ClinchRiverESPHFNPEm Resource

From: Edmondson, Carla <cedmondson@tva.gov>
Sent: Monday, September 18, 2017 10:13 AM
To: Fetter, Allen; Sutton, Mallecia
Cc: Manoharan, Archana
Subject: [External_Sender] CNL-17-116 CRN ETE RAI Response
Attachments: CNL-17-116 CRN ETE RAI Response.pdf

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CNL-17-116 CRN ETE RAI Response

Hard copy to follow via UPS.

On behalf of
Joe Shea
VP Nuclear Regulatory Affairs & Support Services

Carla Edmondson
Executive Management Assistant to Joe Shea
423-751-2638

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Tennessee Valley Authority, 1101 Market Street, Chattanooga, TN 37402

CNL-17-116

September 15, 2017

10 CFR 52.17, Subpart A

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

Clinch River Nuclear Site
NRC Docket No. 52-047

Subject: Response to Request for Additional Information Related to Evacuation Time Estimates in Support of Early Site Permit Application for Clinch River Nuclear Site

References:
1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016
2. USNRC Request for Additional Information No. 8, eRAI 9029, ESPA Application Section: 13.3.4 - Evacuation Time Estimates, dated August 21, 2017

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an early site permit application (ESPA) for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. Based on the staff's review of the ESPA Part 2, Site Safety Analysis Report, Section 13.3, *Emergency Preparedness*, additional information necessary to support the review of the proposed exemption requests has been requested (Reference 2). TVA's response to the staff's request for additional information is contained in the Enclosure to this letter.

There are no new regulatory commitments associated with this submittal. If any additional information is needed, please contact Dan Stout at (423) 751-7642.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 15th day of September 2017.

Respectfully,

J. W. Shea
Vice President, Nuclear Regulatory Affairs & Support Services

Enclosure
cc: See Page 2

Enclosure:
TVA Response to NRC Request for Additional Information (eRAI 9029) Related to Evacuation Time Estimates [13.3-Emergency Planning]

cc (w/ Enclosure):

A. Fetter, Project Manager, Division of New Reactor Licensing, USNRC

cc (w/o Enclosure):

V. McCree, Executive Director of Operations, USNRC
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Enclosure to Letter CNL-17-116

TVA Response to NRC Request for Additional Information (eRAI 9029) Related to Evacuation Time Estimates [13.3-Emergency Planning]

TVA Response to NRC Request for Additional Information (eRAI 9029)
Related to Evacuation Time Estimates [13.3-Emergency Planning

NRC Introduction

Regulatory Basis: 10 CFR 52.17(b)(1), 10 CFR 52.17(b)(2)(i), 10 CFR 50.47(b)(10), Section IV of Appendix E to 10 CFR Part 50, NUREG-0654 Evaluation Criteria J.8 and J.10, NUREG/CR-7002

In Part 2 (Site Safety Analysis Report (SSAR)) of the Early Site Permit Application (ESPA), Section 13.3.4, "Evacuation Time Estimates," states that the Evacuation Time Estimate (ETE) for evacuation of an approximately two-mile plume exposure pathway emergency planning zone (EPZ) is detailed in the ETE report provided in Part 5B. The staff evaluated the ETE report against the applicable regulations and guidance, and identified the requests for additional information (RAIs) listed below. Consistent with the regulations and guidance identified above, please provide the following information, or explain why it is not required.

NRC RAI 13.03-1

Section 2.1, "Permanent Residents and Transient Population," states in part that "[t]he permanent resident population has been estimated using Census block data obtained from the U.S. Census 2010 and is projected to 2015 for this analysis." In addition, Section 2.5.2, "Shadow Evacuation," states in part that "[s]hadow evacuation was determined based on U.S. Census 2010 data, projected to 2015. . . . According to the Census data, projected to 2015, there are 186,500 permanent residents living within 15 miles of the CRN Site."

The use of the U.S. Census 2010 data is consistent with Section IV.2 of Appendix E to 10 CFR Part 50, which states in part that the (ESP) application shall provide evacuation time estimates for the plume exposure pathway EPZ for transient and permanent populations, using the most recent U.S. Census Bureau data as of the date the applicant submits its application to the NRC (which was on May 12, 2016 (ADAMS Accession No. ML16139A752)). However, the ETE report does not describe the method used for projecting the U.S. Census 2010 data to 2015.

