Exelon. Generation

NP-11-0011
April 12, 2011

10 CFR 52, Subpart A

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

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station Early Site Permit Application
Response to Request for Additional Information Letter No. 05
NRC Docket No. 52-042

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) Letter No. 05, dated March 14, 2011, related to Early Site Permit Application (ESPA), Part 2, Sections 02.02.03, 13.03, and 14.03.10. This submittal comprises a complete response to RAI Letter No. 05, and includes responses to the following Questions:

02.02.03-1	13.03-1	13.03-11	14.03.10-1	14.03.10-11
	13.03-2	13.03-12	14.03.10-2	14.03.10-12
	13.03-3	13.03-13	14.03.10-3	
	13.03-4	13.03-14	14.03.10-4	
	13.03-5	13.03-15	14.03.10-5	
	13.03-6	13.03-16	14.03.10-6	
	13.03-7	13.03-17	14.03.10-7	
	13.03-8	13.03-18	14.03.10-8	
	13.03-9	13.03-19	14.03.10-9	
	13.03-10		14.03.10-10	

When a change to the ESPA is indicated by a Question response, the change will be incorporated into the next routine revision of the ESPA, planned for no later than March 31, 2012.

Regulatory commitments established in this submittal are identified in Attachment 35. If any additional information is needed, please contact David J. Distel at (610) 765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 12th day of April, 2011.

Respectfully,

Marilyn C. Kray
Vice President, Nuclear Project Development

Attachments:
1. Question 02.02.03-1
2. Question 13.03-1
3. Question 13.03-2
4. Question 13.03-3
5. Question 13.03-4
6. Question 13.03-5
7. Question 13.03-6
8. Question 13.03-7
9. Question 13.03-8
10. Question 13.03-9
11. Question 13.03-10
12. Question 13.03-11
13. Question 13.03-12
14. Question 13.03-13
15. Question 13.03-14
16. Question 13.03-15
17. Question 13.03-16
18. Question 13.03-17
19. Question 13.03-18
20. Question 13.03-19
21. Question 14.03.10-1
22. Question 14.03.10-2
23. Question 14.03.10-3
24. Question 14.03.10-4
25. Question 14.03.10-5
26. Question 14.03.10-6
27. Question 14.03.10-7
28. Question 14.03.10-8
29. Question 14.03.10-9
30. Question 14.03.10-10
31. Question 14.03.10-11
32. Question 14.03.10-12
33. Revised VCS SSAR Table 13.3-1 (Sheets 1-19), ITAAC For Emergency Planning
34. Final Report IEM/TEC11-010, Evacuation Time Estimates: Exelon Nuclear Texas Holdings, LLC, Victoria County Station, dated April 6, 2011
35. Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO (w/Attachments)
USNRC, Project Manager, VCS, Division of New Reactor Licensing (w/Attachments)
USNRC, Region IV, Regional Administrator (w/Attachments)

RAI 02.02.03-1:

Question:

VCS SSAR Section 2.2.3.1.2.3, "Highways states that, due to propane's low density, highway shipments of propane are limited to 36,800 pounds instead of the standard quantity listed in RG 1.91 of 50,000 pounds. Tanker trucks used for highway shipments of propane generally hold 10,400 gallons or 14,400 gallons. After allowing for a 20% void in the 10,400 gallon tank, it would hold approximately 36,800 pounds. A 14,400 gallon tanker would hold more than 36,800 pounds.

Explain why 14,400 gallon tankers were not considered in this analysis.

Response:

A site specific analysis for transportation explosion hazards was performed for the Victoria County Station (VCS) as described in VCS SSAR Section 2.2.3.1. The guidance of RG 1.91 was followed for this calculation, with the exception of the mass equivalency for propane transported in tanker trucks and acetylene transported in bottles. RG 1.91 states, "The maximum probable hazardous solid cargo for a single highway truck is 50,000 pounds (23,000 kg)." A literature search for propane tanker trucks sizes was performed, and it was determined that 9000 gallons was a reasonable maximum size. The mass of propane was back calculated using the Aloha code assuming a 100% full 9000 gallon tank, which yielded the mass of 36,880 pounds.

Exelon has re-evaluated the maximum tanker truck size for propane transportation. Propane must be carried in Department of Transportation (DOT) type MC-331 vessels, and trucks for transport are divided into two classes; delivery ("bobtails") and highway transport. Though highway tanker sizes of 14,400 gallons were not identified by this search, sizes up to 12,000 gallons were identified. Based on this information, Exelon has revised its transport analysis to use the RG 1.91 value of 50,000 lbm for propane. A description of this revision is summarized as follows.

For the Explosive Analysis, RG 1.91 states that the blast energy of confined vapors is a TNT mass equivalency of 240% of hydrocarbon mass, thus the new propane equivalent TNT value is:

50,000 lbm * 2.4 = 120,000 lbm TNT

The equivalent safe distance is determined by:

$R_1 = 45*W(TNT)^{1/3}$

For 50,000 lbm of propane, the safe distance equates to 2,220 feet, which is still less than the closet highway approach of 2,950 feet. Hydrogen Sulfide remains as the limiting explosion with a safe distance of 2,462 feet.

The second area of the analysis that was impacted by the change in the amount of propane was the Flammable Vapor Cloud evaluation (SSAR 2.2.3.1.2). This analysis is performed using the EPA Aloha code to determine distance from source (e.g. propane tanker truck leak) to the Lower Flammability Limit (LFL) and the 1 psi overpressure limit. These distances should be less than the closet approach value for the transportation route. The revised analysis shows that the distance to the LFL is 1,365 feet, which is less than the closet approach distance of 2,950 feet. The safe distance to stay below the 1 psi overpressure wave is 3,546 feet, which is greater than the closet approach distance.

The 1 psi value for a 9000 gallon tanker truck was 3,237 feet, as shown in SSAR Table 2.2-11. The revised analysis increases this value by 309 feet. The VCS ESP power block area is based on a bounding "footprint" of various reactor technologies, and the exact location of safety related structures within the power block area is not finalized at the ESP stage. SSAR Section 2.2.3.1.2.3 states, "The calculated safe distance for propane will be compared to the actual distances to the nearest safety related structure for the selected technology at the VCS site to ensure the safe distances are adhered to at the COL stage." This statement is still valid for the updated distance values for propane.

As part of making the changes to the SSAR for the above calculation revision, Exelon identified several incorrect values for "Heat of Combustion (Btu/lb) and "Equivalent TNT Mass (lbm) in the existing Table 2.2-10. Investigation determined that there were errors in transferring values from the original calculation to the SSAR table. These errors did not impact the calculation results (i.e. "Distance for Explosion to have less than 1 psi of Peak Incident Pressure (feet"). The corrected values are included as part of the changes below.

The SSAR will be updated to reflect the revised analyses as described in the following section.

Associated ESPA Revisions:

SSAR Section 2.2.3 will be revised in a future revision of the SSAR to incorporate the following wording:

2.2.3.1.1.3 Highways

Table 2.2-3 details the hazardous materials potentially transported on U.S. Highway 77. The hazardous materials that are identified for further analysis with regard to explosion potential are: acetylene, gasoline, hydrogen sulfide, methanol, methyl cyanide, natural gas (methane), and propane (Table 2.2-8). With the exception of acetylene ~~and propane~~, the maximum quantity of the identified chemicals potentially transported on the roadway is 50,000 pounds as provided in RG 1.91. Acetylene is transported in cylinders (References 2.2-37 and 2.2-38). It was conservatively assumed that eight cubic meters of acetylene at 250 psig is equivalent to 144 cubic meters at atmospheric pressure. ~~Due to the low density of propane, the mass of propane assumed is 36,800 pounds based on a determined bounding volume for the transportation of propane.~~

2.2.3.1.2.3 Highways

The VCS power block area is located approximately 2960 feet from U.S. Highway 77. Table 2.2-3 details the hazardous materials potentially transported on U.S. Highway 77. The materials identified for further analysis with regard to flammable vapor clouds are: acetylene, gasoline, hydrogen sulfide, methanol, methyl cyanide, natural gas (methane), and propane (Table 2.2-8). With the exception of acetylene ~~and propane~~, the maximum quantity of the identified chemicals potentially transported on the roadway is 50,000 pounds as provided in RG 1.91. Acetylene is transported in cylinders (References 2.2-37 and 2.2-38). It was conservatively assumed that 8 cubic meters of acetylene at 250 psig is equivalent to 144 cubic meters at atmospheric pressure. ~~Due to the low density of propane, the mass of propane assumed is 36,800 pounds based on a determined bounding volume for the transportation of propane.~~

An analysis for the identified chemicals is conducted using ALOHA as described in Subsection 2.2.3.1.2. The results indicate that any plausible vapor cloud that could form and mix sufficiently would be below the LFL boundary before reaching the VCS power block area. The safe distances are less than the minimum separation distances from the VCS power block area to U.S. Highway 77 for all of the identified chemicals (Table 2.2-11). Propane results in the longest flammable plume of **1365**~~1293~~ feet, which is less than the distance of 2950 feet to the nearest approach of the power block area.

Table 2.2-10
Design-Basis Events — Explosions

Source	Material Evaluated	Quantity (lbm)	Heat of Combustion (Btu/lb)	Equivalent TNT Mass (lbm)	Distance to Power Block Area Boundary (feet)	Distance for Explosion to have less than 1 psi of Peak Incident Pressure (feet)
U.S. Highway 77	Acetylene	339	20,747	814	2,957	420
	Gasoline	50,000	18,720	241		280
	Hydrogen Sulfide	50,000	6,552	**163,800** ~~20,000~~		2462
	Methanol	50,000	8,419	139		233
	Methyl Cyanide	50,000	13,360	125		225
	Natural Gas	50,000	21,517	**120,000** ~~20,000~~		2220
	Propane	**50,000**~~36,330~~	19,782	**120,000**~~88,512~~		**2,220** ~~2005~~
Railway	1,1-Difluoroethane	132,000	7,950	316,800	20,174	3068
	Acetaldehyde	132,000	10,600	**1,061** ~~216~~		459
	Acetone	132,000	12,250	**340** ~~70~~		314
	Benzene	132,000	17,460	**362** ~~74~~		321
	Butyraldehyde	132,000	15,210	**428** ~~88~~		339
	Carbon Bisulphide	132,000	5,814	**519**~~107~~		362
	Gasoline	132,000	18,720	**637** ~~131~~		387
	Hexane	132,000	19,~~244~~26	~~119~~578		375
	Isopropanol	132,000	12,960	**372**~~77~~		324
	Maleic Anhydride	132,000	5,936	132,000		2291
	Methyl Methacrylate Monomer	132,000	11,400	**446**~~92~~		344
	n-Butyl Acetate	132,000	13,130	**391**~~80~~		329
	n-Propanol	132,000	13,130	**392**~~81~~		329

Table 2.2-10
Design-Basis Events — Explosions

Source	Material Evaluated	Quantity (lbm)	Heat of Combustion (Btu/lb)	Equivalent TNT Mass (lbm)	Distance to Power Block Area Boundary (feet)	Distance for Explosion to have less than 1 psi of Peak Incident Pressure (feet)
	n-Propyl Acetate	132,000	11,255	**306**~~63~~		303
	Paraformaldehyde	132,000	6,682	132,000		2291
Railway (continued)	Propane	132,000	19,782	316,800	20,174	3068
	Propylene Oxide	132,000	13,000	**1034**~~213~~		455
	p-xylene	132,000	17,559	**448**~~92~~		344
	Toulene	132,000	17,430	**383**~~79~~		327
	Vinyl Acetate	132,000	9,754	**356**~~73~~		319
	Vinyl Chloride	132,000	8,136	316,800		3068
Victoria Barge Canal	Acetone	10,000,000	12,250	**25,756**~~6027~~	26,020	1329
	Acetone Cyanohydrin	10,000,000	11,312	**27,941**~~5706~~		1366
	Acrylonitrile (Vinyl cyanide)	10,000,000	14,300	**35,735**~~7467~~		1482
	Butadiene	10,000,000	**19,008**~~18,234~~	24,000,000		12,980
	Cyclohexane	10,000,000	**18,684**~~27,031~~	**37,706**~~10,757~~		1509
	Cyclohexanone (Ketone Alcohol)	10,000,000	**15,430**~~24,436~~	**33,701**~~10,908~~		1454
	Gasoline	10,000,000	18,720	**48,257**~~9,985~~		1638
	Hexamethylenediamine	10,000,000	12,200	10,000,000		9695
	Propylene	10,000,000	**19,692**~~14,264~~	24,000,000		12,980
Natural Gas Transmission Pipelines	Natural Gas (methane)[a]	[a]	[a]	[a]	At least 2,237	[a]

(a) Unconfined deflagration of methane gives less than 1 psi overpressure at the release point.

Table 2.2-11
Design-Basis Events — Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions

Source	Material Evaluated	Release Model	Quantity (lbm)	Puddle Area (m^2)	Distance to Power Block Area Boundary (feet)	Distance to LFL (ft)	Distance to 1-psi (ft)
U.S. Highway 77	Acetylene	gas; instant	339	NA	2,950	834	1,092
	Gasoline	puddle	50,000	3123		429	969
	Hydrogen Sulfide	puddle	50,000	3730		1,266	2,547
	Methanol	puddle	50,000	2882		105	333
	Methyl Cyanide	puddle	50,000	2921		174	531
	Natural Gas	puddle	50,000	5531		414	2,850
	Propane	puddle [e]	**50,000**~~36,800~~	**4619**~~3407~~		**1,365**~~1,293~~	**3,546**~~3,237~~
Railway	1,1-Difluoroethane	puddle	132,000	7,155	20,174	1,560	3,231
	Acetaldehyde	puddle	132,000	13,141		1,959	3,984
	Acetone	puddle	132,000	8,626		1,029	2,109
	Benzene	puddle	132,000	7,030		879	1,797
	Butyraldehyde	puddle	132,000	7,513		729	1,596
	Carbon Bisulphide	puddle	132,000	4,772		1,812	2,853
	Gasoline	puddle	132,000	8,245		747	1,590
	Hexane	puddle	132,000	10,629		1,462	2,982
	Isopropanol	puddle	132,000	7,663		501	1,056
	Methyl Methacrylate Monomer	puddle	132,000	6,384		495	1,074
	n-Butyl Acetate	puddle	132,000	7,502		120	336
	n-Propanol	puddle	132,000	7,476		177	495
	n-Propyl Acetate	puddle	132,000	7,754		486	1,032
	Propane	puddle	132,000	17,115		1,701	4,860
	Propylene Oxide	puddle	132,000	7,274		1,725	3,339
	p-xylene	puddle	132,000	7,079		117	333
	Toulene	puddle	132,000	7,757		519	1,125

Table 2.2-11
Design-Basis Events — Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions

Source	Material Evaluated	Release Model	Quantity (lbm)	Puddle Area (m^2)	Distance to Power Block Area Boundary (feet)	Distance to LFL (ft)	Distance to 1-psi (ft)
	Vinyl Acetate	puddle	132,000	7,475		744	1,557
	Vinyl Chloride	puddle	132,000	8,622		1,647	3,690
Victoria Barge Canal	Acetone	puddle	(a)	31,400	26,020	2,100	4,071
	Acetone Cyanohydrin	puddle	(a)	31,400		(b)	(b)
	Acrylonitrile (Vinyl cyanide)	puddle	(a)	31,400		1,893	3,723
	Butadiene	puddle	(a)	31,400		3,444	7,392
	Cyclohexane	puddle	(a)	31,400		2,679	5,277
	Cyclohexanone (Ketone Alcohol)	puddle	(a)	31,400		1,326	2,586 (c)
	Gasoline	puddle	(a)	31,400		2,598	5,082
	Propylene	puddle	(a)	31,400		2,868	7,392
Natural Gas Transmission Pipelines	Natural Gas (methane) (d)	(d)	(d)	Not Applicable	At least 2,237	(d)	(d)

a. ALOHA release is limited by evaporation from a maximum 31,400 m^2 surface area with a puddle mass of 242 tons.

b. Evaporation rate insufficient to create LFL, therefore the plume is not a flammability risk.

c. ALOHA identifies that this chemical's ambient saturation concentration is below the lower explosive limit, so explosions are unlikely.

d. A probabilistic analysis approach is used to demonstrate that the frequency of releases that could lead to hazardous conditions at the power block boundary is less than 10^{-6} events/year.

e. A sensitivity analysis was done with a 10.7 ft^2 hole for comparison with the puddle release and it was found that the puddle release was the limiting case.

RAI 13.03-1:

Question:

ETE-1: Introductory Materials Related to the ETE Report
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Regulatory Guide 1.206, Section I of Appendix 4 to NUREG-0654.

In the ETE Report, provide a general discussion of the underlying algorithms used in the model, including those related to intersection control or justify why this is not necessary.

Response:

The ETE model was developed using VISUM, a macroscopic transportation modeling software with the capability to do dynamic traffic assignment (i.e., assignment and vehicle flow over time). Vehicular demand in the VISUM model was composed of a series of origin-destination (O-D) matrices, an evacuation traffic network, and a traffic assignment procedure. In the traffic network, both the link and turn movement capacities were calculated following the Highway Capacity Manual 2000 methodology using data collected from NAVTEQ, aerial imagery, and the field trip, including the number of lanes, speed limits, intersection control types, and conflicting volumes at intersection approaches. After the O-D matrices and evacuation network were input into VISUM, the dynamic user equilibrium (DUE) traffic assignment procedure was implemented to allocate vehicular demand onto appropriate routes in the traffic network for each time step. The DUE algorithm iteratively calculated the traffic volumes and associated delays on competing routes using the Akçelik volume-delay function (VDF) to assure that the travel times for alternative routes are close to each other (i.e. equilibrium loading). The Akçelik VDF was selected because it provides more accurate delay estimates than other commonly used functions, such as the Bureau of Public Roads (BPR) functions, particularly for oversaturated conditions.[1]

Associated ESPA Revisions:

This explanation of the underlying algorithms has been added to the Section 5.0 introduction in the revised ETE report. The revised ETE Report is provided in Attachment 34.

[1] Singh, R. and Dowling, R. "Improved Speed-Flow Relationships: Application to Transportation Planning Models." *Proceedings of the Seventh TRB Conference on the Application of Transportation Planning Methods*. Page 341. March 1999.

RAI 13.03-2:

Question:

ETE-2: Introductory Materials Related to the ETE Report
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Regulatory Guide 1.206, Section I of Appendix 4 to NUREG-0654.

The VISUM website referenced in Section 5.0, "Evacuation Time Estimate Methodology," includes information regarding how various procedures, such as Highway Assignment and Transit Assignment, provide the analyst multiple choices in the method of analyses. Discuss in the ETE Report the User selections and optional procedures selected and used in the analysis, or justify why this is not necessary.

Response:

IEM selected the dynamic user equilibrium (DUE) traffic assignment method because it allows equilibrium loading of evacuation demand onto the road network for each time step and outputs the traffic volumes on each link for each time step. This allows an analysis of vehicle flow along the evacuation routes and across the emergency planning zone (EPZ) boundary over time, as well as the investigation and reporting of queuing and congestion. While VISUM has the functionality to model transit trips, no transit was modeled in this ETE study because no transit is expected to operate in the study area during the evacuation.

Associated ESPA Revisions:

This information has been added to the Section 5.0 introduction in the revised ETE report. The revised ETE Report is provided in Attachment 34.

RAI 13.03-3:

Question:

ETE-3: Introductory Materials Related to the ETE Report
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Regulatory Guide 1.206, Section I of Appendix 4 to NUREG-0654.

The VISUM software description on the website referenced in Section 5.0 describes that weighting factors can be applied on zone connectors which provide better levels of calibration for side streets and intersection volumes. Discuss in the ETE Report any weighting factors applied to streets and roadways in the modeling process, or justify why this is not necessary.

Response:

By default, when multiple connectors are applied to a single zone in the VISUM software, the traffic originating from that zone is split uniformly across the connectors. Zone connector weighting factors are used to split demand non-uniformly across the connectors. For example, if a zone with two connectors is the origin of 200 vehicles, the model developer could use weighting factors to ensure that 120 of those vehicles travel on one connector and the remaining 80 vehicles travel on the other.

The Victoria County Station evacuation model did not implement weighting factors on the zone connectors. Instead, each zone in the model was designed to group vehicles that would load onto the evacuation network in the same location, thereby making weighting factors unnecessary. In the example above of a zone with 200 vehicles, rather than using weighting factors to create a non-uniform vehicle split, the zone simply would have been divided into two zones, each with a single connector, with 120 vehicles and 80 vehicles, respectively.

Associated ESPA Revisions:

No revisions.

RAI 13.03-4:

Question:

ETE-4: Demand Estimation
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section II of Appendix 4 to NUREG-0654.

Section 13.3.1.2, "Area Population," of the Victoria ESP SSAR, provides an estimate of 6,995 people for the permanent and transient population within 10 miles of the plant site. Section 3.1.2, "Permanent Resident Population," and Section 3.2, "Transient Population," provide population values for the year 2010, of 6,435 persons for the permanent population, and 3,147 persons for the transient population for a total population of 9,582. Explain which estimate is correct, and revise the ETE Report as needed.

Response:

The permanent and transient population value stated in SSAR Section 13.3.1.2 is an estimate for the year 2010, based on year 2000 census data projections. It is noted that the permanent and transient population value of 6,995 stated in SSAR 13.3.1.2 has been revised to 7,195 to account for additional residents as described in SSAR Sections 2.1.3.1 and 2.1.3.3.1. These census projection values are based on a 10-mile radius of the VCS site.

As described in the response to RAI 13.03-6 (ETE-6), the source for the ETE report's employment population has been replaced with an attribute that should provide a more accurate estimate of the number of people working in the EPZ. As a result of this change, the total EPZ transient population estimate has been reduced to 1,311. This reduces the total EPZ population (residents plus transients) to 7,746.

The ETE and ESP SSAR estimates are different because the EPZ boundaries, the basis for the ETE estimate, differ somewhat from the 10-mile radius, which is the basis for the ESP SSAR estimate.

This clarification will be added to SSAR Section 13.3.1.2, and the ETE Report has been revised, as described below.

Associated ESPA Revisions:

SSAR Section 13.3.1.2, second paragraph, will be revised in a future revision of the SSAR to incorporate the following wording:

> The permanent and transient population within approximately 10 miles of the VCS site is estimated to be ~~6995~~ 7195 in 2010, based on year 2000 census data projections. Transient populations consist of individuals in the workforce, hotels/motels, and recreational areas, as well as seasonal residents and migrant populations. The total peak transient population within the 10-mile radius is estimated to be 1270. The total permanent and transient population within the 10-

mile EPZ used in the ETE Report is estimated to be 7746. This value incorporates the areas outside the 10-mile radius which have been included in the 10-mile EPZ for VCS.

The text, figures, and tables in Section 3.2 of the ETE report have been revised to reflect this updated EPZ transient population estimate. The EPZ transient population estimate has also been updated in the Executive Summary of the revised ETE report.

The revised EPZ transient population estimate was incorporated into the evacuation model and re-run to generate updated ETEs. Section 6.0 of the ETE report was updated to reflect the changes in ETEs. However, none of the ETEs changed by more than 10 minutes because employees load onto the network quickly enough that they do not have much impact on the ETEs. As described in Section 6.1 of the ETE report, recreational populations in the EPZ are generally the last to receive the warning and mobilize (see Figure 19 of the ETE report), and as a result drive the ETEs in most scenarios.

The revised ETE Report is provided in Attachment 34.

RAI 13.03-5:

Question:

ETE-5: Demand Estimation
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section II of Appendix 4 to NUREG-0654.

Section 3.1.2, "Permanent Resident Population," explains that the telephone survey identified no households without automobiles and states that this indicates the vast majority of households own at least one vehicle. However, only 125 surveys were completed.

A. Identify in the ETE Report the number of residents assumed to be non car-owning and in need of transportation to evacuate.

B. Discuss in the ETE Report the resources and mobilization times to support evacuation of the non car-owning population.

C. Identify in the ETE Report the number of non-ambulatory residents assumed to need assistance from outside the home due to a special need in order to evacuate.

Response:

A publicly assisted evacuation of the non-auto-owning population was not included in the model. Alternatively, an assumption was made that non-auto-owning households represent a very small proportion of the overall population and would evacuate with their friends and neighbors.

This assumption was made because the telephone survey, which served as the primary basis for the modeling of evacuee behavior in the study, identified no households that did not own automobiles. As noted in the ETE report, the survey was smaller than intended because there were not enough telephone listings available in the databases used to attain the desired sample size. Several efforts were made to get a more comprehensive listing. For example, Genesys Telecommunications Laboratories, a leading provider of survey samples was contacted in an attempt to expand the list of phone numbers for the survey. Genesys reviewed databases from two vendors, InfoUSA and Experian, but neither were able to expand on the sample used.

In order to incorporate a publicly assisted evacuation into the evacuation model, an artificial estimate would need to be created of the size and geographic distribution of potential non-auto-owning or special needs population; their mobilization time distribution, including the time associated with traveling to a bus stop or pickup point; any special needs that would need to be accommodated; and the transportation resources required to do so.

Additionally, since the VCS site is a "Greenfield site", county emergency planning registration programs, a key data source cited in NUREG/CR-7002, are not available at the ESP stage.

Without a viable means of estimating the size and location of this population and characterizing their needs and behavior in an evacuation, it was considered a reasonable assumption that they would be able to evacuate with friends and neighbors. It is also noted that the local county plans (Annex W Plan, Fixed Nuclear Facilites Response, Appendix/Tab 3) address conditions where transportation may need to be provided for some evacuees.

Associated ESPA Revisions:

No revisions.

RAI 13.03-6:

Question:

ETE-6: Demand Estimation
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section II of Appendix 4 to NUREG-0654.

Section 3.2, "Transient Populations," states that employment data was taken from 2008 estimates from Synergos Technologies. Discuss the process used to estimate employment data for the EPZ, or justify why this is not necessary.

Response:

The original ETE study used the Synergos Technologies labor force dataset to estimate the employment population in the EPZ. This dataset estimates the number of people living in a given area who are employed. However, after further review as part of the RAI response, this data has been replaced with the Synergos Technologies workplace population estimates, which reflect the number of workers who are employed in a given area. This dataset is believed to be more accurate for the purposes of the ETE, which should consider how many people are working in the EPZ rather than how many workers live there.

The Synergos Technologies workplace population estimates are derived using a sophisticated mathematical process that correlates and analyzes datasets from the U.S. Census, U.S. Bureau of Labor Statistics (BLS), and U.S. Postal Service (USPS). The number of employees is calculated by assessing the historical averages that are typical within each individual market and industry.

In preparing the ETE study, employers were contacted in the subareas that were believed to have more than 50 employees. The employers that provided information turned out to have fewer than 50 employees and were not included as a separate entity in the ETE study. Other employers never provided employment information despite several attempts to contact them over the course of the study. Nevertheless, their employment populations should be captured in the U.S. Census, BLS, and USPS datasets and, therefore, included in the Synergos Technologies population estimate.

Associated ESPA Revisions:

The text, figures, and tables in Section 3.2 of the ETE report have been revised to reflect this update to the transient population estimate. The transient population estimate in the Executive Summary of the ETE report has also been updated.

The revised estimates were incorporated into the evacuation model and re-run to generate updated ETEs. Section 6.0 of the ETE report was updated to reflect the changes in ETEs. However, none of the ETEs changed by more than 10 minutes because employees load onto the network quickly enough that they do not have significant impact on the ETEs. As described in Section 6.1 of the ETE report, recreational populations in the EPZ are generally the last to receive the warning and mobilize (see Figure 19 of the ETE report), and as a result drive the ETEs in most scenarios.

The revised ETE Report is provided in Attachment 34.

RAI 13.03-7:

Question:

ETE-7: Demand Estimation
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section II of Appendix 4 to NUREG-0654.

Section 3.4, "Vehicle Occupancy Rates," explains that an occupancy rate of 30 students per bus was used for the Bloomington Elementary School which results in the need for 14 buses to evacuate 395 students. In the ETE Report, discuss whether 14 buses are available to support the evacuation of the school.

Response:

Personnel at Bloomington Elementary School were contacted about the availability of buses to support the evacuation. They indicated that the Bloomington Independent School District has at least 14 buses that would typically be at the school within 40 minutes of an evacuation order.

Associated ESPA Revisions:

This information has been incorporated into Section 3.4 of the revised ETE report. The revised ETE Report is provided in Attachment 34.

RAI 13.03-8:

Question:

ETE-8: Traffic Capacity
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section III of Appendix 4 to NUREG-0654.

US Highway 77 is identified as an evacuation route in Figure 12, “Evacuation Map and Routes,” traversing through the entire EPZ in a northern to southern direction indicating a length of about 20 miles. US Highway 77 is identified in Appendix B, “Evacuation Network Links,” as having a length of 6.3 miles. In the ETE Report, discuss why the full length of US Highway 77 was not used in the analysis.

Response:

The length listed for US Highway 77 in Appendix B was incorrect and did not include the entirety of the route as included in the evacuation network. The full length of US Highway 77 that comprised part of the evacuation network was included in the model and used in the analysis.

Associated ESPA Revisions:

Appendix B of the ETE report has been revised to incorporate the correct full length of US Highway 77 that comprised part of the evacuation network and was included in the model. The revised ETE Report is provided in Attachment 34.

RAI 13.03-9:

Question:

ETE-9: Traffic Capacity
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section III of Appendix 4 to NUREG-0654.

In figure 12, the location where US Highway 77 intersects with US Highway 59 indicates an intersection and a left turn required for travelers to access US Highway 77 to continue north. Aerial mapping shows this intersection to be non-signalized and a free flow under the East Frontage Road (State Road 91) with uninterrupted flow on US Highway 77 in the northerly direction. Discuss in the ETE Report how the crossing of US Highway 77 and US Highway 59 was analyzed.

Response:

The evacuation routes are configured in such a way that vehicles approaching the intersection from US-77 N always merge onto US-59 N and then proceed northeast to the Victoria Community Center. As described in Section 4.1 of the ETE report, these vehicles include those that are evacuating from parts of subareas 1 (Option 1), 3, 4 (Option 1), and 8 (Option 2). Only vehicles from subarea 8 (Option 2) approaching the intersection from US-59 N merge onto US-77 N and travel to SW Moody Street (US-77, US-59 Business Route) to the Victoria Community Center.

As a result of this configuration, the through movement of US-77 N at the interchange with US-59 was not included in the evacuation routes and, therefore, not included in the evacuation model.

Associated ESPA Revisions:

No revisions.

RAI 13.03-10:

Question:

ETE-10: Traffic Capacity
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section III of Appendix 4 to NUREG-0654.

Appendix B, "Evacuation Network Links," lists all of the roadways used as evacuation routes and identifies the number of lanes, length, and speed limit for each roadway segment. In the ETE Report, provide an annotated map of the roadway nodal network that relates to Appendix B roadway segments.

Response:

Appendix B of the ETE report has been revised to include an annotated map of the roadway network (see Figure 22).

Associated ESPA Revisions:

Appendix B of the ETE report has been revised to include an annotated map of the roadway network (see Figure 22). The revised ETE Report is provided in Attachment 34.

RAI 13.03-11:

Question:

ETE-11: Traffic Capacity
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section III of Appendix 4 to NUREG-0654.

Section 5.2.2, "The Network Model," explains that roadway capacities used in the evacuation analysis were based on estimates from PTV/NAVTEQ and the values were verified using field collected road attributes and capacity calculation methodology. In the ETE Report, provide the roadway capacities that correspond with the Appendix B roadway segments, or justify why this is not necessary.

Response:

Appendix B of the ETE report has been revised to include roadway capacities.

Associated ESPA Revisions:

Appendix B of the ETE report has been revised to include roadway capacities. The revised ETE Report is provided in Attachment 34.

RAI 13.03-12:

Question:

ETE-12: Analysis of Evacuation Times
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section IV of Appendix 4 to NUREG-0654.

Section 2.1, "General Assumptions," states that for adverse weather conditions, speed limits were reduced by 40 percent and road capacities were reduced by 25 percent. Discuss in the ETE Report the weather type (e.g., fog, rain, etc.) that was considered for the adverse condition.

Response:

The 40 percent reduction in travel speeds and 25 percent reduction capacity used in the adverse condition in the model are consistent with those often observed in snow events.[2] Also, while data on the impact of ice on roadway capacity is not readily available, it is typically assumed that ice will have a similar impact to snow on driver behavior.[3]
A capacity reduction of 25 percent for poor weather roadway conditions is within the range typically used in evacuation studies.[4]

Associated ESPA Revisions:

The fifth bullet of Section 2.1 of the ETE report, which discusses the parameters used in the adverse weather scenarios, has been revised to indicate that the capacity and speed reductions used are typical of a snow or ice event. The revised ETE Report is provided in Attachment 34.

