Appl. EP-15

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
DUKE POWER COMPANY, et al.	)	Docket Nos. 50-413 OL
	)	50-414 OL
(Catawba Nuclear Station, Units 1 and 2)	)	

A-EP-15
5/7/84

APPLICANTS' TESTIMONY ON EMERGENCY PLANNING CONTENTIONS 14 AND 15

Duke Power Company	(R.M. Glover)
Walter M. Kulash	
North Carolina	(J.T. Pugh, III)
South Carolina	(P.R. Lunsford, William M. McSwain)
Gaston County	(Bob E. Phillips)
Mecklenburg County	(Lewis Wayne Broome)
York County	(Phillip Steven Thomas)

April 16, 1984

TESTIMONY OF DUKE POWER COMPANY
(R.M. GLOVER) ON EMERGENCY
PLANNING CONTENTIONS 14/15

Q. HAS DUKE POWER COMPANY PROVIDED ANY ADDITIONAL MEANS FOR INFORMING PARENTS, TEACHERS AND STUDENTS OF ACTIONS TO BE TAKEN IN A NUCLEAR-RELATED EMERGENCY AT CATAWBA?

A. Yes. I directed that a special brochure be prepared.

Q. WERE YOU INVOLVED IN THE PREPARATION OF THIS BROCHURE?

A. Yes. I established the basic information to be provided in the brochure. I felt it necessary that we inform parents, teachers and students of the following:

- the specific shelter for their school
- the role of the parents (i.e., refrain from picking children up at school)
- provide a general area map

Q. DOES THE BROCHURE ADDRESS THESE POINTS TO YOUR SATISFACTION?

A. Yes.

Q. IS THIS BROCHURE REQUIRED BY NRC REGULATIONS OR REGULATORY GUIDANCE?

A. No.

TESTIMONY OF WALTER M. KULASH
EMERGENCY PLANNING CONTENTIONS 14 AND 15

Q. INTERVENORS ALLEGE IN EMERGENCY PLANNING CONTENTION 14 THAT THE EVACUATION TIME STUDY PREPARED BY PRC OVERESTIMATES ACTUAL TRAFFIC MOVEMENT BY A FACTOR OF BETWEEN 3 AND 12. DO YOU AGREE? PLEASE EXPLAIN WHY OR WHY NOT, AND PROVIDE THE BASIS FOR YOUR ANSWER.

A. No, I do not agree. The rates of flow of traffic used in the PRC evacuation time study are not overestimated. (A copy of the study, entitled "Catawba Nuclear Station Evacuation Analysis/ Evacuation Time Estimates," is included as Attachment A to my testimony on Contentions 14 and 15.) The time study assumes a traffic flow rate of 1200 vehicles per lane per hour. This figure is based upon a conservative (i.e., low) interpretation of highway flow rates as set forth in the 1965 Highway Capacity Manual, the definitive guideline on the subject and one in general use by local, State and Federal transportation planning agencies. There is nothing unique about the Charlotte area and Rock Hill which would indicate that these flow rates should not be used.

Moreover, the assertion that the time study overestimates the traffic flow rate by a factor of between three and twelve cannot be reconciled

arithmatically with another assertion made in the contentions that the correct flow rate is 900 vehicles per hour. The time study uses a flow rate of 1200 vehicles per hour, or 133 percent of the rate of 900 vehicles per hour advocated in the contention. This difference (i.e., 133 percent) cannot be related to the 300 to 1200 percent difference that would reflect an overestimation by a factor of three to twelve, as mentioned elsewhere in the contention.

Q. DO YOU ADOPT ATTACHMENT A AS PART OF YOUR TESTIMONY FOR USE IN THIS PROCEEDING?

A. Yes.

Q. HOW DID YOU DERIVE THE FIGURE OF 1200 VEHICLES PER LANE PER HOUR FROM THE HIGHWAY CAPACITY MANUAL?

A. The unadjusted value for hourly flow of traffic on a single lane of surface highway (i.e., a non-interstate highway) is 1800 vehicles per lane per hour. We adjusted this downward to allow a vehicle headway of 3 seconds, which reflects a level of traffic interruption that could be expected in an evacuation.

Q. WHO COMPILED THE 1965 HIGHWAY CAPACITY MANUAL?

A. The Transportation Research Board of the National Academy of Sciences.

Q. WOULD YOU SAY THAT THIS MANUAL IS CONSIDERED THE MOST AUTHORITATIVE SOURCE IN THIS COUNTRY FOR TRAFFIC RATE FLOW ESTIMATES?

A. Yes. It is used by state transportation departments in both North and South Carolina. It was the basis for estimating capacity for most interstate highway planning. It is supported by a large amount of empirical research into traffic flow.

Q. INTERVENORS CITE DR. SHELDON PLOTKIN (SOUTHERN CALIFORNIA FEDERATION OF SCIENTISTS) FOR THE ASSERTION THAT A FLOW OF NO MORE THAN 900 VEHICLES PER LANE PER HOUR SHOULD BE ASSUMED. DO YOU AGREE WITH HIS ESTIMATE? PLEASE EXPLAIN YOUR ANSWER.

A. No. A conservative interpretation of the 1965 Highway Capacity Manual, the definitive source of this type of information, yields a figure of 1200 vehicles per lane per hour.

Q. PLEASE SUMMARIZE THE METHODOLOGY THAT PRC USED IN ESTIMATING EVACUATION TIMES.

A. A summary of the methodology used in estimating evacuation times is included as Attachment B to my testimony on Contentions 14 and 15.

Q. WHAT IS THE BASIS FOR THE METHODOLOGY THAT PRC USED?

A. This methodology is based upon the approach suggested by FEMA in Appendix 4 of NUREG-0654.

Q. DO YOU ADOPT ATTACHMENT B AS PART OF YOUR TESTIMONY FOR USE IN THIS PROCEEDING?

A. Yes.

Q. INTERVENORS FURTHER ALLEGE IN EPC 14 THAT: "TRAFFIC FLOWS ARE FURTHER OVERESTIMATED BY FAILING TO ACCOUNT FOR VOLUNTARY EVACUATION LIKELY TO TAKE PLACE FROM CHARLOTTE VIA I-77. ALL OF THE STUDY'S ESTIMATES ARE PREMISED ONLY ON ESTIMATES OF TRAFFIC FLOW WITHIN THE EPZ. THEY FAIL TO ACCOUNT FOR BACKUPS CAUSED BY EXTRA-EPZ CONGESTION, ESPECIALLY ON I-77 IN CHARLOTTE." DO YOU AGREE WITH THESE ALLEGATIONS? PLEASE EXPLAIN WHY OR WHY NOT.

A. No, I do not agree. PRC has performed two studies related to evacuation of areas beyond the EPZ as presently defined:

(1) We looked at the impact, on EPZ evacuation traffic, of voluntary evacuation from the entire Charlotte area. In this analysis, we tested various combinations of voluntary evacuation extent and notification times.

(2) We looked at evacuation times for two expanded EPZs: (a) approximately the southwest one third of Charlotte encompassing an area out to 17 miles from the Catawba Nuclear Station, and (b) the entire city of Charlotte, extending 20-25 miles from the Catawba Nuclear Station.

Q. WHAT WERE THE FINDINGS IN THE VOLUNTARY EVACUATION STUDY?

A. Voluntary evacuation could, under certain conditions, hinder EPZ evacuation traffic on one route by 30 minutes. Such delay would occur only if more than 50% of the total Charlotte population chose to evacuate, and if such population prepared to evacuate within 30 minutes of the time required by the EPZ population.

Q. WHAT WERE THE FINDINGS IN THE EXPANDED EPZ STUDY?

A. For the southwest third of Charlotte, extending to approximately 17 miles from the Catawba Nuclear Station, an evacuation time of 5 hours, 15 minutes is estimated. The critical determinant of this time is notification time and not traffic congestion. In other words, any traffic congestion on evacuation routes has dissipated by the time that all of the population in the expanded EPZ is notified and prepared.

For the entire city of Charlotte, extending to 20-25 miles from the Catawba Nuclear Station, an evacuation time of approximately 9 hours is estimated.

Q. INTERVENORS ALSO ARGUE IN EMERGENCY PLANNING CONTENTION 14 THAT: "THE APPLICANT'S EVACUATION TIME ESTIMATES ERRONEOUSLY ASSUME QUICK RESPONSE BY SCHOOL BUSES AND MULTIPLE SCHOOL BUS TRIPS. SCHOOL BUSES IN

SOUTH CAROLINA ARE DRIVEN BY HIGH SCHOOL KIDS. NO PUBLIC OFFICIAL WOULD DARE TO SEND HIGH SCHOOL KIDS INTO AN EVACUATION ZONE TO TRANSPORT THOSE WITHOUT VEHICLES. TIME MUST BE ALLOTTED FOR FINDING DRIVERS." CAN YOU COMMENT ON THESE STATEMENTS?

A. The time study does assume an immediate response by those school buses which are located at schools at the time of evacuation. There is no reason for not assuming a "quick response" by these school buses, which will be loaded up and driven out of the EPZ by the student drivers as soon as possible.

Q. WHAT IS THE BASIS FOR YOUR ASSUMPTION THAT THERE WILL BE A "QUICK RESPONSE" BY SCHOOL BUSES?

A. Existing county emergency response plans indicate that there will be a quick response by the school buses, given (1) the assumed rapid notification of student bus drivers and (2) the fact that the buses will be located at the same school as the drivers of the buses. Student drivers will leave the EPZ immediately after loading the buses with students.

Q. DOES THE STUDY ASSUME AN IMMEDIATE RESPONSE FROM THOSE SCHOOLS WHERE NO SCHOOL BUSES AND NO STUDENT BUS DRIVERS ARE LOCATED AT THE TIME OF NOTIFICATION?

A. No. The time estimates do <u>not</u> assume immediate evacuation of schools at which no bus is located at the time of notification. These schools would be

evacuated either when: (1) a bus and student driver arrive directly from the school attended by the driver, or (2) a bus and driver arrive from outside the EPZ. No student driver is assumed to make a return trip into the EPZ for evacuation of transportation dependent people. It was also assumed that student drivers will make only a single trip (one-way) out of the EPZ. (I understand that the regular student drivers in York County will be used to evacuate the schools even when a second trip is required. Thus, the study is conservative in its estimates of the evacuation of the schools.)

Q. DOES THE STUDY TAKE INTO ACCOUNT THE TIME THAT WILL BE NEEDED FOR NON-STUDENT BUS DRIVERS TO REACH THE BUSES FOR EVACUATION OF THE TRANSPORTATION-DEPENDENT POPULATION?

A. Yes.

Q. ARE THERE AN ADEQUATE NUMBER OF SCHOOL BUSES TO REMOVE THE SCHOOL POPULATION IN GASTON, YORK AND MECKLENBURG COUNTIES?

A. Yes.

Q. WHAT IS THE BASIS FOR YOUR ANSWER?

A. PRC has conducted a study entitled "Adequacy of Planning for School Population Evacuation/Catawba Nuclear Station Emergency Planning Zone." A copy of this study is included as Attachment C to my

testimony on Contentions 14/15. This study determined that an adequate number of buses exists to complete the evacuation in less than 2 trips per vehicle in each county.