Provide additional information to describe the methodology used to project population growth from 2010 to 2015 (for transient, permanent, and shadow evacuation populations), including the basis for justifying why the 2015 data is reasonable and accurately reflects the area surrounding the Clinch River Nuclear (CRN) Site. In addition, update the ETE analysis in the ESPA to reflect this methodology description, if appropriate, or explain why this is not required.

TVA Response

The methodology used to project the 2015 transient, permanent, and shadow evacuation populations used in the Evacuation Time Estimate (ETE) report is the same methodology described in Part 2 (Site Safety Analysis Report (SSAR)) of the Early Site Permit Application (ESPA), Section 2.1.3, *Population Distribution*. That is, the population projections were derived from county estimates obtained from the Tennessee State Data Center and are based on a standard cohort component methodology. The data used in this methodology was obtained from reputable sources, including the U.S. Census Bureau (2010 permanent population data), University of Tennessee – Tennessee State Data Center (projection data), and the representative sample of residents discussed in Section 1.1, *Approach*, of the ETE

report. To extend beyond the projection period provided by the data sources, an equation was derived using linear or polynomial regression to calculate population growth for each county. The equation was used in conjunction with the 2010 census data to produce a growth ratio. Ratios were calculated for each county and for each year, and then weighted by area for the geography being considered. It is important to note that for any county with a negative growth rate, a growth ratio of one was used to produce the most conservative results without overestimating. Using a growth ratio of one does not allow the county's projected population to decline. For counties predicting a decline at the end of the projection data set, the ratio calculated for the highest data point of the state's data set was used for the remaining projected years.

The resulting 2015 projected population data is reasonable and accurately reflects the area surrounding the Clinch River Nuclear (CRN) Site because it is based on data obtained from reputable sources, including the U.S. Census Bureau 2010 population counts that were projected using the State of Tennessee derived projection information. The projection information takes into account local birth, death, and migration estimates.

As described above, the methodology used to develop the ETE report is the same methodology as described in SSAR, Section 2.1.3 of the ESPA. The ETE report is supplemental information to Part 5 of the ESPA. Repetition of the methodology already described in the ESPA does not affect the results of the ETE, which identified no physical characteristics of the CRN site that could pose a significant impediment to the development of emergency plans for the site.

NRC RAI 13.03-2

Section 2.5, "Other Demand Estimate Considerations," states that "the presence of major employers in the vicinity of the CRN Site (50 or more employees) was researched during development of the ESPA ER [Environmental Report] and was evaluated for use in development of the ETE report." While Table 2.7, "Major Employers in the EPZ," only lists Kingston Academy and Duratek as major employers, the staff's online (Google) search of the proposed 2-mile EPZ revealed that there may be additional major employers in this area. These include Energy Solutions, located northwest of the CRN Site, and VW Group of America and HT Hackney Company located southeast of the CRN Site.

Explain how the ETE analysis determined that only two major employers are located within the 2-mile EPZ; including how Energy Solutions, VW Group of America, and HT Hackney Company were excluded from consideration.

TVA Response

The major employer data used in the ETE report was provided by the Knoxville Regional Transportation Planning Organization. A review of this information has been performed and TVA has determined the following regarding the Energy Solutions, VW Group of America, and HT Hackney facilities cited in the RAI:

- Energy Solutions – Data obtained from the Knoxville Regional Transportation Planning Organization (TPO) during development of the ETE identified a Duratek facility with 300 employees. Based on GPS coordinates provided with the major employer data,