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[2] National Research Council, Committee on Weather Research for Surface Transportation. Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services; Transportation Research Board (TRB), Board on Atmospheric Services. Page 19–20. 2004.
[3] Han, L.D., Chin, S., Hwang, H. "Estimating Adverse Weather Impacts on Major US Highway Network." Transportation Research Board (TRB) Annual Meeting. 2003.
[4] Urbanik, T. E. and J. D. Jamison, *State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants* (NUREG/CR-4831; PNL-7776). Richland, WA: Pacific Northwest Laboratory, 1992. Page 5.

RAI 13.03-13:

Question:

ETE-13: Analysis of Evacuation Times
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section IV of Appendix 4 to NUREG-0654.

Section 5.1.1, "Trip Generation Events and Activities," states "Figure 14 shows the approach for estimating trip generation for different evacuation activities series." Explain whether this should read "Table 12" rather than "Figure 14" and revise the ETE Report if necessary.

Response:

The referenced statement should read "Table 12" and not "Figure 14."

Associated ESPA Revisions:

The reference to "Figure 14" has been changed to "Table 12" in Section 5.1.1 of the revised ETE report. The revised ETE Report is provided in Attachment 34.

RAI 13.03-14:

Question:

ETE-14: Analysis of Evacuation Times
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section IV of Appendix 4 to NUREG-0654.

Section 5.1.2, "Trip Generation time Estimate," explains that the time distribution for notification presented in "Evaluating Protective Actions for Chemical Agent Emergencies," (ORNL-6615) was adopted for the ETE study and is presented in Figure 16, "Notification Times for Selected Alert and Notification Systems." In the ORNL-6615 study, Figure 3.4, "Probability of Receiving Warning by Warning System by Time Elapsed Since Warning Decision," shows similar, but not the same information, as Figure 16. For instance, Figure 16 provides data for the combination of EAS and siren systems; whereas, Figure 3.4 provides data for EAS or siren systems, but does not combine the data. Explain how Figure 16 was derived from the ORNL-6615 study to present a distribution of warning time for the combined use of EAS and siren.

Response:

The notification time distributions for the warning systems shown in ORNL-6615 (sirens, EAS, and tone-alert radios [TARS]) were developed by measuring and fitting a cumulative distribution function to the curves shown in Figure 3.4 of the ORNL-6615. The notification time distribution for the combination of EAS and sirens was calculated from the individual curves for EAS and sirens using SAS statistical software.[5] First, one 20,000-entry vector was populated with notification times according to each of the siren and EAS distributions. That is, if, for example, the EAS distribution indicated that 20% of the population would be warned by EAS in the first 15 minutes, the notification times in the EAS vector were selected such that 20% of values were 15 minutes or less. The sirens vector was similarly chosen to match the sirens notification time distribution. These vectors could be interpreted as, respectively, the EAS and siren notification times for 20,000 "people."

To generate the notification time distribution for a population with both sirens and EAS, the minimum of the two vectors was taken for each of the 20,000 entries. Thus, this new vector represented the first of the two warning systems to reach each of the 20,000 "people" and, therefore, the notification curve for the combination of the two warning systems. This new vector was then converted into a smoothed distribution for use in ETE studies.

Upon further review, using a notification time distribution was determined to be inappropriate for the Victoria Spiritual Retreat Center. The population at this facility is expected to evacuate in a group in the event of an emergency, so it is best modeled using a single loading time rather than a distribution. According to Figure 3.4 of ORNL-6615, the probability of a population being warned by sirens reaches 50% approximately 15 minutes following the warning decision, therefore, 15 minutes was used as the warning time for the Victoria Spiritual Retreat Center. This was combined with an

[5] http://www.sas.com/

estimated 25 minutes for mobilization to create a loading time for the center's vehicles of 40 minutes.

Associated ESPA Revisions:

The sirens curve was removed from Figure 16 in the ETE report as the distribution was no longer used in the ETE study. However, for completeness, the notification time distribution used for recreational populations (EAS plus 45 minutes) was added to the figure. Figure 16 now includes both notification distributions used in the model.

The change in loading time for the Victoria Spiritual Retreat Center was noted in Section 5.1.3 of the ETE report and incorporated into the evacuation model, which was re-run to generate updated ETEs. The ETEs in Section 6.0 of the ETE report have been updated to reflect this change. This change had no impact on the ETEs because it did not affect the recreational populations that drive the ETEs in most scenarios (see Section 6.1 of the ETE report).

The revised ETE Report is provided in Attachment 34.

RAI 13.03-15:

Question:

ETE-15: Analysis of Evacuation Times
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section IV of Appendix 4 to NUREG-0654.

In the ETE Report, discuss whether the ETEs presented in Table 14, "ETEs in Minutes for NUREG-0654 Evacuation Areas," include time to evacuate the non car-owning population.

Response:

The ETEs in the ETE report include the non-car-owning population, as described in Section 2.1 of the ETE Report. As described in the response to RAI 13.03-5 (ETE-5), a very small subset of the EPZ households are expected to not own a vehicle and, in the absence of survey behavior describing their locations and expected evacuation behavior, the ETE study assumed that they would ride with evacuating neighbors, friends, or relatives, or would be evacuated through coordinated efforts by State and county emergency management officials.

Associated ESPA Revisions:

No revisions.

RAI 13.03-16:

Question:

ETE-16: Analysis of Evacuation Times
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section IV of Appendix 4 to NUREG-0654.

Section 3.3, "Special Facility Populations," identifies Bloomington Elementary School with a population of 395 students. Provide an ETE in the ETE Report for the Bloomington Elementary School, or justify why this is not necessary.

Response:

For all of the scenarios that involve the evacuation of Bloomington Elementary School,[6] the ETEs for the school are 60 minutes and 65 minutes in normal and adverse weather conditions, respectively. The school's close proximity to the ETE boundary meant that the other vehicles involved in the evacuation did not have much effect on the ETE of this facility.

Associated ESPA Revisions:

The ETEs for Bloomington Elementary School have been added to the revised ETE report in Table 15 in Section 6.2. The revised ETE Report is provided in Attachment 34.

[6] These include the daytime scenario for the following evacuation areas: 0–2 Miles, Full; 0–10 Miles, 90° NE; 0–10 Miles, 180° N; 0–10 Miles, 180° E; 0–10 Miles, 180° S; 0–10 Miles, Full EPZ

RAI 13.03-17:

Question:

ETE-17: Other Requirements
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section V of Appendix 4 to NUREG-0654.

Section 7, "Confirmation of Evacuation," explains that the actual time associated with the confirmation process would depend on the process used, number of personnel and equipment available. In the ETE Report, provide an estimate of the time required for confirmation of evacuation, or justify why this is not necessary.

Response:

For the VCS EPZ, which has approximately 2,120 households, it is estimated that a phone survey would need to reach 325 households in order to obtain a 5.0 percent margin of error.[7] This estimate is conservative in that it assumes that no prior information is known about the expected proportion of evacuation compliance; if compliance is assumed to be roughly 75 percent, then the required survey size would be reduced to 254.

The ETE study assumed that the survey would be conducted by manually dialing numbers, since setting up an automated operation on short notice would be difficult. Based on information provided by CR Dynamics, a phone survey company, it is estimated that approximately 20 dials could be completed per hour per person. Therefore, a survey of 325 households would take approximately 16 person-hours to complete, or one hour if the calls were divided among 16 personnel.

As described in Section 3.1.1 of the ETE report, 125 phone surveys were completed for this ETE study, despite several attempts to obtain a larger sample size. Based on this experience, Exelon will recommend that the responsible offsite response organizations conduct outreach to EPZ residents in order to assemble a larger phone survey sample if telephone contact is used as a means of evacuation confirmation. It is noted that the local county plans specify that the designated county officials have responsibility for implementing procedures for accountability of people in an evacuated area and for evacuation of special facilities.

Associated ESPA Revisions:

This information has been added to the ETE report as Section 7.1: Time Estimate for Telephone Confirmation. The revised ETE Report is provided in Attachment 34.

[7] Simple random sample methodology taken from: Scheaffer, Richard L., Mendenhall William, and Ott Lyman. "Elementary Survey Sampling 2nd Edition." Boston, MA: Duxbury Press, p. 45-49, 79. 1979.

RAI 13.03-18:

Question:

ETE-18: Other Requirements
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section V of Appendix 4 to NUREG-0654.

Explain whether recommendations were discussed with local stakeholders.

Response:

The ETE report recommendations were reviewed by and discussed with local stakeholders in August 2008. The appropriate offsite agencies each signed a letter certifying that they had reviewed the plans, including the ETE report, and deemed them to be workable, stating that they would participate in emergency management activities to support the plans and the site.

Associated ESPA Revisions:

No revisions.

RAI 13.03-19:

Question:

ETE-19: Other Requirements
Acceptance Criteria: Requirements A and H; Acceptance Criterion 11
Regulatory Basis: Section V of Appendix 4 to NUREG-0654.

Section 8.2, "Traffic Control Points," states that the responsibility of supervising traffic controls will be shared between the state and emergency management and law enforcement agencies. Discuss whether the ETE Report has been provided to principal state and local organizations for review and whether comments from these agencies have been received and addressed.

Response:

The ETE report was reviewed and discussed with the appropriate offsite agencies in August 2008. Comments received from these agencies were addressed in the report before submittal to the NRC. The agencies each signed a letter certifying that they had reviewed the plans, including the ETE report, and deemed them to be workable, stating that they would participate in emergency management activities to support the plans and the site.

Associated ESPA Revisions:

No revisions.

RAI 14.03.10-1:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-1: In Section 13.3 of the ESP application, "Emergency Planning," Table 13.3-1, "ITAAC for Emergency Planning," the acceptance criteria are prefaced with the phrase "A report exists that ..." ITAAC Acceptance Criteria must be specific and objective in order to clearly identify specific requirements and compliance. NRC Regulatory Issue Summary (RIS) 2008-05, "Lessons Learned to Improve Inspections, Tests, Analyses, and Acceptance Criteria Submittal," dated February 27, 2008, provides the following guidance:

"If applicants use the phrase, "a report exists and concludes that ...," they should consider specifying the scope and the type of report. For example, they should explain whether the scope of the report includes the design, the as-built construction (as reconciled with the design), or any other information."

The use of the phrase "a report exists that" in the acceptance criteria does not clearly describe how verification is actually conducted to confirm compliance. An area that might be appropriate for using a report to confirm that various ITAAC have been met is in Planning Standard 8.0, "Exercises and Drills," for which an Exercise Report could serve to verify that various exercise-related ITAAC (e.g., exercise objectives) have been met.

Consistent with RIS 2008-05, discuss the type and scope of the reports cited in ITAAC Table 13.3-1, including how the report will serve to provide accurate and reliable confirmation that compliance with acceptance criteria is evident, or consider removing the words "a report exists that" from the Table.

Response:

SSAR Table 13.3-1, Acceptance Criteria, is revised to remove the words "a report exists that" from the table, and the Table 13.3-1 Acceptance Criteria wording is revised to be consistent with RG 1.206.

ITAAC 4.1 is also revised to remove the references to specific EAL designations since these will be established based on the final reactor technology selected at the COL stage.

These revisions are shown in Attachment 33.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-2:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-2: Table C.II.1-B1, "Emergency Planning – Generic Inspection, Test, Analysis, and Acceptance Criteria (EP-ITAAC)," in Appendix C.II.1-B, "Development Guidance for emergency Planning ITAAC," to RG 1.206 contains the generic EP-ITAAC table. This table includes 16 Planning Standards and the accompanying EP Program Elements, Inspection, tests, Analysis, and Acceptance Criteria. The VCS ESP application EP-ITAAC Table 13.3-1 does not address eight of the generic ITAAC Planning Standards. The following generic ITAAC Planning Standards are not addressed:

1. Assignment of Responsibility-Organizational Control – 10 CFR 50.47(b)(1)
2. Onsite Emergency Organization – 10 CFR 50.47(b)(2)
3. Emergency Response support and Resources – 10 CFR 50.47(b)(3)
4. Radiological Exposure Control – 10 CFR 50.47(b)(11)
5. Medical and Public Health Support – 10 CFR 50.47(b)(12)
6. Recovery and Reentry Planning and Post-Accident Operations – 10 CFR 50.47(b)(13)
7. Radiological Emergency Response Training – 10 CFR 50.47(b)(15)
8. Responsibility for the Planning Effort: Development, Periodic Review, and Distribution of Emergency Plans – 10 CFR 50.47(b)(16)

Discuss why ITAAC were not developed for the above Planning Standards, or propose appropriate ITAAC.

Response:

SSAR Table 13.3-1 is revised to include ITAAC for the following Planning Standards:

1. Assignment of Responsibility-Organizational Control - 10 CFR 50.47(b)(1)
2. Onsite Emergency Organization – 10 CFR 50.47(b)(2)
3. Emergency Response Support and Resources – 10 CFR 50.47(b)(3)
4. Radiological Exposure Control – 10 CFR 50.47(b)(11)
5. Medical and Public Health Support – 10 CFR 50.47(b)(12)
6. Recovery and Reentry Planning and Post-Accident Operations – 10 CFR 50.47(b)(13)
7. Radiological Emergency Response Training – 10 CFR 50.47(b)(15)
8. Responsibility for the Planning Effort: Development, Periodic Review, and Distribution of Emergency Plans – 10 CFR 50.47(b)(16)

These revisions are shown in Attachment 33, ITAAC Nos. 1, 2, 3, 11, 12, 13, 15, and 16.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-3:

<u>Question:</u>

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-3: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 2.1.1 does not include language regarding notification of State and Local agencies within 15 minutes. Revise Acceptance Criteria 2.1.1 to be consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 5.1, or propose an acceptable alternative.

<u>Response:</u>

SSAR Table 13.3-1, Acceptance Criteria 5.1.1 (previously Acceptance Criteria 2.1.1) is revised to be consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 5.1. These revisions are shown in Attachment 33, ITAAC No. 5.

<u>Associated ESPA Revisions:</u>

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-4:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-4: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 2.2 does not provide the specific acceptance criteria for determination of successful test completion of mobilizing the VCS emergency response organization. Revise Table 13.3-1 Acceptance Criteria 2.2 to include the specific acceptance criteria, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 5.2 (previously Acceptance Criteria 2.2) is revised to be consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 5.2. These revisions are shown in Attachment 33, ITAAC No. 5.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-5:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-5: In Table 13.3-1,"ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria for Planning Standard 5.0, "Emergency Facilities and Equipment," do not include a criteria detailing the capabilities of the TSC – specifically whether it has the means to receive, store, process, and display plant and environmental information, and to initiate emergency measures and conduct emergency assessment. Revise Table 13.3-1 Acceptance Criteria for Planning Standard 5.0 to include the specific acceptance criteria, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria for Planning Standard 8.0 (previously Planning Standard 5.0) is revised to include the TSC criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 8.1.5. These revisions are shown in Attachment 33, ITAAC No. 8.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-6:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-6: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 5.1.6 does not indicate whether the OSC is in a location separate from the TSC. Revise Table 13.3-1 Acceptance Criteria 5.1.6 to include the specific location, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 8.1.6 (previously Acceptance Criteria 5.1.6) is revised to include the TSC criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 8.1.6. These revisions are shown in Attachment 33, ITAAC No. 8.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-7:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-7: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria for Planning Standard 5.0, "Emergency Facilities and Equipment," do not include a criteria concerning EOF habitability. Revise Table 13.3-1 Acceptance Criteria for Planning Standard 5.0 to include the specific acceptance criteria, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 8.2.2 is added to include the EOF habitability criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 8.2.2. Acceptance Criteria 8.2.3 (previously Acceptance Criteria 5.2.2 and 5.2.3) is renumbered. These revisions are shown in Attachment 33, ITAAC No. 8.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-8:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-8: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 6.4 describes specified meteorological data being available to the control room, TSC, and EOF. RG 1.206, Table C.II.1-B1 corresponding Acceptance Criteria 9.4 describes the need to demonstrate the ability to communicate meteorological data to the control room, TSC, EOF, offsite NRC center and to the state. Revise Acceptance Criteria 6.4 to be consistent with Table C.II.1-B Acceptance Criteria 9.4, or propose an acceptable alternative.

Response:

SSAR Table 13.3-1, Acceptance Criteria 9.4 (previously Acceptance Criteria 6.4) is revised to include the criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 9.4. These revisions are shown in Attachment 33, ITAAC No. 9.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-9:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-9: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 6.7 describes relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements. RG 1.206, Table C.II.1-B, corresponding Acceptance Criteria 9.9 describes the need to have the capability to compare these doses and levels with the EPA protective action guides (PAGs). Revise Acceptance Criteria 6.7 to be consistent with Table C.II.1-B Acceptance Criteria 9.9, or propose an acceptable alternative.

Response:

SSAR Table 13.3-1, Acceptance Criteria 9.7 (previously Acceptance Criteria 6.7) is revised to include the criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 9.9. These revisions are shown in Attachment 33, ITAAC No. 9.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-10:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-10: In Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application, Acceptance Criteria 8.1.2.2 addresses RG 1.206 Table C.II.1-B1 Acceptance Criteria 14.1.2, however, it does not include the word "successfully", as it relates to emergency responder performance. Revise the acceptance criteria to include the word "successfully" or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 14.1.2 (previously Acceptance Criteria 8.1.2.1 and 8.1.2.2) is revised to include the criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 14.1.2. These revisions are shown in Attachment 33, ITAAC No. 14.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-11:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-11: In RG 1.206, "Emergency Planning-Generic Inspection, Test, Analyses, and Acceptance Criteria (EP-ITAAC)," Table C.II.1-B1 acceptance criteria 14.1.1 includes the bracketed statement that "The COL applicant will identify exercise objectives and associated acceptance criteria." Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application Acceptance Criteria 8.1.1.2 states that exercise objectives, including specific acceptance criteria, addressed each of the eight listed emergency planning program elements. However, Table 13.3-1 does not identify what the exercise objectives and associated acceptance criteria are in order to clearly identify what the requirements are, and to provide the ability to determine whether they have been met. Revise the acceptance criteria to include specific exercise objectives and associated acceptance criteria, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 14.1.1 (previously Acceptance Criteria 8.1.1.2) is revised to include the specific exercise objectives and associated acceptance criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 14.1.1. These revisions are shown in Attachment 33, ITAAC No. 14.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

RAI 14.03.10-12:

Question:

SITE-18: ITAAC
Basis: 10 CFR 52.80(a)
SRP Acceptance Criteria: Requirement E; Acceptance Criterion 23

ITAAC-12: In RG 1.206, "Emergency Planning-Generic Inspection, Test, analyses, and Acceptance Criteria (EP-ITAAC)," C.II.1-B1 acceptance criteria 14.1.3 addresses offsite exercise objectives associated with the full participation exercise. However, Table 13.3-1, "ITAAC for Emergency Planning," in Section 13 of the ESP application does not include acceptance criteria to reflect the offsite exercise objectives associated with the full participation exercise. Revise Table 13.3-1 to include the appropriate acceptance criteria, or explain why it is not required.

Response:

SSAR Table 13.3-1, Acceptance Criteria 14.1.3 is added to include the offsite exercise objectives criteria referenced above, consistent with Table C.II.1-B1 of RG 1.206, Acceptance Criteria 14.1.3. These revisions are shown in Attachment 33, ITAAC No. 14.

Associated ESPA Revisions:

SSAR Table 13.3-1 will be revised in a future revision of the VCS ESP application to incorporate the changes described above.

ATTACHMENT 33

REVISED VCS SSAR TABLE 13.3-1 (SHEETS 1-19)

ITAAC FOR EMERGENCY PLANNING

Table13.3-1 (Sheet 1 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
1.0 Assignment of Responsibility- Organization Control			
10 CFR 50.47(b)(1) – Primary responsibilities for emergency response by the nuclear facility licensee, and by State and local organizations within the EPZs have been assigned, the emergency responsibilities of the various supporting organizations have been specifically established, and each principle response organization has staff to respond and to augment its initial response on a continuous basis.	1.1 The staff exists to provide 24-hour per day emergency response and manning of communication links, including continuous operations for a protracted period. [A.1.e, A.4]	1.1 An inspection of the implementing procedures or staffing rosters will be performed.	1.1 The staff exists to provide 24-hour per day emergency response and manning of communications links, including continuous operations for a protracted period. These positions include the positions listed in Figures B-1a - d of the Exelon Nuclear Standardized Radiological Emergency Plan, EP-AA-1000, Revision VCS-B.
2.0 Onsite Emergency Organization			
10 CFR 50.47(b)(2) – On-shift facility licensee responsibilities for emergency response are unambiguously defined, adequate staffing to provide initial facility accident response in key functional areas is maintained at all times, timely augmentation of response capabilities is available, and the interfaces among various onsite response activities and offsite support and response activities are specified.	2.1 The staff exists to provide minimum and augmented on-shift staffing levels, consistent with Table B-1 of NUREG-0654/FEMA-REP-1, Re. 1. [B.5, B.7]	2.1 An inspection of the implementing procedures or staffing rosters will be performed. 2.2 An inspection of records showing the demonstration of the capability to notify and mobilize the VCS emergency response organization.	2.1 The staff exists to provide minimum and augmented on-shift staffing levels, consistent with Table B-1 of NUREG-0654/FEMA-REP-1, Rev. 1. These positions include the positions listed in Figures B-1a - d of the Exelon Nuclear Standardized Radiological Emergency Plan, EP-AA-1000, Revision VCS-B. 2.2 Demonstration of notification and mobilization of the VCS emergency response organization in accordance with the emergency plan and the implementing procedures.

Table13.3-1 (Sheet 2 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
3.0 Emergency Response Support and Resources			
10 CFR 50.47(b)(3) – Arrangements for requesting and effectively using assistance resources have been made, arrangements to accommodate state and local staff at the licensee's near-site Emergency Operations Facility have been made, and other organizations capable of augmenting the planned response have been identified.	3.1 Letters of agreement (LOA) have been established for assistance resources. 3.2 There is space available to accommodate state and local staff in the EOF.	3.1 An inspection of the LOAs will be performed. 3.2 An inspection has been performed showing that there is adequate space in the EOF for state and local staff.	3.1 There are sufficient LOAs in place to address the anticipated assistance resources for offsite support. 3.2 Space is available for state and local staff in the EOF.
4.0 Emergency Classification System			
10 CFR 50.47(b)(4) — A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee, and state and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures.	4.1 A standard emergency classification and emergency action level (EAL) scheme exists, and identifies facility system and effluent parameters constituting the bases for the classification scheme. [D.1] <u>ITAAC element addressed in:</u> EP II.D.1	4.1 An inspection of the control room, technical support center (TSC), and emergency operations facility (EOF) will be performed to verify that they have displays for retrieving facility system and effluent parameters identified in the following list of EALs (Reference Section 3, Emergency Plan VCS Annex): <u>Fission Product Barrier Thresholds:</u> Fuel Clad Barrier Thresholds Values: 1. Primary coolant activity level 2. Reactor vessel water level 3. Primary containment radiation monitoring 4. Other indications <u>RCS Barrier Threshold Values:</u> 1. Primary containment pressure 2. Reactor vessel water level 3. RCS leak rate 4. Primary containment radiation monitoring <u>Containment Barrier Threshold Values:</u> 1. Primary containment conditions 2. Primary containment isolation failure or bypass 3. Primary containment radiation monitoring	4.1.1 The specific parameters identified in the EALs listed in ITA Section 1.1 are retrievable and displayed in the control room, TSC, and EOF, and the ranges of the displays encompass the values specified in the emergency classification and EALs listed in Section 1.1.

NARS per 13.03-24 response 5/13/11

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
5.0 Notification Methods and Procedures			
10 CFR 50.47(b)(5) — Procedures have been established for notification, by the licensee, of state and local response organizations and for notification of emergency personnel by all organizations, the content of initial and follow-up messages to response organizations and the public has been established, and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone (EPZ) have been established.	5.1 The means exist to notify responsible state and local organizations within 15 minutes after the licensee declares an emergency. [E.1] <u>ITAAC element addressed in:</u> EP II.E.1	5.1 A test will be performed of the capabilities.	5.1.1 Communications have been established via the Operational Hotline among the control room, the state of Texas, Victoria County, Refugio County, and Goliad County; and these agencies have received notifications within 15 minutes after the licensee declares an emergency.
	5.2 The means exist to notify emergency response personnel. [E.2] <u>ITAAC element addressed in:</u> EP II.E.2	5.2 A test will be performed of the capabilities.	5.2 Emergency response personnel receive the notification and mobilization communication.
	5.3 The means exist to notify and provide instructions to the populace within the plume exposure EPZ. [E.6] <u>ITAAC element addressed in:</u> EP II.E.6	NOTE: The means to notify and provide instructions to the populace within the plume exposure EPZ is addressed by Acceptance Criteria 14.1.1.2.	5.3 The means for notifying and providing instructions to the public are demonstrated to meet the design objectives, as stated in the emergency plan.

ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
6.0 Emergency Communications			
10 CFR 50.47(b)(6) — Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public.	6.1 The means exist for communications among the control room, TSC, EOF, principal state and local emergency operations centers (EOCs), and radiological field assessment teams. [F.1.d] ITAAC element addressed in: EP II.F.1	6.1 A test will be performed of the capabilities.	6.1.1 Communications are established among the control room, operations support center (OSC), and TSC. 6.1.2 Communications are established among the control room, TSC, and EOF. 6.1.3 Communications via the Operational Hotline are established among the TSC, state of Texas, Victoria County, Refugio County, and Goliad County. 6.1.4 Communications are established between the TSC and radiological monitoring teams.
	6.2 The means exist for communications from the control room, TSC, and EOF to the NRC headquarters and regional office EOCs (including establishment of the Emergency Response Data System (ERDS) between the onsite computer system and the NRC Operations Center.) [F.1.f] ITAAC element addressed in: EP II.H	6.2 A test will be performed of the capabilities.	6.2 Communications are established from the control room, TSC, and EOF to the NRC headquarters and Region IV EOCs and an access port for ERDS is provided.

Table13.3-1 (Sheet 5 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
7.0 Public Education and Information			
10 CFR 50.47(b)(7) — Information is made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) are established in advance, and procedures for coordinated dissemination of information to the public are established.	7.1 The licensee has provided space that may be used for a limited number of the news media at the EOF. [G.3.b] ITAAC element addressed in: EP II.H	7.1 An inspection of the emergency news center will be performed to verify that space is provided for a limited number of the news media.	7.1 The licensee has provided the emergency news center space for a limited number of the news media.

Table13.3-1 (Sheet 6 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
8.0 Emergency Facilities and Equipment			
10 CFR 50.47(b)(8) — Adequate emergency facilities and equipment to support the emergency response are provided and maintained.	8.1 The licensee has established a TSC and onsite OSC. [H.1] <u>ITAAC element addressed in:</u> EP II.H	8.1 An inspection of the as-built TSC and OSC will be performed.	8.1.1 The TSC size is consistent with NUREG-0696. 8.1.2 TSC communications equipment is installed and voice transmission and reception are accomplished: • NRC systems: emergency notification system, health physics network, management counterpart link • Dedicated telephone to EOF • Dedicated telephone to control room • Dedicated telephone to OSC 8.1.3 The common TSC (i.e., for both Unit 1 and Unit 2) is close to the control room, and the walking distance from the TSC to the control room does not exceed two minutes. Advanced communication capabilities may be used to satisfy the two minute travel time to either control room. 8.1.4 The TSC has comparable habitability with the control room under accident conditions. Backup electrical power supply is available for the TSC. 8.1.5 The TSC has the means to receive, store, process, and display plant and environmental information, and to initiate emergency measures and conduct emergency assessment. 8.1.6 The OSC for each unit is in a location separate from the control room and TSC (i.e., each unit will have a separate OSC). 8.1.7 The following communications equipment have been installed in the OSC and voice transmission and reception are accomplished: • Dedicated telephone to control room • Dedicated telephone to TSC • Plant page system (voice transmission only)

Table13.3-1 (Sheet 7 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[(a)]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
8.0 Emergency Facilities and Equipment (Continued)			
	8.2 The licensee has established an EOF. [H.2] <u>ITAAC element addressed in:</u> EP II.H	8.2 An inspection of the EOF will be performed.	8.2.1 The EOF working space size is consistent with NUREG-0696, and is large enough for required systems, equipment, records and storage. 8.2.2 The EOF habitability is consistent with that of a normal office building with adequate HVAC, as the EOF is located well outside the EPZ. A monitoring station is mounted at the entrance to ensure contamination is not brought into the facility by facility responders or by Field Teams returning to the EOF. 8.2.3 EOF communications equipment is installed, and voice transmission and reception are accomplished with the control room, TSC, NRC, and voice transmission and reception are accomplished via the Operational Hotline among the EOF, state of Texas, Victoria County, Refugio County, and Goliad County.

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
9.0 Accident Assessment			
10 CFR 50.47(b)(9) — Adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition are in use.	9.1 The means exist to provide initial and continuing radiological assessment throughout the course of an accident. [I.2] ITAAC element addressed in: EP II.I	9.1 A test of the emergency plan will be conducted by performing an exercise or drill to verify the capability to perform accident assessment.	9.1 An exercise or drill is accomplished including use of selected monitoring parameters identified in the EALs listed in ITA Section 1.1, to assess simulated degraded plant conditions and initiate protective actions in accordance with the following criteria: A. Accident Assessment and Classification 1. Initiating conditions identified, EALs parameters determined, and the emergency correctly classified throughout the drill. B. Radiological Assessment and Control 1. Onsite radiological surveys performed and samples collected. 2. Radiation exposure of emergency workers monitored and controlled. 3. Field monitoring teams assembled and deployed. 4. Field team data collected and disseminated. 5. Dose projections developed. 6. The decision whether to issue radioprotective drugs to VCS emergency workers made. 7. Protective action recommendations developed and communicated to appropriate authorities.
	9.2 The means exist to determine the source term of releases of radioactive material within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors. [I.3] ITAAC element addressed in: EP II.I	9.2 An analysis of emergency plan implementing procedures will be performed.	9.2.1 The means exists to determine the source term of releases of radioactive materials within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors.

Table13.3-1 (Sheet 9 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[(a)]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
9.0 Accident Assessment (Continued)			
	9.3 The means exist to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions. [I.4] ITAAC element addressed in: EP II.I	9.3 An analysis of emergency plan implementing procedures will be performed.	9.3 The means exists to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions.
	9.4 The means exist to acquire and evaluate meteorological information. [I.5] ITAAC element addressed in: EP II.I	9.4 An inspection of the control room, TSC, and EOF will be performed to verify the availability of the following meteorological data: • Wind speed (at 10 m and 60 m) • Wind direction (at 10 m and 60 m) • Ambient air temperature (at 10 m and 60 m)	9.4 Specified meteorological data is available at the control room, TSC, EOF, offsite NRC center, and to the state of Texas.
	9.5 The mean exist to make rapid assessments of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways, including activation, notification means, field team composition, transportation, communication, monitoring equipment, and estimated deployment times. [I.8]	9.5 An analysis of emergency plan implementing procedures will be performed	9.5 The means exists to make rapid assessment of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways.

Table13.3-1 (Sheet 10 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
9.0 Accident Assessment (Continued)			
	ITAAC element addressed in: EP II.I		
	9.6 The capability exists to detect and measure radioiodine concentrations in air in the plume exposure EPZ, as low as $1x10^{-7}$ µCi/cc (microcuries per cubic centimeter) under field conditions. [I.9] ITAAC element addressed in: EP II.I	9.6 A test of VCS field survey instrumentation will be performed to verify the capability to detect airborne concentrations as low as $1x10^{-7}$ microcuries per cubic centimeter.	9.6 Radioiodine can be detected in the plume exposure EPZ, as low as $1x10^{-7}$ microcuries per cubic centimeter.
	9.7 The means exist to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the EPA protective action guidelines. [I.10] ITAAC element addressed in: EP II.I	9.7 An analysis of emergency plan implementing procedures will be performed to verify that a methodology is provided to establish means for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the following isotopes — Kr-88, Ru-106, I-131, I-132, I-133, I-134, I-135, Te-132, Xe-133, Xe-135, Cs-134, Cs-137, Ce-144.	9.7 The means exists to relate contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the specified isotopes, to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the EPA protective action guides (PAGs).