Q. DO YOU ADOPT ATTACHMENT C AS PART OF YOUR TESTIMONY FOR USE IN THIS PROCEEDING?

A. Yes.

Q. INTERVENORS ALSO ARGUE THAT THE STUDY "MAKES NUMEROUS ASSUMPTIONS REGARDING WORK AND LIVING HABITS WHICH ARE APPARENTLY MADE UP OUT OF WHOLE CLOTH." CAN YOU COMMENT ON THIS ASSERTION?

A. The bases for the assumptions made on work and living habits are set forth in a study prepared by PRC entitled "Assumptions Underlying Departure Times for Evacuation of the Catawba Nuclear Station Emergency Planning Zone." A copy of this study is included as Attachment D to my testimony on Contentions 14/15.

Q. CAN YOU SUMMARIZE THE APPROACH TAKEN IN THIS STUDY TO SIMULATE WORK AND LIVING HABITS OF THE EPZ POPULATION?

A. Yes. The total time required for preparing to evacuate is derived by combining times for a series of sub-activities, estimated on the basis of: (1) requirements of NUREG-0654; (2) time and motion analyses; (3) travel time/speed analyses. In the case of some activities, a maximum time was

established. Evacuees requiring longer preparation times than such maximum values cannot reasonably be considered as cooperating with the evacuation order, and the time required to secure their cooperation cannot be considered as an element in the evacuation times for the cooperating population.

Q. DO YOU ADOPT ATTACHMENT D AS PART OF YOUR TESTIMONY FOR USE IN THIS PROCEEDING?

A. Yes.

Q. EMERGENCY PLANNING CONTENTION 14 FURTHER ALLEGES THAT: "THE EVACUATION TIME ESTIMATES SHOULD BE BASED ONLY UPON WORST CASE CONDITIONS, RATHER THAN BEST CASE CONDITIONS. THE APPLICANT'S STUDY IS FAR TOO OPTIMISTIC IN ASSUMING THAT WORST CASE CONDITIONS WILL REQUIRE ONLY 156 PERCENT OF THE TIME OF BEST CASE CONDITIONS."DO YOU AGREE THAT EVACUATION TIME ESTIMATES SHOULD BE BASED <u>ONLY</u> UPON WORST CASE CONDITIONS?

A. No. Worst case conditions would apply only a very small percentage of the times during which accidents might occur, therefore their usefulness in guiding a proper protective response is limited. There is an overwhelming probability that any accident would occur during the time periods defined as "normal" or "adverse weather" as defined in Appendix 4 to NUREG-0654.

In addition, basing emergency management decisions on scenarios much worse than expected is dangerous. It could lead to advising people to stay home when evacuation is actually safe. Moreover, it is not possible to base the evacuation time estimates on a worst case analysis; no matter how far-fetched the conditions one assumes in the analysis, it is always possible to assume still worse conditions that would result in still longer evacuation times. Thus, no time estimate could properly be identified as worst case. County plans make provisions for emergency response under various "worst case" situations. In some instances, evacuation may not even be a recommended protective response.

Q. DOES THE STUDY ASSUME ONLY "BEST CASE CONDITIONS," AS INTERVENORS CONTEND?

A. No. As set forth in FEMA requirements, the time study provides estimates based upon both normal and adverse weather conditions. I would not equate either one of these scenarios with "best case conditions." On the contrary, both assumed conditions are less optimistic and represent the "most probable" case.

Q. DO YOU AGREE THAT THE STUDY IS TOO OPTIMISTIC IN ASSUMING THAT "WORST CASE CONDITIONS WILL REQUIRE ONLY 156% OF THE TIME OF BEST CASE CONDITIONS"?

A. No. The adverse weather condition evaluated in this study is by definition bas upon regularly recurring severe weather, which we interpret as snow and ice conditions. Under such conditions, empirical studies have indicated that highway capacity is reduced to 60% of that under normal weather conditions. We have adopted this value (i.e., 60% of normal weather capacity). This is the basis for the conclusion that worst case conditions will require only 156% of the evacuation time assumed for best case conditions.

Furthermore, it should be noted that in extreme weather situations, many factors actually favor an improved emergency response, including evacuation, since (1) schools are dismissed; (2) attendance at work is curtailed drastically; (3) local public safety agencies (police, fire) are at a constant state of increased readiness; and (4) increased fractions of the area population are tuned in to radio and television broadcasts.

Q. INTERVENORS ALSO CRITICIZE THE TIME STUDY FOR "NAIVELY" FAILING TO TAKE INTO ACCOUNT PARENTS FIRST GOING TO THE SCHOOLS TO PICK UP THEIR CHILDREN BEFORE EVACUATING. CAN YOU COMMENT ON THIS CRITICISM?

A. Parents will be instructed both beforehand and during any emergency not to attempt to pick up their children at school. There is no basis for projecting

that this directive will be massively disobeyed. Time estimates do not attempt to reflect widespread disregard of evacuation orders in other areas and this policy is extended to behavior of parents.

However, our evacuation estimates do recognize that some parents will attempt to pick up their children at school. Traffic attempting to go to schools to pick up children is one of many factors that is reflected in the reduction in evacuation flow rates assumed in the study from the 1800 vehicles per hour rate given in the Highway Capacity Manual to the adopted value of 1200 vehicles per hour.

Q. INTERVENORS ASSERT IN EMERGENCY PLANNING CONTENTION 14 THAT THE STUDY "DISMISSES THE MAJOR IMPACT OF THE PRESENCE OF LARGE TRANSIENT POPULATIONS AT CAROWINDS AMUSEMENT PARK AND HERITAGE USA. THOSE POPULATIONS WILL TAKE LONGER TO EVACUATE THAN THE STUDY ASSUMES AND WILL CO-CONGEST I-77 WITH RESIDENT TRAFFIC." DOES THE EVACUATION TIME STUDY CONSIDER THE IMPACT OF CAROWINDS AND HERITAGE USA?

A. Yes.

Q. HOW WAS THE IMPACT OF CAROWINDS DETERMINED?

A. The Carowinds and Heritage USA populations were the subject of a detailed study by PRC. A copy of this study is included as Attachment E to my testimony on Contentions 14/15.

Q. WHAT DID THE ANALYSIS OF THE PROJECTED CAROWINDS AND HERITAGE USA POPULATION CONCLUDE?

A. This study established that this transient population can be evacuated without further lengthening the projected maximum evacuation times for resident traffic on any route, including I-77 used by these transient populations. The time study was conservative (i.e., tending toward longer times) in that it projected maximum Carowinds and Heritage USA populations for the "critical" time period for working hours during the school year. In fact, the transient populations at Carowinds and Heritage USA are at a minimum during these periods.

Q. WHERE DID YOU ASSUME THAT THE TRAFFIC FROM CAROWINDS AND HERITAGE USA WOULD GO?

A. The study assumes that Carowinds traffic would exit in 3 lanes. One lane will go west and evacuate on State Route 49. Two lanes will go east and evacuate on I-77.

All Heritage USA traffic will exit onto U.S. 21. Most of this traffic will be directed north to Routes SC 74, NC 51 and US 521. The remainder will be directed south on US 21 and SC 160.

Both Heritage USA and Carowinds have their own emergency response procedures. These procedures contemplate the use of Carowinds and Heritage USA

employees to direct traffic within the respective sites. Once evacuating traffic clears the site, traffic control would be performed by the N.C. and S.C. state highway patrols, county sheriff deputies or other traffic control officers.

Q. WHAT IS THE BASIS FOR YOUR CONCLUSION THAT THE EVACUATION OF THESE POPULATIONS WILL NOT INCREASE OVERALL EVACUATION ESTIMATES?

A. There is adequate capacity on the highways involved -- specifically, I-77, SC 160, US 21, NC 51 and US 521 -- to permit the evacuation of Heritage USA and Carowinds population without increasing the maximum time for any evacuee (resident or transient) beyond 3 hours and 25 minutes on any of these routes.

Q. DO YOU ADOPT ATTACHMENT E AS PART OF YOUR TESTIMONY FOR USE IN THESE PROCEEDINGS?

A. Yes.

Q. EMERGENCY PLANNING CONTENTION 14 FURTHER ALLEGES THAT: "A MORE REALISTIC ESTIMATE OF EVACUATION TIME FOR THE CATAWBA NUCLEAR STATION IN THE SOUTH CAROLINA PIEDMONT IS THAT EVACUATION WILL REQUIRE A MINIMUM OF 33 HOURS, ASSUMING A CONSERVATIVE 600 VEHICLES/LANE/HOUR VEHICLE TRAVEL TIME. APPLICANTS ARE, THUS, UNABLE TO PROVIDE REASONABLE ASSURANCE OF BEING ABLE TO AVOID OR MEANINGFULLY MINIMIZE

RADIATION EXPOSURE IN THE EVENT OF A RADIATION RELEASE AT CATAWBA." DO YOU AGREE WITH INTERVENORS' TIME ESTIMATE?

A. No.

Q. WHY NOT?

A. No reasonable combination of traffic flow rates, street congestions, or traffic contingencies could yield Intervenors' estimated 33 hour evcuation time. The only possible explanation for times of this magnitude would appear to be extreme assumptions regarding the behavior of evacuees, particularly with regard to the times needed to leave home.

Moreover, it should be noted that the flow rate of 600 vehicles per hour per lane is at variance with the suggested flow rate of 900 vehicles per hour suggested in the second paragraph of this contention. Both suggested flow rates are at large variance with standards contained in the 1965 Highway Capacity Manual, the ITE Traffic Engineering Handbook, and other standard sources of road capacity.

Q. FINALLY, EMERGENCY PLANNING CONTENTION 14 ALLEGES THAT APPLICANTS' EVACUATION TIME ESTIMATES FAIL TO SATISFY NUREG-0654. ARE YOU FAMILIAR WITH NUREG-0654?

A. Yes.

Q. DO YOU BELIEVE THE TIME ESTIMATES USED SATISFY THE REQUIREMENTS OF NUREG-0654?

A. Yes.

Q. IN EMERGENCY PLANNING CONTENTION 15, INTERVENORS CRITICIZE APPLICANTS' ESTIMATE THAT 10% OF FAMILIES ARE WITHOUT VEHICLES DURING PART OF THE DAY. WHAT IS THE BASIS FOR THIS ESTIMATE?

A. PRC conducted a census on the number of families within the EPZ who are without a car during the day. This study confirmed the validity of the figures used in the PRC Voorhees evacuation time studies. A summary of this census study, entitled "Catawba Nuclear Station Evacuation Analysis/Transport-Dependent Population," is included as Attachment F to my testimony on Contentions 14 and 15.

Q. DO THE RESULTS OF THIS CENSUS CALL INTO QUESTION ANY OF THE TIME ESTIMATES OR CONCLUSIONS CONTAINED IN THE OTHER PRC VOORHEES STUDIES CONDUCTED FOR THE CATAWBA PLANT?

