a walking speed of 4.0 ft/sec for a pedestrian, which means the walk should take 22 minutes. Transit-dependent persons will be able to complete their preparation activities and walk to the routes by the time the buses arrive. Subsequent buses on a route will arrive later to service those who take longer to

mobilize. Thus, the time needed for transit-dependent people to walk to the bus routes has been considered in the calculation of the transit-dependent ETE.

In **RAI 13.03-08(I)(1)(2)** the staff requested that the applicant provide additional information on bus stop locations. In a response letter dated January 6, 2009, the applicant stated that transit-dependent persons will walk to the nearest route and "flag" down a bus. There are no pre-established pickup points.

In **RAI 13.03-08(I)(3)** the staff requested that the applicant clarify whether stopping and dwell time were considered in the estimation of the average route travel time. In a response letter dated January 6, 2009, the applicant stated that dwell time was considered pickup time which was estimated to be about 15 minutes per bus run taking into consideration slowing of the bus and loading of passengers.

The estimated time to evacuate transit-dependent people within the plume exposure pathway EPZ is provided in Table 8-6A, "Transit Dependent Evacuation Time Estimates-Good Weather," and Table 8-5B, "Transit Dependent Evacuation Time Estimates-Adverse Weather" (pages 8-15/16).

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. Additional information was requested in **RAI 13.03-13(C)(D)** to clarify assumptions regarding "shadow" population that is expected to evacuate and the numbers of vehicles that were proposed to be used. In **RAI 13.03-13(C)** the staff requested that the applicant explain what percentage of shadow residents are expected to evacuate. In a response letter dated January 6, 2009, the applicant stated that the population within the shadow region is comprised of residents and employees. Employees in the shadow region are estimated to be in the same proportion relative to residents, as determined for the EPZ. This proportion is the ratio of 732 vehicles for employees to the total number of evacuating vehicles used by residents ( $4,439 + 2,123 = 6,562$ , listed in Columns 2 and 3 for Scenarios 1 and 2). This ratio is equal to 0.112. The total population of residents plus employees within the shadow region is  $1.112 \times$  the number of residents. Multiplying 1.112 by 0.3 (the percentage assumed to evacuate) yields 0.33 or the 33% figures shown in Column 6 of Table 6-3 for Scenarios 1 and 2. The same methodology applied to all scenarios in Column 6 of Table 6-3, and the estimates of evacuating vehicles shown in column 6 entitled "Shadow" of Table 6-4.

In **RAI 13.03-13(D)** the staff requested that the applicant discuss the timing of the traffic loading onto the network for the shadow population identified in Table 6-4. In a response letter dated January 6, 2009, the applicant stated that Table 6-4 indicates 7,678 shadow vehicles evacuating versus the 6,908 evacuating shadow vehicles shown in Table I-2. Table I-2 only shows the shadow resident population and shadow resident vehicles evacuating. Based on the information provided in response to **RAI 13.03-13(D)**, the applicant has revised Table I-2 to reflect the correct number of evacuating vehicles. The text on page I-2 will also be revised to reflect this correction. The following sentence will be added to the end of the first paragraph,

The case considered was Scenario 1, Region 3; a summer, midweek, midday, good weather evacuation for the entire EPZ."

The following two sentences will be added to the end of the second paragraph followed by an updated formula used to calculate evacuating vehicles:

As discussed in the "Shadow" footnote to Table 6-3, the shadow evacuation demand assumes a 30% relocation of shadow residents along with a proportional percentage of shadow employees. The percentage of shadow employees is computed using the scenario-specific ratio of EPZ employees to residents. Thus, for Scenario 1, with reference to Table 6-4.

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

A total of 252 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 21 Evacuation Regions to completely evacuate from that Region, under the circumstances defined for one of twelve Evacuation Scenarios (21 x 12 = 252). Separate evacuation time estimates are 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.

There are separate distributions for auto-owning households, school population, and transit-dependent populations.

On-road travel and delay times are calculated. An estimate of the time required to evacuate a particular segment of the non-auto-owning population dependent on public transportation is developed, in a manner similar to that used for the auto-owning population.

The staff finds the additional information submitted in response to **RAIs 13.03-08(F)(1)(2) (H) (I)(1)(2)(3) (J)(1) (M), 13.03-09(D), 13.03-13(A)(B)(C), 13.03-14(B)** to be acceptable and therefore resolved.

The staff finds the additional information and textual revision submitted in response to **RAIs 13.03-07(D), 13.03-08(G)(1)(2) (J)(2) (K)(L), 13.03-12(A)(B), 13.03-14(A)(C)(D)** to be acceptable. The following Confirmatory Action NRC Items were created to track proposed revisions the applicant has committed to include in a future revision of the ETE Report.

- In response to **RAI 13.03-07(D)** the applicant revised Figure 5-1 to include those households with employees who work during the evening or on weekends. The final paragraph on page 5-3 will also be revised to read to reflect this change. **Confirmatory Action NRC Items 13.03-30 and 13.03-31** were created to track these proposed revisions.