this facility was located approximately 0.75 miles west-southwest (WSW) of the CRN Site. This facility is identified in Table 2.7, *Major Employers in the EPZ*, of the ETE Report. Duratek was acquired by Energy Solutions in 2006, however some existing facilities continued to operate under the Duratek name until all license transfers were completed. Follow-up conversations with the TPO indicate that the previously identified Duratek facility is no longer listed on the major employer database used by the TPO. Energy Solutions operates two facilities in the vicinity. One facility is identified outside the Emergency Planning Zone (EPZ), approximately 3.25 miles southwest of the CRN Site. The second is located approximately one mile northwest (NW) of the CRN Site. Based on information obtained directly from Energy Solutions, the facility located approximately one mile NW of the CRN Site employs up to 225 individuals. Based on this information, TVA has determined that the Duratek facility identified in the ETE report is actually the Energy Solutions facility cited in the RAI, and the global positioning system coordinates provided by the TPO were incorrect. Therefore, this facility, the employees, and associated vehicles were analyzed in the ETE. Table C.2, *Data Input by Zone*, indicates that loading zone 51 has, on average, the largest number of vehicles loading onto the evacuation network. The vehicles evacuating from the Energy Solutions facility identified in the RAI would be loaded onto the network at loading zone 188, upstream from loading zone 51. The vehicles would then travel northwest to SR 58, then southwest on SR-58 towards loading zone 51 on their approximately 3-mile trip from loading node 188 to exit the EPZ. As indicated in Table C.8, *Average Speeds for Major Evacuation Routes (mph)*, the average travel speed along SR 58 is in excess of 30 miles per hour (mph) in each adverse weather scenario and in excess of 40 mph in all other scenarios, indicating a travel time of 6 minutes from loading node 188 to the EPZ boundary during an adverse weather scenario and a travel time of 4 minutes 30 second during all other scenarios.

Because there was no congestion identified during the simulations, loading these 71 vehicles (<0.2% of the total vehicles considered in any evacuation scenario) at loading zone 188 rather than at loading zone 51, over a reasonable trip generation time, is not statistically significant and thus would not create congestion and would have no appreciable effect on the results of the ETE.

- VW Group of America – This is a new employer to the area and this location was opened subsequent to the ETE submittal and ESPA, therefore the facility was not included in the employer data provided by the TPO and the ETE analysis. Based on information obtained directly from the facility via a telephone interview, the facility operates one shift and the number of employees at the facility fluctuates between 50 and 55 during the shift. Using the assumptions included in Table 2.7 of the ETE report (1 employee per vehicle, 90% of employees are at work when the order to evacuate is issued, and 26.4% of employees evacuate directly from their place of employment) results in 13 vehicles evacuating directly from the VW Group of America facility. The remainder of the employees (37) return home and would be included in the evacuating permanent resident EPZ population. Because there was no congestion identified during the simulations, these 13 additional vehicles (<0.04% of the total vehicles considered in any evacuation scenario) are not statistically significant and thus, would not create congestion and would have no appreciable effect on the results of the ETE.

- HT Hackney Company - The HT Hackney facility was not listed in the employer data provided by the TPO during ETE analysis. According to information obtained directly from the facility via a telephone interview, the facility currently employs a total of 265 workers on two shifts. The night shift averages 71 workers and the day shift averages 120 workers. The remaining employees either travel extensively or work primarily in another office location. Using the assumptions included in Table 2.7 of the ETE report (1 employee per vehicle, 90% of employees are at work when the order to evacuate is issued, and 26.4% of employees evacuate directly from their place of employment) a maximum of 29 vehicles evacuate directly from the HT Hackney facility. The remainder of the employees (79) return home and would be included in the evacuating permanent resident EPZ population. Because there was no congestion identified during the ETE simulations, these 29 additional vehicles (<0.06% of the total vehicles considered in any evacuation scenario) are not statistically significant and thus, would not create congestion and would have no appreciable effect on the results of the ETE.

The VW of America facility and the HT Hackney facility are located immediately adjacent to access points to a major thoroughfare (Interstate-40 (I-40)) which remains uncongested for the duration of the analysis. The addition of these employees to the evacuation model using standard notification and trip generation times is not reasonably expected to impact the overall results of the ETE analysis because the number of vehicles involved is <0.2% of the total number of vehicles considered in any evacuation scenario.

As described in 10 CFR 52.17, *Contents of applications; technical information*, the SSAR must identify physical characteristics of the proposed site, such as egress limitations from the area surrounding the site, that could pose a significant impediment to the development of emergency plans. Informing guidance provided in NUREG-0654, Revision 1, Supplement 2, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants – Criteria for Planning in an Early Site Permit Application*, states that, "*an ESP applicant may identify such unique physical characteristics by performing a preliminary analysis of the time required to evacuate various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations, noting major impediments to the evacuation or the taking of other protective actions.*" Based on the absence of congestion observed during the traffic simulation modeling, direct loading of the additional vehicles from the VW Group of America and HT Hackney facilities onto I-40 will not negatively impact the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN ESPA provides a reasonable reflection of the area surrounding the CRN Site, and identified no physical characteristics of the CRN site that could pose a significant impediment to the development of emergency plans for the site.