Table13.3-1 (Sheet 11 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
10.0 Protective Response			
10 CFR 50.47(b)(10) — A range of protective actions has been developed for the plume exposure EPZ for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Guidelines for the choice of protective actions during an emergency, consistent with federal guidance, are developed and in place, and protective actions for the ingestion exposure EPZ appropriate to the locale have been developed.	10.1 The means exist to warn and advise onsite individuals of an emergency, including those in areas controlled by the operator, including: [J.1] a. Employees not having emergency assignments b. Visitors c. Contractor and construction personnel d. Other people who may be in the public access areas, on or passing through the site, or within the owner controlled area. ITAAC element addressed in: EP II.E	10.1 A test of the onsite warning and communications capability will be performed during a drill or exercise.	10.1.1 During a drill or exercise, notification and instructions are provided to onsite workers and visitors, within the protected area, over the plant public announcement system. 10.1.2 During a drill or exercise, audible warnings are provided to individuals outside the protected area, but within the owner controlled area.

Table13.3-1 (Sheet 12 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[(a)]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
11.0 Radiological Exposure Control			
10 CFR 50.47(b)(11) – Means for controlling radiological exposures, in an emergency, are established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA Emergency Worker and Lifesaving Activity PAGs.	11.1 The means exists to provide onsite radiation protection. [K.2] 11.2 The means exists to provide 24-hour-per-day capability to determine the doses received by emergency personnel and maintain dose records. [K.3] 11.3 The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. [K.5.b, K.7] 11.4 The means exists to provide onsite contamination control measures. [K.6]	11.1 – 11.4 A test will be performed of the capabilities.	11.1 The means exists to provide onsite radiation protection. 11.2 The means exists to provide 24-hour-per-day capability to determine the doses received by emergency personnel and maintain dose records. 11.3 The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. 11.4 The means exists to provide onsite contamination control measures.
12.0 Medical and Public Health Support			
10 CFR 50.47(b)(12) – Arrangements are made for medical services for contaminated, injured individuals.	12.1 Arrangements have been implemented for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake. [L.1] 12.2 The means exists for onsite first aid capability. [L.2]	12.1 -12.3 A test will be performed of the capabilities.	12.1 Arrangements have been implemented for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake. 12.2 The means exists for onsite first aid capability.

Table13.3-1 (Sheet 13 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
12.0 Medical and Public Health Support (Continued)			
	12.3 Arrangements have been implemented for transporting victims of radiological accidents, including contaminated injured individuals, from the site to offsite medical support facilities. [L.4]		12.3 Arrangements have been implemented for transporting victims of radiological accidents, including contaminated injured individuals, from the site to offsite medical support facilities.
13.0 Recovery and Reentry Planning and Post-Accident Operations			
10 CFR 50.47(b)(13) – General plans for recovery and reentry are developed.	13.1 Licensee has general plans in place for recovery and reentry.	13.1 A test or analysis of the emergency plan and implementing procedures will be conducted to determine that recovery and reentry procedures are available.	13.1 A demonstration has shown that the emergency plan and implementing procedures are effective for recovery and reentry.
14.0 Exercises and Drills			
10 CFR 50.47(b)(14) — Periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills are (will be) corrected.	14.1 Licensee conducts a full participation exercise to evaluate major portions of emergency response capabilities, which includes participation by each state and local agency within the plume exposure EPZ, and each state within the ingestion control EPZ. [N.1] <u>ITAAC element addressed in:</u> EP II.N.1	14.1 A full participation exercise (test) will be conducted within the specified time periods of Appendix E to 10 CFR Part 50.	14.1.1 The exercise is completed within the specified time periods of Appendix E to 10 CFR Part 50, onsite exercise objectives have been met, including: A. *Accident Assessment and Classification* 1. Demonstrate the ability to identify initiating conditions, determine emergency action levels (EAL) parameters, and correctly classify the emergency throughout the exercise. Standard Criteria: a. Determine the correct emergency classification level based on events which were in progress, considering past events and their impact on the current conditions within 15 minutes from the time the initiating condition(s) or EAL is exceeded during the exercise. B. *Notifications* 1. Demonstrate the ability notify responsible state and local government agencies within 15 minutes and the NRC within 60 minutes after declaring an emergency.

Table13.3-1 (Sheet 14 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
14.0 Exercises and Drills (Continued)			
			Standard Criteria: a. Accurately transmit information in accordance with Emergency Plan Implementing Procedures within 15 minutes of the emergency declaration 2. Demonstrate the ability to alert, notify, and mobilize site emergency response personnel during the exercise. Standard Criteria: a. Complete the designated actions in accordance with Emergency Plan Implementing Procedures and perform the announcement concerning the initial event classification of Alert or higher during the exercise. b. Mobilize site emergency responders in accordance with Emergency Plan Implementing Procedures at the initial event classification for an Alert or higher during the exercise. 3. Demonstrate the ability to warn or advise onsite individuals of emergency conditions. Standard Criteria: a. Initiate notification of onsite protective actions. 4. Demonstrate the capability of the Alert and Notification System (ANS) to operate properly when required. Standard Criteria: a. 90% of the sirens operate properly, as indicated by the feedback system, or other physical evidence. C. *Emergency Response* 1. Demonstrate the ability to direct and control emergency operations.

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
14.0 Exercises and Drills (Continued)			
			Standard Criteria: a. Command and control is demonstrated by the Control Room (simulator) in the early phase of the emergency and by the Technical Support Center (TSC) and Emergency Operations Facility (EOF) within 75 minutes of the emergency declaration. 2. Demonstrate the ability to transfer emergency direction from the Control Room (simulator) to the EOF. Standard Criteria: a. Turnover briefings are conducted in accordance with Emergency Plan Implementing Procedures. 3. Demonstrate the ability to prepare for around-the-clock staffing requirements. Standard Criteria: a. Complete 24-hour staffing assignments. 4. Demonstrate the ability to perform assembly and accountability for personnel in the Protected Area within 30 minutes of the declaration of a Site Area Emergency or higher classification. Standard Criteria: a. Protected Area personnel assembly and accountability completed within 30 minutes of the declaration of a Site Area Emergency or higher classification. D. *Emergency Response Facilities* 1. Demonstrate activation of the Operational Support Center (OSC), and full functional operation of the TSC and EOF within 75 minutes of a declaration of Alert or higher emergency classification. Standard Criteria: a. The TSC, OSC, and EOF are activated within 75 minutes of the declaration of an Alert of higher emergency classification.

Table13.3-1 (Sheet 16 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
14.0 Exercises and Drills (Continued)			
			2. Demonstrate the adequacy of equipment, security, provisions, and habitability precautions for the TSC, OSC, and EOF, as appropriate. Standard Criteria: a. Demonstrate the adequacy of the emergency equipment in the emergency response facilities as specified in Emergency Plan Implementing Procedures, as appropriate. b. The security force implements and follows applicable security plan and emergency plan procedures as appropriate during the exercise. c. Demonstrate the capability of TSC and EOF equipment and data displays to clearly identify and reflect the affected unit. 3. Demonstrate the adequacy of communications for emergency support resources. Standard Criteria: a. Emergency response facility personnel are able to operate primary or backup communication systems in accordance with Emergency Plan Implementing Procedures as needed during the exercise. b. Primary or backup emergency response communication systems listed in the Emergency Plan Implementing Procedures are available and operational for the duration of the exercise. E. *Radiological Assessment and Control* 1. Demonstrate the ability to obtain onsite radiological surveys and samples Standard Criteria: a. Health Physics personnel demonstrate the ability to obtain appropriate instruments and perform surveys as needed during the exercise.

ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
14.0 Exercises and Drills (Continued)			
			b. Airborne samples are taken, handled, and analyzed as appropriate, in accordance with Emergency Plan Implementing Procedures during the exercise. 2. Demonstrate the ability to continuously monitor and control radiation exposure to emergency workers. Standard Criteria: a. Emergency workers are issued self-reading dosimeters when radiation levels require, provided dose limits and turn back levels, and exposures are controlled to 10 CFR Part 20 limits (unless the Station Emergency Director authorizes emergency limits), as appropriate during the exercise. b. The Station Emergency Director evaluated a request and authorized an emergency exposure during the exercise. c. Exposure records are available during the exercise. 3. Demonstrate the ability to assemble and deploy field monitoring teams. Standard Criteria: a. Field Monitoring Teams are briefed, obtain equipment, and are dispatched in accordance with Emergency Plan Implementing Procedures. 4. Demonstrate the ability to collect and disseminate field team data. Standard Criteria: a. Field teams collect data for dose rate and airborne radioactivity levels, as applicable, in accordance with emergency plan implementing procedures. b. Field team communicates data to the EOF in accordance with Emergency Plan Implementing Procedures during the exercise.

Table13.3-1 (Sheet 18 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
14.0 Exercises and Drills (Continued)			
			5. Demonstrate the ability to develop dose projections. Standard Criteria: a. Timely and accurate dose projections are performed in accordance with Emergency Plan Implementing Procedures during the exercise. 6. Demonstrate the ability to develop appropriate Protective Action Recommendations (PARs) and notify appropriate authorities within 15 minutes, once data is available, after the declaration of a General Emergency or change in PARs during the exercise. Standard Criteria: a. Total Effective Dose Equivalent (TEDE) and Committed Dose Equivalent (CDE) dose projections from the dose assessment computer code, or backup method, are developed in accordance with Emergency Plan Implementing Procedures during the exercise. b. PARs are developed and transmitted within 15 minutes of data availability during the exercise. 14.1.2 Onsite emergency response personnel were mobilized in sufficient numbers to fill emergency response positions, and they successfully performed their assigned responsibilities. 14.1.3 The exercise is completed within the specified time periods of Appendix E to 10 CFR Part 50, offsite exercise objectives have been met, and there are either no uncorrected offsite exercise deficiencies or a license condition requires offsite deficiencies to be addressed prior to operation above 5% of rated power.

Table13.3-1 (Sheet 19 of 19)
ITAAC For Emergency Planning

Planning Standard	EP Program Elements[(a)]	Inspections, Tests, Analyses (ITA)	Acceptance Criteria
15.0 Radiological Emergency Response Training			
10 CFR 50.47(b)(15) – Radiological emergency response training is provided to those who may be called on to assist in an emergency.	15.1 Site-specific emergency response training has been provided for those who may be called upon to provide assistance in the event of an emergency. [O.1]	15.1 An inspection will be performed of the capabilities.	15.1 Site-specific emergency response training has been provided for those who may be called upon to provide assistance in the event of an emergency.
16.0 Responsibilities for the Planning Effort: Development, Periodic Review, and Distribution of Emergency Plans			
10 CFR 50.47(b)(16) – Responsibilities for plan development and review and for distribution of emergency plans are established, and planners are properly trained.	16.1 The emergency response plans have been forwarded to all organizations and appropriate individuals with responsibility for implementation of the plans. [P.5]	16.1 An inspection of the distribution list will be performed.	16.1 The emergency response plans have been forwarded to all organizations and appropriate individuals with responsibility for implementation of the plans. There are receipt acknowledgements from each organization.
17.0 Implementing Procedures			
10 CFR Part 50, App. E.V — No less than 180 days before the scheduled issuance of an operating license for a nuclear power reactor or a license to possess nuclear material, the applicant's detailed implementing procedures for its emergency plan shall be submitted to the Commission.	17.1 The licensee has submitted detailed implementing procedures for its emergency plan no less than 180 days before fuel load.	17.1An inspection of the submittal letter will be performed.	17.1 The licensee has submitted detailed implementing procedures for the onsite emergency plan no less than 180 days before fuel load.

[(a)]The alphanumeric designations in square brackets correspond to NUREG-0654/FEMA-REP-1, Rev. 1, evaluation criteria.

ATTACHMENT 34

Final Report IEM/TEC11-010

Evacuation Time Estimates: Exelon Nuclear Texas Holdings, LLC

Victoria County Station

April 6, 2011

(99 pages)

April 6, 2011

IEM

FINAL REPORT

Evacuation Time Estimates: Exelon Nuclear Texas Holdings, LLC Victoria County Station

Revised in Response to U.S. Nuclear Regulatory Commission Requests for Additional Information

IEM/TEC11-010

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EXECUTIVE SUMMARY

Exelon Generation Company (Exelon) has contracted with Bechtel Power Corporation (Bechtel) to develop and deliver a combined operating license application (COLA) for two proposed nuclear power units to be located in Victoria County, Texas. In support of this license application, Bechtel contracted IEM to perform an evacuation time estimate (ETE) study for the proposed 10-mile emergency planning zone (EPZ) around the Victoria County Station (VCS) for inclusion as part of the Emergency Plan for the proposed two units at the site. This document describes the methods used to obtain 2008 population data, model existing evacuation routes, and estimate evacuation times. It also reports the estimated population figures, evacuation road network information, and ETEs.

In compliance with the U.S. Nuclear Regulatory Commission's (USNRC) and the Federal Emergency Management Agency's (FEMA) guidelines and criteria for preparing ETE studies (NUREG-0654/FEMA-REP-1, NUREG/CR-4831/PNL-7776, NUREG/CR-6863, NUREG/CR-6864), this report breaks down the population by subarea and by sector.[1] Three population categories have been identified in this report: permanent residents, transients, and special facilities.

The permanent resident population is made up of individuals residing in the 10-mile EPZ. The total year 2008 permanent resident population within the proposed 10-mile EPZ around VCS is estimated at approximately 6,435. The transient population consists of workers employed within the area, recreational sportsmen, and visitors to the area. The total transient population within the 10-mile EPZ is estimated to be approximately 1,311. The special facilities populations in the VCS EPZ include one school, one religious retreat center, and the VCS itself. In these analyses, IEM contacted special facilities with more than 50 people to collect current enrollment and staff figures. The total special facility population for the 10-mile EPZ, obtained through the facilities' response to IEM's communication, is estimated to be 5,995.

A bilingual (English and Spanish) telephone survey of residents living in the EPZ was also conducted to measure public behavior during an evacuation. The results were used to quantify the mobilization times and vehicle usage for residential and transient populations. Analogous information for special facilities was ascertained via direct contact with the facilities.

Using geographic information system (GIS) analysis and field observation, IEM developed a set of evacuation routes for the VCS site, which were approved by Exelon, Bechtel, and local emergency management agency officials. IEM personnel traveled the routes to gather information on the road network, such as speed limits and the number of lanes, which were incorporated into the evacuation model.

[1] USNRC and FEMA. *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants.* NUREG-0654, FEMA-REP-1. November 1980. Online: http://www.nrc.gov.edgesuite.net/reading-rm/doc-collections/nuregs/staff/sr0654/sr0654r1.pdf (last accessed November 29, 2007).

IEM used PTV Vision VISUM, a computer traffic simulation model, to perform the ETE analyses. For the analyses, the 10-mile EPZ was divided into 11 evacuation areas based on 90°, 180°, 360° sectors to comply with NUREG-0654 and 20 areas that will be used by VCS personnel to develop protective action recommendations (PAR) in the event that a general emergency is declared at the site. In order to represent the most realistic emergency scenarios, evacuations for the areas were modeled individually for weekday, weeknight, and weekend scenarios. Each of these scenarios was then considered under both normal and adverse weather conditions. ETEs were developed at Exelon's request for each of the 11 individual subareas for the weekend adverse weather scenario. Lastly, ETEs were prepared for a special scenario considering the construction and operations workforce at the VCS and the full EPZ population.

ETEs for the NUREG-0654 evacuation areas ranged from 2 hours 5 minutes to 4 hours 10 minutes. ETEs for the PAR evacuation areas ranged from 2 hours 10 minutes to 4 hours 10 minutes. ETEs for the individual subareas ranged from 1 hour 20 minutes to 3 hours 40 minutes. The factors that contributed to the variations in ETEs between scenarios include differences in the number of evacuating vehicles, capacity of the evacuation routes, type of proposed warning systems within the subareas, and/or distance from the origin subareas to the EPZ boundary. The weekend scenario produced the highest evacuation times, because this scenario included the most recreational transients, the population segment with the longest mobilization times. The evacuation times for the above scenarios were primarily driven by the loading times and, for the most part, not influenced by significant congestion. The evacuation times for the VCS special scenario were 6 hours 30 minutes for both normal and adverse weather conditions. The vast evacuation demand from VCS caused significant congestion at some intersections, producing the longer ETEs.

The following recommendations will help emergency managers to improve the evacuation times during an event at VCS:

- ETEs can be reduced by implementing additional measures that will shorten the elapsed time the public uses to take required protective actions after an event's occurrence, especially for recreational area users, such as hunters and fishermen.
- Use traffic control points (TCPs) to facilitate traffic flow out of the EPZ. The recommended locations for traffic control points are discussed in detail in Section 8.2.
- Develop comprehensive regional evacuation plans to enhance the effectiveness and efficiency of cross-institutional coordination and cooperation during an evacuation. A regional evacuation plan requires the collaborative contribution of all EPZ counties and incorporates the individual county evacuation plans in a broader regional context.
- Encourage the construction and operations workforce to carpool when evacuating from the VCS.
- Develop specific site-dismissal plans and procedures for VCS personnel to possibly consider for staggered or phased evacuation process.

TABLE OF CONTENTS

1.0 INTRODUCTION

Exelon Generation Company (Exelon) contracted with Bechtel Power Corporation (Bechtel) to develop and deliver a combined operating license application (COLA) for two proposed nuclear power units to be located in Victoria County, Texas. In support of this license application, Bechtel contracted IEM to perform an evacuation time estimate (ETE) study for the proposed 10-mile emergency planning zone (EPZ) around the Victoria County Station (VCS) that will be included in the emergency plans developed for the site. This document presents the results of that study, including population figures, road network information, evacuation behavior data, and ETEs, as well as the assumptions and methodologies used by IEM to obtain them. The study was performed using 2008 population estimates for the VCS 10-mile EPZ.

This population evacuation study fulfills regulatory requirements outlined in the U.S. Nuclear Regulatory Commission (USNRC) and Federal Emergency Management Agency's (FEMA) Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants (NUREG-0654), Appendix 4.[2] When appropriate, the study uses guidance contained in NUREG/CR-6863[3] and NUREG/CR-6864, Volume 1.[4] The study is intended to provide information for State, local, and VCS emergency preparedness personnel to effectively plan for an event at the proposed site.

1.1. Site Location

VCS is located in the Gulf Coast region of Texas, in Victoria County. The city of Victoria is beyond the northern edge of the 10-mile EPZ. The site is approximately 13 miles south of the city of Victoria. In relation to larger cities, it lies approximately 110 miles southeast of San Antonio, approximately 125 miles southwest of Houston and south-southeast of Austin, and approximately 65 miles northeast of Corpus Christi. Figure 1 shows the location of VCS.

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[2] USNRC and FEMA. *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants*. NUREG-0654, FEMA-REP-1. November 1980. Online: http://www.nrc.gov.edgesuite.net/reading-rm/doc-collections/nuregs/staff/sr0654/sr0654r1.pdf (last accessed November 29, 2007).

[3] USNRC. *Development of Evacuation Time Estimate Studies for Nuclear Power Plants*. NUREG/CR-6863. January 2005. Online: http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6863/cr6863.pdf (last accessed November 29, 2007).

[4] USNRC. *Identification and Analysis of Factors Affecting Emergency Evacuations Emergency Evacuations*, Volume 1. NUREG/CR-6864. January 2005. Online: http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6864/v1/cr6864v1.pdf (last accessed November 29, 2007).

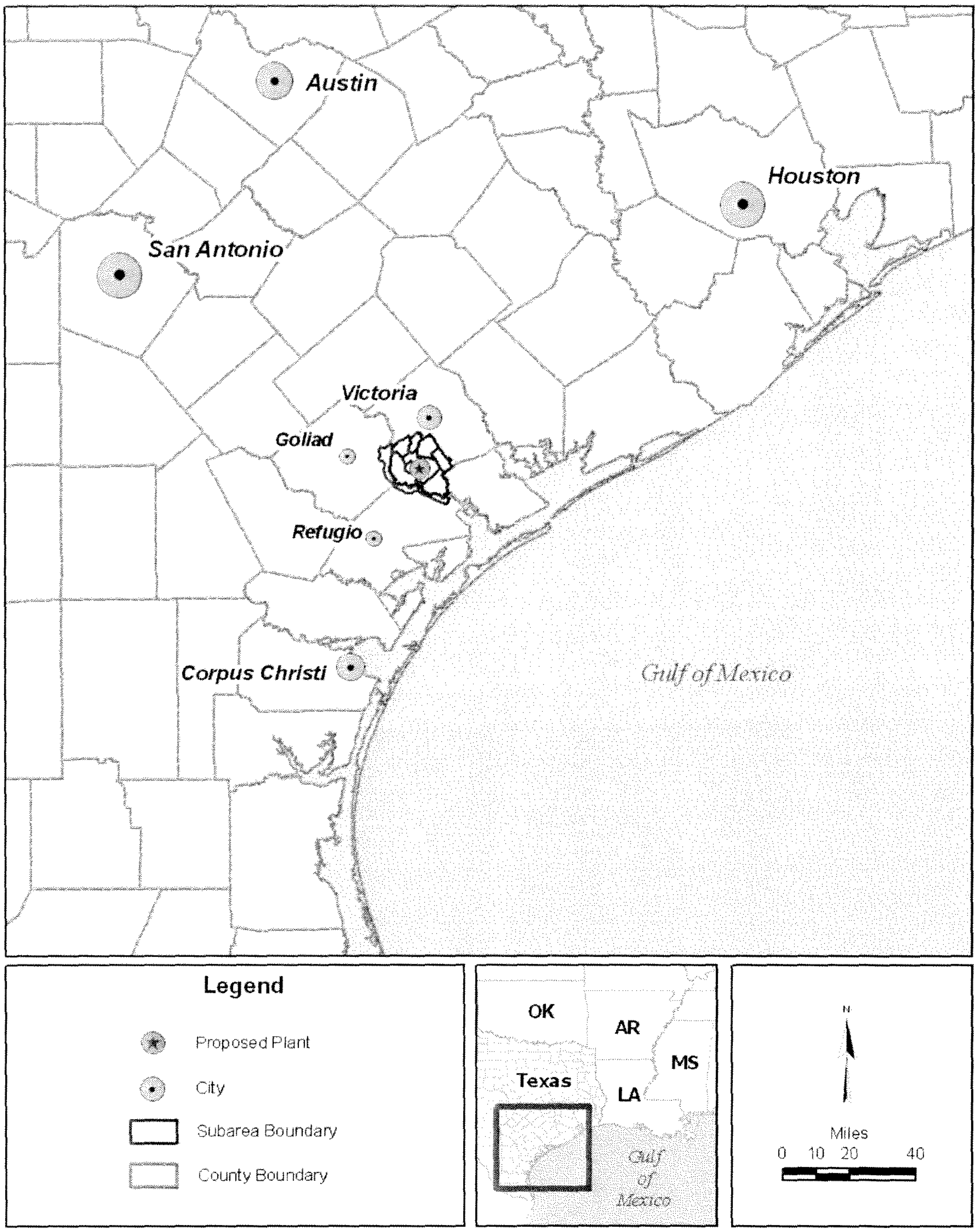

Figure 1: Victoria County Station Location[5]

[5] The 'City' legend is representative of the sizes of the cities

1.2. Emergency Planning Zone

The proposed 10-mile emergency planning zone (EPZ), which was developed by Bechtel and Exelon personnel in coordination with local emergency management agency officials, covers the 10-mile geographic area surrounding VCS, including portions of Victoria, Goliad, and Refugio counties in Texas. For evacuation and emergency response planning purposes, the EPZ has been further divided into 11 subareas. The subareas were selected based on existing political boundaries and prominent physical features, either natural (e.g., rivers and lakes) or man-made (e.g., roads), to enhance direction and coordination of the public in the affected area. Bechtel provided IEM with the details of the EPZ and the sub-areas. Figure 2 is a map of the EPZ and subareas for VCS. Appendix A contains boundary descriptions of the subareas.

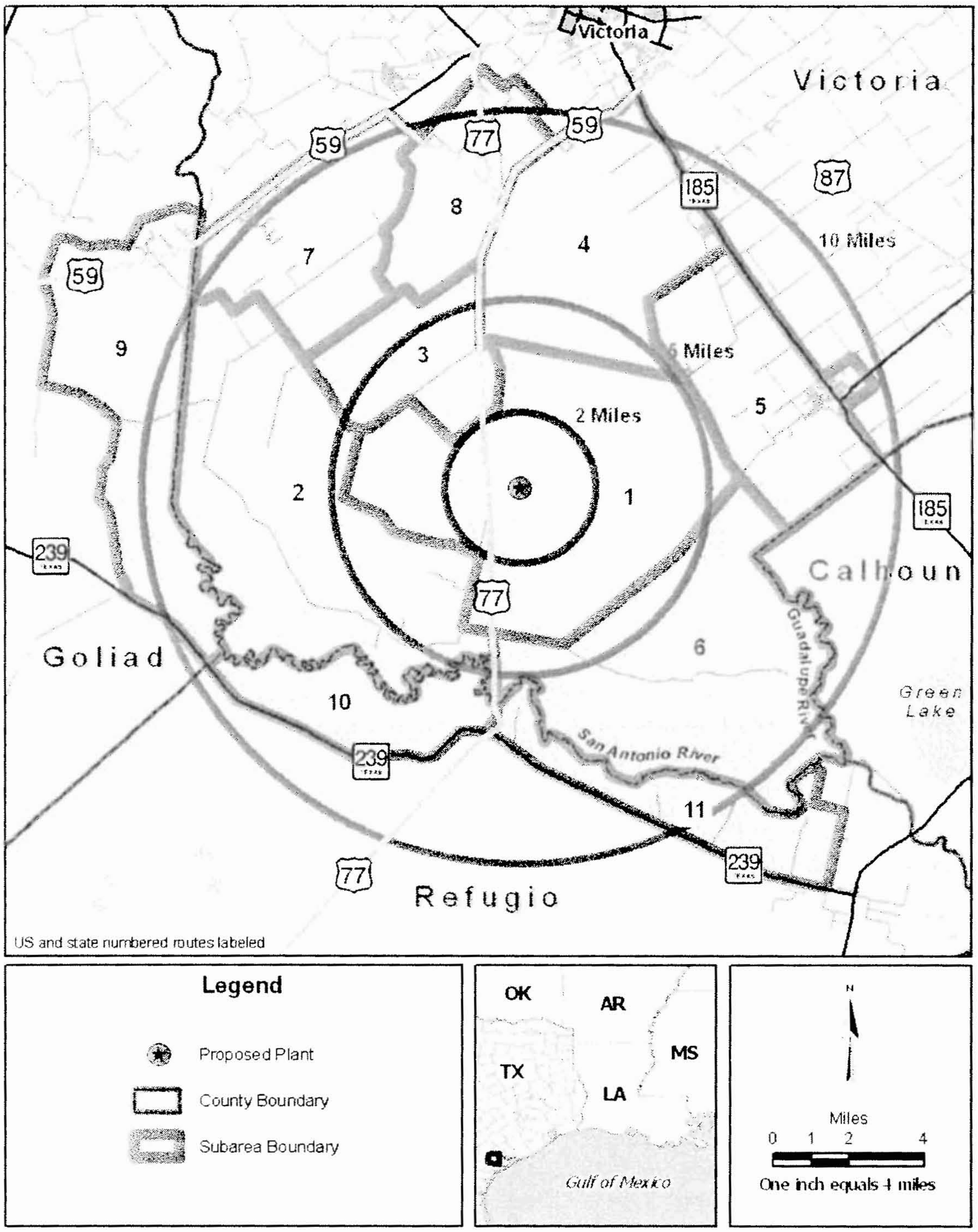

Figure 2: VCS EPZ Boundary and Subareas[6]

[6] Only the major highways and arterials have been shown in this graphic.

1.3. Evacuation Areas

Through consultation between IEM, Bechtel, and Exelon, the subareas were grouped into evacuation areas using three different methods. The first method divided the EPZ based on the 2-, 5-, and 10-mile radius, and 90°, 180°, and 360° sectors, in accordance with NUREG-0654.[7] The resulting NUREG-0654 evacuation areas are shown in Table 1 and Figure 3, with one 0 to 2-mile area, one 0 to 5-mile area, and nine 0 to 10-mile areas. The second set of evacuation areas were grouped by Exelon personnel into 20 keyhole-shaped wedges, which will be used by VCS personnel to develop protective action recommendations (PAR) in the event a general emergency is declared at the site. These PAR areas, which include 8 wind directions for the 2-mile radius and 5 miles downwind and 12 wind directions for the 5-mile radius and 10 miles downwind, are shown in Table 2, Figure 4, and Figure 5. IEM obtained this information from designated Exelon personnel. The third set of evacuation areas, shown in Table 3, considers each of the 11 subareas individually.

Table 1: NUREG-0654 Evacuation Areas

Evacuation Area	Subareas
0–2 Miles	1
0–5 Miles	1, 2, 3, 4, 6
0–10 Miles, 90° NE	1, 4, 5
0–10 Miles, 90° SE	1, 6, 11
0–10 Miles, 90° SW	1, 2, 9, 10
0–10 Miles, 90° NW	1, 2, 3, 7, 8, 9
0–10 Miles, 180° N	1, 2, 3, 4, 5, 7, 8, 9
0–10 Miles, 180° E	1, 4, 5, 6, 8, 11
0–10 Miles, 180° S	1, 2, 5, 6, 9, 10, 11
0–10 Miles, 180° W	1, 2, 3, 4, 6, 7, 8, 9, 10, 11
0–10 Miles, Full EPZ	All Subareas

[7] NUREG-0654. pg. 4-4.

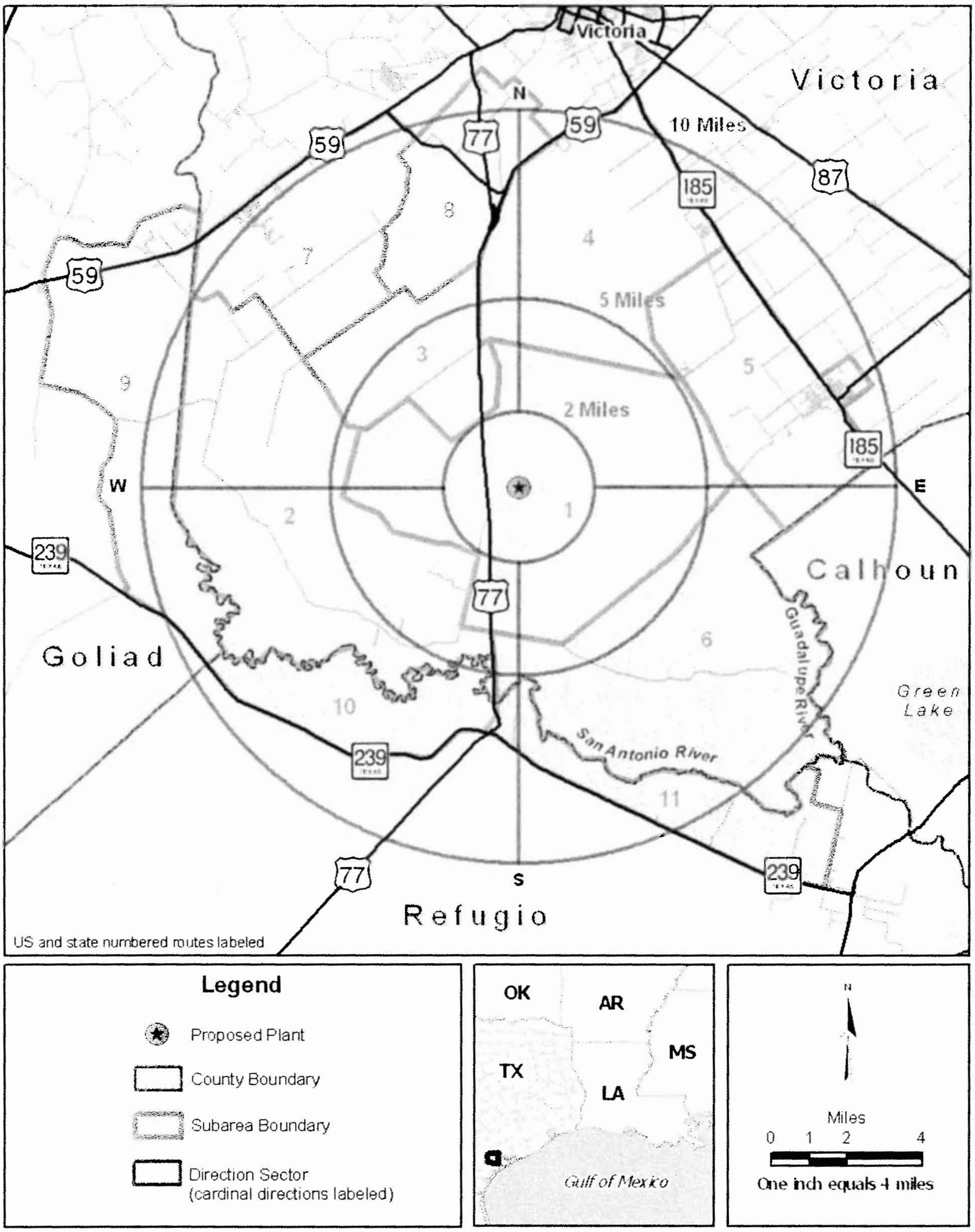

Figure 3: NUREG-0654 Evacuation Area Sectors

Table 2: PAR Evacuation Areas[8]

Evacuation Area: Distance	Evacuation Area: Wind Direction[9]	Subareas
2-mile radius, 5 miles downwind	340°-24°	1, 3, 4
	25°-54°	1, 4
	55°-94°	1, 4, 6
	95°-154°	1, 6
	155°-229°	1, 2, 6
	230°-254°	1, 2
	255°-309°	1, 2, 3
	310°-339°	1, 2, 3, 4
5-mile radius, 10 miles downwind	345°-4°	1, 2, 3, 4, 6, 7, 8
	5°-14°	1, 2, 3, 4, 5, 6, 7, 8
	15°-44°	1, 2, 3, 4, 5, 6, 8
	45°-94°	1, 2, 3, 4, 5, 6
	95°-134°	1, 2, 3, 4, 5, 6, 11
	135°-154°	1, 2, 3, 4, 6, 11
	155°-209°	1, 2, 3, 4, 6, 10, 11
	210°-224°	1, 2, 3, 4, 6, 9, 10, 11
	225°-264°	1, 2, 3, 4, 6, 9, 10
	265°-279°	1, 2, 3, 4, 6, 7, 9, 10
	280°-289°	1, 2, 3, 4, 6, 7, 9
	290°-344°	1, 2, 3, 4, 6, 7, 8, 9

[8] This information was provided to IEM by designated Exelon personnel. IEM was not involved in the development of the PAR Evacuation Areas.