- In response to **RAI 13.03-14(A)** the applicant revised the discussion of Distribution 1 on page 5-4 to indicate that the distribution is assumed. **Confirmatory Action NRC Items 13.03-32** was created to track this proposed revision.
- In response to **13.03-14(C), and 13.03-14(D)** the applicant revised Figures 5-2, 5-3 and Distribution 4 on page 5-8 to reflect the truncation procedure discussed in response to **RAI 13.03-9(C)**. **Confirmatory Action NRC Items 13.03-33, 13.03-34, and 13.03-35** were created to track these revisions.
- In response to **RAIs 13.03-12(A)(B)** the applicant revised the ETE to include a new Scenario 11. Scenarios will be renumbered accordingly. The applicant has also revised the table on page 2-2, Table 6-2, Tables 7-1 A through D, and the table on page 2-5 to reflect this change. All references to "1 2 scenarios" will also be changed to "1 3 scenarios." **Confirmatory Action NRC Items 13.03-36, 13.03-37 , 13.03-38 , 13.03-39 , 13.03-40 , 13.03-41, 13.03-42, 13.03-43** were created to track these proposed revisions.
- In response to **13.03-08(J)(2)** the applicant revised column labeled, "Distance" in Table 8-2 to "Distance from VCSNS (miles)." **Confirmatory Action NRC Item 13.03-44** was created to track this proposed revision.
- In response to **13.03-08(K)** the applicant revised Table 8-2 to identify the correct number of buses required to evacuate Chapin Middle School. **Confirmatory Action NRC Item 13.03-45** was created to track this proposed revision.
- In response to **13.03-08(G)(1)** the applicant provided a new Table 8-6C, "Transit Dependent Evacuation Time Estimates – Ice." **Confirmatory Action NRC Item 13.03-46** was created to track this proposed revision.
- In response to **13.03-08(G)(2)** the applicant provided a new sentence that will be added to the end of Section 9 to support the evacuation are assumed to be unhindered by personnel manning TCP. **Confirmatory Action NRC Item 13.03-47** was created to track this proposed revision.
- In response to **13.03-08(L)** the applicant provided a revised Table 8-2 that will clarify that transportation resources are adequate. **Confirmatory Action NRC Item 13.03-48** was created to track this proposed revision.

In **RAI 13.03-7(C)** the staff requested that the applicant provide additional information regarding evacuating Monticello Reservoir. In response the applicant states that it is reasonable to expect boaters will be able to return to boat launch sites, trailer their boats, and begin to evacuate the area within the four hour mobilization time. To support this expectation, discuss the capacity of the marinas and boat ramps and assumptions on mobilization times assumed for loading of boats at the boat ramps considering that ramps may have limited capacity to load more than a few boats at a time. Discuss if the trip generation time includes residents returning home to drop off the boat, pack and evacuate. These issues will be track as **Open Item 13.03-05 and 13.03-06**.

In **RAI 13.03-9(C)** the staff requested clarification regarding truncation of data. The response provides a detailed discussion and basis for truncating data developed from

the telephone survey. The ETE Report currently does not include any discussion on truncating data. The discussion provided with the response to **13.03-9(C)** should be added to the ETE. This issue will be track as **Open Item 13.03-07**.

In **RAI 13.03-13(D)** the staff requested that the applicant explain the values used in the shadow population and discuss the timing of traffic loading traffic loading onto the network for the shadow population identified in Table 6-4. The applicant provided a detailed response on the development and calculation of the shadow population vehicles and will included a revision to Page I-2 of the ETE report. **Confirmatory Action NRC Items 13.03-49 and 13.03-50** were created to track these revisions. However, the applicant did not provide a discussion regarding the timing of the traffic loading onto the evacuation network. This information is still needed to support the potential effect on the ETE. This issue will be tracked as **Open Item 13.03-08**.

**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 Time," suggests a possible alternative 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. Based on calculations it would be necessary to make 300 random phone calls to confirm that 20% of the population has not yet evacuated. This process could be completed within 90 minutes if five people are assigned to the task. Since confirmation begins three hours after the advisory, confirmation should be made when the evacuation area is clear. If more than 20% of the population is determined to have not yet evacuated, the telephone survey will be repeated after an hour interval until evacuation is complete. The development of the ETE Report was coordinated with emergency planners from the State of South Carolina and Fairfield, Lexington, Newberry, and Richland County who are involved in emergency response for the site. Additional information related to confirming evacuation was requested in **RAI 13.03-16 (A) and (B)**. In **RAI 13.03-16(A)** the staff requested that the applicant clarify whether there are other confirmation plans being used or whether other counties have agreed to this plan. In response letter dated January 6, 2009, the applicant stated that the county emergency operations/response plans were reviewed and there is no mention of methodologies to confirm that the advisory to evacuate is being adhered to. All of the county plans discuss the use of route alerting by warning teams as a backup to siren notification in the event sirens fail to operate properly. County Plans discuss reports on the "Status of Evacuation", and "completion time of evacuation", however it does not indicate how this information will be obtained. The signed certification letters for each county indicate that the EPZ counties have reviewed the ETE Report and will consider its content.