TVA Response to NRC Request for Additional Information (eRAI 9029)
Related to Evacuation Time Estimates [13.3-Emergency Planning

NRC RAI 13.03-3

Table 2.1, "Permanent Resident Population By Sector," and Figure 2.1. "Permanent Resident Population by Sector," show that a significant portion of the population resides in the southeastern quadrant of the 2-mile EPZ. However, based on the data in Tables 2.8, "Total Population Considered for Each Scenario," Table 2.9, "Total Vehicles Considered for Each Scenario," and Table C.2, "Data Input by Zone," it appears that all vehicles from this area are generated and loaded onto the network at node 59. (Node 59 is shown in Figure 3.1, "Evacuation Network Map." Figure 3.3, "Evacuation Network Map – Grid II," and Figure 3.4, "Evacuation Network Map – Grid III.")

Explain why the population in the area spanning the East-Northeast to South sectors are loaded onto the network at only one location (i.e., node 59). In addition, describe how the locations for the input nodes were determined?

TVA Response

The traffic simulation model INTEGRATION was used for the CRN Site ETE analysis. INTEGRATION is a microscopic traffic assignment and simulation model using a simplified network. In a microscopic simulation environment, it is impractical to model every local road over a large area. Consequently, traffic is loaded onto the simulation network through zones. The zones used in the analysis are representative of major access points in the local area.

As described in the ETE report, the INTEGRATION software is listed in the U.S. Department of Transportation's (DOT) *Evacuation Management Operations (EMO) Modeling Assessment: Transportation Modeling Inventory*, developed to support selection of an appropriate model for use in evacuation analyses. The INTEGRATION software calculates a number of Measures of Effectiveness (MOEs), which are addressed by NUREG/CR-7002, *Criteria for Development of Evacuation Time Estimate Studies* (NUREG/CR-7002). This model has been validated against state-of-the-art delay estimation procedures using queuing theory and shockwave analysis and against standard traffic flow theory and has been utilized for the evaluation of real-life applications.

Locations for the input nodes used in the analysis were generated through the following steps:

1. Higher hierarchical roads (interstate freeways) are selected as the skeleton road network to be used in a simulation environment;
2. Middle hierarchical roads (state roads and arterials) are added to the network; and
3. Local roads are added to the network as local access paths. Such roads typically are located in higher populated or more congested areas. The ending points of such local roads are extracted as the origin and destination zones.

Based on the use of the INTEGRATION traffic simulation model, the absence of middle and higher hierarchical roads exiting the EPZ in the area spanning the east-northeast to south sectors of the EPZ, and the presence of I-40 in the southeastern portion of the EPZ, as the primary east-west traffic route in the vicinity of the proposed CRN Site, the loading of vehicles at Node 59, with subsequent access to I-40 is appropriate. The ArcGIS shapefile used to develop the simulation network did not include the completed interchange at Exit 362. The

inclusion of this interchange in the simulation network could potentially provide an additional node at which population in the area spanning the east-northeast to south sectors could be loaded onto the network with subsequent access to I-40. Based on the absence of congestion observed during the traffic simulation modeling, aggregating the traffic in the area to one loading zone will not impact the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN ESPA provides a reasonable reflection of the area surrounding the CRN Site, and does not identify any physical characteristics unique to the proposed site that could pose an impediment to the development and implementation of appropriate emergency plans.

NRC RAI 13.03-4

From Figures 3.1 and 3.4, it appears that the Interstate 40 interchange at Exit 360 is modeled, but not the interchange at Exit 362, which is located (but not shown) east of Exit 360 and within the 2-mile EPZ. Explain the modeling decision to exclude Exit 362 from the network.