[9] Wind direction is the direction (in degrees) toward which the wind is blowing (000° or 360° represents a wind from north to south).

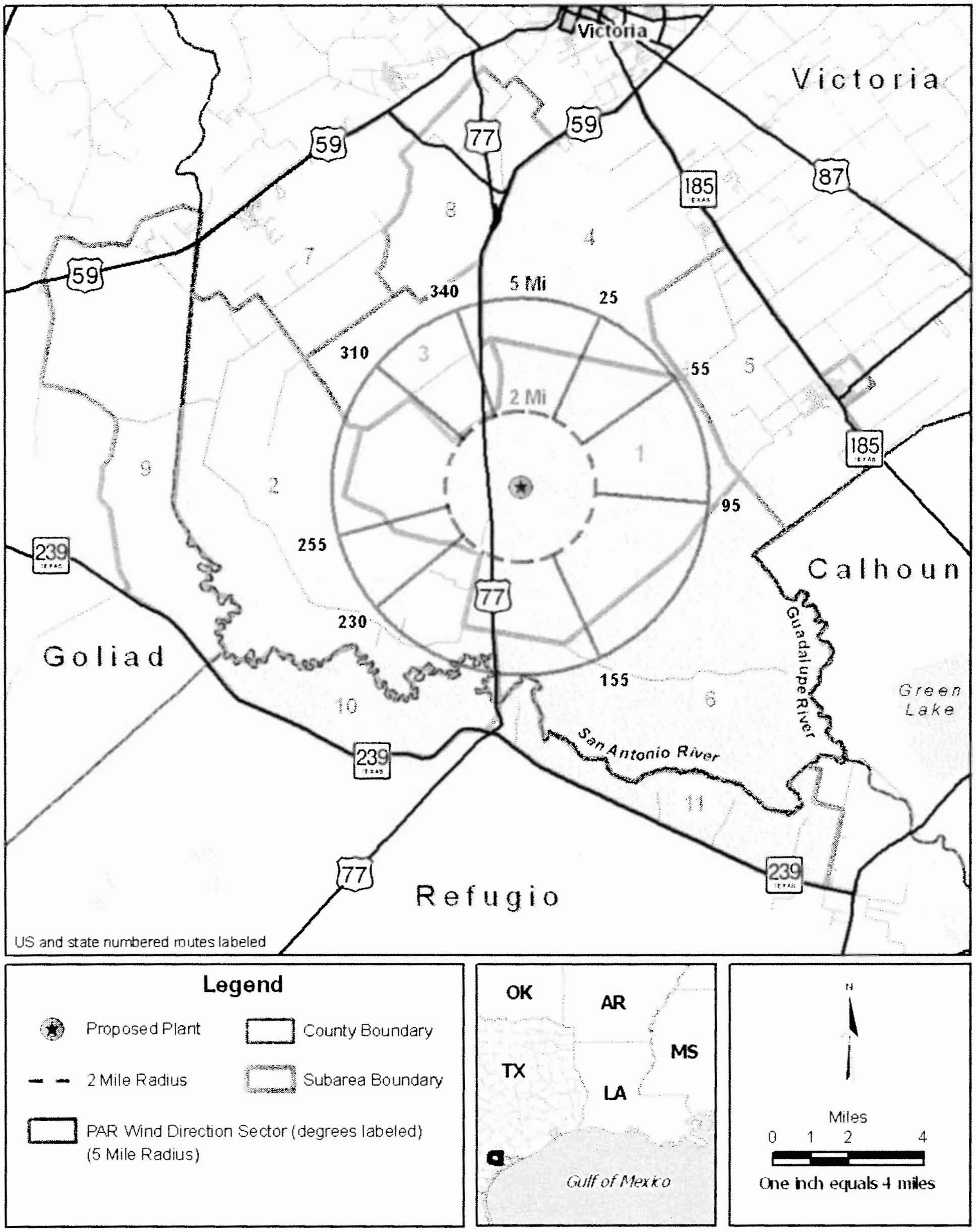

Figure 4: PAR Evacuation Area Sectors for 2-Mile Radius, 5 Miles Downwind

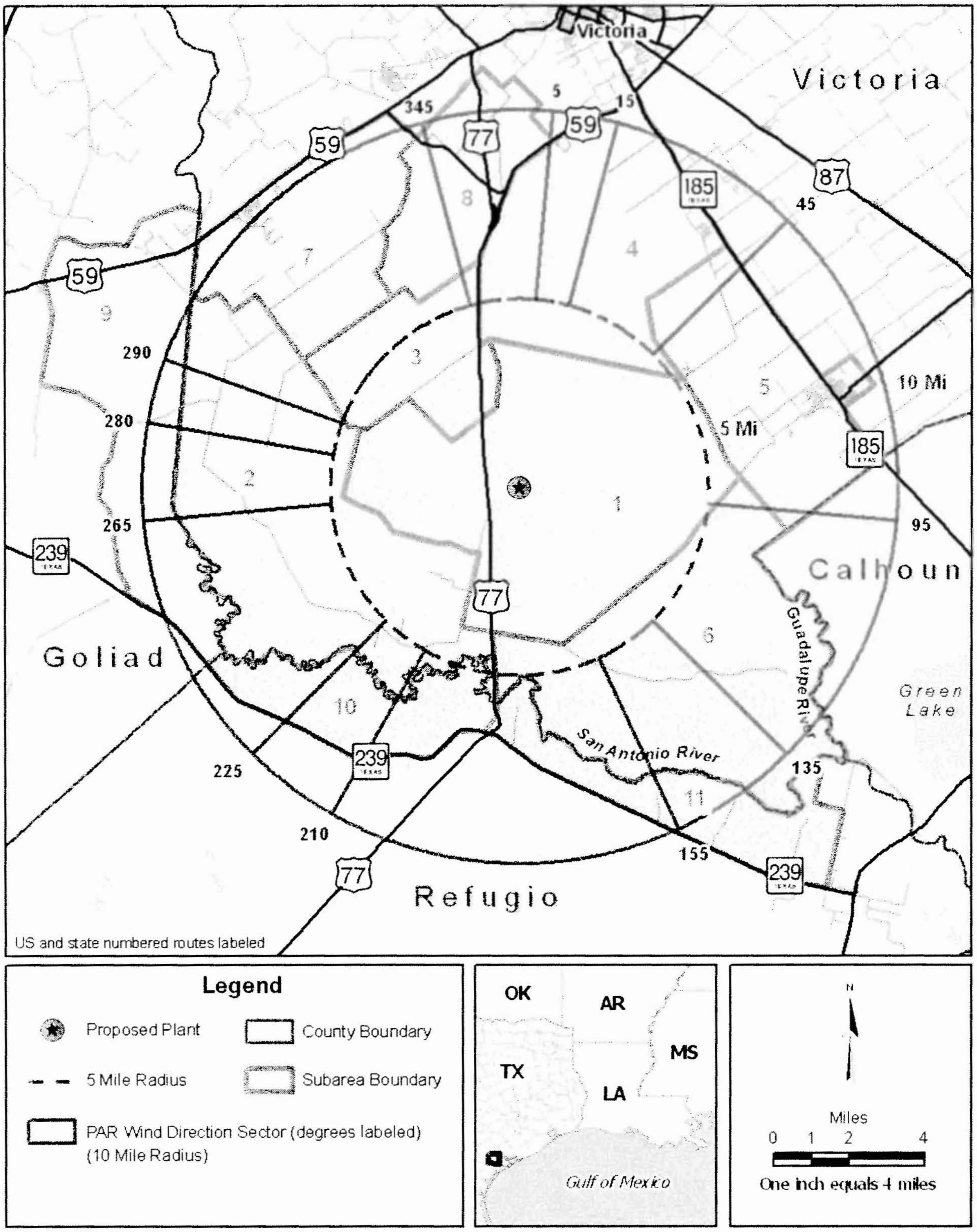

Figure 5: PAR Evacuation Area Sectors for 5-Mile Radius, 10 Miles Downwind

Table 3: Individual Subarea Evacuation Areas

Evacuation Area	Subareas
Subarea 1	1
Subarea 2	2
Subarea 3	3
Subarea 4	4
Subarea 5	5
Subarea 6	6
Subarea 7	7
Subarea 8	8
Subarea 9	9
Subarea 10	10
Subarea 11	11

2.0 ASSUMPTIONS AND METHODOLOGY

2.1. General Assumptions

IEM made the following general assumptions to model the population evacuation study:

- The ETEs include the times associated with warning diffusion, public mobilization, and travel time out of the EPZ.
- Following initial notification, all persons within the EPZ will evacuate. Evacuation of the EPZ will be considered complete after all evacuating vehicles are outside the EPZ.
- Existing lane utilization patterns will prevail during the course of the evacuation. Traffic control point (TCP) locations will be determined and recommended based on the results of the ETE analyses.
- Any non-auto-owning households will evacuate with neighbors, friends, and relatives, or they will be evacuated through coordinated efforts by State and county emergency management officials. For evacuation modeling purposes, it is assumed one vehicle will be made available to evacuate each household of this population segment. The telephone survey indicated very few households in the EPZ do not have vehicles.

- To model the evacuation during adverse weather conditions, speed limits are reduced by 40 percent and road capacities are reduced by 25 percent. This is consistent with research that concludes that during snow events, drivers may reduce their velocity by nearly 40 percent, which can result in a 25 percent to 30 percent reduction in capacity.[10] Also, while data on the impact of ice on roadway capacity is not readily available, it is typically assumed that ice will have a similar impact to snow on driver behavior.[11] Weather-related capacity reductions of 20 percent to 25 percent are generally used in current evacuation studies for bad weather roadway conditions.[12]
- NUREG/CR-6864, Volume 1, a study of past evacuations due to a variety of emergencies, found that "shadow evacuations (people evacuating outside of the designated evacuation area) had no significant impact on traffic or on the efficiency of the evacuation, in general".[13] Given this result, and because the VCS EPZ is sparsely populated and no major population centers exist just beyond the boundary of the EPZ, shadow evacuation was assumed to have a negligible impact on ETEs for this analysis.

2.2. Methodology

IEM used PTV Vision VISUM, a computer simulation model, to perform the ETEs for VCS.[14] PTV Vision is the leading software suite for transportation planning and operations analyses used in more than 70 countries. Detailed information on the evacuation time analysis methodology using PTV Vision is provided in Section 5.0.

2.3. Data Sources

The most up-to-date data sources were reviewed and analyzed to prepare appropriate input data for running the traffic simulation and providing the best ETEs. These data sources are explained below:

- Population estimates were based on first-quarter 2008 estimates obtained from Synergos Technologies and direct contact with individual facilities.[15]
- Evacuation routes and reception center locations were developed via coordination between IEM, Bechtel, and Exelon, and approved by local emergency management agency officials.
- Roadway geometric data was obtained from PTV. PTV data is based on high-quality, regularly updated NAVTEQ street network data. NAVTEQ networks are detailed and

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[10] National Research Council, Committee on Weather Research for Surface Transportation. *Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services:* Transportation Research Board (TRB), Board on Atmospheric Services. 2004.

[11] Han, L.D., Chin, S., Hwang, H. "Estimating Adverse Weather Impacts on Major US Highway Network." Transportation Research Board (TRB) Annual Meeting. 2003.

[12] Urbanik, T. E. and J. D. Jamison, *State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants* (NUREG/CR-4831; PNL-7776). Richland, WA: Pacific Northwest Laboratory, 1992. Page 5.

[13] USNRC. *Identification and Analysis of Factors Affecting Emergency Evacuations Emergency Evacuations*, Volume 1. NUREG/CR-6864. January 2005. Online: http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6864/v1/cr6864v1.pdf (last accessed November 29, 2007).

[14] PTV Vision can be found online at http://www.ptvamerica.com.

[15] Synergos Technologies, Inc. Online: http://www.synergos-tech.com.

include neighborhood streets in every community in North America. This data was validated by IEM during a "ground truthing" field trip in May 2008.

- The roadway capacities used in the evacuation model were based on estimates from PTV/NAVTEQ. These values were verified using field collected road attributes and capacity calculation methodology from the U.S. Federal Highway Administration.[16]
- A telephone survey was conducted to interview a sample of residents who live or work within the proposed EPZ to acquire information required for the ETE study, including local travel patterns, vehicle usage, household size, and mobilization time.

2.4. Scenarios Modeled

In accordance with NUREG-0654 guidelines, ETEs for each of the evacuation areas (see Section 1.3) have been prepared for several temporal and weather conditions. Estimates have been prepared for weekday normal and adverse weather conditions, weeknight normal and adverse weather conditions, and weekend normal and adverse weather conditions.

Normal weather refers to conditions where roads are dry and visibility is not impaired. Adverse weather refers to rainy conditions that cause the reduction of road capacities by 25 percent and travel speeds by 40 percent.[17]

Evacuation conditions are modeled on first quarter 2008 population estimates. The various population components for different scenarios are summarized below:

- **Weekday:** This situation represents a typical weekday period when the workforce is at a full daytime level. Assumptions on the population levels for this condition include the following:
  - Permanent residents within the EPZ will evacuate from their places of residence. Some households will wait for members to return from work before evacuating.
  - Workplaces are fully staffed at daytime levels.
  - Schools are in session.
  - Recreational activities, such as hunting and fishing, are at daytime levels.
  - The Diocese of Victoria Spiritual Renewal Center is closed.
- **Weeknight:** This situation reflects a typical nighttime period when the workforce is at a nighttime level. Assumptions on the population levels for this condition include the following:
  - Permanent residents within the EPZ will evacuate from their places of residence.
  - Workplaces are at nighttime levels.

[16] U.S. Federal Highway Administration. "Highway Performance Monitoring System Field Manual, Appendix N - Procedures for Estimating Highway Capacity." Online: http://www.fhwa.dot.gov/ohim/hpmsmanl/appn.htm.
[17] Urbanik, T. E. and J. D. Jamison, *State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants* (NUREG/CR-4831; PNL-7776), Richland, WA: Pacific Northwest Laboratory, 1992. Page 5.

- Schools are closed.
- There are no recreational (hunting and fishing) activities.
- The Diocese of Victoria Spiritual Renewal Center is closed.

- **Weekend:** The weekend situation represents a daytime period when recreational activities are at peak levels. This condition would most likely occur during any weekend day during the hunting season. Assumptions on the population levels for this condition include the following:
  - Permanent residents within the EPZ will evacuate from their places of residence.
  - Workplaces are at weekend levels.
  - Schools are closed.
  - Recreational activities, such as hunting and fishing, are at peak levels.
  - The Diocese of Victoria Spiritual Renewal Center is open.
- **Special:** The special situation represents an occurrence in which an event has happened at the proposed VCS Unit 1 at its operational state while VCS Unit 2 is still under construction. This condition would most likely occur during any weekday after 66 months of construction and the completion of the test operation for Unit 1. Assumptions on the population levels[18] for this condition include the following:
  - There is a construction workforce of 4,800 working at Unit 2.
  - There is an operation staff of 800 working at Unit 1.
  - Among the total 5,600 (4,800 at Unit 2 and 800 at Unit 1) workforce, 100 people are essential and will remain onsite. The other 5,500 will evacuate.
  - The evacuees from the plant will be split heading north and south on US-77.
  - Permanent residents within the EPZ will evacuate from their places of residence. Some households will wait for members to return from work before evacuating.
  - Workplaces are fully staffed at daytime levels.
  - Schools are in session.
  - Recreational activities, such as hunting and fishing, are at daytime levels.
  - The Diocese of Victoria Spiritual Renewal Center is closed.

3.0 POPULATION AND VEHICLE DEMAND ESTIMATION

IEM identified three population categories within the EPZ surrounding VCS, as specified in the NUREG-0654 guidelines. These populations include the permanent resident population, the transient population, and the special facilities population. The VCS EPZ is primarily a rural area with an industrialized region consisting of chemical plants northwest of the town of Bloomington. The majority of the population consists of

[18] Determined in consultation with Bechtel personnel.

permanent residents, workers, and a varying number of recreational visitors, mostly hunters.

Special facility populations may require additional consideration in the event of an evacuation. Special facilities populations in the VCS EPZ include major employers and one school. For the purpose of this study, only special facilities having 50 or more people are considered under the special facility category.

IEM derived the permanent population estimates from first-quarter 2008 population estimates supplied by Synergos Technologies, Inc.[19] Special facility data was obtained through contact with the individual facilities. The recreational visitors population figures were based on information obtained from Guadalupe Delta Wildlife Management Area—San Antonio River Unit. These population estimates formed the basis for determining the evacuee demand used in the analyses for any given evacuation scenario. The populations from these sources were assigned to each applicable subarea.

3.1. Permanent Residents

IEM used GIS software to process the geographic data and associated population counts for census blocks in each of the counties surrounding VCS. IEM then aggregated these populations over each subarea to generate a permanent resident population count that comprises the nighttime population.

To calculate population by subarea and radial sector, the census block population was aggregated for each of these types of areas. Since boundaries of sectors do not follow census block boundaries, many of the blocks had to be subdivided based on sector boundaries. To do this, IEM overlaid the census blocks with the subareas and 10-mile radius sectors. The blocks were then subdivided at sector boundaries, and each new block part was assigned a population based on an area ratio method. The populations of the block parts within the sector boundaries were then aggregated for each radius sector.

The area ratio method assigns each block part a portion of the original block population based on the ratio of the area of that block part to the area of the entire block. For example, if a particular block part contains one-fourth of the original block area, the block part receives one-fourth of the block's total population. Figure 6 illustrates this principle, in which one-fourth of the total area is located in the block part and it includes one-fourth of the population. The area ratio method assumes the population within the block is evenly distributed, a typical assumption in the absence of data describing the population locations within the block.

The populations of the block parts within the sector boundaries are then aggregated for each sector. This method is also used in any instance in which subarea boundaries do not follow block boundaries, making it necessary to split blocks along a particular subarea boundary.

[19] Synergos Technologies, Inc. Online: http://www.synergos-tech.com.

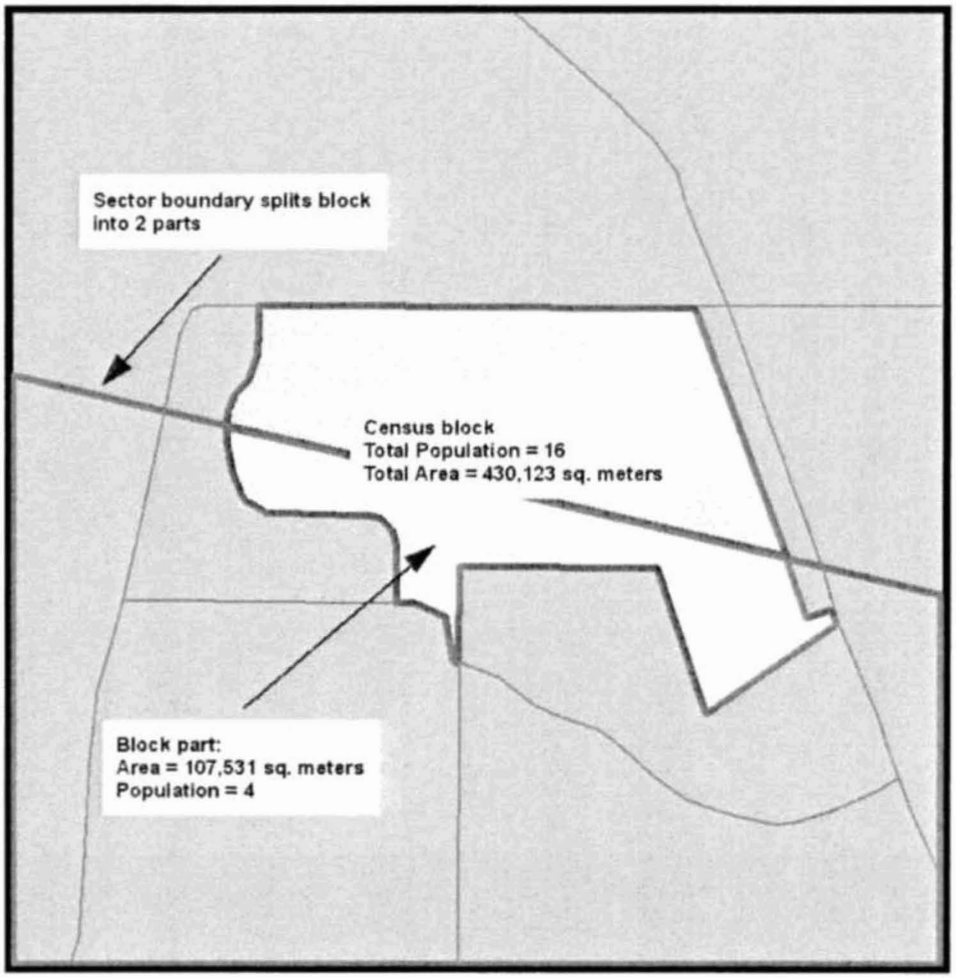

Figure 6: An Example of the Area Ratio Method Applied to a Census Block Divided into Parts by a Sector Boundary

3.1.1. Telephone Survey

A bilingual (English and Spanish) telephone survey was conducted to effectively quantify mobilization time and vehicle usage for residents responding to an evacuation advisory. The survey was conducted to interview a sample of residents who live within 10 miles of VCS to acquire the information required for the ETE study.

IEM secured the services of DataSource in San Marcos, Texas, to provide the database of telephone numbers to be used in the survey, conduct the telephone survey, and provide data to IEM for analysis. The calls were restricted to published, land-based telephone numbers; wireless carriers were not included. DataSource made calls in the early evening hours from Wednesday, May 21 to Thursday, May 29. Only residents 18 years of age and older were allowed to participate in the survey. All telephone calls were made during weekday evenings or on weekends, in an attempt to reach households with both workers and non-workers. The survey was conducted in both English and Spanish. To ensure the highest quality of work was performed, a quality assurance plan was implemented in this survey process that included call-taker training, telephone monitoring by IEM, and extensive data quality control checks. Exelon issued a special press release in local newspapers in advance of the telephone survey to help increase the survey compliance rate.

The survey required around 600 completed surveys in order to achieve a margin of error of 4 percentage points or less. However, there were not enough telephone listings (landlines) available in the databases used by DataSource to attain this sample size. Several efforts were made to get a more comprehensive listing. In an attempt to check the completeness of the telephone database used, IEM contacted other telephone data providers around the country, but the sample counts obtained from these providers were similar to what was available through DataSource. With the available telephone numbers, the survey effort produced a total of 125 completed surveys.

3.1.2. Permanent Resident Population

The telephone survey found an average household size of 2.82 persons in the VCS EPZ. No households without automobiles were identified by the survey, indicating the vast majority of households in the EPZ own at least one vehicle. Table 4 shows the distribution of the 2008 total permanent resident population by sector and ring, while Figure 7 presents the same data graphically.

Table 4: 2008 Permanent Resident Population Distributions by Sector and Ring

Sector[20]	Ring[21]	Permanent Resident Population
N	2	1
N	5	11
N	10	265
NNW	2	1
NNW	5	26
NNW	10	352
NW	2	3
NW	5	21
NW	10	1314
WNW	2	4
WNW	5	14
WNW	10	378
W	2	3
W	5	13
W	10	26
WSW	2	1
WSW	5	9
WSW	10	13
SW	2	0
SW	5	8
SW	10	14
SSW	2	0
SSW	5	6
SSW	10	27

[20] There are 48 sectors, each measured 22.5°. Sectors of 22.5°are designated by compass direction going outward from the plant on the centerline of the sector (e.g., the sector from 348.75° to 11.25° is designated "N" for north). The remaining sectors are designated NNW, NW, WNW, W, WSW, SW, SSW, S, etc.

[21] Rings are defined as the area between two circles of radius 0 and 2 miles, 2 and 5 miles, and 5 and 10 miles.

Table 4: 2008 Permanent Resident Population Distribution by Sector and Ring (continued)

Sector[22]	Ring[23]	Permanent Resident Population
S	2	0
S	5	0
S	10	19
SSE	2	0
SSE	5	32
SSE	10	57
SE	2	0
SE	5	4
SE	10	27
ESE	2	0
ESE	5	0
ESE	10	0
E	2	0
E	5	1
E	10	24
ENE	2	0
ENE	5	4
ENE	10	3217
NE	2	0
NE	5	7
NE	10	419
NNE	2	0
NNE	5	7
NNE	10	107

[22] There are 48 sectors, each measured 22.5°. Sectors of 22.5°are designated by compass direction going outward from the plant on the centerline of the sector (e.g., the sector from 348.75° to 11.25° is designated "N" for north). The remaining sectors are designated NNW, NW, WNW, W, WSW, SW, SSW, S, etc.
[23] Rings are defined as the area between two circles of radius 0 and 2 miles, 2 and 5 miles, and 5 and 10 miles.

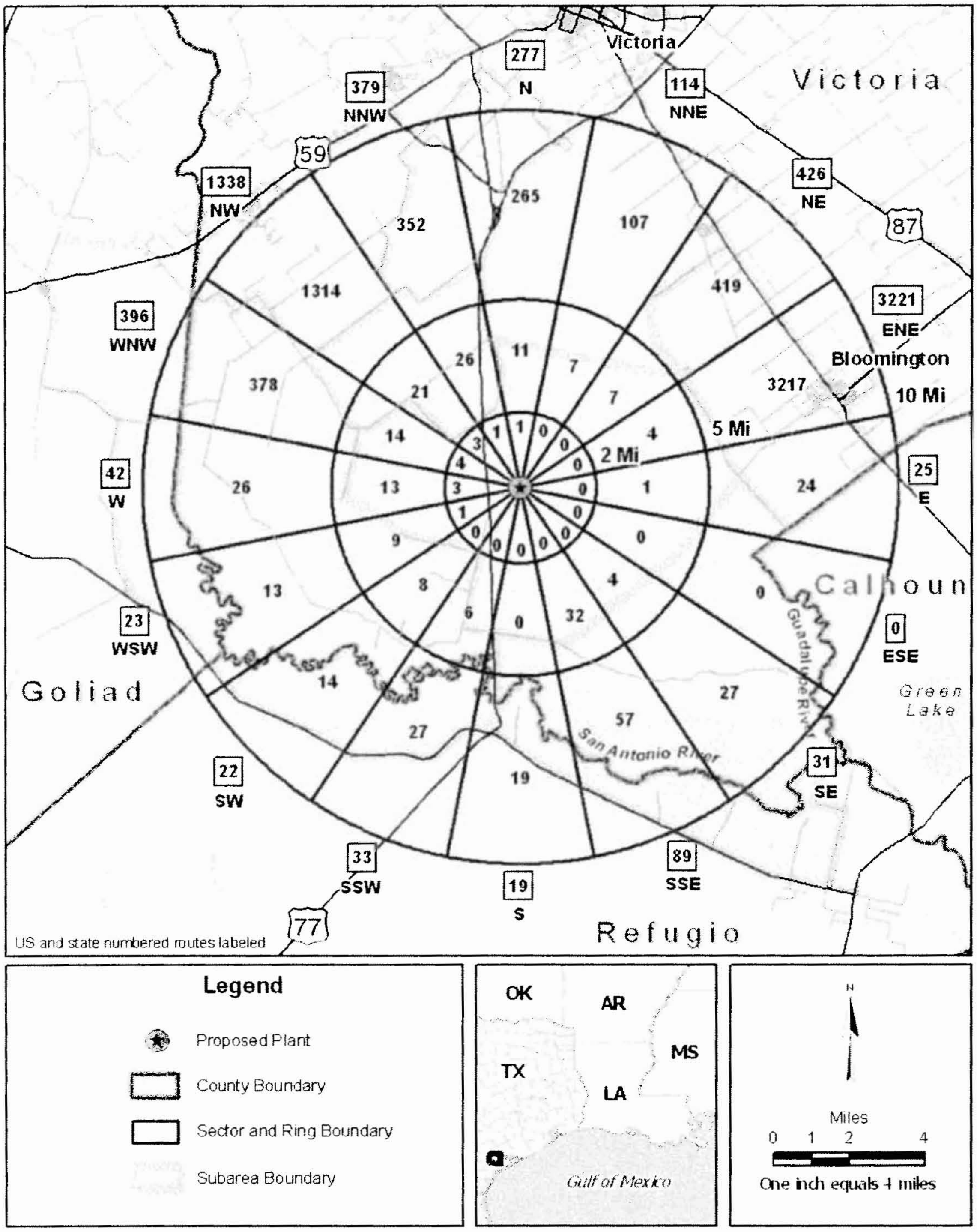

Figure 7: 2008 VCS Sector and Ring Permanent Resident Population Map

Table 5 shows the distribution of the permanent resident population by subarea. Figure 8 presents this data graphically.