A. No.

Q. DO YOU ADOPT ATTACHMENT F AS PART OF YOUR TESTIMONY FOR USE IN THESE PROCEEDINGS?

A. Yes.

Q. IN CONDUCTING ITS EVACUATION TIME STUDY, DID PRC TAKE INTO ACCOUNT THE EVACUATION OF NURSING HOMES, DAY CARE CENTERS, AND HOSPITALS LOCATED IN THE TEN-MILE PLUME EPZ?

A. Yes. PRC examined the county evacuation plans for nursing homes, day care centers, and hospitals. These were all accounted for in making the evacuation time estimates.

Q. DID THE TIME STUDY TAKE INTO ACCOUNT THE TIME WHICH WOULD BE REQUIRED FOR BACKUP BUS DRIVERS TO GET TO THE SCHOOL BUSES AT NIGHT ASSUMING THAT NOT ALL OF THE BUSES WOULD BE AT A CENTRAL MOTOR POOL?

A. No. Our time estimates conservatively assumed a daytime evacuation.

TESTIMONY OF THE STATE OF NORTH CAROLINA
(J.T. PUGH, III) ON
EMERGENCY PLANNING CONTENTIONS 14 AND 15

Q. DOES THE STATE PLAN PROVIDE INFORMATION REGARDING THIS CONTENTION?

A. Yes, Part 1, figure 16 and Part 1 Section IV.E. of the N.C. State Plan.

Q. ARE YOU FAMILIAR WITH THE EVACUATION TIME STUDY AND ITS SUPPLEMENTS PREPARED BY PRC VOORHEES FOR APPLICANTS?

A. Yes.

Q. HOW, IF AT ALL, WOULD STATE AND LOCAL GOVERNMENTS USE THESE STUDIES? WOULD THEY USE THEM IN DECIDING BETWEEN EVACUATION AND OTHER PROTECTIVE ACTION?

A. Yes. The time factors indicated could very possibly weight the decision to order evacuation or designate shelter in place.

Q. GIVEN THE ANSWER TO THE PRECEDING QUESTION, IS IT MORE IMPORTANT AND USEFUL TO YOU TO HAVE A RANGE OF REALISTIC ESTIMATES OF EVACUATION TIMES FOR A VARIETY OF NORMAL AND ADVERSE WEATHER CONDITIONS OR, AS INTERVENORS CONTEND, SHOULD SUCH STUDIES BE BASED ON WORST-CASE ASSUMPTIONS?

A. A range of normal and adverse conditions would be most useful. Worst case conditions are difficult to define in that some other problem could always be added in to make the situation worse.

Q. PLEASE EXPLAIN YOUR ANSWER.

A. Ideally, the decision maker should have realistic estimates of evacuation times for the normal and poor travel conditions to base a decision on. I would like to note that with regard poor travel conditions, we would need a reasonable adverse weather condition, such as a snow storm.

Q. HAVE YOU COMPARED THE TRAFFIC FLOW RATES USED IN APPLICANTS' STUDIES TO VALUES USED OR OBSERVED BY STATE AND LOCAL GOVERNMENTS FOR OTHER PURPOSES?

A. Yes. Flow rates were compared with the 1983 hurricane evacuation, a study of Brunswick County by the N.C. Department of Transportation.

Q. WHAT WERE THE RESULTS OF THE COMPARISON?

A. A comparison review indicates the PRC Voorhees study to be very similar to the DOT study. This is evident by the fact that the PRC Voorhees study is based on an average of 1,200 vehicles per lane per hour, whereas the DOT used an average of 1,000 vehicles per lane per hour. However, the DOT study was based on adverse weather conditions. Both studies are consistent with the Highway Capacity Manual. (Highway Capacity Manual Highway Research Board, Special Report 87, National Academy of Sciences, National Research Council, Washington, D. C., 1965.) Voorhees assumes 1,200 vehicles per hour under normal road conditions and approximately 700 vehicles per

hour under worst case conditions. Thus, PRC's estimate is conservative when compared to 1,000 vehicles per hour used in the DOT study for adverse weather conditions.

Q. WITH REGARD TO INTERVENORS' ALLEGATION REGARDING THE ADVERSE IMPACT THE VOLUNTARY EVACUATION OF CHARLOTTE MIGHT HAVE ON THE EVACUATION OF THE EPZ, DO YOU BELIEVE THAT IT IS NECESSARY TO PROVIDE FURTHER MEASURES FOR PROTECTIVE ACTION WITHIN THE CHARLOTTE CITY LIMITS SUCH AS THE INSTALLATION OF SIRENS AND THE PREPARATION OF SPECIFIC PLANS AND PROCEDURES WITH REFERENCE TO A POSSIBLE RADIOLOGICAL EMERGENCY AT CATAWBA?

A. No. We believe the plan as written meets the scope and requirements of NUREG 0654. Any expansion or contraction of the existing EPZ is beyond the expertise of this office.

Q. DO YOU FEEL THAT THE EPZ IS ADEQUATE TO PROTECT THE PEOPLE OF GASTON AND MECKLENBURG COUNTIES WITHIN THE TEN-MILE EPZ?

A. Yes.

Q. DO YOU THINK THAT TO PROTECT ADEQUATELY THE NORTH CAROLINIANS WITHIN THE EPZ IT IS NECESSARY TO INCLUDE RESIDENTS OF CHARLOTTE IN THE EPZ?

A. No. I feel that our plan will adequately take care of our citizens. The proximity of Charlotte should not affect the situation.

Q. PLEASE STATE WHETHER YOU HAVE CONSIDERED THE MATTER OF PARENTS "GOING FIRST TO THE CHILDREN'S SCHOOLS TO PICK UP THEIR CHILDREN BEFORE EVACUATION," WHETHER YOU PLAN TO ENCOURAGE OR DISCOURAGE SUCH PRACTICES, WHAT DEGREE OF SUCCESS YOU ANTICIPATE IN REGARD TO ENCOURAGING OR DISCOURAGING PARENTS FROM DOING THIS, AND WHAT YOU ANTICIPATE THE PRACTICAL RESULT WILL BE.

A. It is the State's policy to call for an early evacuation of the schools. The EBS message would encourage the parents not to come to the school and would advise them where to pick up their children. As a practical matter, we cannot eliminate this practice. However, we do not feel it will have any major impact.

Q. PLEASE EXPLAIN HOW PERSONS WITHOUT THEIR OWN MEANS OF TRANSPORTATION WILL BE ABLE TO SECURE TRANSPORTATION IN THE EVENT OF AN ORDER TO EVACUATE. PLEASE INCLUDE IN YOUR RESPONSE BOTH ANTICIPATORY MEASURES AND MEASURES TO BE TAKEN AT THE TIME OF AN EVACUATION AND INCLUDE ARRANGEMENTS AS TO LOCATIONS, ETC., FOR PICKING UP SUCH PERSONS.

A. We anticipate that most people without their own means of transportation will be able to secure transportation from neighbors or friends. Planning includes the establishment of transportation pick-up points supported by publicly controlled buses. Selected pick-up points will be included in the appropriate EBS broadcast.

Q. PLEASE DESCRIBE THE ARRANGEMENTS THAT WILL BE MADE FOR EVACUATING HOSPITALS AND NURSING HOMES IN THE EPZ SHOULD SUCH BE REQUIRED.

A. State emergency medical services (EMS) has established agreements with all rescue squads and ambulance services to respond for evacuation of threatened hospitals and nursing homes.

Q. PLEASE STATE WHETHER ARRANGEMENTS WILL BE MADE TO PROVIDE TRANSPORTATION FOR CHILDREN AT DAY CARE FACILITIES AND IF SO, THE EXTENT OF THE NEED AND HOW IT WILL BE MET.

A. Our planning would provide publicly controlled transportation for children at day care facilities utilizing the staff at those facilities for the control and comfort of the children. Consideration would also be given to asking the Division of Facility Services to provide a medical technician to support the evacuation if deemed necessary.

Q. PLEASE STATE WHETHER YOU AGREE THAT SUBSTANTIAL NUMBERS OF PERSONS WILL REFUSE TO EVACUATE EVEN THOUGH ADVISED OR ORDERED TO DO SO BY COGNIZANT PUBLIC OFFICIALS.

A. I do not agree.

Q. ARE ADEQUATE BUSES AVAILABLE TO MOVE SCHOOL CHILDREN WITHOUT MULTIPLE BUS PICKUPS?

A. Yes. However, one lift evacuation will require additional buses from outside the EPZ. Mecklenburg County has 51 buses on site at schools (2,818 school population) within the EPZ. One lift evacuation will require at least 16 additional buses which are available at South Mecklenburg High School approximately 15 minutes away. Gaston County has three buses on site within the EPZ. Evacuation of the W.A. Bess Elementary School's 464 students and faculty will require at least an additional eight buses. These eight buses are programmed to come from Ashbrook High School outside the EPZ, which is less than 10 minutes away.

TESTIMONY OF THE STATE OF SOUTH CAROLINA
(W.M. MCSWAIN AND P.R. LUNSFORD) ON
EMERGENCY PLANNING CONTENTION 14 AND 15

Q. DO THE STATE PLANS CONTAIN INFORMATION REGARDING THIS CONTENTION?

A. Yes, Parts IV.B.6 and IV.B.8 of the S.C. Site-Specific Plan.

Q. ARE YOU FAMILIAR WITH THE EVACUATION TIME STUDY PREPARED BY PRC VOORHEES FOR THE APPLICANTS?

A. Yes. (WM, PL)

Q. DO YOU BELIEVE THAT THE TRAFFIC FLOW ESTIMATES USED IN THE TIME STUDY ARE TOO OPTIMISTIC?

A. I don't have any evidence myself that would cause me to disbelieve the estimates. (PL, WM)

Q. HAVE YOU COMPARED THE TRAFFIC FLOW RATES USED IN APPLICANTS' STUDIES TO THE VALUES USED OR OBSERVED BY THE STATE AND LOCAL GOVERNMENTS FOR OTHER PURPOSES?

A. No we have not, but during the development of the evacuation time study there were a lot of meetings that State and local officials were involved in. In each case, representatives of the State of South Carolina Highway Patrol and local law enforcement were present and involved in these meetings to inject their points of view. I presume they agreed with the time estimates and traffic flow estimate since I heard no dissenting views presented at those

meetings. These are the people that deal with it on a daily basis and my belief is that if they had an objection they would have voiced it. (PL, WM)

Q. ARE YOU SATISFIED THEN THAT THE TRAFFIC FLOW ESTIMATES USED IN THE APPLICANTS TIME STUDY ARE ADEQUATE BASED UPON INPUT PROVIDED BY THE HIGHWAY PATROL AND LOCAL LAW ENFORCEMENT IN THOSE MEETINGS?

A. Yes. (PL, WM)

Q. HOW, IF AT ALL, WOULD THE STATE USE THESE STUDIES?

A. Our expert in the Department of Health and Environmental Control uses those figures to decide whether to recommend evacuation or shelter. (PL)

Q. GIVEN THAT ANSWER, IS IT MORE IMPORTANT AND USEFUL TO YOU TO HAVE A RANGE OF REALISTIC ESTIMATES OF EVACUATION TIMES FOR A VARIETY OF NORMAL AND ADVERSE WEATHER CONDITIONS, OR, AS INTERVENORS CONTEND, SHOULD SUCH STUDIES BE BASED ON THE WORST CASE ASSUMPTION?