In **RAI 13.03-16(B)** the staff requested that the applicant provide information regarding mobilization times for people who will be conducting the evacuation confirmation. In a response letter dated January 6, 2009, the applicant stated that Section 12 of the ETE Report suggests the use of a telephone survey to confirm evacuation. As indicated on Page 12-1, the confirmation process should not begin until three hours after the Advisory to Evacuate, to ensure that households have had enough time to mobilize. This three hour timeframe will enable telephone operators to arrive at their workplace, access the call list and prepare to make phone calls. Section 12 of the ETE Report provides a

recommended methodology for evacuation confirmation. The suggested approach can be reinforced by other methods but this is a state/local planning issue and outside the scope of the ETE. The purpose of including the proposed approach in the ETE was to provide an estimate of the time required to conduct the confirmation, using one suggested method. The inclusion of an estimated confirmation time is required by Section V of NUREG-0654, FEMA-REP-1, Rev. 1, App. 4, p. 4-10.

#### **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 of South Carolina and Fairfield, Lexington, Newberry, and Richland County who are involved in emergency response for the site.

The staff finds the additional information submitted in response to **RAI 13.03-16(A)(B)** to be acceptable and therefore resolved.

#### **13.3.1B.R.7 Conclusion for the VCSNS ETE Report**

The NRC staff has reviewed the evacuation time estimates and the applicant's responses to **RAIs 13.03-01** through **RAI 13.03-16** in regards to Section 13.3 of NUREG-0800 related to the evacuation time estimate analysis. Final determination regarding whether the ETE Report meets applicable requirements will be based on verification of **Confirmation Action NRC Items 13.03-01** through **13.03-25** and the applicant's response to the follow open items:

In response to **RAI 13.03-5 (C)** the applicant provided a discussion of the variables for the intersection algorithm in Section 4, "Estimation of Highway Capacity," that states that the model was executed iteratively to provide assurance that the allocation of effective green time appropriately represents the operating conditions. The response to **13.03-5(C)**, discusses that this iterative procedures represents a reasonably efficient operation under evacuation conditions. This approach is appropriate, if the traffic control is in place to support a reasonably efficient operation under evacuation conditions. However, in the ETE Section 13, "Recommendations," states that the traffic management plan "should be" reviewed by state and county emergency planners with local and state police to reconcile resources with current assets. This indicates that the plan is not currently approved. Clarify if the traffic management plan has been approved by state and county emergency planners. Discuss the appropriateness of this modeling approach and whether actual signal cycle timing should be used if the traffic management plan is not implemented. These issues will be tracked as **Open Items 13.03-01 and 13.03-02**.

In response to **RAI 13.03-02(B)** the applicant stated that the ETE report assumes that no major transient attractions or major employers would be introduced between 2007 and 2014 so these population estimates were not extrapolated. The applicant also provided the permanent resident and shadow estimated populations for the 2014. The staff has requested that this assumptions and population estimates be included in the ETE Report. This issue will be tracked as **Open-Item 13.03-03**.

In **RAI 13.03-11(B)** the staff asked for clarification of road characteristics. A detailed discussion is provided on the application of field data into the calculation and states that bridges are treated for as Links in the network. The inclusion of the large scale nodal

map supports review of the integration of highway characteristics and some bridges are clearly defined as links in the roadway network. However, there is a bridge located between nodes 185 and 186 and there are two bridges between nodes 171 and 172. The discussion in the response to **RAI 13.03-11(B)**, indicates that these bridges should be identified as separate links in the system to account for their unique characteristics. Discuss the criteria by which links are established at bridges or other narrow roadway segments. This issue will be tracked as **Open Item 13.03-04**.

In **RAI 13.03-7(C)** the staff requested that the applicant provide additional information regarding evacuating Monticello Reservoir. In response, the applicant states that it is reasonable to expect boaters will be able to return to boat launch sites, trailer their boats, and begin to evacuate the area within the four hour mobilization time. To support this expectation, discuss the capacity of the marinas and boat ramps and assumptions on mobilization times assumed for loading of boats at the boat ramps considering that ramps may have limited capacity to load more than a few boats at a time. Discuss if the trip generation time includes residents returning home to drop off the boat, pack and evacuate. These issues will be track as **Open Item 13.03-05 and 13.03-06**.

In **RAI 13.03-9(C)** the staff requested clarification regarding truncation of data. The response provides a detailed discussion and basis for truncating data developed from the telephone survey. The ETE document currently does not include any discussion on truncating data. The discussion provided with the response to **13.03-9(C)** should be added to the ETE. This issue will be track as **Open Item 13.03-07**.

In **RAI 13.03-13(D)** the staff requested that the applicant explain the values used in the shadow population and discuss the timing of traffic loading traffic loading onto the network for the shadow population identified in Table 6-4. In response the applicant provided a detailed discussion the development and calculation of shadow population vehicles. However, the applicant did not provide a discussion regarding the timing of the traffic loading onto the evacuation network. This information is still needed to support the potential effect on the ETE. This issue will be tracked as **Open Item 13.03-08**.