Table 5: 2008 Permanent Resident Population Distributions by Subarea

Subarea	Permanent Resident Population
1	59
2	139
3	197
4	546
5	3,251
6	53
7	1,360
8	328
9	395
10	23
11	84

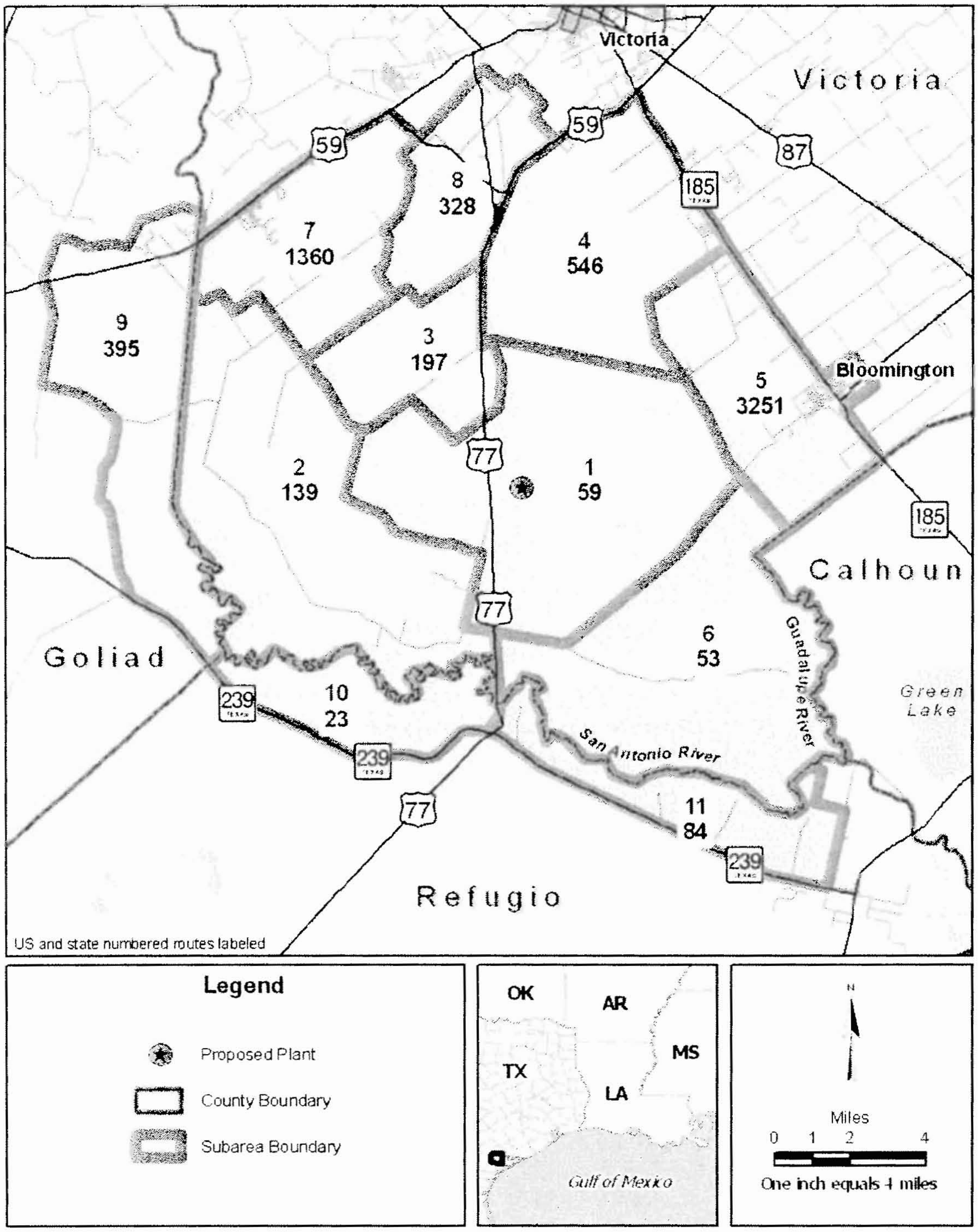

Figure 8: 2008 VCS Subarea Permanent Resident Populations Map

3.2. Transient Populations

The transient population for the VCS EPZ area is derived from recreation populations and employment data. The total transient population in the EPZ is 1,311. The employment data was taken from first-quarter 2008 estimates from Synergos Technologies, Inc.[24] The recreational population shown for VCS is composed of hunters and fishermen in the San Antonio and Guadalupe Rivers and their tributaries. Through conversations with staff from the San Antonio River Unit of the Guadalupe Delta Wildlife Management Area, IEM estimated there will be approximately 125 hunters/boaters throughout the EPZ on weekdays during the hunting season and approximately 500 hunters/boaters on peak weekends. IEM also attempted to contact Saxet Lakes Park for information on the recreational population using the park. The facility did not respond and was not included in the evacuation model.

Table 6 shows the distribution of the transient population by sector and ring, while Figure 9 presents the same data graphically.[25]

Table 6: Transient Population Distribution by Sector and Ring

Sector	Ring	Transient Population
N	2	1
N	5	12
N	10	150
NNW	2	1
NNW	5	12
NNW	10	123
NW	2	1
NW	5	7
NW	10	234
WNW	2	1
WNW	5	6
WNW	10	140
W	2	1
W	5	7
W	10	33
WSW	2	1
WSW	5	6
WSW	10	26

[24] Synergos Technologies, Inc. Online: http://www.synergos-tech.com.
[25] Transient figures shown in this and subsequent tables and figures represent the sum of peak figures for employment and recreational populations.

Table 6: Transient Population Distribution by Sector and Ring (continued)

Sector	Ring	Transient Population
SW	2	1
SW	5	6
SW	10	28
SSW	2	1
SSW	5	6
SSW	10	20
S	2	1
S	5	6
S	10	16
SSE	2	1
SSE	5	22
SSE	10	43
SE	2	1
SE	5	8
SE	10	48
ESE	2	1
ESE	5	5
ESE	10	11
E	2	1
E	5	4
E	10	10
ENE	2	1
ENE	5	6
ENE	10	96
NE	2	1
NE	5	8
NE	10	118
NNE	2	1
NNE	5	10
NNE	10	68

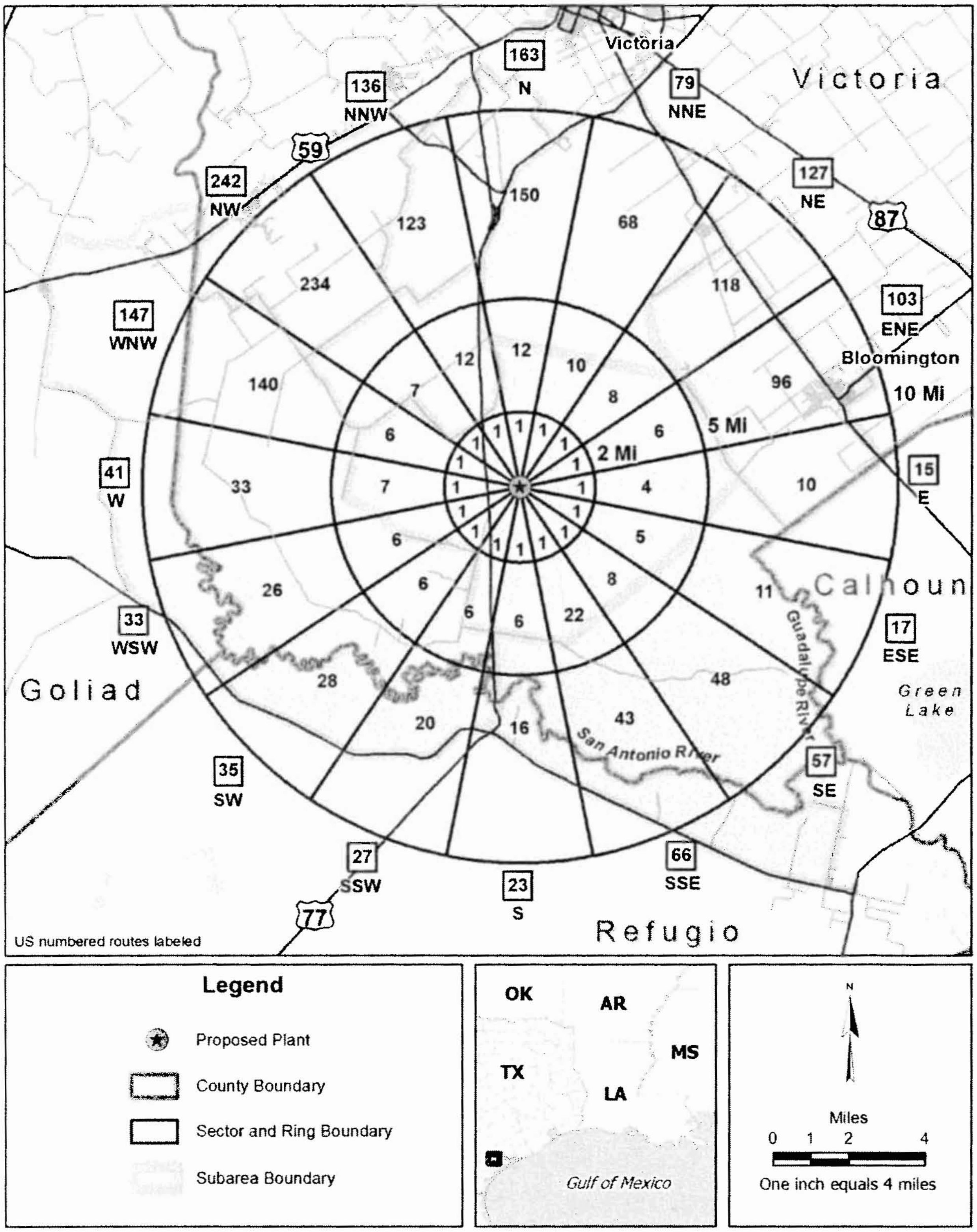

Figure 9: VCS Sector and Ring Transient Populations Map

Table 7 shows the distribution of the transient population by subarea. Figure 10 presents this data graphically.

Table 7: Transient Population Distribution by Subarea

Subarea	Transient Population
1	65
2	81
3	43
4	226
5	116
6	91
7	252
8	167
9	175
10	40
11	55

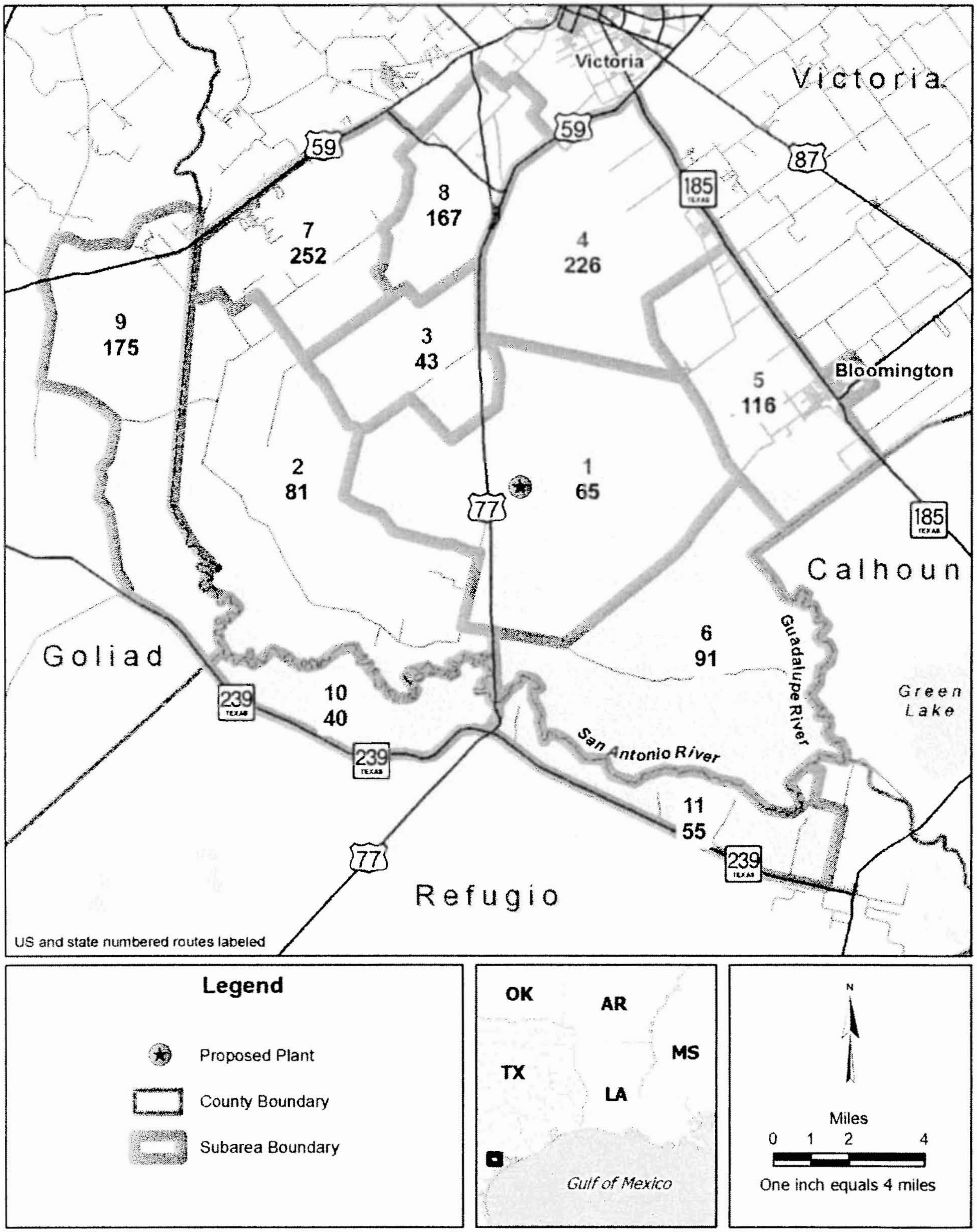

Figure 10: VCS Subarea Transient Population Map

3.3. Special Facility Populations

IEM has identified several special facilities[26] within the EPZ, including the following:

- 1 school
- 1 religious retreat center
- Proposed Victoria County Station

Table 8 shows the peak evacuation population for the special facilities, identified by IEM with help from Bechtel personnel, within the EPZ. Figure 11 shows the locations of the facilities in the table.[27]

Table 8: Peak Population for Special Facilities

Facility Name	Facility Type	Subarea	Peak Population
Bloomington Elementary School	School	5	395
Diocese of Victoria Spiritual Renewal Center	Religious Center	2	100
Victoria County Station	Nuclear Plant	1	5,500

[26] The term "special facilities" in this document generally refers to facilities with a peak population greater than 50. IEM also contacted several facilities that are not listed above and were not included in the evacuation analysis because they had a peak population under 50.

[27] Workers for the major employers in the EPZ, including ConAgra International Fertilizer, DuPont, Equistar Chemicals, Invista S.A.R.L., and Valerus Compression Services, have been accomodated as part of the daytime employment population.

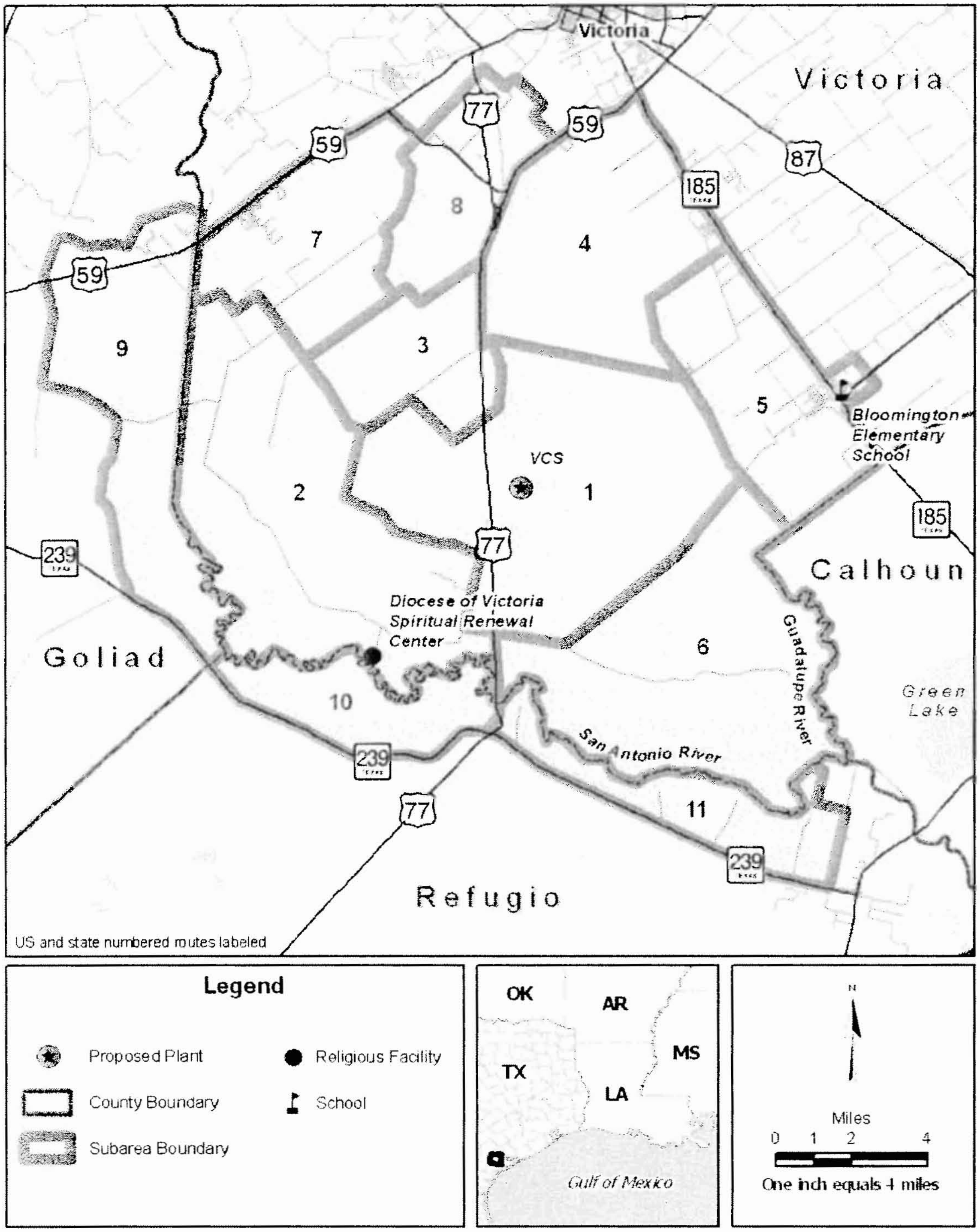

Figure 11: Map of Special Facilities within the VCS EPZ

3.4. Vehicle Occupancy Rates

Vehicle occupancy rates (VORs), which represent the average number of people traveling in each vehicle, are used to convert population to the number of vehicles in the evacuation model. Different VORs were used for the various population categories. Because the behavior of permanent residents differed for day, night, and weekend scenarios, separate VORs were estimated for each. Each household was assumed to evacuate using one vehicle during the day (not including workers' vehicles), while responses to the telephone survey showed households would use an average of 1.51 vehicles to evacuate at night or on weekends. Dividing the average household size of 2.82 by these vehicles per household figures yielded permanent resident VORs of 2.82 during the day and 1.87 at night and on weekends. The telephone survey results were also used to calculate VORs of 1.18 and 2.67 for workers and recreational populations, respectively.

Vehicle occupancy rates of 30 students per bus and one teacher/staff per car were used for Bloomington Elementary School based on IEM experience in past ETE studies. This is a conservative figure that accounts for items that evacuees may try to bring with them on a bus. Personnel at Bloomington Elementary School were contacted about the availability of buses and indicated that the Bloomington Independent School District had at least 14 buses available to support an evacuation.

A VOR of one for the Diocese of Victoria Spiritual Renewal Center was obtained via communication with the director of the facility. The VOR for the VCS was estimated with guidance from Bechtel personnel. Table 9 below summarizes the VORs used for the evacuation modeling for each population segment.

Table 9: Vehicle Occupancy Rates by Population Category

Population Category	Population Subtype		Vehicle Occupancy Rate
Permanent Residents	Permanent Residents		2.82 for day 1.87 for night/weekend
Transients	Workforce Transient		1.18
	Recreational Hunters and Fishers		2.67
Special Facilities	Victoria County Station		1
	Diocese of Victoria Spiritual Renewal Center		1
	Bloomington Elementary School	Student	30
		Staff	1

The permanent resident vehicle occupancy rates were applied to the population figures described in Table 5 to obtain the permanent resident vehicle totals shown in Table 10.

Table 10: Permanent Resident Vehicles by Subarea and Scenario

	All Vehicles		
Subarea	Day	Night	Weekend
1	21	31	31
2	49	74	74
3	70	105	105
4	193	292	292
5	1,151	1,736	1,736
6	19	28	28
7	482	726	726
8	116	175	175
9	140	211	211
10	8	12	12
11	30	45	45
Total	**2,278**	**3,436**	**3,436**

4.0 THE EVACUATION ROADWAY NETWORK

4.1. Evacuation Route Descriptions

The evacuation network modeled for the ETE analyses covers portions of Victoria, Goliad, and Refugio counties. The evacuation routes were developed by IEM and approved by designated local emergency management agency officials. The evacuation route network is composed of three types of roads: highways, major arterial roads (roads connecting to highways), and minor arterial or connector roads (residential roads connecting to major arterial roads).

U. S. Highway 77 (US-77) is an example of a highway in the EPZ. Examples of major arterial roads include State Road 239 (SR-239) and SW Moody Street. An example of the connector roads is Commercial Street, located within the city of Bloomington. The connector roads, although not part of the evacuation routes, actually load the evacuee population onto the evacuation routes. Evacuation route attributes, such as speed limits and the number of lanes, are described in detail in Appendix B.

Evacuation routes lead to one of two designated reception centers, which were identified by Exelon personnel in coordination with local stakeholders. Table 11 lists the designated reception centers and their associated subareas, based on evacuation network characteristics.

Table 11: Reception Centers

Reception Center	Address	Sub-Area
Victoria Community Center	2905 E North St Victoria, TX 77901	1, 2, 3, 4, 5, 7, 8, 9
Refugio County Fairgrounds	Fairgrounds Rd Refugio, TX 78377	1, 2, 6, 9, 10, 11

Evacuees north and east of VCS generally evacuate to the Victoria Community Center in Victoria County, whereas evacuees south and west of VCS generally evacuate to the Refugio County Fairgrounds. This routing scheme has been adopted to ensure evacuation occurs in a radial fashion, away from the site, subject to the availability of evacuation routes. This scheme may require some evacuees to drive longer distances, but it allows for better overall protection from the event that triggers the evacuation. The evacuation routes for each subarea are described below and displayed in Figure 12.

Subarea 1 (Victoria County)

- Option 1: If located north of VCS, travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.
- Option 2: If located south of VCS, go south on US-77 to the Refugio County Fairgrounds.

Subarea 2 (Victoria County)

- Option 1: Go south on Warburton Road to San Antonia River Road, east on San Antonia River Road to US-77 and then proceed south to the Refugio County Fairgrounds.
- Option 2: Travel northwest on San Antonia River Road to Bayou Road. Go west on Bayou Road to Duke Bridge Road. From there, take the shortest route to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.
- Option 3: Take shortest route to Cologne Road and then go northwest on Cologne Road to US-59. Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.

Subarea 3 (Victoria County)

- Take Kemper City Road, and/or Fleming Prairie Road to US-77. Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 4 (Victoria County)

- Option 1: Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

- Option 2: Go northwest on TX-185 to the Victoria Community Center.

Subarea 5 (Victoria County)

- Option 1: Take Farm to Market Road 1686 (FM-1686), McCoy Road, Key Road, or Farm to Market Road 616 (FM-616) to US-87 and then proceed northwest to the Victoria Community Center.
- Option 2: Go northwest on TX-185 to the Victoria Community Center.

Subarea 6 (Victoria County)

- Go west on McFaddin Road to US-77 and then proceed south to the Refugio County Fairgrounds.

Subarea 7 (Victoria County)

- Option 1: Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 2: Take Farm to Market Road 446 (FM-446) to SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 3: Take Fleming Prairie Road to US-77. Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 8 (Victoria County)

- Option 1: Take US-77, US-59 S, or Farm to Market Road 446 (FM-446) to SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 2: Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 9 (Goliad County)

- Option 1: Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 2: Travel west on US-59 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.
- Option 3: Go northwest on TX-239 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.

Subarea 10 (Refugio County)

- Option 1: Travel east on TX-239 to US-77 and then proceed south to the Refugio County Fairgrounds.
- Option 2: Travel west on TX-239 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.

Subarea 11 (Refugio County)

- Go east on TX-239 to TX-35, south on TX-35 to TX-774, and then proceed southwest to the Refugio County Fairgrounds.

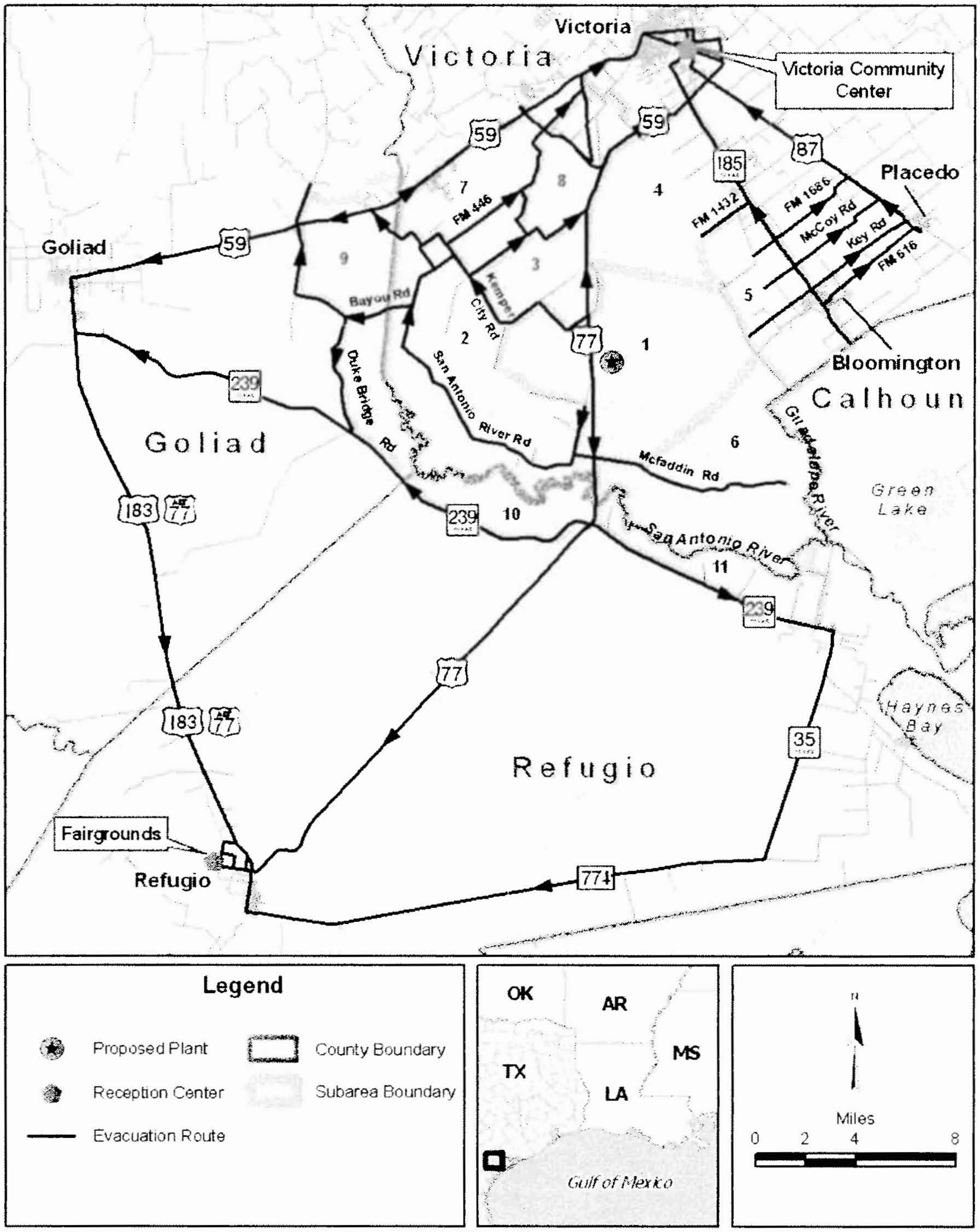

Figure 12: Evacuation Map and Routes

4.2. Evacuation Network Characteristics

A GIS file of the evacuation network was developed using road network data from NAVTEQ as a basis.[28] The high accuracy NAVTEQ street network GIS data, obtained for the PTV Vision simulation software, was used for field validation purposes and to build the digital evacuation network database. To ensure the accuracy of this data, the entire evacuation network, including those roads outside the 10-mile EPZ leading to the reception centers, was verified by traveling each route in the network in the direction of evacuation and collecting detailed information regarding the properties of each road section using a global positioning system (GPS)-enabled device. The GPS device allowed the location of any sections that had changed in curvature, speed limits, or other necessary network information to be determined with a high degree of precision.

The specific network attributes collected during the field trip included the number of lanes, speed, turns, traffic controls, pavement type and width, shoulder width, and any other information required to model the traffic capacity of each link in the network. Any differences between the NAVTEQ data and existing field conditions were noted and, where necessary, were incorporated into the analyses.

The highways generally have a posted speed limit of 50 to 60 mph. The major and minor arterial or connector roads generally have a posted speed limit of 40 to 50 mph. On some of the roads, especially the highways, the posted speed limit decreases to 25 to 35 mph near city limit boundaries. Unpaved roads or dirt roads have randomly posted speed limits, so a speed limit of 35 mph was assumed for modeling purposes based on comfortable and safe driving speeds achieved by IEM personnel on these roads during field verification. Most of the links in the evacuation network (including some highways) generally have one lane available in the direction of evacuation. There are no interstates within the 10-mile EPZ. The U.S. highways, as well as some state highways, have two lanes available in the direction of evacuation.

5.0 EVACUATION TIME ESTIMATE METHODOLOGY

ETE studies are performed using VISUM, one of the core components of the PTV Vision software suite. VISUM is a macroscopic transportation modeling software with the capability to do dynamic assignment (i.e., assignment and vehicle flow over time). Vehicular demand in the VISUM model was composed of a series of origin-destination (O-D) matrices, an evacuation traffic network, and a traffic assignment procedure. In the traffic network, both the link and turn movement capacities were calculated following the Highway Capacity Manual 2000 methodology using data collected from NAVTEQ, aerial imagery, and the field trip, including the number of lanes, speed limits, intersection control types, and conflicting volumes at intersection approaches. After the O-D matrices and evacuation network were input into VISUM, the dynamic user equilibrium (DUE) traffic assignment procedure was implemented to allocate vehicular demand onto appropriate routes in the traffic network for each time step. The DUE algorithm

[28] PTV America, Inc. "NAVTEQ Data for PTV VISION." Online: http://www.ptvamerica.com/navteq_tiles/index.html (last accessed December 13, 2007).

iteratively calculated the traffic volumes and associated delays on competing routes using the Akçelik volume-delay function (VDF) to assure that the travel times for alternative routes are close to each other (i.e. equilibrium loading). The Akçelik VDF was selected because it provides more accurate delay estimates than other commonly used functions, such as the Bureau of Public Roads (BPR) function, particularly for oversaturated conditions.[29]

IEM selected the DUE traffic assignment method because it allows equilibrium loading of evacuation demand onto the road network for each time step and outputs the traffic volumes on each link for each time step. This allows an analysis of vehicle flow along the evacuation routes and across the EPZ boundary over time, as well as the investigation and reporting of queuing and congestion. While VISUM has the functionality to model transit trips, no transit was modeled in this ETE study because no transit is expected to operate in the study area during the evacuation.

Estimates of people and vehicles loaded onto the network are based on the data and methods described in Section 3.0. The development of the evacuation network and collection of road network data is detailed in Section 4.0. This section details the methodology adopted to develop ETEs based on the evacuation network and population data. Key assumptions that have a substantial impact on the ETE results are also included in the following subsections.

5.1. Loading of the Evacuation Network

In the event of an emergency, the public notification will mark the beginning of the evacuation times. So, public behavior (how long it takes the population to learn of the emergency and begin to evacuate) will impact the ETEs. The loading time distributions, also known as "trip generation times," described in this section are measured from the public notification, rather than from the occurrence of a hypothetical event.

5.1.1. Trip Generation Events and Activities

NUREG-0654 requires planners estimate the amount of time for the public to begin evacuating. These elapsed times are represented as statistical distributions to reflect the variety of activities the public may undertake before evacuating. In addition, separate distributions are prepared for each population group, because, for example, a person evacuating from home will behave differently than someone who is at work, fishing, or in a nursing home, This is due to differences in their available alert systems and also systematic differences in their pre-evacuation preparations.

Evacuation Events and Activities Series for Different Population Groups

[29] Singh, R. and Dowling, R. "Improved Speed-Flow Relationships: Application to Transportation Planning Models." *Proceedings of the Seventh TRB Conference on the Application of Transportation Planning Methods*. Page 341. March 1999.

The trip generation process consists of a series of events and activities. Each event occurs at an instant in time and is the outcome of an activity. Activities are undertaken over a period of time. As shown in Figure 13 through Figure 15, different population groups have different events and activity series for evacuation.

In Figure 13 through Figure 15, circles represent events. Each event is coded by a number, which represents the following:

1. First notification of public
2. Individual's awareness of incident
3. Leave work/facilities
4. Arrive home
5. Leave home

An arrow indicates an activity. The following describe the activities that take place between each event:

- 1 → 2: Receive notification
- 2 → 3: Prepare to leave work/facilities
- 3 → 4: Travel home
- 2 → 5: Prepare to leave home

Transient evacuees, including travelers, boaters, hunters, and employees living outside the EPZ, will follow Series A as shown in Figure 13. They will be notified of the event and will leave their activities.