A. In our view, as the persons responsible for emergency planning for the State of South Carolina, it is better to have a wide range of estimates based on varying conditions rather than being constrained to do all of your decision-making based on a worst case estimate. (PL, WM)

Q. WOULD PARTIAL OR COMPLETE EVACUATION OF CHARLOTTE SERIOUSLY AFFECT THE ABILITY TO EVACUATE SOUTH CAROLINA RESIDENTS FROM THE EXISTING EPZ?

A. My view is that it would not since we are planning on doing the sheltering in South Carolina for South Carolina citizens. (PL, WM)

Q. DO YOU FEEL THAT SOUTHWEST CHARLOTTE NEEDS TO BE INCLUDED IN THE EPZ IN ORDER TO PROTECT EMERGENCY RESPONSES BY SOUTH CAROLINA EPZ RESIDENTS?

A. No. I feel the federal regulations are specific in so far as what the emergency planning zone is and that it is sufficient in this instance. That zone would be about ten miles. I have no evidence it would not be adequate. (PL, WM)

Q. EXPLAIN THE EXTENT TO WHICH SCHOOL BUSES WILL BE OR MAY BE USED AS PART OF THE EVACUATION PLAN.

A. We rely very heavily on school buses to assist in the evacuation. There are plans within York County and to the best of my knowledge each school district has its own plan for evacuation utilizing the buses. (PL, WM)

Q. THE INTERVENORS STATE THAT APPLICANTS' EVACUATION TIME ESTIMATES ERRONEOUSLY ASSUME QUICK RESPONSE BY SCHOOL BUSES AND MULTIPLE SCHOOL BUS TRIPS; THAT THE SCHOOL BUSES IN SOUTH CAROLINA ARE DRIVEN BY HIGH SCHOOL STUDENTS; THAT NO PUBLIC OFFICIAL WOULD DARE

TO SEND HIGH SCHOOL STUDENTS INTO AN EVACUATION ZONE TO TRANSPORT THOSE WITHOUT VEHICLES. DO YOU AGREE WITH THIS STATEMENT?

A. High school student drivers would be used for multiple trips only to pick up other students. The plan is not to use students to drive the buses for other purposes. Rather, York County's plan provides for volunteer firemen to man the buses for such trips. (WM)

Q. PLEASE STATE WHETHER YOU HAVE CONSIDERED THE POSSIBILITY OF PARENTS GOING FIRST TO THEIR CHILDRENS' SCHOOL TO PICK UP THEIR CHILDREN BEFORE EVACUATION. DO YOU PLAN TO ENCOURAGE OR DISCOURAGE SUCH PRACTICES? WHAT DEGREE OF SUCCESS DO YOU ANTICIPATE WITH REGARD TO ENCOURAGING OR DISCOURAGING PARENTS FROM DOING THIS? WHAT DO YOU ANTICIPATE THE PRACTICAL RESULT WILL BE?

A. We have considered at length the problem of parents going first to the children's schools to pick up their children. We have gone along with discouraging it. We plan to continue to discourage it, although I don't think we will have one hundred percent success. I do think the practical results would be that most of the parents, once they have been educated about what is going on, will abide by those instructions. (PL, WM)

Q. IN THE EVENT COUNTIES CALL ON YOU TO PROVIDE ASSISTANCE IN EVACUATING INDIVIDUALS WITHOUT TRANSPORTATION ABILITIES, WOULD YOU BE PREPARED TO PROVIDE SUCH ASSISTANCE?

A. Yes. We could do it from several courses: by taking school buses out of other counties; by using National Guard trucks; and by asking for volunteers. (PL, WM)

Q. DOES YOUR EXPERIENCE INDICATE THAT SUCH ASSISTANCE WOULD BE FORTHCOMING?

A. Yes, based on the recent experience of the tornado where the one area that I was working in called for volunteers for rescue squads, and volunteer firemen we got far more than we needed. I presume some rescue squads come with their vehicles. A lot of vehicles are equipped to handle non-ambulatory patients in hospitals. (WM, PL)

Q. WITH RESPECT TO PATIENTS IN HOSPITALS AND INDIVIDUALS IN NURSING HOMES, WOULD THE STATE BE PREPARED TO PROVIDE ASSISTANCE IF REQUESTED TO MOVE SUCH NONAMBULATORY INDIVIDUALS?

A. Yes, but I don't believe unless it was on a very large scale that the state resources would have to be used because York County has mutual aid agreements with the surrounding counties and the rescue squad effort is very well organized throughout the state in

that area. I believe if the county put the word out to its surrounding counties it would get sufficient help. (PL, WM)

Q. IN YOUR OPINION, WOULD YOU AGREE THAT A SUBSTANTIAL NUMBER OF PERSONS WOULD REFUSE TO EVACUATE EVEN THOUGH ADVISED OR ORDERED TO DO SO BY COGNIZANT PUBLIC OFFICIALS?

A. Having been born and raised in the Charlotte area and knowing a little about the people who live there I believe they are sensible and that the great majority of them would follow the instructions that they were given. (PL)

TESTIMONY OF GASTON COUNTY
(BOB E. PHILLIPS) ON
EMERGENCY PLANNING CONTENTIONS 14 AND 15

Q. DOES YOUR COUNTY PLAN CONTAIN INFORMATION RELATED TO THIS CONTENTION?

A. Yes, Part 2, Section IV.E and Part 2, figure 4 of the N.C. State Plan.

Q. EMERGENCY PLANNING CONTENTION 14 FOCUSES ON APPLICANTS' EVACUATION TIME STUDY. ARE YOU FAMILIAR WITH THE EVACUATION TIME STUDY AND ITS SUPPLEMENTS PREPARED BY PRC VOORHEES?

A. Yes.

Q. DO YOU BELIEVE THAT THE TRAFFIC FLOW ESTIMATES USED IN THE TIME STUDY ARE TOO OPTIMISTIC?

A. No, I don't.

Q. HOW, IF AT ALL, WOULD GASTON COUNTY MAKE USE OF THIS STUDY OR THE DATA THAT IT CONTAINS IN THE EVENT OF AN EMERGENCY?

A. We would expect to follow the Duke Power Company recommendation on action to take during an emergency: however the evacuation time study contains useful information.

Q. GIVEN YOUR ANSWER TO THE PRECEDING QUESTION, IS IT MORE IMPORTANT AND USEFUL TO YOU TO HAVE A RANGE OF REALISTIC ESTIMATES OF EVACUATION TIMES FOR A VARIETY OF NORMAL AND ADVERSE WEATHER CONDITIONS OR, AS INTERVENORS CONTEND, SHOULD SUCH STUDIES BE BASED ON WORST CASE ASSURPTIONS?

A. I disagree that only worst-case weather should be assumed.

Q. PLEASE EXPLAIN YOUR ANSWER.

A. We don't always have adverse weather conditions such as sleet, snow and ice, and an emergency has a greater chance of happening in normal weather than in worst-case weather.

Q. DO YOU HAVE ANY BASIS FOR QUESTIONING THE ADEQUACY OF THE PRC EVACUATION TIME STUDY?

A. No.

Q. HAVE YOU REVIEWED THE SUPPLEMENTAL PRC STUDY EXAMINING THE QUESTION OF VOLUNTARY EVACUATION BY SOME RESIDENTS IN CHARLOTTE AND ITS EFFECT ON TRAFFIC FLOW WITHIN THE EPZ?

A. Yes.

Q. IF SO, DO YOU HAVE ANY BASIS FOR QUESTIONING THE CONCLUSION OF THAT SUPPLEMENTAL STUDY?

A. No.

Q. HAVE YOU REVIEWED THE SUPPLEMENTAL PRC STUDY WHICH EXAMINES THE EFFECT OF THE EVACUATION OF THE ENTIRE CITY OF CHARLOTTE ON TRAFFIC FLOW WITHIN THE EPZ?

A. Yes.

Q. IF SO, DO YOU HAVE ANY BASIS FOR QUESTIONING THE CONCLUSIONS OF THAT SUPPLEMENTAL STUDY?

A. No.

Q. DO YOU BELIEVE THAT THE PRESENT EPZ IS ADEQUATE TO PROTECT THE PEOPLE OF GASTON COUNTY?

A. Yes.

Q. HAVE YOU HAD SOME EXPERIENCE IN GASTON COUNTY WITH EVACUATING PEOPLE?

A. Yes, we have had several incidents over the past few years -- chemical explosions, tanker truck accidents that we have had to evacuate people until we could get the situation under control.

Q. HAVE YOU HAD THE OPPORTUNITY TO OBSERVE HOW WELL PEOPLE FOLLOW INSTRUCTIONS THAT ARE GIVEN FOR THEIR OWN PROTECTION?

A. If they are simple and to the point, it is my experience that people will follow them.

Q. WILL THE EBS MESSAGES BE SIMPLE AND TO THE POINT?

A. Yes.

Q. WHAT KIND OF ARRANGEMENTS DO YOU HAVE FOR EVACUATION OF SCHOOLS IN THE EPZ? IF THERE IS AN EMERGENCY DURING THE SCHOOL DAY WOULD THE SCHOOL BUSES TAKE THE CHILDREN OUT?

A. Yes. There is one school in Gaston County which is in the EPZ, the W.A. Bess School on Beatty Road. It is right on the perimeter of the EPZ. We have 464 faculty and students in this school. We have 3 buses at the school that would begin transportation of students to the shelters. In addition, we have 8

buses designated for this at the nearby Ashbook High School, which is less than ten minutes' drive from Bess Elementary, but outside the EPZ. In the event of an accident, the drivers at Ashbrook would get in their buses, travel to the elementary school, load them up and transport the children to the shelters. Back-up will be provided by the Gaston County Central Transportation Service buses. The service has 6 to 15 passenger vans, and 7-12 passenger vans and one 22-passenger bus which are all radio equipped.

Q. WHO WOULD DRIVE THE SCHOOL BUSES THAT WOULD BE SENT TO BESS ELEMENTARY SCHOOL?

A. The high school drivers. The high school is out of the EPZ and they would be right on the perimeter. If it looked like we couldn't let them in there, then through radio communication, police would stop the buses.

Q. HOW WILL THE SCHOOL BUS DRIVERS BE NOTIFIED?

A. There is a radio receiver at the high school which we can call from the EOC.

Q. DO YOU HAVE ANY WAY OF PROVIDING ALTERNATE TRANSPORTATION MEANS FOR THE SCHOOL CHILDREN IF THE NEED SHOULD ARISE?

A. We have a central transport department which I already mentioned. They are all radio equipped and we could press these into operation should we have to.

Q. DO YOU HAVE ANY WAY OF PROVIDING ALTERNATE BUS DRIVERS?

A. I could use county employees, who are all adults, or put police officers or volunteer firemen in the school buses.

Q. HOW QUICKLY COULD YOU DO THAT?

A. I feel like real quick, within 15 or 20 minutes.

Q. ARE THERE ENOUGH BUSES AVAILABLE TO TRANSPORT ALL THE CHILDREN AT BESS SCHOOL AT THE SAME TIME, OR WILL MULTIPLE BUS PICK-UPS BE NECESSARY?