TVA Response

The ArcGIS shapefile used to develop the simulation network was obtained commercially in 2010 and did not include the subsequently completed interchange at Exit 362. The inclusion of this interchange into the simulation network would reduce already low vehicle demand on local access paths to I-40, particularly around Exit 360. Additionally, the interchange at Exit 362 would provide unimpeded access to I-40 for those vehicles evacuating from the VW Group of America and HT Hackney facilities, located adjacent to the I-40 Exit 362 interchange. Based on the absence of congestion observed on I-40 during the traffic simulation modeling, direct loading of these vehicles onto the major thoroughfare will not impact the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN ESPA provides a reasonable reflection of the area surrounding the CRN Site, and does not identify any physical characteristics unique to the proposed site that could pose an impediment to the development and implementation of appropriate emergency plans.

NRC RAI 13.03-5

Assumption 4 in Table 1.2, "General Assumptions," states that "[b]ackground traffic is on the roadway when initial notification occurs and stops entering the EPZ upon establishment of Access Control Points at 90 minutes following the advisory to evacuate." Section 5.1, "Development of Traffic Controls Plans," describes an assumed traffic control plan, in which the background and pass-through traffic stops entering the EPZ 90 minutes after the evacuation order is issued. Section 4.3, "Evacuation Time Estimates for the General Public," describes the timing of background and pass-through traffic, and states that a 45 minute background traffic simulation is assumed to ensure equilibration prior to initiating the ETE simulation.
Step 4 of Section 4.3, which states that "[a]t 90 minutes the background traffic will stop entering the network," is unclear as to whether the background and pass-through traffic stops 90 minutes after the evacuation begins, or if it stops 90 minutes from the beginning of the simulation (including the equilibration time). Clarify when the evacuation starts, with regard to the timing and simulation of background and pass-through traffic.

TVA Response to NRC Request for Additional Information (eRAI 9029)
Related to Evacuation Time Estimates [13.3-Emergency Planning

TVA Response

The simulation used for the CRN Site ETE report begins with a 45-minute background traffic simulation to ensure equilibrium in the evacuation network prior to initiating the evacuation. The 45-minute background traffic simulation discussed in ETE report Section 4.3, *Evacuation Time Estimates for the General Public*, is the simulation equilibration period run prior to the order to evacuate. This equilibration period is used to populate normal daily traffic flow throughout the simulation network prior to start of an evacuation. In the simulation, the advisory to evacuate occurs at the conclusion of the 45-minute equilibration period. Background and pass-through traffic gradually decrease at the rate shown in Table 4.3 and eventually the simulated traffic becomes 100% evacuation traffic 90 minutes after the advisory to evacuate.

NRC RAI 13.03-6

The trip generation distributions in Table 4.8, "Trip Generation Distributions (Daytime)," Table 4.9, "Trip Generation Distribution (Nighttime)," and Table 4.10, "Trip Generation Distributions (Weekend)," contain almost identical data, with the longest trip generation time of 300 minutes reflected in trip generation Distribution C in each table. While the network-wide travel times in Table C.6, "Network-Wide Travel Time (Minutes)," are all close to 3 minutes (excluding Scenario 10), the ETEs provided in Table 4.13, "ETEs for Evacuation of the General Public (90% of the Affected Population)," and Table 4.14, "ETEs for the General Public (100% of the Affected Population)," show differences between daytime, evening, and weekend ETEs on the order of 30 to 40 minutes. These differences appear to reflect the loading curves in Table C.1, "Loading Curves," since the network-wide travel times in Table C.6 are all close to 3 minutes (excluding Scenario 10). Describe the relationships between the trip generation distributions and the loading curves in Table C.1.

In addition, clarify why the evacuation times in Table 4.14 for 100 percent of the general public are less than the maximum times specified by the trip generation distribution curves in Figure 4.2, "Trip Generation Distributions Comparison (Daytime)," Figure 4.3, "Trip Generation Distributions Comparison (Nighttime)," and Figure 4.4, "Trip Generation Distributions Comparison (Weekend)."

TVA Response

The loading curves in Table C.1, *Loading Curves*, reflect the trip generation distributions of Table 4.8, *Trip Generation Distributions (Daytime)*, Table 4.9, *Trip Generation Distribution (Nighttime)*, and Table 4.10, *Trip Generation Distributions (Weekend)*, while also factoring in the percentage of vehicles departing from home/work and the total number of evacuating vehicles.