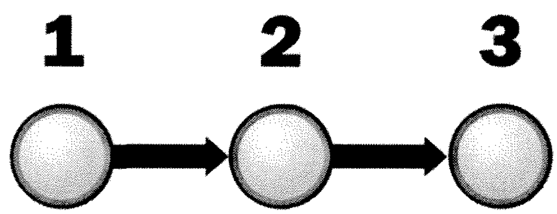

Figure 13: Evacuation Events and Activity Series for Transients, Special Facilities (Series A)

Households that do not have to wait for household members to return home will be notified of the emergency and leave home, following Series B, shown in Figure 14.

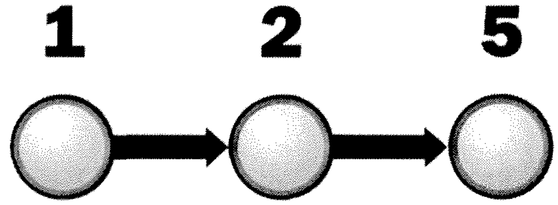

Figure 14: Evacuation Events and Activity Series for Residences without Family Members Returning Home (Series B)

The results of a phone survey suggest around 48 percent of residences have regular commuters who would wait for household members to return home before evacuating. This portion of the population will follow series C in Figure 15 to evacuate. Note the activities of the people at home (denoted with a subscript H) can be undertaken in parallel with those of the commuter (denoted with a subscript C). Specifically, an adult member of a household can prepare to leave home while others are traveling home from work. In this instance, the household members would be able to evacuate sooner than a household that prepares to leave home after all members have returned home.

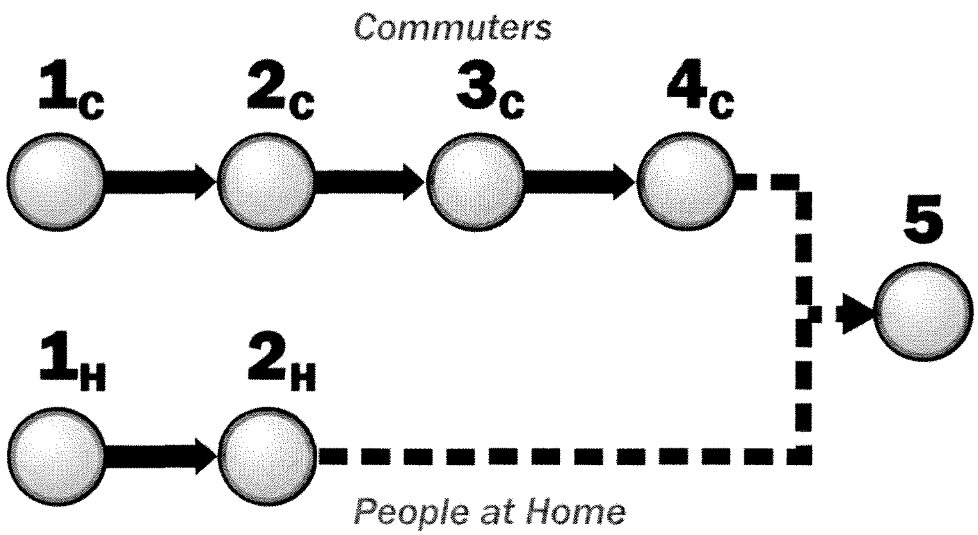

Figure 15: Evacuation Events and Activity Series for Residences with Family Members Returning Home (Series C)

Calculation of Composite Distribution for Events and Activities Series in Evacuation

As indicated by NUREG-0654, activities may be in sequence (i.e., an activity will be undertaken upon completion of a preceding event) or may be in parallel (i.e., two or more activities may take place over the same period of time). Given the assumption the time distribution of each activity is independent, the combined trip generation time required for individual activities undertaken in sequence would be the sum of the times required for each activity. On the other hand, the combined trip generation time required for individual activities undertaken in parallel would be the maximum of the times required for each activity. Table 12 shows the approach for estimating trip generation for different evacuation activity series.

Table 12: Trip Generation Estimate for Different Evacuation Activity Series

Trip Generation Series	Composite Distribution Calculation
A	{1→2 + 2→3}
B	{1→2 + 2→5}
C	Max: {(1_C→2_C + 2_C→3_C + 3_C→4_C), (1_H→2_H + 2_H→5)}

5.1.2. Trip Generation Time Estimate

Trip generation consists of two phases of activities: notification (i.e., activity 1 → 2) and mobilization, which includes the rest of the activities. The notification process includes transmitting information and receiving and correctly interpreting the information that is transmitted. IEM adopted the time distribution for notification presented in *Evaluating Protective Actions for Chemical Agent Emergencies* (ORNL-6615).[30] This data was collected during evacuations executed in response to large-scale chemical spills and explicitly incorporates the time required for the communication of the warning. The data collected in this meta-study was based on transient, permanent, and special populations and is therefore appropriate to use as "general" notification curves for all three population types.

The underlying assumption in applying the ORNL-6615 notification curves to a nuclear ETE study is the public perception of radiological emergencies is similar to that of a chemical event. These curves were developed from the empirical data collected from real-life evacuations in response to actual events, and no similar study developed specifically for radiological events is readily available. In the absence of such a study, empirical data from similar events was deemed to be more justifiable than estimating or hypothesizing about the public response to a nuclear event. IEM has successfully used this data for multiple ETE studies in the past, both for nuclear and chemical incidents or accident scenarios.

Since the ORNL-6615 notification distribution of times depends on the warning system employed, IEM personnel incorporated the planned alert and notification systems (ANS) around the site, based on discussions with Exelon personnel. These discussions revealed the basic ANS within the VCS EPZ will include sirens and Emergency Alert Systems (EAS).

Hunters, boaters, and park visitors were expected to be notified by local emergency officials patrolling the forest, river, or park with loud speakers. These officials, in turn, were expected to be notified of the emergency via EAS. This process was incorporated into the model by adding 45 minutes to the ORNL-6615 notification time distribution for EAS.

The notification time distributions for these warning systems are shown in Figure 16. Any loss in capability of the ANS components would potentially increase the notification times and, as a result, ETEs.

[30] Rogers, G. O., et al., *Evaluating Protective Actions for Chemical Agent Emergencies* (ORNL-6615), Oak Ridge, TN: Oak Ridge National Laboratory, 1990.

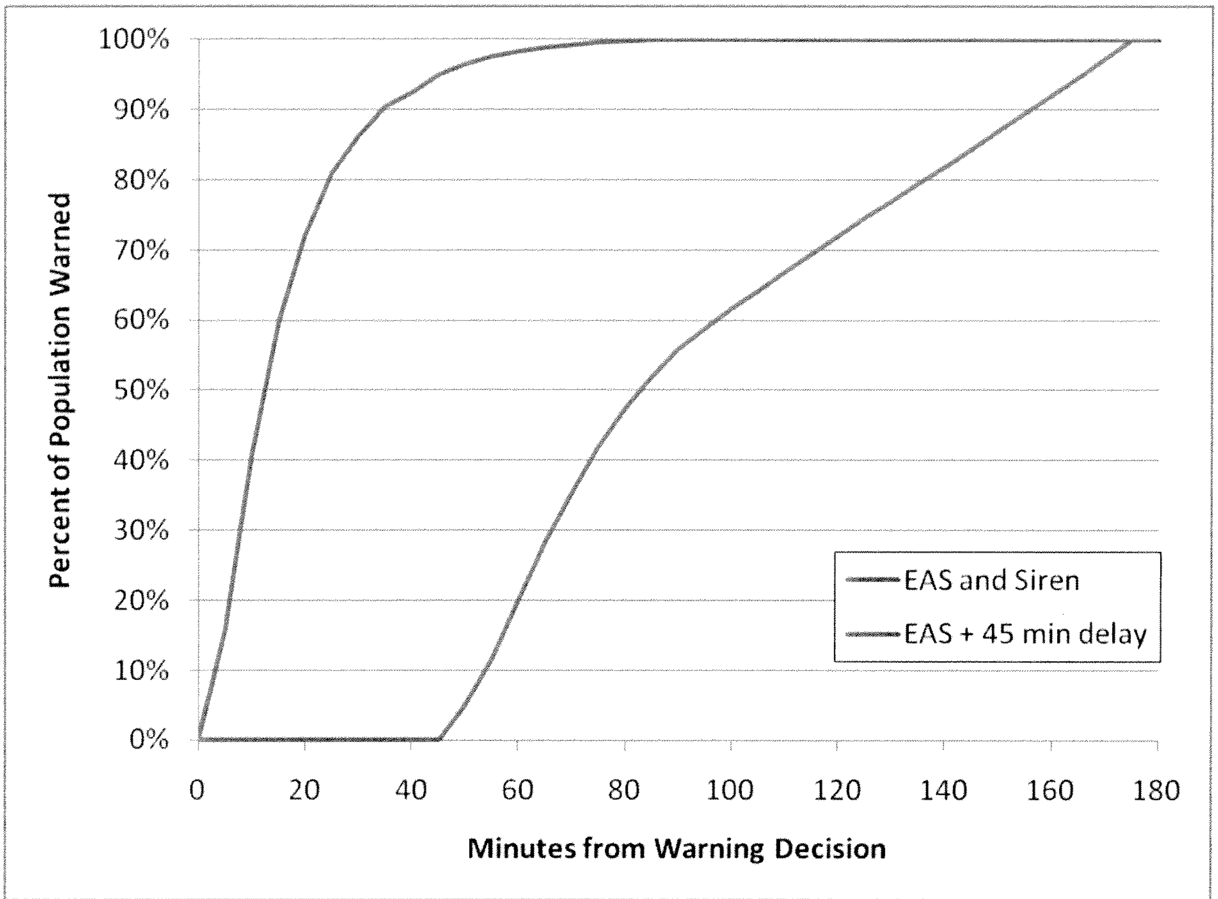

Figure 16: Notification Times for Selected Alert and Notification Systems[31]

Generally, the information required to estimate the second phase of trip generation, the mobilization process, was obtained from a telephone survey of EPZ residents. See Appendix C for details about the survey and its raw data.

Figure 17 and Figure 18 present mobilization time distribution for different activities obtained from the telephone survey. The points in the figures represent the raw data from the survey and the lines represent the smoothed cumulative distribution function obtained by applying polynomial regression to the raw data points.

[31] *Ibid.*

Mobilization times will vary from one individual to the next depending on where they are, what they are doing, and related factors. Furthermore, some persons, including commuters, shoppers, and other travelers, will return home to join the other members of their households for evacuation upon receiving notification of an emergency. Therefore, the time elapsed for those people to travel home should be considered as part of the mobilization time before evacuation can begin.

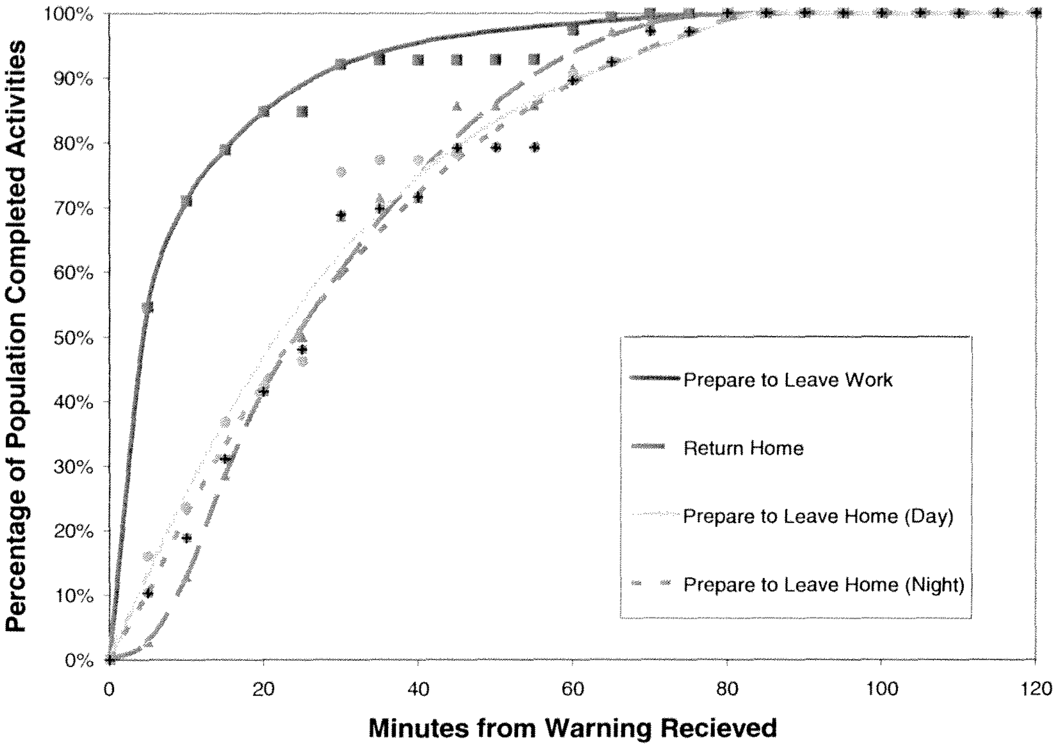

Figure 17: Non-Recreational Population Mobilization Time for Different Activities

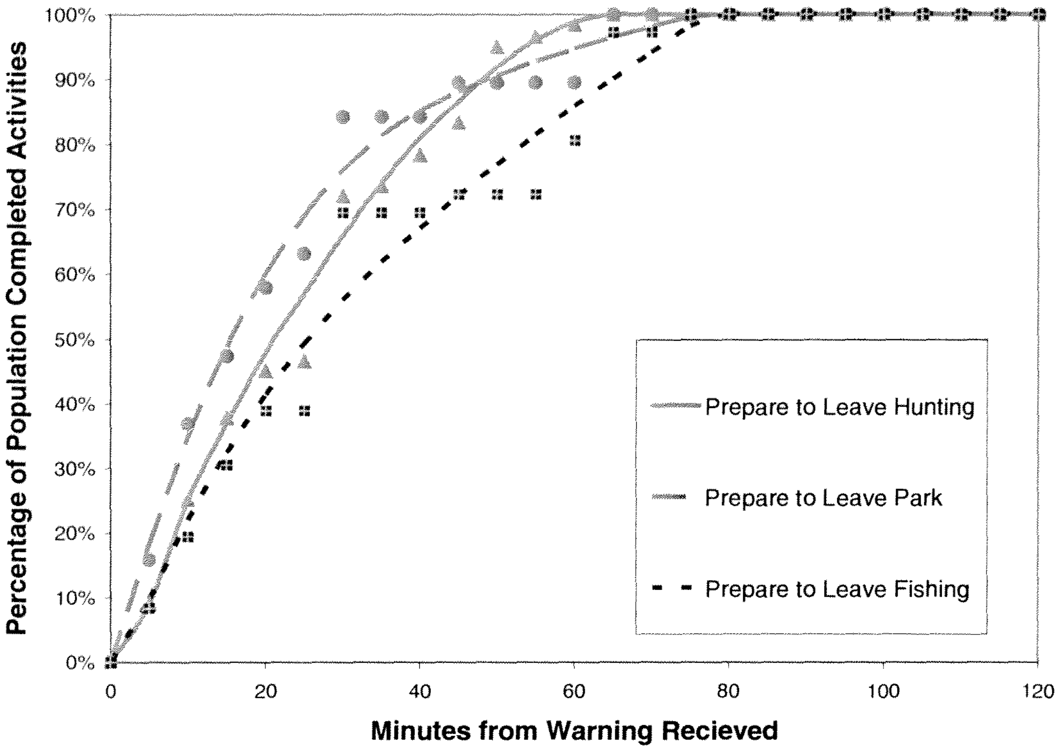

Figure 18: Recreational Population Mobilization Time for Different Activities

Figure 19 presents the distribution of trip generation times (i.e., the combination of notification and mobilization times) for different population groups. These curves were obtained by applying the methodology described in Table 12 to the activities of each population group.

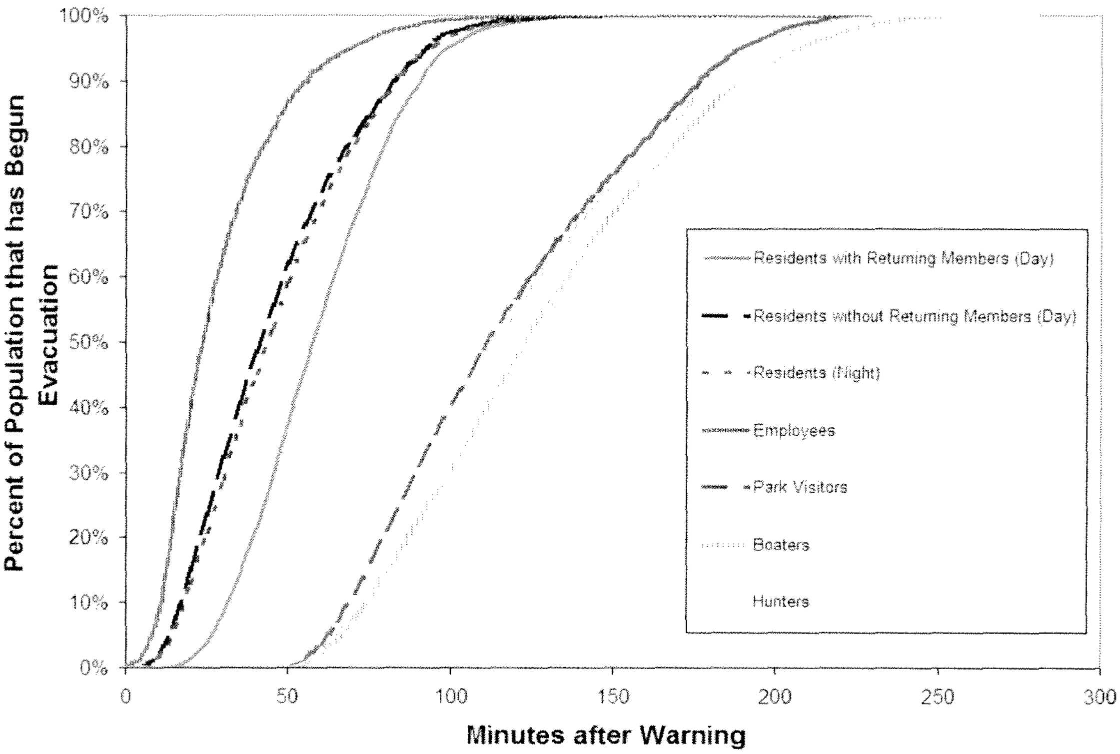

Figure 19: Distribution of Trip Generation Times by Population Group

5.1.3. Trip Generation Times for Special Facilities

As described in Section 3.3, the special facilities within the VCS EPZ include the Bloomington Elementary School, Victoria Spiritual Retreat Center, and the proposed Victoria County Station. Table 13 shows the assumptions for determining trip generation times for the population segments associated with these facilities. The trip generation times for special facilities in each category were determined by consulting with relevant personnel at the facilities.

Sirens will be the warning system available to the Victoria Spiritual Retreat Center, though the population at this facility is expected to evacuate in a group in the event of an emergency. According to Figure 3.4 of ORNL-6615,[32] the probability of a population being warned by sirens reaches 50% approximately 15 minutes following the warning decision, so 15 minutes was used as the warning time for the Victoria Spiritual Retreat Center. This was combined with an estimated 25 minutes for mobilization to create a loading time for the center's vehicles of 40 minutes.

Table 13: Trip Generation Time for Population in Special Facilities

Facility Category	Facility Name	Assumptions	Trip Generation Time
School Students	Bloomington Elementary School	Student will evacuate in 40 minutes.	40 minutes
School Staff	Bloomington Elementary School	Staff will not leave until students have evacuated.	Trip generation time for students (40 minutes) plus 5 minutes
Chapel	Victoria Spiritual Retreat Center	People will be warned by siren. People will leave using personal vehicles.	40 minutes
Nuclear Plant	Victoria County Station	Personnel will evacuate in a similar manner to employees in the rest of the EPZ	Trip generation time for employees (as shown in Figure 19)

[32] *Ibid.*

5.2. Evacuation Simulation

Evacuations were simulated using the population and vehicle demand data, evacuation network data, and loading distribution data discussed in the previous sections. VISUM was used to simulate evacuations. Figure 20 describes the framework of the analysis and three of its main features: the demand model, the network model, and the impact model.

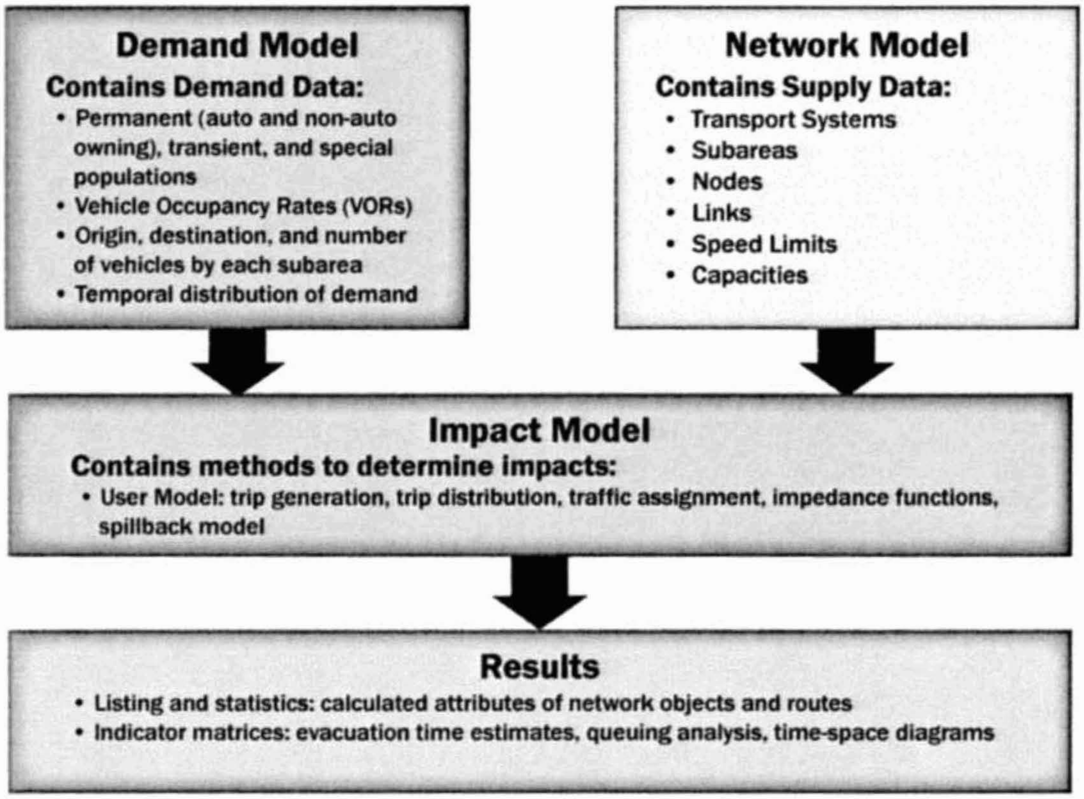

Figure 20: ETEs Analysis Framework Using VISUM

5.2.1. The Demand Model

The demand model contains the travel demand data. The total number of vehicles originating from a subarea is calculated by dividing a population by its expected vehicle occupancy rate. The total number of vehicles originating from a subarea is then distributed to different time intervals based on the loading distribution curve for the subarea. The loading distribution curve for the subarea depends on the warning system available for that subarea. The travel demand is described by an origin-destination (OD) matrix. The OD matrix refers to a time interval and the total number of vehicles departing in that time interval.

5.2.2. The Network Model

The network model describes the relevant supply data of an evacuation network. The supply data consists of subareas, nodes, links, speed limits, and capacities. The subareas describe areas with particular boundaries based on demography, topography, land characteristics, access routes, and local jurisdictions. They represent the origin and destination of trips within the evacuation network. Nodes define positions of intersections in the evacuation network. Links connect nodes and, therefore, describe the road infrastructure. Every network object is described by its attributes (e.g., speed limits and capacities for the links). The travel time of a vehicle on a given link depends on the permitted speed and the capacity (i.e., the traffic volume a road can handle before the formation of a traffic jam) of the link. The roadway capacities used in the evacuation analysis were based on estimates from PTV/NAVTEQ. These values were verified using field collected road attributes and capacity calculation methodology from the U.S. Federal Highway Administration.[33]

5.2.3. The Impact Model

The impact model takes its input data from the demand model and the network model. PTV Vision provides different impact models to analyze and evaluate the evacuation network. A user model simulates the behavior of travelers. It calculates traffic volumes and service indicators, such as travel time. The VISUM traffic assignment procedure chosen for this analysis simulates the movement of vehicles on the network as time passes in the evacuation and outputs volumes for each link at each time after analyzing the queuing behavior. This time-dynamic functionality allows for loading of the network via distributions, as when using a range of mobilization times.

The ETE is measured by noting when the last car passes the boundary of the EPZ. VISUM displays the calculated results in graphic and tabular forms and allows graphical analysis of results. In this way, for example, routes per OD pair, traffic flow, and isochrones can be displayed and analyzed.

6.0 ANALYSIS OF EVACUATION TIMES

Evacuation times were estimated in order to give emergency planners in the area as well as the proposed VCS personnel an approximate time required for evacuation of various parts of the footprint. The estimates were derived by using population (demand) data to determine the number of vehicles and then by modeling the travel of the vehicles along the evacuation routes from their origin to their assigned reception center. The evacuation time estimate is the time between public notification and when the last evacuating vehicle exits the EPZ.

[33] U.S. Federal Highway Administration. "Highway Performance Monitoring System Field Manual, Appendix N - Procedures for Estimating Highway Capacity." Online: http://www.fhwa.dot.gov/ohim/hpmsmanl/appn.htm.

The ETEs are composed of two components. The first is loading (or "trip generation") time, which is the time required for residents within the area to prepare and then begin their evacuation. Loading times depend, in part, on how long it takes residents to receive the warning and is, thus, dependent on the warning systems in their area. The trip generation times estimated for the VCS EPZ are described in detail in Section 5.1. The second component of an ETE is travel time, which is the time between the resident's departure and when they cross the EPZ boundary. The travel time is determined via the evacuation model.

As a part of the analysis, subareas in the study area were grouped to represent the different areas that might need to be evacuated during an emergency so decision makers could more effectively order evacuations based on the scenarios and potential wind direction. These areas are discussed in more detail in Section 1.3.

Each subarea has been assigned a set of evacuation routes, developed by IEM in coordination with Exelon, Bechtel, and designated local emergency management agency officials. The route restrictions were then reflected in the modeling of the scenarios. The routing guidance generally routes evacuees to evacuate in a radial manner away from VCS, subjected to the availabilities of roadway networks. The evacuation routes are described in more detail in Section 4.1.

6.1. Summary of ETE Results

The evacuation time estimate results are displayed and discussed in Sections 6.2, 6.3, 6.4, and 6.5. Evacuation times listed include warning diffusion, public mobilization, and travel time out of the EPZ. They do not include the travel time from the EPZ boundary to the reception centers. It is also important to note the evacuation time is the time from the moment public notification begins and not at the start time of an event. The analysis of ETEs revealed the following general trends:

- The ETEs, in either normal or adverse weather, are driven more by the planned alert and notification systems rather than by the roadway capacities, because vehicular demand is low compared to the available roadway capacities. While some congestion was observed in the network, it was minor enough that the last vehicles to exit the EPZ did not have to wait in queuing before reaching the EPZ boundary.
- Adverse weather conditions have little impact on the ETEs with an increase of 0 to 10 minutes due primarily to reduced travel speeds.
- For each evacuation area, the weekend scenario produced the highest evacuation times. This is due to the increased amount of recreational transients in the area (e.g., hunters, boaters, and park visitors) on the weekend. This population has a higher trip generation time than other populations and therefore takes longer to begin evacuating.

6.2. ETEs for NUREG-0654 Evacuation Areas

The evacuation time estimate for the NUREG-0654 evacuation areas are displayed in Table 14.

Table 14: ETEs in Minutes for NUREG-0654 Evacuation Areas

Evacuation Area	Subareas Impacted	Normal Weather			Adverse Weather		
		Weekday	Weeknight	Weekend	Weekday	Weeknight	Weekend
0-2 Miles, Full	1	125	125	185	125	130	190
0-5 Miles, Full	1, 2, 3, 4, 6	210	155	245	215	160	250
0-10 Miles, 90° NE	1, 4, 5	165	150	230	170	150	235
0-10 Miles, 90° SE	1, 6, 11	150	130	225	150	130	225
0-10 Miles, 90° SW	1, 2, 9, 10	165	140	235	170	145	235
0-10 Miles, 90° NW	1, 2, 3, 7, 8, 9	175	165	235	180	165	235
0-10 Miles, 180° N	1, 2, 3, 4, 5, 7, 8, 9	210	165	245	210	165	245
0-10 Miles, 180° E	1, 4, 5, 6, 8, 11	195	155	240	200	155	245
0-10 Miles, 180° S	1, 2, 5, 6, 9, 10, 11	205	150	240	210	155	245
0-10 Miles, 180° W	1, 2, 3, 4, 6, 7, 8, 9, 10, 11	215	165	250	220	165	250
0-10 Miles, Full EPZ	All Subareas	220	165	250	220	165	250

Table 15: ETEs in Minutes for Bloomington Elementary School

Evacuation Area	Weekday, Normal Weather	Weekday, Adverse Weather
0-2 Miles, Full	60	65
0-10 Miles, 90° NE	60	65
0-10 Miles, 180° N	60	65
0-10 Miles, 180° E	60	65
0-10 Miles, 180° S	60	65
0-10 Miles, Full EPZ	60	65

6.2.1. Evacuation Area 1: 0 to 2 Miles

The majority of the population within the two-mile radius (Subarea 1) consists of a small number of permanent residents and transient employees. The loading time for this population was small due to the combined warning system of sirens and EAS. Depending on their location relative to VCS, this population will evacuate using the high capacity highway, US-77, to travel to either the north or south reception center. The evacuation times for this evacuation area range from 2 hours 5 minutes to 3 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning diffusion times and are not influenced by significant congestion.

6.2.2. Evacuation Area 2: 0 to 5 Miles

This evacuation area includes all population in subareas 1, 2, 3, 4, and 6. This population includes permanent residents, transient employees, and recreational fishers and hunters. During an emergency, evacuees will proceed north to the reception center at the Victoria Community Center or south to the reception center at the Refugio County Fairgrounds. The evacuation times range from 2 hour 35 minutes to 4 hours 10 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven by the time required for population notification and mobilization and are not influenced by significant congestion.

6.2.3. Evacuation Area 3: 0 to 10 Miles, 90° NE

This evacuation area includes all population in the 0 to 10 miles 90° northeastern area (consisting of subareas 1, 4, and 5). This population includes permanent residents, transient employees, and recreational fishers and hunters. This area also includes Bloomington Elementary School in Victoria County. The evacuation times ranged from 2 hours 30 minutes to 3 hours 55 minutes. The highest evacuation times are for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the evacuation times are mainly driven by notification and mobilization times. The congestion points are presented and discussed in Section 8.0.

6.2.4. Evacuation Area 4: 0 to 10 Miles, 90° SE

This evacuation area includes all population in the 0 to 10 miles 90° southeastern area (consisting of subareas 1, 6, and 11). This population includes permanent residents, transient employees, and recreational fishermen and hunters. The evacuation times ranged from 2 hours 10 minutes to 3 hours 45 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times and are not influenced by significant congestion.

6.2.5. Evacuation Area 5: 0 to 10 Miles, 90° SW

This evacuation area includes all population in the 0 to 10 miles 90° southwestern area (consisting of subareas 1, 2, 9, and 10). This population includes permanent residents, transient employees, and recreational fishers and hunters. The evacuation times ranged from 2 hours 20 minutes to 3 hours 55 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times. No significant congestion occurred in this scenario.

6.2.6. Evacuation Area 6: 0 to 10 Miles, 90° NW

This evacuation area includes all population in the 0 to 10 miles 90° northwestern area (consisting of subareas 1, 2, 3, 7, 8, and 9). This population includes permanent residents, transient employees, and recreational fishers and hunters. The evacuation times ranged from 2 hours 45 minutes to 3 hours 55 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times and are not influenced by significant congestion.

6.2.7. Evacuation Area 7: 0 to 10 Miles, 180° N

This area includes each of the 10-mile subareas north of VCS (consisting of subareas 1, 2, 3, 4, 5, 7, 8, and 9). The evacuation times ranged from 2 hours 45 minutes to 4 hours 5 minutes. These times are higher than the evacuation times for the 0 to10 miles 90° NE and 0 to 10 miles 90° NW scenarios because the shared use of some evacuation routes produced additional congestion. For each scenario, the evacuation time for the 0 to 10 miles 180° N was 0 to 35 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° NW scenarios.