A. There are enough buses so that multiple bus pick-ups will not be necessary. Eight buses are delegated to Ashbrook High School to go to Bess School.

Q. CONTENTION 14 ALSO ASSERTS THAT PARENTS WILL PICK UP THEIR CHILDREN AT SCHOOL INSTEAD OF MEETING THE CHILDREN AT SHELTERS. DO YOU THINK THAT LARGE NUMBERS OF PARENTS WILL LIKELY GO DIRECTLY TO THE W.A. BESS ELEMENTARY SCHOOL (WHICH YOU HAVE SAID IS THE ONE SCHOOL IN THE EPZ) TO PICK UP THEIR CHILDREN RATHER THAN HAVE THEM EVACUATED ON THE BUS?

A. Myself along with the people from Duke Power have met with the PTA to explain to the people what we would do should a situation arise, and where their children will be sent in an emergency. We will encourage parents to either go to the shelter to pick up their children or stay with them at the shelter. Our first interest is the protection of our children and I feel like after we explain this to the parents and the PTA, I don't feel like we will have that problem. In addition, Duke has prepared a brochure especially for parents of school children.

Q. EVEN IF YOU DID HAVE SOME PARENTS GO PICK UP THEIR CHILDREN, GIVEN WHAT YOU SAY ABOUT THE LOCATION OF THE SCHOOL BEING RIGHT ON THE EDGE OF THE 10-MILE ZONE, WOULD THAT HAVE MUCH OF AN IMPACT ON THE TIME IT TAKES?

A. I don't feel like it would.

Q. DO YOU HAVE ANY REASON TO AGREE WITH THE INTERVENORS' ARGUMENT THAT IT MIGHT TAKE 33 HOURS TO COMPLETE EVACUATION OF THE EPZ?

A. Not in Gaston County.

Q. WHAT PROVISIONS ARE YOU MAKING IN YOUR PLAN FOR THE EVACUATION OF PERSONS WHO DON'T HAVE THEIR OWN MEANS OF TRANSPORTATION, WHEREVER THEY HAPPEN TO BE?

A. As I mentioned when you asked about hearing impaired people, our volunteer fire departments in these areas will start their fund drive in May. As they go door-to-door, they have been instructed to ask if somebody there in the EPZ does not have transportation or needs an ambulance to get out. This information will be communicated back to me after they make their fund drive. Also, the Duke Power Co. brochure directs people without transportation to call the Gaston County Emergency Management Department.

Q. SO IN EFFECT THIS WILL BE A CENSUS?

A. That is correct.

Q. WHAT ARRANGEMENTS WILL YOU MAKE FOR THOSE PEOPLE OR HOUSEHOLDS WHICH ARE WITHOUT VEHICLES AT SOME TIMES?

A. Our police officers and the central transport service will go pick them up and take them out of the EPZ.

Q. IS THERE A PUBLIC TRANSIT SYSTEM IN GASTON COUNTY?

A. The only one is in Gastonia.

Q. IS THERE A PUBLIC TRANSPORTATION SYSTEM WITHIN THE EPZ PART OF GASTON COUNTY?

A. No.

Q. WOULD THIS SUGGEST ANYTHING TO YOU ABOUT HOW PEOPLE ORDINARILY GET AROUND?

A. Using their own vehicles, or in friend's, relatives' or neighbors' vehicles.

Q. WOULD THAT SUGGEST ALSO THAT THE NUMBERS OF PEOPLE TOTALLY WITHOUT ANY KINDS OF PRIVATE TRANSPORTATION AVAILABLE TO THEM WOULD BE REASONABLY SMALL?

A. That's my feeling, yes.

Q. ARE THERE ANY HOSPITALS OR PRISONS IN THE GASTON COUNTRY PART OF THE EPZ?

A. There are no hospitals or prisons.

Q. ARE THERE ANY DAY CARE CENTERS IN THE GASTON COUNTY PART OF THE EPZ?

A. I have one day care center that is right on the borderline, almost like the same situation as Bess Elementary School. It can have between 60 and 90 children that would have to be taken out. I have met with the officials of this day care center to discuss this problem. They had one bus which would not be capable of moving all of them, and the Duke Power Company school brochure has gone out to all of the parents down there. These children would be taken out with our central transportation vans and taken to the shelters and the parents will be notified which shelter they will be at so that they could pick them up.

Q. IS THERE A NURSING HOME IN GASTON COUNTY?

A. I've got one nursing home which has maybe four or five residents and this is all.

Q. DO THEY HAVE THEIR OWN MEANS OF TRANSPORTATION?

A. Right. They would be taken out in private cars.

Q. DO YOU THINK THAT THERE WILL BE A SUBSTANTIAL NUMBER OF PEOPLE THAT WOULD REFUSE TO EVACUATE WHEN AN ORDER TO EVACUATE IS GIVEN?

A. I don't feel so in Gaston County. If we give them the warning, I feel like we have done our job. But I don't feel like there will be any large number that would refuse to leave.

TESTIMONY OF MECKLENBURG COUNTY
(LEWIS WAYNE BROOME) ON
EMERGENCY PLANNING CONTENTIONS 14 AND 15

Q. DOES YOUR COUNTY PLAN PROVIDE INFORMATION WHICH ADDRESSES THIS CONTENTION?

A. Yes, Part 3, Section IV.E and Part 3, figure 4 of the N.C. State Plan.

Q. EMERGENCY PLANNING CONTENTION 14 FOCUSES ON APPLICANTS' EVACUATION TIME STUDY. ARE YOU FAMILIAR WITH THIS STUDY?

A. Yes.

Q. DO YOU BELIEVE THAT THE TRAFFIC FLOW ESTIMATES PREPARED BY PRC VOORHEES USED IN THE STUDY ARE TOO OPTIMISTIC?

A. In actuality, I think the Voorhees count is somewhat conservative. I think that the roads that PRC Voorhees looked at have also been evaluated by the North Carolina Department of Transportation. Although I have not seen the DOT study, it is my understanding that its estimate shows higher volume for those roads because of the six or seven primary roads identified as evacuation routes. All of them are good roads, one of them is an interstate highway. I think that the study is conservative from the standpoint of evacuation time and I think it can actually be done in less time.

Q. HOW MUCH OF A DIFFERENCE ARE WE TALKING ABOUT?

A. Probably a 10 to 15 percent variation between what DOT is indicating and what PRC Voorhees is indicating.

Q. HOW, IF AT ALL, WOULD CHARLOTTE-MECKLENBURG GOVERNMENT OFFICIALS USE THE PRC STUDY? WOULD THEY RELY ON IT IN DECIDING BETWEEN EVACUATION AND OTHER PROTECTIVE ACTION?

A. It would be one factor in weighing evacuation versus sheltering.

Q. DO YOU AGREE WITH THE INTERVENORS THAT THE EVACUATION TIME ASSESSMENT SHOULD ASSUME WORST CASE WEATHER CONDITIONS SUCH AS SNOW AND ICE ON THE ROADS?

A. No. I don't think so. It should assume a range of normal and adverse conditions. In the event of snow and ice, sheltering may be the recommended protective action.

Q. HAVE YOU REVIEWED THE SUPPLEMENTAL PRC STUDY WHICH EXAMINES THE QUESTION OF VOLUNTARY OR "SHADOW" EVACUATION BY SOME CHARLOTTE RESIDENTS AND ITS EFFECT ON TRAFFIC FLOW WITHIN THE EPZ?

A. Yes.

Q. DO YOU ACCEPT THE CONCLUSION OF THIS SUPPLEMENTAL STUDY ON "SHADOW" EVACUATION?

A. Yes, I have seen the report and I agree with it to the extent that I think a large percentage of the population of the City of Charlotte would have to voluntarily evacuate before it would cause unusual delay with the traffic flow coming out of the EPZ.

Q. EMERGENCY PLANNING CONTENTION 14 ALSO CONTENDS THAT THE EVACUATION TIME ESTIMATES ERRONEOUSLY ASSUME QUICK RESPONSE BY SCHOOL BUSES AND MULTIPLE SCHOOL BUS TRIPS. DO YOU HAVE ANY COMMENT ON WHETHER THE ESTIMATES ARE ERRONEOUS IN THIS RESPECT?

A. I do not think they are erroneous. The draft school plan distributed for review indicates that there would be enough buses to evacuate all the students on a one trip basis without anybody making a round trip. There are 51 buses and 2818 students, assuming that every student is in school.

Q. WILL THE RESPONSE BE AS RAPID AS THE STUDY ASSUMES?

A. I think so because the buses are for the most part a maximum of 30 minutes away and a minimum of five minutes away, not counting the buses that are physically located at the schools within the 10 mile EPZ. The drivers will be alerted through the tone alert radio system provided at the schools. Also, a two-way local law enforcement frequency is available by dispatching a law enforcement vehicle to each school. I don't think that the response would be

slow. I think it would be very active and I think that the procedure once it's finalized and agreed upon will be very viable, very workable.

Q. THE QUESTION OF HOW MANY HOUSEHOLDS ARE WITHOUT VEHICLES, EITHER AT ALL TIMES OR DURING CERTAIN TIMES OF THE DAY IS THE SUBJECT OF FURTHER STUDY. HOWEVER, WHAT EFFECT WOULD IT HAVE ON THE MECKLENBURG COUNTY EVACUATION PLAN IF AS MANY AS 10 PERCENT OF THE HOUSEHOLDS WERE WITHOUT CARS DURING THE WORK DAY?

A. If you look at 10 percent of the permanent population that has been identified in the 10-mile EPZ in Mecklenburg County, you are looking at, on a conservative basis, about 700 people. With the transportation capability that we have in Charlotte/Mecklenburg, which would include the Department of Transportation city buses (approximately 100 buses) as primary source and the school bus system (627 buses) as backup, then I see no problem at all in evacuating that population from the EPZ.

Q. WOULD HIGH SCHOOL STUDENT SCHOOL BUS DRIVERS BE USED IN THE CHARLOTTE-MECKLENBURG COUNTY AS PART OF THE EVACUATION PLAN?

A. Student drivers drive the buses in North Carolina. However, the present draft version of the school plan will allow the student bus drivers only to leave the

area with a load of passengers. It will not allow a student driver to reenter the EPZ for evacuation of transportation dependent people. Adult bus drivers, emergency workers driving the buses will be allowed back in there but not students.

Q. WHERE WILL THESE BACKUP BUS DRIVERS, THE ADULT EMERGENCY WORKERS, COME FROM?

A. These backup drivers would be fire department personnel not assigned a specific function, or police department personnel, or emergency workers from city and county government. It could be any one of a number of sources up to and including active members of the fire or police station, members of the National Guard or the Air National Guard.

Q. HOW WILL THESE BACKUP DRIVERS BE NOTIFIED AND HOW LONG WILL THIS NOTIFICATION TAKE?

A. To some extent the emergency workers will be in place with regard to certain administrative staff within an EOC of all city and county departments. We would have auxiliaries - we would have approximately 800 volunteer firemen that would be available and they could be notified via phone. Also, the volunteer firemen have pagers or monitors that they can be notified on. Individual organizations have alerting notifications listings that they maintain as part of their own internal procedures and we would just

notify the department head or the representative in the EOC to contact X number of people so that they could come in and mobilize to drive vehicles or assist in whatever matter is necessary.