All ETEs will identify an evacuation tail (i.e., a small portion of the population that takes a longer time to evacuate than the rest of the general public, generally conforming to about the last 10 percent of the population). However, the CRN Site ETE showed a very pronounced and extended evacuation tail, heavily influenced by a very small portion of the population (<0.1%) that anticipated a longer time to prepare to evacuate than the rest of the general public included in the telephone survey. This is evidenced by the generally zero slope of the trip generation distributions of Figure 4.2,*Trip Generation Distributions Comparison (Daytime),*

Figure 4.3, *Trip Generation Distributions Comparison (Nighttime)*, and Figure 4.4, *Trip Generation Distributions Comparison (Weekend)* past the 240-minute mark.

Due to the dynamics of microscopic simulation, trip generation times follow a distribution within a window of time. Including this small percentage (<0.1%) of outlier evacuees changes that window of time, which results in unrealistic variations of the overall ETE. In order to prevent this hypothetical difference in evacuee preparation behavior from having undue influence on the ETE results, these outliers were truncated from the results and the 100% ETE values listed in Table 4.14, *ETEs for the General Public (100% of the Affected Population)*, actually reflect greater than 99.9% of the evacuating public. By truncating these outliers, randomness in the simulation is maintained while minimizing their impact on the result obtained for the remainder of the evacuating population. This truncation, does not identify any physical characteristics of the proposed site, such as egress limitations from the area surrounding the site that could pose a significant impediment to the development of emergency plans and therefore is appropriate for an ETE in support of the CRN Site ESPA.

NRC RAI 13.03-7

Tables C.4, "Existing Number of Vehicles by Hour by Exiting Node," and Table C.5, "Existing Percentage of Vehicles by Hour by Exiting Node," show that vehicles exiting the network are counted on exit links 2495, 504, and 1811 (nodes 913, 892, and 1801, respectively). These links do not appear to cover all possible EPZ exit routes. Describe how the evacuation routes were determined (i.e., development of the origin-destination matrix for evacuees), including why exiting vehicles are only counted on the specified links.

TVA Response

The CRN ETE is based on information available at the time the ESPA was developed. As there is no operational nuclear plant at the CRN Site, evacuation plans have not been developed by local authorities and specific locations of congregate care and reception centers have not been established. State and local authorities were involved in the development of the ETE as discussed in Section 5.3, *State and Local Review*, of the ETE report, and these officials indicated that due to the existence of current evacuation planning for the nearby U.S. Department of Energy Oak Ridge Reservation, evacuation shelter locations already established for Oak Ridge National Laboratory (ORNL) would likely be used as a basis for future plan development. The existing ORNL evacuation shelters were used as the intended destinations for evacuating traffic, and appropriate exit nodes were established based on evacuee origin locations.

NRC RAI 13.03-8

Section 2.1.1, "Permanent Residents with Vehicles," estimates that 506 evacuating vehicles are needed for the estimated 856 permanent EPZ residents. This same number is summarized in Table 2.2, "Permanent Resident Population and Evacuating Vehicles," However, Table 2.9 lists the permanent resident vehicles at 658 (excluding Scenario 10), which appears to be the number used in the model described in Appendix C, "Traffic Simulation Model Inputs and Outputs." Explain the difference between the number of estimated permanent resident vehicles, and the numbers used for the Appendix C model input.

TVA Response to NRC Request for Additional Information (eRAI 9029)
Related to Evacuation Time Estimates [13.3-Emergency Planning

TVA Response

The 506 evacuating vehicles provided in Table 2.2, *Permanent Resident Population and Evacuating Vehicles*, and Section 2.1.1, *Permanent Residents with Vehicles*, of the ETE report is the correct number of vehicles needed for the estimated 856 permanent EPZ residents. Table 2.9, *Total Vehicles Considered for Each Scenario*, erroneously lists the permanent resident vehicles at 658 (excluding Scenario 10), and this value was used as the model input as described in Appendix C, *Traffic Simulation Model Inputs and Outputs*. Based on the absence of congestion observed during traffic simulation modeling with this higher value, the ETE analysis provides a valid bounding analysis for the CRN Site.