6.2.8. Evacuation Area 8: 0 to 10 Miles, 180° E

This area includes each of the 10-mile subareas east of VCS (consisting of subareas 1, 4, 5, 6, 8, and 11). The evacuation times ranged from 2 hours 35 minutes to 4 hours 5 minutes. These times are higher than the evacuation times for the 0 to 10 miles 90° NE and 0 to 10 miles 90° SE scenarios because the shared use of some evacuation routes and additional evacuees from subarea 8 produced additional congestion. For each scenario, the evacuation time for this area was 0 to 30 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° SE scenarios.

6.2.9. Evacuation Area 9: 0 to 10 Miles, 180° S

This area includes each of the 10-mile subareas south of VCS (consisting of subareas 1, 2, 5, 6, 9, 10, and 11). The evacuation times ranged from 2 hours 30 minutes to 4 hours 5 minutes. These times are higher than the evacuation times for the 0 to10 miles 90° SE and 0 to 10 miles 90° SW scenarios because the shared use of some evacuation routes and additional evacuees from subarea 5 produced additional congestion. For each scenario, the evacuation time for the 0 to 10 miles 180° N was 0 to 40 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° NW scenarios.

6.2.10. Evacuation Area 10: 0 to 10 Miles, 180° W

This area includes each of the 10-mile subareas west of VCS (consisting of subareas 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11). The evacuation times ranged from 2 hours 45 minutes to 4 hours 10 minutes. These times are higher than the evacuation times for the 0 to 10 miles 90° NW and 0 to 10 miles 90° SW scenarios, because the shared use of some evacuation routes and additional evacuees from subarea 4, 6, and 11 produced additional congestion. For each scenario, the evacuation time for this area was 0 to 40 minutes higher than the highest time for the 0 to 10 miles 90° NW and 0 to 10 miles 90° SW scenarios.

6.2.11. Evacuation Area 11: 0 to 10 Miles, Full EPZ

The evacuation times for the entire 10-mile EPZ ranged from 2 hours 45 minutes to 4 hours 10 minutes. These times were driven by warning times and not influenced by significant congestion. For all scenarios, the 10-mile radius evacuation times were 0 to 5 minutes longer than the highest 180° sector evacuation time. No significant congestion occurred in this scenario.

6.3. ETEs for PAR Evacuation Areas

The evacuation time estimate for the protective action recommendation (PAR) evacuation areas are displayed in Table 16.

Table 16: ETEs in Minutes for PAR Evacuation Areas

Evacuation Area		Subareas Impacted	Normal Weather			Adverse Weather		
Distance	Wind Direction[34]		Weekday	Weeknight	Weekend	Weekday	Weeknight	Weekend
2-mile Radius, 5 miles Downwind	340°-24°	1, 3, 4	165	150	230	170	150	230
	25°-54°	1, 4	160	145	230	160	145	230
	55°-94°	1, 4, 6	180	145	240	180	145	240
	95°-154°	1, 6	150	130	225	150	130	225
	155°-229°	1, 2, 6	175	145	240	180	145	240
	230°-254°	1, 2	155	140	230	160	145	230
	255°-309°	1, 2, 3	165	150	230	170	150	235
	310°-339°	1, 2, 3, 4	190	155	240	195	155	245
5-mile Radius, 10 miles Downwind	345°-4°	1, 2, 3, 4, 6, 7, 8	215	160	245	215	165	250
	5°-14°	1, 2, 3, 4, 5, 6, 7, 8	215	165	245	220	165	250
	15°-44°	1, 2, 3, 4, 5, 6, 8	215	160	245	215	160	250
	45°-94°	1, 2, 3, 4, 5, 6	215	160	245	215	160	250
	95°-134°	1, 2, 3, 4, 5, 6, 11	215	160	245	215	160	250
	135°-154°	1, 2, 3, 4, 6, 11	210	155	245	215	160	250
	155°-209°	1, 2, 3, 4, 6, 10, 11	215	155	245	215	160	250
	210°-224°	1, 2, 3, 4, 6, 9, 10, 11	215	155	245	215	160	250
	225°-264°	1, 2, 3, 4, 6, 9, 10	215	155	245	215	160	250
	265°-279°	1, 2, 3, 4, 6, 7, 9, 10	215	160	250	220	165	250
	280°-289°	1, 2, 3, 4, 6, 7, 9	215	160	245	215	165	250
	290°-344°	1, 2, 3, 4, 6, 7, 8, 9	215	160	245	215	165	250

[34] Wind direction is the direction (in degrees) toward which the wind is blowing (000° or 360° represents a wind from north to south).

6.3.1. Evacuation Area 1: 2-mile Radius and 5 miles downwind with 340° to 24° Wind Direction

The evacuation times for this evacuation area range from 2 hours 30 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.2. Evacuation Area 2: 2-mile Radius and 5 miles downwind with 25° to 54° Wind Direction

The evacuation times for this evacuation area range from 2 hours 25 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.3. Evacuation Area 3: 2-mile Radius and 5 miles downwind with 55° to 94° Wind Direction

The evacuation times for this evacuation area range from 2 hours 25 minutes to 4 hours and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.4. Evacuation Area 4: 2-mile Radius and 5 miles downwind with 95° to 154° Wind Direction

The evacuation times for this evacuation area range from 2 hours 10 minutes to 3 hours 45 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.5. Evacuation Area 5: 2-mile Radius and 5 miles downwind with 155° to 229° Wind Direction

The evacuation times for this evacuation area range from 2 hours 25 minutes to 4 hours and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.6. Evacuation Area 6: 2-mile Radius and 5 miles downwind with 230° to 254° Wind Direction

The evacuation times for this evacuation area range from 2 hours 20 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.7. Evacuation Area 7: 2-mile Radius and 5 miles downwind with 255°to 309° Wind Direction

The evacuation times for this evacuation area range from 2 hours 30 minutes to 3 hours 55 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.8. Evacuation Area 8: 2-mile Radius and 5 miles downwind with 310°to 339° Wind Direction

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 5 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.9. Evacuation Area 9: 5-mile Radius and 10 miles downwind with 345°to 4° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.10. Evacuation Area 10: 5-mile Radius and 10 miles downwind with 5°to 14° Wind Direction

The evacuation times for this evacuation area range from 2 hours 45 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.11. Evacuation Area 11: 5-mile Radius and 10 miles downwind with 15°to 44° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.12. Evacuation Area 12: 5-mile Radius and 10 miles downwind with 45° to 94° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.13. Evacuation Area 13: 5-mile Radius and 10 miles downwind with 95° to 134° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.14. Evacuation Area 14: 5-mile Radius and 10 miles downwind with 135° to 154° Wind Direction

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.15. Evacuation Area 15: 5-mile Radius and 10 miles downwind with 155° to 209° Wind Direction

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.16. Evacuation Area 16: 5-mile Radius and 10 miles downwind with 210° to 224° Wind Direction

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.17. Evacuation Area 17: 5-mile Radius and 10 miles downwind with 225° to 264° Wind Direction

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.18. Evacuation Area 18: 5-mile Radius and 10 miles downwind with 265° to 279° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.19. Evacuation Area 19: 5-mile Radius and 10 miles downwind with 280° to 289° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.20. Evacuation Area 20: 5-mile Radius and 10 miles downwind with 290° to 344° Wind Direction

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.4. *ETEs for Individual Subareas*

Evacuation time estimates for the individual evacuation of each subarea, which were prepared at Exelon's request, are displayed in Table 17. ETEs for the subareas were prepared for the adverse weather weekend scenario, which was chosen to represent the "worst" case, because ETEs for this scenario were typically the longest for other evacuation areas. ETEs for the individual subareas ranged from 1 hour 20 minutes to 3 hours 40 minutes. These individual ETEs cannot be combined to produce ETEs for combinations of subareas because they do not account for interactions between evacuating vehicles from different subareas.

The ETEs are mainly driven by warning systems and free flow speeds rather than by roadway capacities, because vehicular demand is low compared to available roadway capacities. Since the recreational transient evacuees require higher trip generation time than other populations, the ETE for each subarea is greatly impacted by number of hunters, boaters, and park visitors.

Table 17: ETEs in Minutes for Individual Subareas

Subarea	Weekend with Adverse Weather
1	190
2	220
3	150
4	215
5	150
6	210
7	160
8	130
9	80
10	155
11	105

6.4.1. Subarea 1

The majority of the population in subarea 1 consists of a limited number of permanent residents and a few hunters and boaters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.2. Subarea 2

The majority of the population in subarea 2 consists of permanent residents and a few hunters. The Victoria Spiritual Renewal Center is also located within this subarea. The notification time for this facility will be longer, because people inside it may not be notified by media and have to rely on the siren to be warned during the weekend. The evacuation time for subarea 2 is among the highest of the individual subareas because this subarea has a relatively large number of recreational transients, who take longer to mobilize than other population segments in the EPZ. The ETE is not influenced by significant congestion.

6.4.3. Subarea 3

The majority of the population in subarea 3 consists of permanent residents and a small number of hunters. Because this subarea has less recreational transients, it is closer to the EPZ boundary, and its area is relatively small, the ETE of this area is shorter than that of subarea 1. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.4. Subarea 4

The majority of the population in subarea 4 consists of permanent residents and a few hunters and boaters. Subarea 4's ETE is among the highest of the individual subareas because it has a relatively large number of recreational transients, the slowest population to mobilize in the EPZ. The evacuation time is not influenced by significant congestion.

6.4.5. Subarea 5

The majority of the population in subarea 5 consists of a massive amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.6. Subarea 6

The majority of the population in subarea 6 consists of permanent residents and a few hunters and boaters. The evacuation time for subarea 6 is among the highest of the individual subareas because this subarea has a relatively large number of recreational transients, who take longer to mobilize than other population segments in the EPZ. The ETE is not influenced by significant congestion.

6.4.7. Subarea 7

The majority of the population in subarea 7 consists of a significant amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.8. Subarea 8

The majority of the population in subarea 8 consists of permanent residents and a small number of hunters. This subarea is close to the EPZ boundary. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.9. Subarea 9

The majority of the population in subarea 9 is outside the EPZ. There are only a small number of households residing within the EPZ. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.10. Subarea 10

The majority of the population in subarea 10 consists of a massive amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.11. Subarea 11

The majority of the population in subarea 11 is outside the EPZ. There are only a small number of households residing within the EPZ. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.5. ETE of the Special Scenario: Full EPZ with VCS Operations and Construction Personnel

The large construction and operation workforce at the VCS when Unit 1 is operational and Unit 2 is under construction creates a unique evacuation scenario should an event occur at Unit 1. The VCS is located in the heart of subarea 1 and is close to US-77. During an evacuation, the construction and operation personnel will split and evacuate to both the northern and southern reception centers to make full use of the roadway capacity. As shown in Table 18, ETEs are 6 hours 30 minutes and 6 hours 35 minutes for normal and adverse weather conditions, respectively. All evacuees proceeding to the northern and southern reception centers have to transfer from the high capacity US-77 highway to the low capacity local streets in the cities of Victoria and Refugio. Congestion will occur at those intersections, as the bottleneck for the network. Additionally, the large vehicular demand created in a short period will form queues in the network, which will take a long time to dissipate.

Table 18 : ETEs in Minutes for Special Scenario

Weather Condition	ETE
Normal	390
Adverse	390

7.0 CONFIRMATION OF EVACUATION

The confirmation of evacuation process determines if the evacuation has been completed. The time required for confirmation of evacuation is dependent upon the method employed. The most time-consuming method typically employed is to use ground vehicles. The time required involves the driving time for each route selected.

Informing people to leave some standard signs on their doors or windows, such as tying a white cloth to the front doorknob of the house or to the mailbox when they leave their homes would help authorities in the confirmation of evacuation. The presence of traffic control points (TCPs) at strategic locations within the evacuation network could provide real-time feedback regarding the progress of the evacuation process. All evacuees are encouraged to go to their designated county reception center. It is recommended that they register as they arrive. This procedure helps authorities to account for the population within the designated county. This can be counted as one of the means of confirmation of evacuation, only under the assumption all the evacuees would actually report to the reception centers and nowhere else. A similar method would be to monitor key evacuation routes using personnel or electronic equipment to determine whether the number of evacuating vehicles is consistent with high compliance rates.

Telephoning people at their homes could also be considered as a means of ensuring completion of evacuation; the time required to conduct such a survey is estimated below.

7.1. Time Estimate for Telephone Confirmation

For the VCS EPZ, which has approximately 2,120 households, IEM estimates that a phone survey would need to reach 325 households in order to obtain a 5.0 percent margin of error.[35] This estimate is conservative in that it assumes that no prior information is known about the expected proportion of evacuation compliance; if compliance is assumed to be roughly 75 percent, then the required survey size would be reduced to 254.

To estimate the time required to conduct a survey, IEM contacted CR Dynamics, a phone survey company. IEM assumed that the survey would be conducted by manually dialing numbers, since setting up an automated operation on short notice would be difficult. In this case, CR Dynamics estimated that approximately 20 dials could be completed per hour per person. Therefore, a survey of 325 households would take approximately 16 person hours to complete, or one hour if the calls were divided among 16 personnel.

As described in Section 3.1.1, only 125 phone surveys were completed for this ETE study, despite several attempts to obtain a larger sample size. Based on this experience, IEM recommends that offsite response organizations conduct outreach to EPZ residents to assemble a larger phone survey sample if they want to use telephone as a means of evacuation confirmation.

[35] Simple random sample methodology taken from: Scheaffer, Richard L., Mendenhall William, and Ott Lyman. "Elementary Survey Sampling 2nd Edition." Boston, MA: Duxbury Press, p. 45-49, 79. 1979.

8.0 CONCLUSION AND RECOMMENDATIONS

The ETEs developed for the 11 NUREG-0654 evacuation areas, 20 PAR evacuation areas, 11 individual subareas, and special scenario within the 10-mile VCS EPZ measured the time from the public notification to when the last evacuating vehicle exited the EPZ boundary.

ETEs for the NUREG-0654 evacuation areas ranged from 2 hours 5 minutes to 4 hours 10 minutes for the normal weather scenarios and from 2 hours 10 minutes to 4 hours 10 minutes for scenarios occurring in adverse weather. ETEs for the PAR evacuation areas ranged from 2 hours 10 minutes to 4 hours 10 minutes for the normal weather scenarios and from 2 hours 10 minutes to 4 hours 10 minutes for scenarios occurring in adverse weather. ETEs for the individual subareas, which were conducted for the adverse weather weekend scenarios, ranged from 1 hour 20 minutes to 3 hours 40 minutes. Variations in ETEs between scenarios generally correlated to differences in the number of evacuating vehicles, the capacity of the evacuation routes, the roadway conditions, and/or the distance from the origin subareas to the EPZ boundary. The weekend scenario produced the highest evacuation times due to the longer mobilization time for the higher number of recreational transients (hunters and fishers) in the area on the weekend. The evacuation times for the special scenario to evacuate construction and operation workforce from the VCS along with the full EPZ populations are 6 hours 30 minutes and 6 hours 35 minutes for normal and adverse weather conditions, respectively. The vast evacuation demand from the VCS caused excessive congestion at the bottleneck, which resulted in long ETEs. These congestion points are discussed in the following sections.

8.1. Congestion Points

The analysis shows that for most scenarios the capacity of the roadway network within the EPZ is sufficient to accommodate the evacuating vehicles with limited congestion. However, a few intersections, where two heavily-traveled evacuation routes converge, were identified from the model as possible congestion points. These points are listed in Table 19.

Table 19: Potential Congestion Points for Evacuation of the VCS EPZ

Operation Control	Inside EPZ	Description
Victoria County	Yes	Access Road to VCS and US-77[36]
Victoria County	No	Anthony Road and US-59[36]
Victoria County	No	Hanselman Road and US-59[36]
Victoria County	No	McCoy Road and US 87
Victoria County	No	Key Road and US 87
Victoria County	No	FM-616 and US-87
Victoria County	Yes	FM-616 and TX-185
Victoria County	Yes	Key Road and TX-185
Refugio County	No	Houston Street and US 77[36]

All of the points listed with the exception of Houston Street and U.S. 77, which is located too far outside the EPZ for queuing to affect evacuation within the EPZ, have the potential to impact ETEs in at least one scenario. The traffic model showed that congestion at the other traffic congestion points located outside the EPZ contributed to vehicle queuing within the 10-mile EPZ, increasing ETEs. To reduce this effect, these intersections could be controlled (i.e., through manual control of the intersection) to facilitate a smoother evacuation to reception centers (see Section 8.2). Providing an efficient and effective flow of traffic through these intersections will ensure the evacuees en route to reception centers are outside of the EPZ before encountering potential congestion points.

8.2. Traffic Control Points

In order to efficiently promote smooth traffic flow during an evacuation of the VCS EPZ, IEM has identified several locations recommended for TCPs. These TCPs are listed in Table 20 and shown graphically in Figure 21. The TCPs were not modeled in the ETE study. Conversely, the TCP locations were identified as part of a recommendation for future evacuation implementation via two methods. Nine of the sites were identified as potential congestion points based on the outputs from the evacuation model; these points are denoted by a "Yes" in the "Model Congestion Point" column of the Table 20. The remaining three locations were identified by reviewing the hurricane evacuation TCPs in Victoria, Goliad, and Refugio counties for sites that would facilitate traffic flow along VCS evacuation routes.[37] Some of the locations are well outside of the EPZ and implementing TCPs at these sites would likely not affect ETEs; however, they would help minimize congestion as the evacuating traffic passes through the towns of Goliad, Refugio, Placedo, and Victoria and ease the flow to the reception centers.

[36] Congestion at these intersections occurred only during the special scenario.
[37] Texas Highway Patrol District "3A" Corpus Christi. "Traffic Management Plan". April 2007. Online: ftp://ftp.txdps.state.tx.us/dem/plan_state/hurr_evac_tmp_3a.pdf

Table 20: Traffic Control Points for the VCS EPZ

Map ID	Subarea	Model Congestion Point	Town	County	Location
1	1	Yes	McFaddin	Victoria	Access Road to VCS and US-77
2	-	Yes	Placedo/DaCosta	Victoria	McCoy Road and US-87
3	-	Yes	Placedo	Victoria	Key Road and US-87
4	-	Yes	Placedo	Victoria	FM-616 and US-87
5	5	Yes	Bloomington	Victoria	FM-616 and TX-185
6	5	Yes	Bloomington	Victoria	Key Road and TX-185
7	-	Yes	Victoria	Victoria	Anthony Road and US-59
8	-	Yes	Victoria	Victoria	Hanselman Road and US-59
9	-	Yes	Refugio	Refugio	Houston Street and US 77
10	4	No	Victoria	Victoria	TX-185 and US-59
11	-	No	Victoria	Victoria	US-87 and US-59
12	-	No	Goliad	Goliad	US-183 and US-59

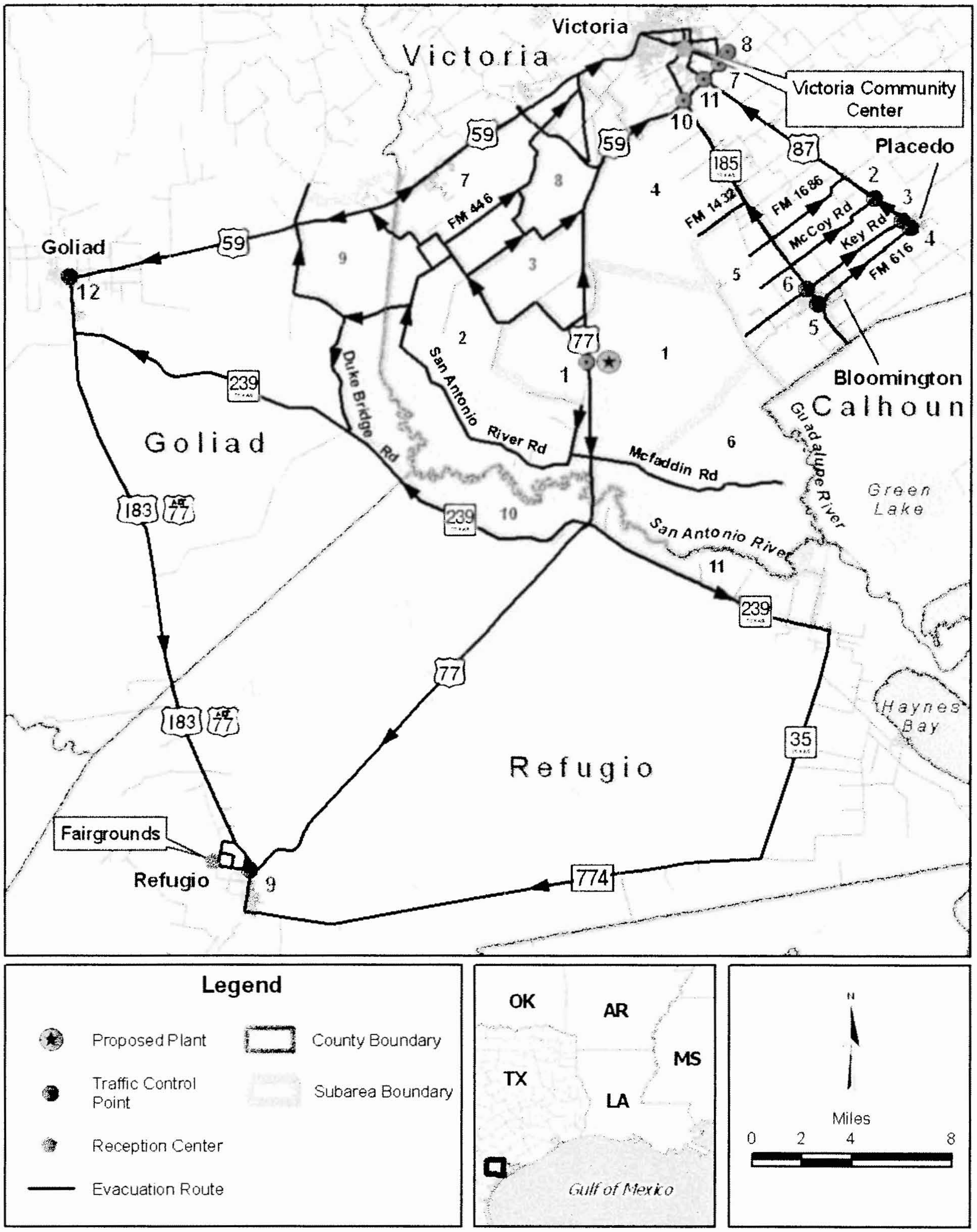

Figure 21: Traffic Control Points in and around the VCS EPZ

The responsibility of supervising traffic controls during an evacuation will be shared between the state's and counties' emergency management and law enforcement agency personnel, as available. Each TCP will be staffed and/or road blocks will be established to direct evacuees out of the EPZ and to deny access into the affected area. Also, route markers will be placed along the evacuation routes at critical intersections and road block locations to promote more efficient traffic flow out from the EPZ.

8.3. Summary of Recommendations

The following recommendations will help emergency managers to improve the evacuation times from an event at VCS:

- ETEs can be reduced by implementing additional measures to shorten the time the public requires to begin evacuating after the event's occurrence, especially for recreational area users, such as hunters and fishers.
- Use TCPs to facilitate traffic flow out of the EPZ in populated areas where congestion may occur during an evacuation (see Sections 8.1 and 8.2).
- Develop comprehensive regional evacuation plans to enhance the effectiveness and efficiency of cross-institutional coordination and cooperation during evacuation. A regional evacuation plan requires the involvement of all the EPZ counties to contribute collaboratively, and it incorporates the individual county evacuation plans in to a broader regional context.
- Encourage that the construction and operation workforce carpool when evacuating from the VCS.
- Develop specific site-dismissal plans and procedures for VCS personnel to possibly consider for staggered or phased evacuation process.

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9.0 APPENDIX A: GEOGRAPHICAL BOUNDARIES OF EVACUATION SUBAREAS

Evacuation Subareas	Subarea Boundaries	Landmark Descriptions
1	**North:** Kemper City Road E, Kemper City Road S, Old Refugio Road, a line from the intersection of Old Refugio Road and Kemper City Road E to the intersection of Levee Road and Dupont Road, Levee Road **East/South:** railway tracks, FM-445 **West:** Warburton Road, Murphy Road, a line from the western end of Murphy Road to the southern end of Morris Town Road, Morris Town Road	Victoria County Station (VCS)
2	**North/East:** Cologne Road, Kemper City Road W, Morris Town Road, a line from the southern end of Morris Town Road to the western end of Murphy Road, Murphy Road, Warburton Road, San Antonio River Road, US-77 **South/West:** Victoria-Refugio County line, Victoria-Goliad County line	Diocese of Victoria Spiritual Renewal Center
3	**Northwest:** Fleming Prairie Road **East:** US-77, Old Refugio Road **South/West:** Kemper City Road S, Kemper City Road E, Kemper City Road W	
4	**North/West:** US-77, US-59 S **East:** TX-185, FM-1432, canal **South:** a line from the intersection of Levee Road and Dupont Road to the intersection of Old Refugio Road and Kemper City Road E, Kemper City Road E	
5	**North:** FM-1432 **East:** TX-185, Key Road, Philips Road, E Kings Road, TX-185 **South:** Victoria-Calhoun County line **West:** Levee Road, canal	City of Bloomington
6	**Northwest:** FM-445, railway tracks **East:** Levee Road, Victoria-Calhoun County line **South:** Victoria-Refugio County line **West:** US-77	McFaddin
7	**North:** US-59 **East:** FM-446, Givens Road **South:** Fleming Prairie Road, Kemper City Road W, Cologne Road **West:** Victoria-Goliad County line	
8	**West/North:** Givens Road, FM-446, Timber Drive, Fordyce Road, Fox Road **East/South:** US-59 S, US-77, Fleming Prairie Road	Saxet Lakes Park

Evacuation Subareas	Subarea Boundaries	Landmark Descriptions
9	**North:** south shore of Coleto Creek Reservoir **East:** Victoria-Goliad County line **South:** Refugio-Goliad County line **West:** TX-239, Duke Bridge Road, FM-2506, FM-2987	Lott Lake
10	**North:** Victoria-Refugio County line **East:** US-77 **South:** TX-239 **West:** Refugio-Goliad County line	
11	**North:** Victoria-Refugio County line **East:** Dedear Road **South:** TX-239 **West:** US-77	

10.0 APPENDIX B: EVACUATION NETWORK LINKS

Table 21 summarizes the links used in the evacuation model. The roads in the evacuation network are shown in Figure 22 and identified by the Map ID column.

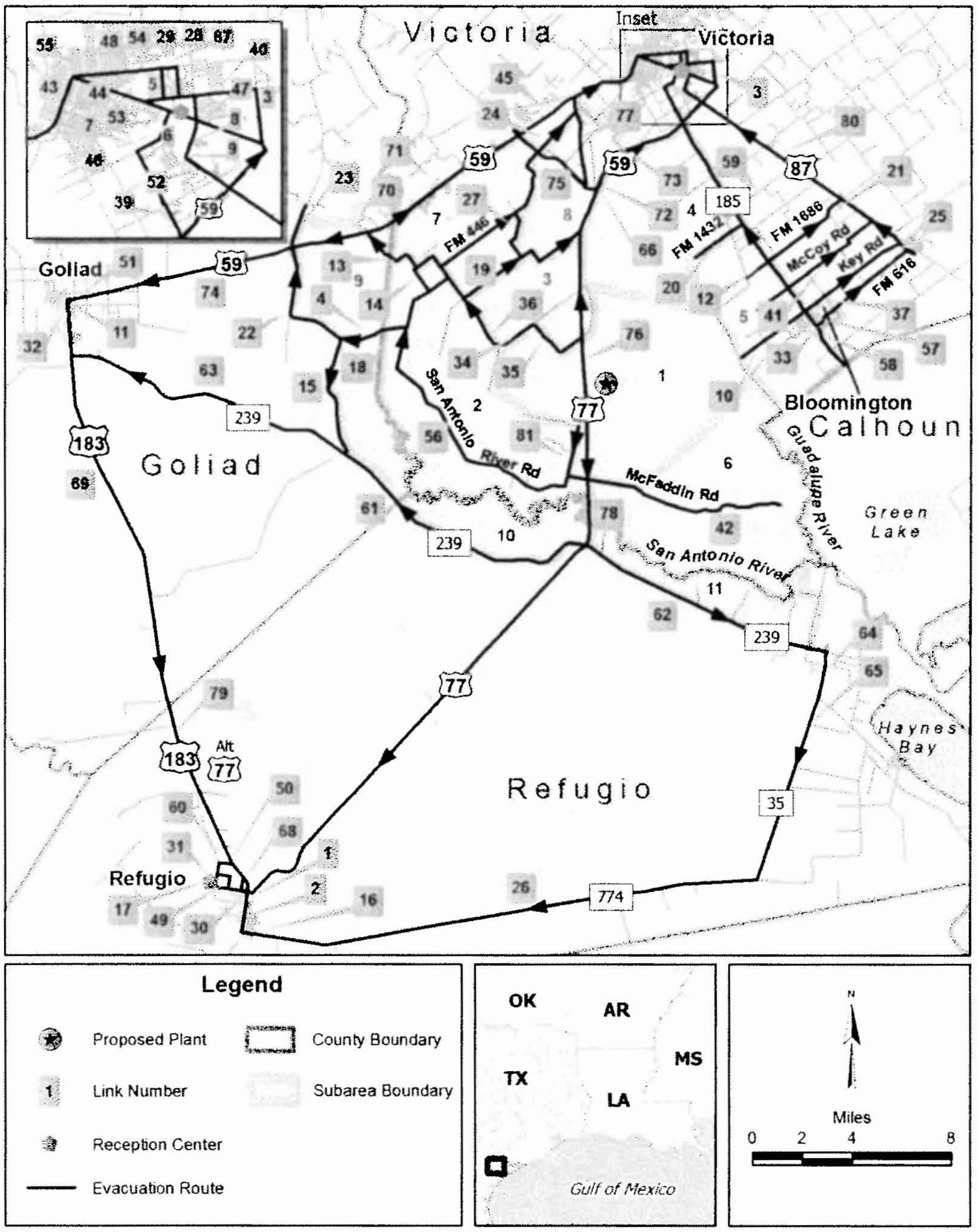
Table 21: Summary of Evacuation Links

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacity (veh/hr)	Speed Limit (max)
1	Alamo St N	15	2	0.9	3,200	50
2	Alamo St S	9	2	0.6	3,000	50
3	Anthony Rd	8	1	2.1	800	35
4	Bayou Rd	1	1	1.8	800	35
5	Ben Jordan St N	2	1	0.2	800	35
6	Ben Jordan St S	6	1	0.5	800	35
7	Ben Jordan St SW	4	1	0.8	800	35
8	Ben Wilson St N	36	1	2.7	800	35
9	Ben Wilson St S	6	1	0.4	800	35
10	Black Bayou Rd No 1	18	1	4.0	800	35
11	Burke St S	10	1	1.0	800	35
12	Canal Rd	4	1	2.1	1,500	45
13	Cologne Rd	12	1	5.5	1,500	40
14	Cologne Rd S	2	1	2.5	800	35
15	Duke Bridge Rd	3	1	5.0	1,500	45
16	Empresario St E	7	1	0.6	1,500	45
17	Fairground Rd	10	1	2.0	800	35
18	Fannin Rd	2	1	2.0	800	35
19	Fleming Prairie Rd	6	1	6.1	800	35
20	FM 1432	2	1	2.3	1,500	35
21	FM 1686	6	1	3.9	1,500	45
22	FM 2506	19	1	5.0	1,500	45
23	FM 2987	1	1	1.3	1,500	45
24	FM 446	17	1	9.2	1,500	45
25	FM 616	10	1	4.5	1,500	45
26	FM 774	11	1	20.4	1,500	45
27	Givens Rd	2	1	4.2	800	35
28	Houston Hwy	4	1	0.2	1,500	45
29	Houston Hwy/E Rio Grande St E	2	1	0.2	1,500	45

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacity (veh/hr)	Speed Limit (max)
30	Houston St E	1	1	0.2	800	35
31	Houston St W	12	1	1.3	800	35
32	Jefferson St S/US Hwy 183 S	4	2	0.1	3,200	45
33	Johnson St	10	1	0.6	1,500	45
34	Kemper City Rd	1	1	1.6	1,500	40
35	Kemper City Rd S	4	1	5.2	1,500	40
36	Kemper City Rd W	8	1	8.1	1,500	40
37	Key Rd	10	1	7.8	800	35
38	La Valliere St	12	1	1.0	800	35
39	Laurent St S	42	1	3.2	1,500	45
40	Lone Tree Rd	48	1	3.8	800	35
41	McCoy Rd	13	1	10.3	800	35
42	McFaddin Rd	8	1	7.8	1,500	35
43	Moody St N	12	2	0.8	3,000	50
44	Moody St S	15	2	0.8	3,000	50
45	Moody St SW	27	2	5.1	3,600	60
46	Moody St SW/US Hwy 59 S	2	2	0.1	3,000	50
47	North St E	66	1	6.3	800	35
48	North St W	6	1	0.4	800	35
49	Obrian Rd	2	1	1.0	800	35
50	Old Beeville Rd	2	1	1.0	800	35
51	Pearl St E	8	1	0.6	1,500	50
52	Port Lavaca Dr	18	2	1.9	3,000	50
53	Proctor St	2	1	0.4	800	35
54	Rio Grande St E	16	2	0.8	3,000	50
55	Rio Grande St W	6	2	0.4	3,000	50
56	San Antonio River Rd	11	1	21.1	800	35
57	Shepley St N	22	1	1.4	1,500	45
58	Shepley St S	14	1	0.6	1,500	45
59	SR 185 N	55	1	10.8	1,500	45
60	SR 202	5	1	0.5	1,800	55
61	SR 239 (to Duke Bridge)	7	1	19.8	1,500	45
62	SR 239 E (E of US 77)	18	1	10.7	1,800	55

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacit y (veh/hr)	Speed Limit (max)
63	SR 239 W (to US 183/77)	6	1	12.0	1,500	45
64	SR 239/35	7	2	1.6	3,600	55
65	SR 35	7	2	8.0	3,600	55
66	SR 91 spur	9	2	1.5	3,600	60
67	Stolz St	2	1	0.7	800	35
68	Swift St	14	1	1.1	800	35
69	US Hwy 183 S	21	2	16.6	3,600	55
70	US Hwy 59	16	2	8.4	3,600	60
71	US Hwy 59 N	23	2	6.1	3,600	60
72	US Hwy 59 N (connector)	2	1	0.4	1,500	55
73	US Hwy 59 N (SE belt)	19	2	6.0	3,600	60
74	US Hwy 59 S	13	2	9.0	3,000	50
75	US Hwy 59 S (SW belt)	7	2	3.0	3,000	45
76	US Hwy 77 N	14	2	6.8	3,600	60
77	US Hwy 77 N (inside belt)	12	1	3.6	1,500	55
78	US Hwy 77 S	46	2	26.3	3,600	60
79	US Hwy 77/183 S	15	2	7.5	3,600	55
80	US-87 N	29	2	10.5	3,600	55
81	Warburton Rd	2	1	2.0	800	35

Figure 22: Map of Evacuation Network Links (from Table 21)



11.0 APPENDIX C: TELEPHONE SURVEY

Introduction

The development of evacuation time estimates (ETE) for the area surrounding the Victoria County Station requires the identification of travel patterns, available vehicles, and household size of the people who live or work in the area. Specific data is needed in developing ETEs in order to effectively quantify mobilization time and vehicle usage for residents responding to an evacuation advisory. A bilingual (English and Spanish) telephone survey was conducted to interview a sample of residents who live within the 10-mile EPZ of the proposed nuclear power plant site to acquire information required for the ETE study.