Q. WILL IT BE NECESSARY TO HAVE SOME PROCEDURES FOR GETTING THE BACKUP DRIVERS TO THE BUSES?

A. There is a pool at the Department of Transportation garage where these buses are maintained. The drivers would be directed there. In the event access to school buses is necessary, and such are at a residence at night, the garage for the city transportation system would serve as a staging area; emergency drivers would congregate there and would be driven to the school buses, the location of which is known to the Department of Transportation. The Department has duplicate keys.

Q. EMERGENCY PLANNING CONTENTION 14 ALSO ARGUES THAT THE TIME STUDY FAILS TO ACCOUNT FOR PARENTS GOING TO THEIR CHILDREN'S SCHOOLS TO PICK UP THEIR CHILDREN BEFORE EVACUATION. DO YOU BELIEVE THAT THIS WILL OCCUR?

A. No. I don't think so in substantial numbers.

Q. WHY NOT?

A. I think through the education process that parents will be made aware that a school plan is in place for the children to be taken to shelters with their

teachers and that the children are going to be evacuated on a very conservative basis (that is, if there is any indication at all that it might be needed). We will explain that it would be unnecessary for parents to try and get back into the 10-mile EPZ, drive to a school, and pick up their child. We will explain to them that they are jeopardizing the health and safety of their child as opposed to doing any good.

Q. HAVE EFFORTS BEEN MADE BY THE CHARLOTTE-MECKLENBURG SCHOOLS TO EXPLAIN TO PARENTS WHAT THEY SHOULD DO IN THE EVENT OF A RADIOLOGICAL EMERGENCY WHILE SCHOOL IS IN SESSION?

A. Yes. Duke has published a brochure for school children and parents as to actions to be taken in an emergency. I am not sure of the efforts that the school system itself nas made with regard to explaining the brochure and providing additional information to support the brochure. I would assume that they would have a program that would be developed to respond to these areas in question.

Q. HAVE SIMILAR EFFORTS BEEN MADE IN THE PRIVATE SCHOOLS?

A. There are no private schools in this area of Mecklenberg County.

Q. DO YOU THINK THAT EVACUATION IN THE EPZ WOULD TAKE AS LONG AS 33 HOURS, AS INTERVENORS CONTEND?

A. I do not think it would take nearly that length of time. We in the community of Charlotte-Mecklenburg traverse the county routinely. We bring about eighty to one-hundred thousand people downtown every day over a period of about two hours and we evacuate them in the evening when they quit work in about the same time frame.

Q. DO YOU THINK THAT PRC VOORHEES ESTIMATES ARE CLOSER TO THE MARK?

A. I think they are more realistic.

Q. DO YOU HAVE PROCEDURES FOR EVACUATING HOSPITALS IN MECKLENBURG COUNTY?

A. Mecklenburg County has no hospital within the 10-mile EPZ.

Q. WHAT ARRANGEMENTS WILL BE MADE TO EVACUATE NURSING HOMES IN MECKLENBURG COUNTY THAT ARE WITHIN THE 10-MILE EPZ?

A. There is only one nursing home within the EPZ, with a population of approximately 12 patients. It is my understanding that it can handle its own transportation needs. If they request assistance, we will provide it.

Q. WHAT ARRANGEMENTS HAVE BEEN MADE TO EVACUATE CHILD DAY-CARE CENTERS IN MECKLENBURG COUNTY?

A. We have contacted all of the day-care facilities. To date, only one has indicated that it would need a bus to assist in transporting the children. Such will be provided.

Q. PLEASE EXPLAIN HOW PEOPLE WITHOUT THEIR OWN MEANS OF TRANSPORTATION WOULD BE ABLE TO SECURE TRANSPORTATION IN THE EVENT THAT EVACUATION BECAME NECESSARY.

A. First of all we would do the same thing that we did at McGuire which was to go ahead and assign or predesignate a certain number of buses to specific locations so that if people did not have their own transportation, it would be a minimal distance between their home and a transportation point. They could also contact the office or contact the emergency numbers that they normally contact for assistance, in which case we could provide it for them at that time.

Q. IF THE LOCAL TELEPHONE SYSTEM BECOMES OVERLOADED, WHAT ALTERNATIVE MEANS ARE AVAILABLE TO NOTIFY PERSONS WITHOUT VEHICLES OF AVAILABLE TRANSPORTATION?

A. The primary means would be the Emergency Broadcasting System where we would activate the EBS and broadcast the message. In addition, we could use the supplemental system whereby every road in the EPZ would be covered by a emergency response vehicle.

Q. DO YOU AGREE THAT THERE MAY BE SOME PEOPLE WHO WILL REFUSE TO EVACUATE EVEN IF ORDERED TO DO SO BY PUBLIC OFFICIALS?

A. Yes.

Q. DO YOU THINK THAT WILL BE A LARGE COMPONENT OF THE POPULATION?

A. No. I think it will be very small -- less than one-half of one percent would be my estimate.

Q. DO YOU THINK THE LICENSING BOARD SHOULD BE CONCERNED ABOUT THIS SEGMENT OF THE POPULATION?

A. I don't think the Licensing Board can do anything about it. Some people just won't cooperate. They just won't go! I think a case in point would be Truman during the Mount St. Helen eruption. He just refused to go. We cannot physically pick somebody up out of their home and move them. I think that is a bad approach. It is my understanding that Mecklenburg County would not force anyone out of their home.

Q. DO YOU HAVE ANY COMMENT ON THE EFFECT THAT PANIC OR IRRESPONSIBLE BEHAVIOR MIGHT HAVE ON SUCCESSFUL PROTECTIVE ACTION?

A. I think that panic is a potential problem in any disastrous situation but does not exist to the extent that most people think it does. And I think that existing data indicates that that does not take

place. Hurricanes are an example. The situation that we had here in Mecklenburg County/City of Charlotte in 1982 with the chemical fire is an example. Panic is not one of the things that we had to concern ourselves with.

TESTIMONY OF YORK COUNTY
(PHILLIP STEVEN THOMAS) ON
EMERGENCY PLANNING CONTENTIONS 14 AND 15

Q. EMERGENCY PLANNING CONTENTION 14 FOCUSES ON THE EVACUATION TIME STUDY THAT WAS PREPARED BY PRC VOORHEES FOR DUKE POWER COMPANY. ARE YOU FAMILIAR WITH THIS STUDY?

A. Generally, yes.

Q. HOW, IF AT ALL, WOULD YORK COUNTY GOVERNMENT MAKE USE OF THAT STUDY OR THE DATA THAT IT CONTAINS IN THE EVENT OF AN EMERGENCY?

A. We would use that along with other data in weighing information we receive from the utility as to evacuation and/or in-place sheltering.

Q. GIVEN THE ANSWER TO THE PRECEDING QUESTION, IS IT MORE IMPORTANT AND USEFUL TO YOU TO HAVE A RANGE OF REALISTIC ESTIMATES OF EVACUATION TIMES FOR A VARIETY OF NORMAL AND ADVERSE WEATHER CONDITIONS OR, AS INTERVENORS CONTEND, SHOULD SUCH STUDIES BE BASED ON WORST-CASE ASSUMPTIONS?

A. It is more important and useful to have a range of realistic estimates.

Q. PLEASE EXPLAIN YOUR ANSWER.

A. Any time you can use realistic assumptions, they are more useful in planning.

Q. DO YOU HAVE ANY BASIS FOR QUESTIONING THE ADEQUACY OF THE PRC EVACUATION TIME STUDY?

A. No.

Q. HAVE YOU REVIEWED THE SUPPLEMENTAL PRC STUDY EXAMINING THE QUESTION OF VOLUNTARY EVACUATION BY SOME RESIDENTS IN CHARLOTTE AND ITS EFFECT ON TRAFFIC FLOW WITHIN THE EPZ?

A. No.

Q. HAVE YOU REVIEWED THE SUPPLEMENTAL PRC STUDY WHICH EXAMINES THE EFFECT OF EVACUATION OF THE ENTIRE CITY OF CHARLOTTE UPON TRAFFIC IN THE EPZ?

A. No.

Q. DO YOU FEEL THAT THE CURRENT 10-MILE EPZ IS ADEQUATE TO PROTECT THE PEOPLE OF YORK COUNTY?

A. Yes.

Q. DO YOU FEEL THAT TO ADEQUATELY PROTECT THE YORK COUNTY POPULATION IT IS NECESSARY TO EXPAND THE 10-MILE EPZ TO INCLUDE RESIDENTS OF CHARLOTTE?

A. No. I feel our plan will adequately take care of our citizens and the proximity of Charlotte should not affect the situation.

Q. IS THERE A SECTION OF THE YORK COUNTY EMERGENCY OPERATIONS PLAN THAT DEALS WITH THE ISSUES RAISED IN CONTENTION 14?

A. Yes. Annexes C, L, K and Q of the York County Emergency Operations Plan.

Q. EMERGENCY PLANNING CONTENTIONS 14 AND 15 ALSO FOCUS ON THE USE OF SCHOOL BUSES IN EVACUATION OF THE EPZ. WOULD SCHOOL BUSES BE USED AS A PART OF THE YORK COUNTY RESPONSE TO A RADIOLOGICAL EMERGENCY?

A. Yes.

Q. HOW WOULD THEY BE USED?

A. They would be used not only to transport the school children if school is in session; but would also be utilized to transport other transportation-dependent individuals.

Q. WOULD HIGH SCHOOL STUDENT DRIVERS BE USED TO TRANSPORT SCHOOL CHILDREN?

A. Yes.

Q. IF SO, EXPLAIN HOW THESE STUDENT DRIVERS WOULD BE NOTIFIED DURING SCHOOL HOURS.

A. During school hours, student drivers would be advised by school officials. Each school district has operating procedures to get buses rolling.

Q. IF A RADIOLOGICAL EMERGENCY ARISES OTHER THAN ON A SCHOOL DAY WHO WILL THE BUS DRIVERS BE AND HOW WILL THEY BE NOTIFIED?

A. In that particular situation, we will be calling on our volunteer firemen to act as the drivers. They will be notified by contacting the volunteer fire department through the fire marshall's office, which is one of the agencies that has a representative in

the EOC. They would sound the notification system that they are normally notified through. They would be told by a voice transmittal pager to report to a specific location where, depending on the situation, they would be brought together collectively to pick up the buses at a specific site or taken collectively as a group and let off one by one at the buses, which might be at the homes of the student drivers.

Q. ARE YORK COUNTY'S VOLUNTEER FIREMEN USUALLY NOTIFIED BY A PAGER OR DEVICE WHICH ALLOWS VERBAL COMMUNICATION WITH THE VOLUNTEER FIREMEN?

A. There is a paging system that they use where they can have verbal communication, one way communication, or messages given to them to report or to call, depending upon that situation.

Q. WOULD THE STUDENT BUS DRIVERS ONLY MAKE ONE TRIP OUT OF THE EPZ OR WOULD THEY GO BACK INTO THE EPZ TO MAKE MULTIPLE TRIPS?