Based on the low population of the 2-mile EPZ, the limited number of vehicles involved in the evacuation, the relative simplicity of the roadway network within the EPZ, and the absence of congestion observed during the traffic simulation modeling, simulation scenarios run with these extra vehicles did not impact the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN ESPA provides a reasonable reflection of the area surrounding the CRN Site, and identified no physical characteristics of the CRN site that could pose a significant impediment to the development of emergency plans for the site.

NRC RAI 13.03-9

Table A.2, "Link Input File," includes the identification of node 113 and link 757. Figure 3.2, "Evacuation Network Map – Grid I," shows node 113 outside of the 2-mile EPZ, and link 757 leading to that node from within the 2-mile EPZ. However, node 113 is not identified as a destination node in Table C.3 "Destination Nodes and Capacities, or listed in Table C.2. Identify whether there are any vehicles on this link; and if so, explain how they are accounted for in the ETE?

TVA Response

For the CRN Site ETE analysis, evacuating vehicles are loaded onto the simulation network through zones representative of major access points of the local area. Node 113 is an origination node for resident vehicles in the vicinity of the EPZ boundary (both EPZ residents and shadow evacuees), and the vehicles loaded at this node are directed toward established ORNL evacuation shelters at destination zone 132. Node 113 is not a destination node, because there are no roads in the vicinity of Node 113 that traverse the Clinch River in a westerly direction. Vehicles evacuating from the vicinity of Node 113 must travel east along link 757 to Gallaher Rd./Oak Ridge Turnpike prior to exiting the EPZ.

NRC RAI 13.03-10

Table 2.9 lists the total vehicles considered for each scenario, including the number of permanent resident vehicles, transient vehicles, transit dependent permanent resident vehicles, and major employers' vehicles. Table C.2 appears to be the model input for the same groups of vehicles that are generated at specific zones within the network. However, in each scenario there are minor differences between these two tables in the range of 1 to 6 vehicles (e.g., for Scenario 1, Table 2.9 totals 880 vehicles, while Table C.2 totals 882 vehicles). Explain this discrepancy.

TVA Response to NRC Request for Additional Information (eRAI 9029)
Related to Evacuation Time Estimates [13.3-Emergency Planning

TVA Response

The traffic simulation model INTEGRATION was used in performance of the CRN Site ETE report. INTEGRATION performs traffic simulations by tracking the movement of individual vehicles every 1/10 of a second. This microsimulation relies on random numbers to generate variables such as vehicle departures, speeds, and driving behavior. Because of this variation, it is necessary to run the model several times with different random number seeds to obtain the desired accuracy for the ETE results. The minor inconsistencies noted between Table 2.9, *Total Vehicles Considered for Each Scenario,* and Table C.2, *Data Input by Zone*, are a result of running the simulations with different random seeds. This practice produces slight variations in the model output which have no impact on the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN Site ESPA provides a reasonable reflection of the area surrounding the CRN Site, and identified no physical characteristics of the CRN site that could pose a significant impediment to the development of emergency plans for the site.

NRC RAI 13.03-11

Table C.2 appears to provide the number of vehicles loaded onto the network, and Table C.4 and Table C.7, "Total Vehicles Exiting the Network," provide the total number of vehicles exiting the network. In each scenario, the number of exiting vehicles in Tables C.4 and C.7 is less than the number of input vehicles in Table C.2 by as much as 9 vehicles (e.g., for Scenario 1, Table C.2 totals 882 vehicles, while Tables C.4 and C.7 total 874 vehicles). Explain what is happening to the missing vehicles.

TVA Response

As described in the response to RAI 13.03-10 above, microsimulation relies on random numbers to generate variables such as vehicle departures, speeds, and driving behavior. The minor inconsistencies noted between Table C.2, *Data Input by Zone*, Table C.4, *Exiting Number of Vehicles by Hour by Exiting Node*, and Table C.7, *Total Vehicles Exiting the Network*, are a result on running the simulations with different random seeds producing slight variations in the demand. This randomness produces slight variations in the model output which have no impact on the results of the ETE analysis. Therefore, the ETE analysis submitted in support of the CRN Site ESPA provides a reasonable reflection of the area surrounding the CRN Site, and identified no physical characteristics of the CRN site that could pose a significant impediment to the development of emergency plans for the site.