IEM secured the services of DataSource in San Marcus, Texas to conduct the telephone survey and provide data to IEM for analysis.

Survey Instrument and Sampling Plan

A survey instrument/questionnaire was developed by IEM, and was reviewed and approved by Exelon and Bechtel project personnel, as well as the State and county emergency management personnel during the project kick-off meeting in Victoria, TX. The approved survey questionnaire was used to interview a sample of residents who live or work within 10 miles of the site to acquire information required for the ETE study. To achieve a representative sample of households living in the emergency planning zone (EPZ), respondents were randomly selected to participate in the survey. DataSource fielded the telephone survey and provided data to IEM for analysis. Calls were conducted in the early evening hours from Wednesday, May 21 to Thursday, May 29. Only residents 18 years of age and older were allowed to participate in the survey. All telephone calls were made during weekday evenings or on weekends in an attempt to reach households with both workers and non-workers. The survey was conducted in both English and Spanish. To ensure the highest quality of work was performed, a quality assurance plan was implemented in this survey process that included call-taker training, telephone monitoring by IEM, and extensive data quality control checks.

The sampling frame consisted of a list of households within the study area. The survey required around 600 completed surveys in order to achieve the desired margin of error of 4 percentage points or less. However, there were not enough telephone listings available in the databases used by DataSource to attain this sample size. Several efforts were made to get a more comprehensive listing. In an attempt to check the completeness of the telephone database used, IEM contacted other telephone data providers in the country, but the sample counts obtained from these providers were similar to what was available through DataSource. With the available telephone numbers, the survey effort produced a total of 125 completed surveys.

Survey Results

Household Size

Figure 23 presents the distribution of household sizes in the area. The average household contains 2.82 people.

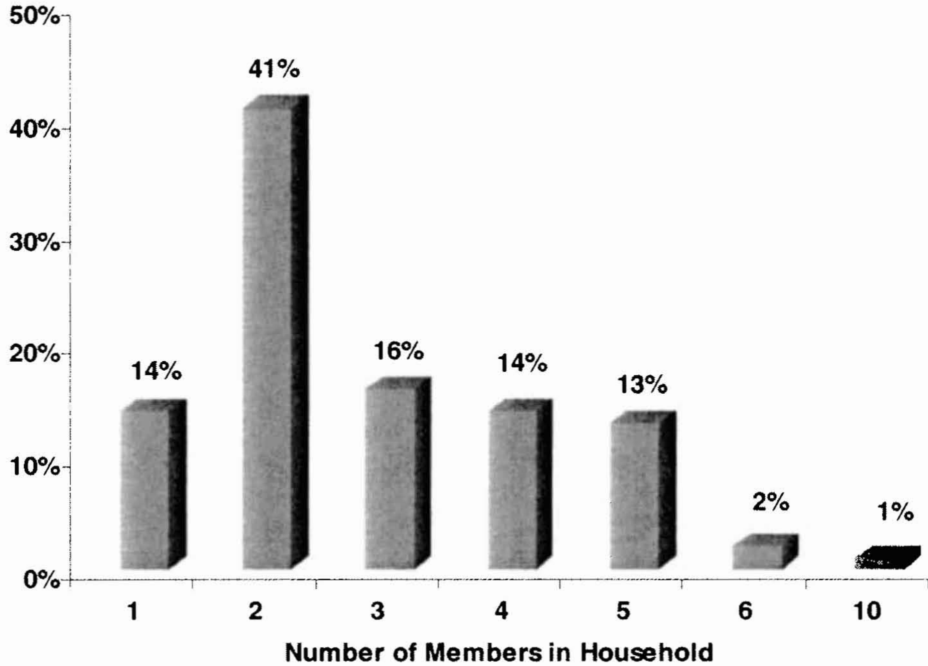


Figure 23: Distribution of Household Size

Automobile Ownership

The average number of vehicles per household is 2.26. Figure 24 illustrates the distribution of automobile ownership within the households.

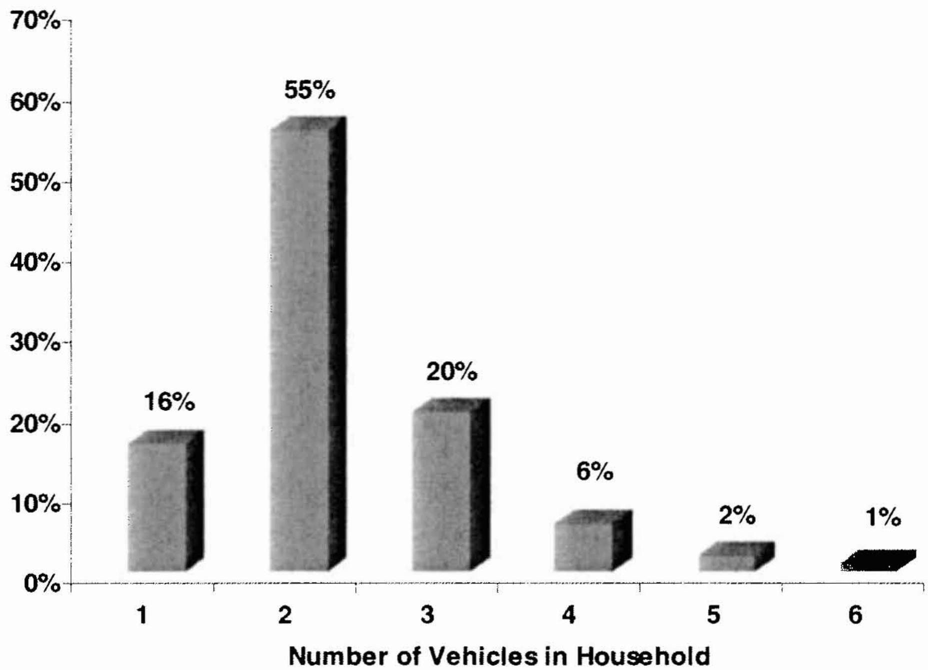


Figure 24: Distribution of Vehicles

Commuters

Figure 25 presents the number of commuters in each household. On an average there are 1.27 commuters per household in the area.

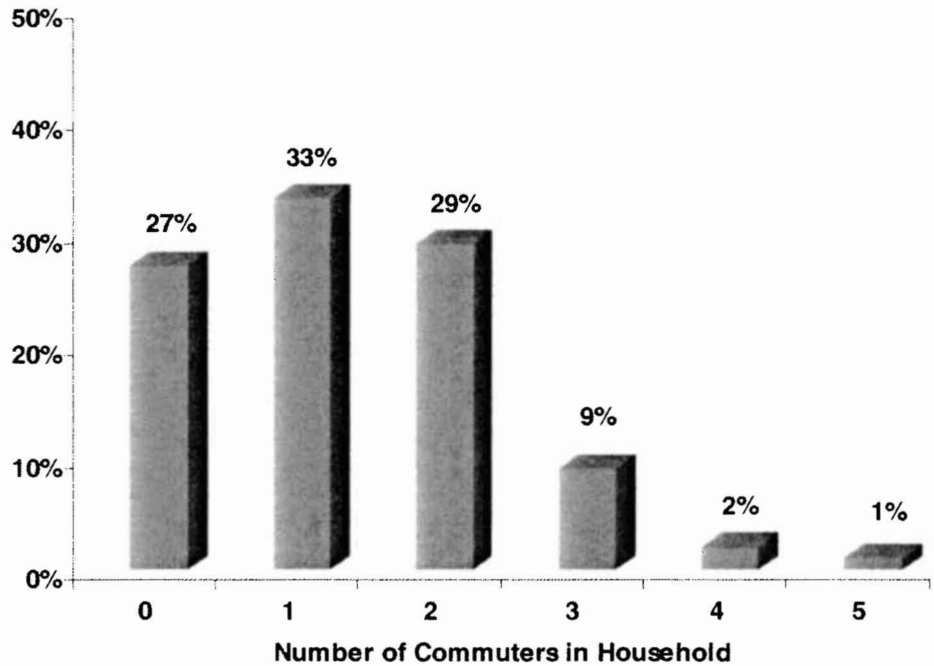


Figure 25: Distribution of Commuters

Trip Generation Times

On average 1.5 vehicles would be used per household for evacuation during nighttime. Figure 26 presents the distribution of vehicles that will be used for evacuation purposes.

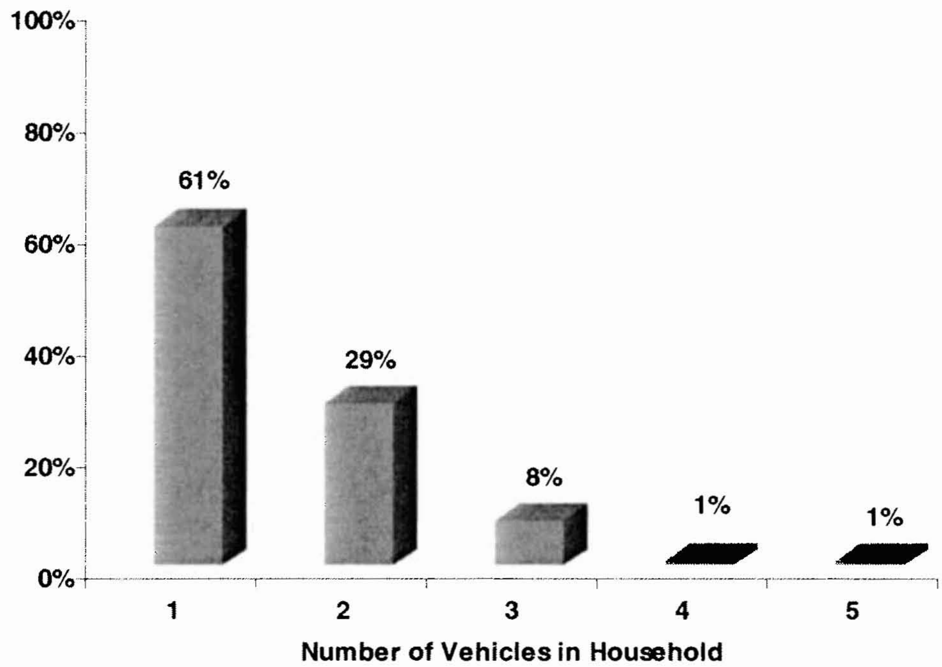


Figure 26: Number of Vehicles used for Evacuation

Time Distributions

Some of the questions asked on the survey were to get an estimate of how much time the residents would take in order to perform certain evacuation related activities.

Preparation to Leave Work

In the event of an emergency that does not include weather related events, approximately how long does it take to complete preparation for leaving work or college prior to departure?

Figure 27 presents the cumulative distributions for all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 92 percent of the commuters complete this activity within 30 minutes.

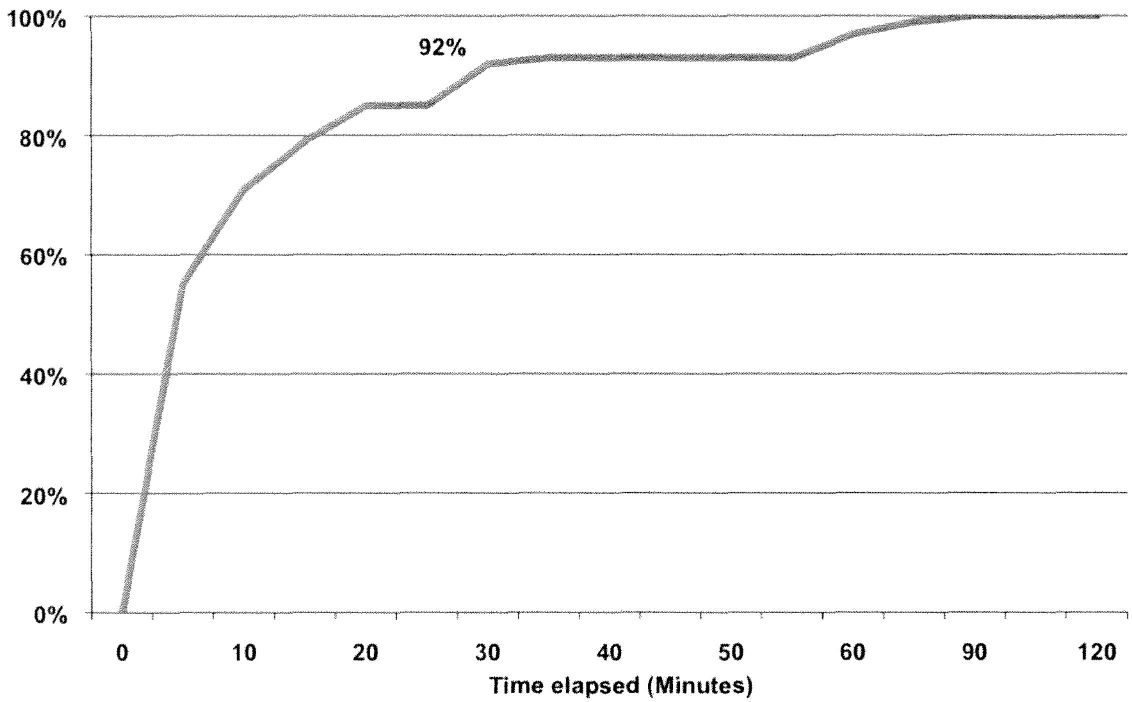


Figure 27: Preparation Time to Leave Work

Travel from Work to Home

How long would it take the returning commuter to reach home, including the preparation time to leave work? Figure 28 presents the time it takes for the commuters to travel from work to home. The figure shows cumulative percentages of all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 91 percent of the residents can reach home within 60 minutes.

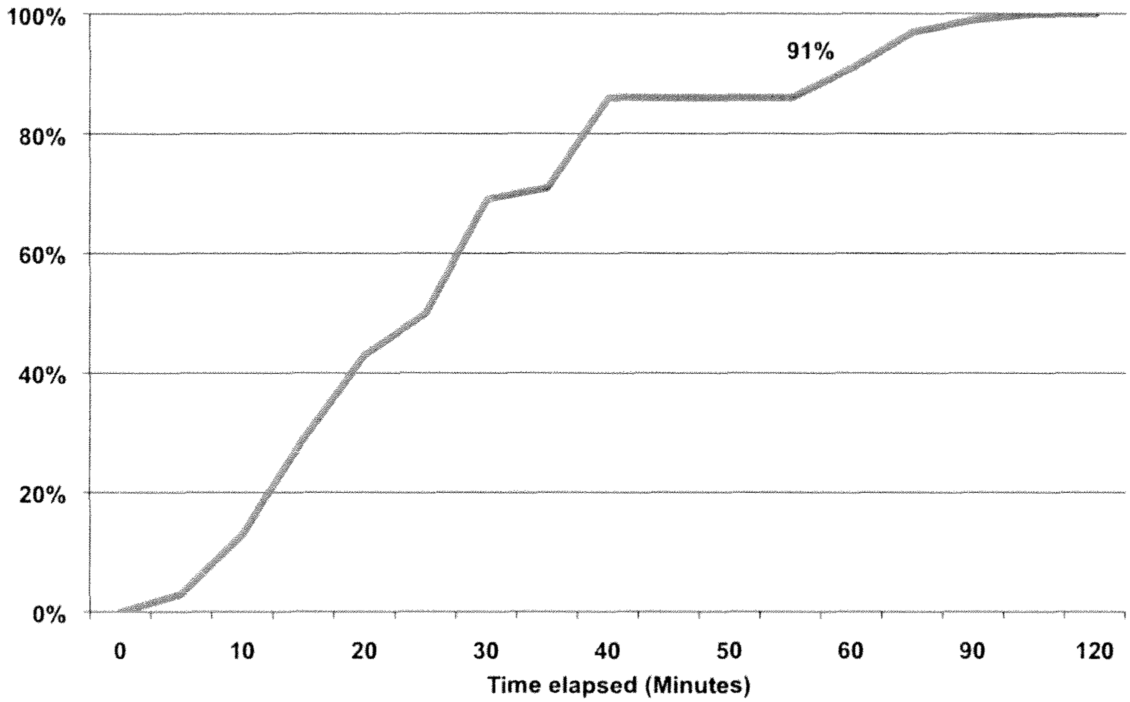


Figure 28: Preparation Time to Travel from Work to Home

Preparation during Daytime

How long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the daytime?

Figure 29 presents the distribution of the time it would take for residents to make preparations to leave the house during the daytime. The distribution is based on all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 75 percent of the residents would be ready for evacuation in about 30 minutes. However, it might take as long as 2 hours for some to complete preparations for the leave.

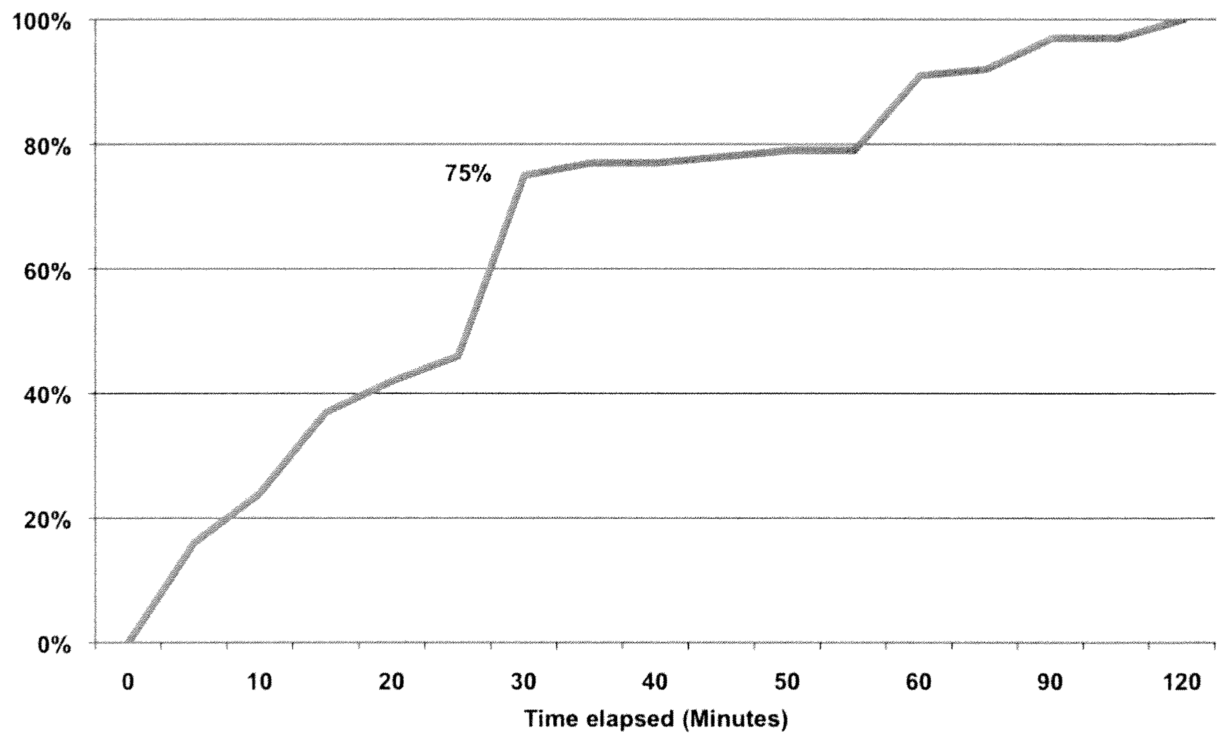


Figure 29: Time to Prepare for Evacuation from Home (Daytime)

Preparation during Nighttime

How long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the nighttime?

Figure 30 presents the distribution of the time it would take for residents to make preparations to leave the house during the nighttime. The figure shows cumulative percentages of all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As expected, the preparation times would be slightly more during the night compared to the daytime. Approximately 69 percent of the residents would be ready for evacuation in about 30 minutes.

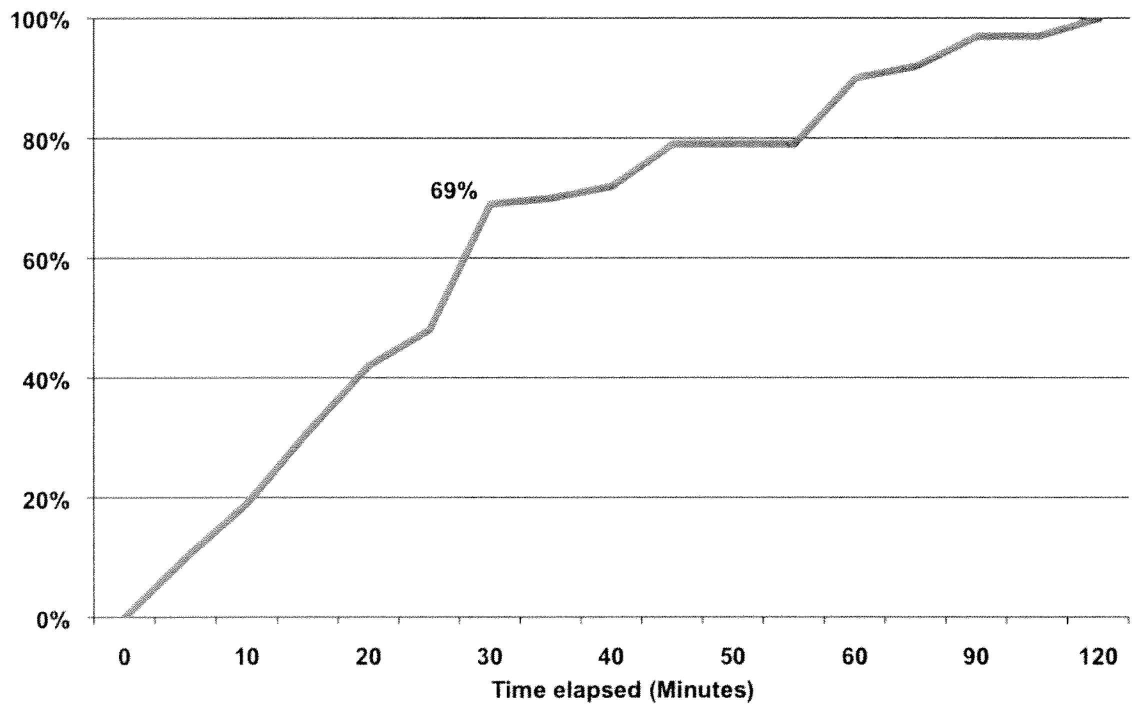


Figure 30: Time to Prepare for Evacuation from Home (Nighttime)

Survey Tabulations

1. How many members are there in your household?

Table 22: Responses to Question 1

Response	Percentage of Households
One	14%
Two	41%
Three	16%
Four	14%
Five	13%
Six	2%
Seven	—
Eight	—
Nine	—
Ten	1%
Others	—

2. In total, how many cars or other vehicles are usually available to your household?

Table 23: Responses to Question 2

Response	Percentage of Households
One	16%
Two	55%
Three	20%
Four	6%
Five	2%
Six	1%
Seven	—
Eight	—
Nine or more	—
None	—
Don't Know/Refused	—

3. How many people in your household commute to a job or to college at least four times a week?

Table 24: Responses to Question 3

Response	Percentage of Households
One	27%
Two	33%
Three	29%
Four	9%
Five or more	2%
None	—
Don't Know/Refused	—

4. How many of the commuters you just mentioned are in a carpool?

Table 25: Responses to Question 4 (Only Households That Have Commuters)

Response	Percentage of Households
One	10%
Two	4%
Three	—
Four	—
Five or more	—
None	86%
Don't Know/Refused	—

5. In the event of an emergency that does not include weather related events, approximately how long does it take Commuter #1 (repeat for all commuters) to complete preparation for leaving work or college prior to departure?

Table 26: Responses to Question 5

Response	Percentage of Commuters
5 minutes or less	52%
6-10 minutes	16%
11-15 minutes	8%
16-20 minutes	6%
21-25 minutes	—
26-30 minutes	7%
31-35 minutes	1%
36-40 minutes	—
41-45 minutes	—
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	4%
Between 1 hour and 1 hour 15 minutes	2%
Between 1 hour 16 minutes and 1 hour 30 minutes	1%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	3%
Don't Know/Refused	2%

6. In the event of an emergency when the commuters are away from home, is there a working vehicle available for the family members at home that could be used for evacuation?

Table 27: Responses to Question 6

Response	Percentage of Households
Yes	79%
No	21%

7. In the event of an emergency, would the members at home await the return of the family members prior to evacuating the area?

Table 28: Responses to Question 7

Response	Percentage of Households
Yes	42%
No	46%
Don't Know/Refused	13%

8. In the event of an emergency, will the members at home wait for a ride from the commuter or leave with someone else?

Table 29: Responses to Question 8

Response	Percentage of Households
Wait	46%
Leave with someone else	38%
Don't Know/Refused	15%

9. In the event of an emergency, would anyone go home before evacuating?

Table 30: Responses to Question 9

Response	Percentage of Households
Yes	37%
No	53%
Don't Know/Refused	10%

10. How many would return home?

Table 31: Responses to Question 10

Response	Percentage of Households
One	48%
Two	38%
Three	10%
Four	—
Five or more	5%

11. How long would it take the returning commuter (repeat for all returning commuters) to reach home, including the preparation time to leave work?

Table 32: Responses to Question 11

Response	Percentage of Commuters
5 minutes or less	3%
6-10 minutes	9%
11-15 minutes	15%
16-20 minutes	14%
21-25 minutes	7%
26-30 minutes	18%
31-35 minutes	3%
36-40 minutes	—
41-45 minutes	14%
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	5%
Between 1 hour and 1 hour 15 minutes	5%
Between 1 hour 16 minutes and 1 hour 30 minutes	1%
Between 1 hour 31 minutes and 1 hour 45 minutes	1%
Between 1 hour 46 minutes and 2 hours	—
Other	4%
Don't Know/Refused	1%

12. In the event of an emergency, how long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the daytime?

Table 33: Responses to Question 12

Response	Percentage of Households
5 minutes or less	15%
6-10 minutes	7%
11-15 minutes	13%
16-20 minutes	5%
21-25 minutes	4%
26-30 minutes	28%
31-35 minutes	2%
36-40 minutes	—
41-45 minutes	1%
46-50 minutes	1%
51-55 minutes	—
56 minutes to an hour	11%
Between 1 hour and 1 hour 15 minutes	2%
Between 1 hour 16 minutes and 1 hour 30 minutes	5%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	3%
Other	5%
Don't Know/Refused	—

13. In the event of an emergency, how long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the nighttime?

Table 34: Responses to Question 13

Response	Percentage of Households
5 minutes or less	10%
6-10 minutes	8%
11-15 minutes	12%
16-20 minutes	10%
21-25 minutes	6%
26-30 minutes	20%
31-35 minutes	1%
36-40 minutes	2%
41-45 minutes	7%
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	10%
Between 1 hour and 1 hour 15 minutes	3%
Between 1 hour 16 minutes and 1 hour 30 minutes	5%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	3%
Other	5%
Don't Know/Refused	—

14. How many of the vehicles usually available to your household would your family use for evacuation during the night/weekend?

Table 35: Responses to Question 14

Response	Percentage of Households
One	61%
Two	29%
Three	8%
Four	1%
Five	1%
Six	–
Seven	–
Eight	–
Nine or more	–
None	1%
Don't Know/Refused	–

15. Do you or any member of your household hunt, fish, or visit parks within five miles from your home?

Table 36: Responses to Question 15

Response	Percentage of Households
Hunt	18%
Fish	33%
Visit Parks	17%

16. How many people typically travel in the same vehicle for this purpose?

Table 37: Responses to Question 16

Response	Percentage of Households
One	23%
Two	31%
Three	15%
Four	17%
Five or more	13%

17. In the event of an emergency when you are asked to evacuate, how long would it take you to complete preparations to evacuate the area?

a. Hunting

Table 38: Responses to Question 17a. (Percentages of Hunters)

Response	Percentage of Households
5 minutes or less	26%
6-10 minutes	13%
11-15 minutes	9%
16-20 minutes	4%
21-25 minutes	4%
26-30 minutes	13%
31-35 minutes	—
36-40 minutes	—
41-45 minutes	9%
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	13%
Between 1 hour and 1 hour 15 minutes	—
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	9%
Don't Know/Refused	—

b. Fishing

Table 39: Responses to Question 17b. (Percentages Fishers)

Response	Percentage of Households
5 minutes or less	7%
6-10 minutes	10%
11-15 minutes	10%
16-20 minutes	7%
21-25 minutes	—
26-30 minutes	27%
31-35 minutes	—
36-40 minutes	–
41-45 minutes	2%
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	7%
Between 1 hour and 1 hour 15 minutes	15%
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	2%
Between 1 hour 46 minutes and 2 hours	—
Other	12%
Don't Know/Refused	—

c. Park Visitors

Table 40: Responses to Question 17c. (Percentages of Park Visitors)

Response	Percentage of Households
5 minutes or less	14%
6-10 minutes	19%
11-15 minutes	10%
16-20 minutes	10%
21-25 minutes	5%
26-30 minutes	19%
31-35 minutes	—
36-40 minutes	—
41-45 minutes	4%
46-50 minutes	—
51-55 minutes	—
56 minutes to an hour	—
Between 1 hour and 1 hour 15 minutes	10%
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	10%
Don't Know/Refused	—