A. Some school districts in York County will utilize student bus drivers to make more than one trip if it is necessary to do so to evacuate their school. They will not make more than one trip to pick up any other transportation dependent individuals. School district 3 will also use a staging area concept to move children within the EPZ to other schools either

on the perimeter or outside the EPZ where parents may pick children up. If the children are not picked up, they will then be moved to a shelter.

Q. WHO WOULD PICK UP OTHER TRANSPORTATION DEPENDENT INDIVIDUALS?

A. Volunteer firemen will be assigned this function.

Q. HAVE YOU CONSIDERED THE POSSIBILITY THAT SOME PARENTS MAY GO TO THE CHILDREN'S SCHOOLS TO PICK THEM UP BEFORE EVACUATING? DO YOU PLAN TO ENCOURAGE OR DISCOURAGE PARENTS FROM DOING THAT?

A. Yes, we have considered that and we plan to discourage parents.

Q. HOW WILL YOU DISCOURGE PARENTS FROM DOING SO?

A. We see that as an educational process. The school districts will provide information to the parents so that they understand what will be taking place during such an emergency and that students will be taken to a certain site outside the EPZ and should be picked up there. Duke Power Company has prepared a brochure for this specific purpose. I feel this brochure will have a positive influence.

Q. CAN YOU EXPLAIN BRIEFLY WHY YOU WOULD DISCOURAGE PARENTS FROM GOING TO THE SCHOOL TO PICK UP THEIR CHILDREN?

A. In our opinion, it would create a traffic bottleneck and it would release some students that are under the care of the school district. Students that are in school and are being reported as being present that day would have to be released to their parent's custody, which would slow down the group evacuation of the school children. In addition, allowing parents to do this would clog the road with additional traffic coming in and backing up waiting to load and unload, etc.

Q. DO YOU ANTICIPATE SUCCESS IN DISCOURAGING PARENTS FROM PICKING UP THEIR CHILDREN AT SCHOOL RATHER THAN AT A SHELTER?

A. We would hope for the best, but we would recognize it would probably be less than totally successful. Accordingly, in an emergency we will be particularly watchful for traffic congestion around schools and will provide law enforcement authorities as necessary.

Q. YOU HAVE STATED EARLIER THAT SCHOOL BUSES WOULD ALSO BE USED TO PROVIDE TRANSPORTATION FOR THOSE WHO MIGHT BE WITHOUT THEIR OWN MEANS OF TRANSPORTATION. IS THAT RIGHT?

A. That is correct.

Q. PLEASE EXPLAIN HOW PERSONS WHO ARE TRANSPORTATION-DEPENDENT WOULD BE ABLE TO GET IN CONTACT WITH YOU SO THAT YOU KNOW THAT THEY NEED SCHOOL BUS TRANSPORTATION.

A. This has already been done to some extent through the Duke Power brochure, which tells people to call in and identify themselves and their location if they have a need for transportation. During an event as it was taking place, we would be utilizing the EBS system to identify just that. If a particular zone was being evacuated, we would let people know over the EBS how many school buses or vans we had in the area, where they would be located, if they were primary pickup points, or to what extent their involvement would be in bringing additional clothes, or suitcases, etc. This kind of information would be given to them over the EBS.

Q. ARE THERE HOSPITALS, NURSING HOMES, PRISONS, DAY CARE CENTERS OR OTHER INSTITUTIONAL FACILITIES IN YORK COUNTY?

A. Yes. There are 2 hospitals, 1 prison, 5 detention centers, 7 nursing homes and 26 day care centers.

Q. DESCRIBE THE ARRANGEMENTS THAT WOULD BE MADE FOR EVACUATING YORK COUNTY HOSPITALS AND OTHER INSTITUTIONS SUCH AS NURSING HOMES IN THE EPZ SHOULD THAT BECOME NECESSARY.

A. We have been in contact with all of the administrators of the facilities you have mentioned, the hospitals, nursing homes, etc., and found out from them the number of patients they have typically that would require ambulances or special types of transportation. We have matched up the number of vehicles and personnel we have with their need. In addition to that, we would have vans and school buses that we would dedicate to remove them from the 10-mile EPZ. We also have the ability to call on other counties and hospitals for additional support to evacuate these facilities.

Q. DO YOU FEEL THESE ARRANGEMENTS ARE ADEQUATE?

A. Yes.

Q. WHAT ARRANGEMENTS WILL BE MADE TO PROVIDE TRANSPORTATION FOR CHILDREN AT DAY CARE FACILITIES IF THERE ARE SUCH THAT DO NOT HAVE ADEQUATE TRANSPORTATION OF THEIR OWN?

A. As with the nursing homes and hospitals, we have been in contact with the supervisors and administrators of the day care centers and found out exactly what their needs are for evacuation purposes, such as whether they have enough vehicles or if they need additional vehicles or if they want to depend solely upon us for their transportation in this particular case. We are prepared to furnish the necessary support.

Q. DO YOU FEEL THESE ARRANGEMENTS ARE ADEQUATE?

A. Yes.

Q. HAVE YOU MADE ARRANGEMENTS FOR BACKUP BUS DRIVERS?

A. Yes. Presently as a resource we have about a dozen regular school bus drivers (18 or older). Our primary source for backup drivers would be our rural fire department. We have 573 rural firemen presently in our system. We have 24-50 people in our public works department and other county departments we would call on to drive buses going back into the EPZ. We have been offered by the Red Cross a list of possible back up drivers for our buses. We feel like this is more than adequate to man our buses to go back in for an entire 10 mile EPZ evacuation.

Q. HOW WILL SUCH BACK-UP DRIVERS BE INSTRUCTED AS TO THEIR DUTIES?

A. Procedures will be in place that specify action to be taken. These procedures will provide for the contingency that school buses may be at the regular driver's home at night.

Q. HOW MANY SCHOOL CHILDREN WILL HAVE TO BE MOVED IN THE EVENT OF AN EVACUATION DURING SCHOOL HOURS?

A. Approximately 21,000.

Q. HOW MANY SCHOOL BUSES WOULD BE INVOLVED IN SUCH AN EVACUATION?

A. We have 239 buses that we would be manning for this purpose. An additional 400 outside of York County could be called on as a resource if we need them from other counties in South Carolina.

Q. DO YOU FEEL THAT THE NUMBER OF BUSES IS ADEQUATE TO MOVE SCHOOL CHILDREN?

A. Based upon the capacity of the school buses, the location of the schools and the number of children, I do feel the number of buses is adequate. In some instances multiple trips may be necessary, but this will not detract from the timely evacuation.

Q. DOES YOUR COUNTY HAVE ANY EXPERIENCE WITH ACTUAL EVACUATIONS FOR ANY KIND OF EMERGENCY?

A. Yes, we have.

Q. COULD YOU GIVE US SOME EXAMPLES?

A. As recently as Christmas Day 1983, we had a nursing home have a problem with its sprinkler system that required the evacuation of the entire nursing home and I believe it was in the neighborhood of 100 or so residents that had to be evacuated. This was during the Director of Emergency Preparedness Agency's illness and the backup personnel were out of town, but everybody filled in their slot accordingly. It went off beautifully: they were evacuated either to a local church as a shelter site, a hospital, or homes with their families and it took about four hours

under very adverse conditions. It worked real well. That was the third time we have had an experience like that in a nursing home evacuation.

Q. WAS THERE A NEED FOR THE COUNTY GOVERNMENT TO BECOME DIRECTLY INVOLVED IN DIRECTING THIS EVACUATION?

A. Yes, the county government was responsible for the entire coordination.

Q. WHO WAS IN CHARGE OF THIS EXERCISE, IN VIEW OF THE ILLNESS OF THE DIRECTOR OF EMERGENCY PLANNING?

A. Our fire marshal.

Q. HAD YOU PROVIDED FOR A CHAIN OF COMMAND WITH BACKUPS FOR EACH JOB?

A. Yes, that is correct.

Q. HAS THE COUNTY HAD ANY OPPORTUNTY TO OBSERVE HOW WELL PEOPLE FOLLOW INSTRUCTIONS THAT ARE GIVEN FOR THEIR OWN PROTECTION IN THE COURSE OF THESE EVACUATIONS?

A. Yes, we have. Using the nursing home evacuation as a good example, it went very well. Everyone that was involved understood the seriousness of the situation with the elderly people in the cold weather and the possibility of a lot of patients being dampened by the sprinkler system. Due to the obvious potential medical problems and the need for speed, everyone, including the evacuees, followed directions and performed well. They recognized who was in charge

and took directions and followed through on all directions given. All things considered, it was very successful.

Prepared for:
Duke Power Company

Catawba Nuclear Station Evacuation Analysis

Evacuation Time Estimates

Final Report

PRC Voorhees
1500 Planning Research Drive
McLean, Virginia 22102

April 1983

CATAWBA NUCLEAR STATION
EVACUATION ANALYSIS

EVACUATION TIME ESTIMATES

Prepared for:

DUKE POWER COMPANY

by

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April 1983

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CHAPTER I. INTRODUCTION

PURPOSE OF THIS STUDY

The study summarized in this report was made to determine the time needed to evacuate the population of the Plume Exposure Pathway Emergency Planning Zone (EPZ) surrounding the Catawba Nuclear Station in York County, South Carolina.

LOCATION OF THE CATAWBA NUCLEAR STATION

The Catawba Nuclear Station is located on Wylie Lake in northeastern York County, South Carolina (Figure 1). The Catawba Station is 6 miles north of Rock Hill, South Carolina and 17 miles southwest of downtown Charlotte, North Carolina.

STATE AND LOCAL OFF-SITE PREPAREDNESS PLANNING

State and local preparedness plans have been developed by the State of South Carolina and York County, the only South Carolina county within the EPZ. Similarly, North Carolina and the two North Carolina counties in the EPZ (Gaston and Mecklenburg) have preparedness plans. These plans provide for recources and manpower needed for a successful evaucation of the area, specifically:

- Detailed evacuation plans, addressing notification, routing, manpower and resource requirements, confirmation of evaucation and transportation of non-vehicle-owning population (schools, households without vehicles, and persons in institutions)
- Communication within the EPZ, and between the plant, state agencies, the counties, and local governments within the EPZ
- Local (city and town) mobilization and decisionmaking
- Local notification procedures, including siren, public address, and telephone notification, procedures for radio and television information
- Detailed traffic control plan

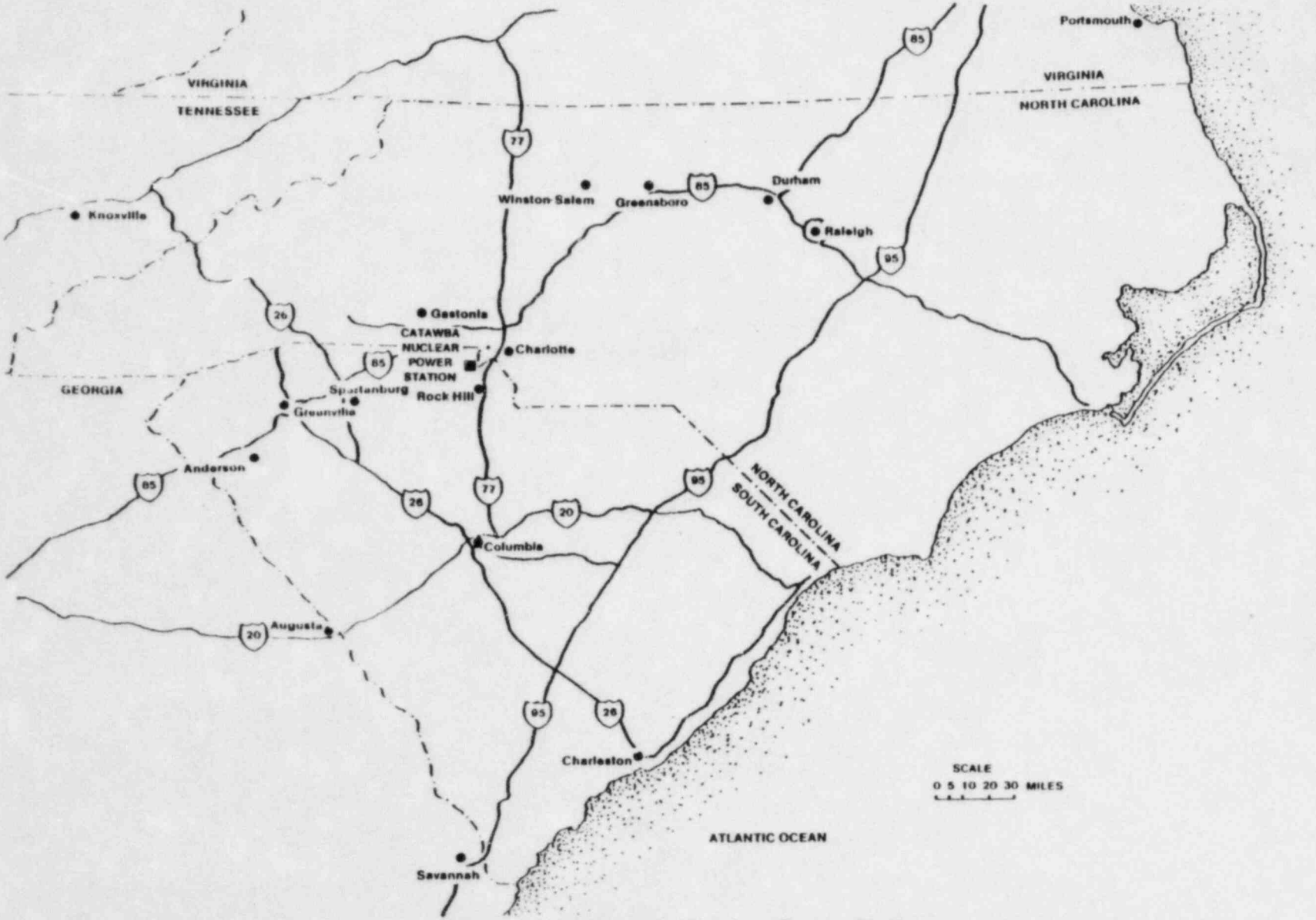

Figure 1. Location of the Catawba Nuclear Power Station

- Transportation for the school population
- Transportation for non-vehicle-owning population and persons in institutions
- Transportation for non-ambulatory population
- Reception centers[1] and procedures for clearing evacuated population through them
- Shelters[1] for temporary lodging of evacuees
- Manpower (traffic control, supervisory, security, and emergency services) for conducting the evacuation

SUMMARY OF THE METHOD FOR ESTIMATING EVACUATION TIMES

In developing these evacuation time estimates, the population is divided into three segments: (1) permanent resident population (2) transient population and, (3) special facility population. For each population segment, a series of discrete action steps is identified, and the completion time for each step determined.

The time for completing each step is then linked together statistically to yield the total evacuation time for that population segment.

The apparent advantage of this method is that travel time is estimated for each individual step of the evacuation sequence (for which data are more readily available) rather than for the entire evacuation as a single entity (for which data are non-existent).[2]

Two cases of evacuation time estimates are made: (1) for fall/winter weekday under normal weather conditions and, (2) a winter weekday under severe weather conditions.

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1. In South Carolina, reception centers and shelters are separate facilities. In North Carolina, the reception and shelter functions are combined into a single facility, designated as "shelters." In North Carolina, the terms "reception centers" and "shelters" are synonomous.
2. NUREG 0654, Appendix 4.

SUMMARY OF EVACUATION TIMES

Under normal weather and for the critical time period (weekday during school hours), the maximum evacuation time for the Catawba EPZ is four hours. Times are measured from the beginning of notification until all the population voluntarily leaving the EPZ has done so. The critical component in the evacuation is the permanent resident population; all other segments of the population can be evacuated in less than four hours.

Under severe weather conditions (winter storm) the evacuation time for the Catawba EPZ is 6 hours and 15 minutes, 156 percent of the time required for evacuation under normal weather conditions.

In normal weather, traffic congestion will occur on 11 of the 18 major routes out of the area. At the location of maximum congestion, congestion will occur for 2 hours and 15 minutes. In the worst case, a vehicle could spend 60 minutes in traffic delays when evacuating by that route.

On 8 of the 11 routes experiencing traffic congestion, the congestion will end before all permanent resident population has completed preparation to leave home. On these routes, evacuation time is not determined by traffic congestion but, rather, by the time needed to prepare for leaving home.

On 3 of the 18 routes, traffic congestion will continue until after the time that all the permanent resident population has completed preparations to leave home. On these routes, the maximum evacuation time is determined by the traffic congestion.

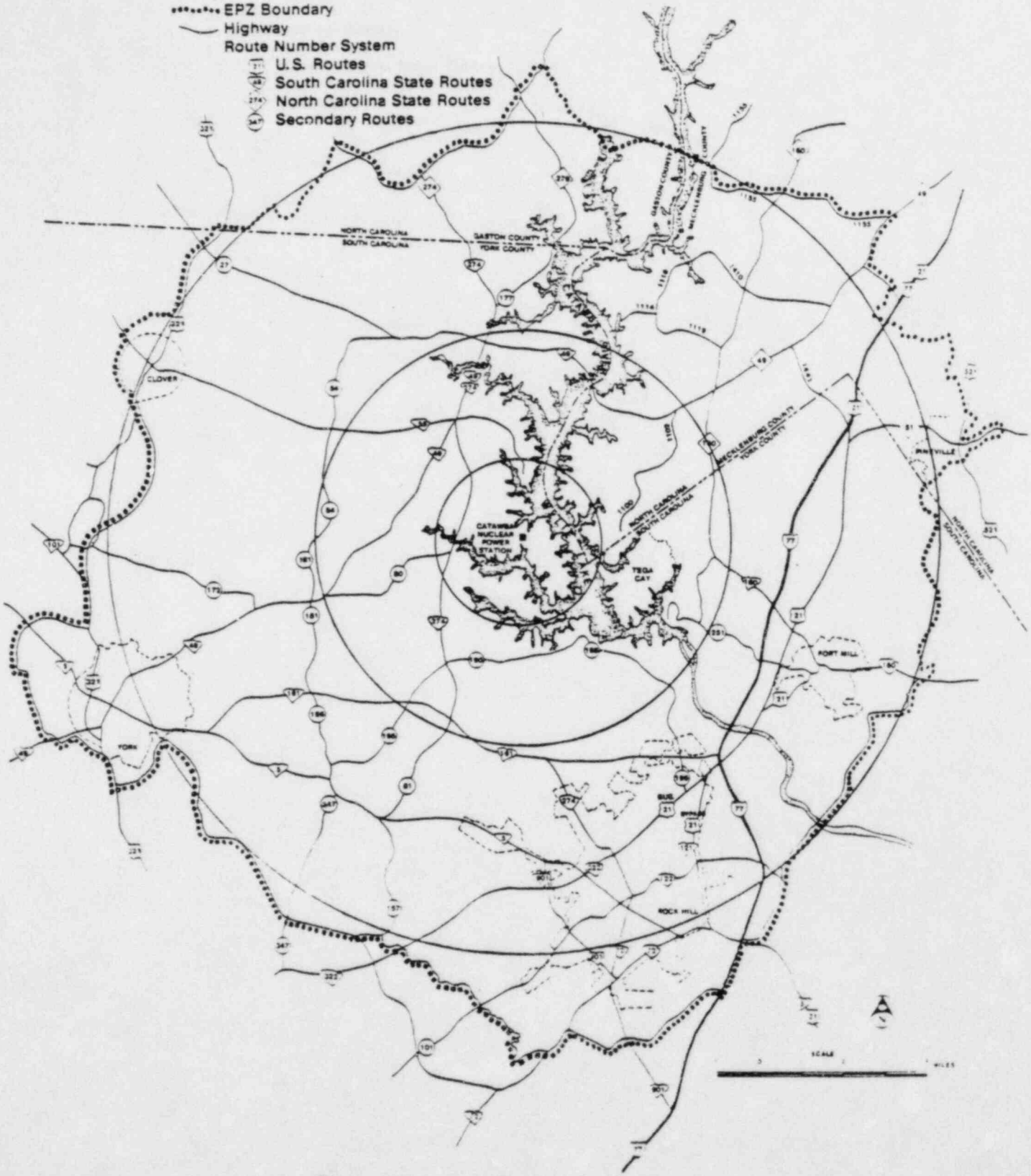

Figure 2. Highway System in the Vicinity of the Catawba Nuclear Power Station

Routes 901, 72, and 322 southbound, and State Routes 5 and 161 running both east and west.

In addition to the interstate, there are several segments of four-lane road in the Rock Hill area. Also, U.S. 321 leaving the EPZ to the northwest and U.S. 21 leaving in the southeast are four-lane roads.

OTHER TRANSPORTATION FACILITIES IN THE CATAWBA NUCLEAR STATION AREA

As Figure 3 shows, a Southern Railroad line crosses the southern part of the 10-mile area in an east-west direction and another runs through Rock Hill to Charlotte with an industrial spur just north of Pineville. Along the western edge of the EPZ are the tracks of the Carolina and Northwestern Railway.

GOVERNMENTAL JURISDICTIONS

Three counties—York, Gaston, and Mecklenburg—are included in the 10-mile radius of the Catawba Station (Figure 4). Six incorporated areas are at least partly within the 10-mile radius of the plant: Pineville, Fort Mill, Rock Hill, York, Clover, and Tega Cay.

SPECIAL FACILITIES WITHIN THE 10-MILE RADIUS OF THE CATAWBA NUCLEAR STATION

Figure 5 shows the location of the special facilities in the area. These consist of 43 schools (public and private), 23 day-care centers, 6 nursing homes, 2 hospitals, and the York County Prison. The schools include Winthrop University and York Technical College in Rock Hill. Nearly all of the schools are in or near the cities, with over one-half in the Rock Hill area. Two-thirds of the day-care centers are in the Rock Hill area, with the rest in Clover, Fort Mill, or York. The nursing homes are predominantly in Rock Hill. The prison is about two miles east of York on SC 55.

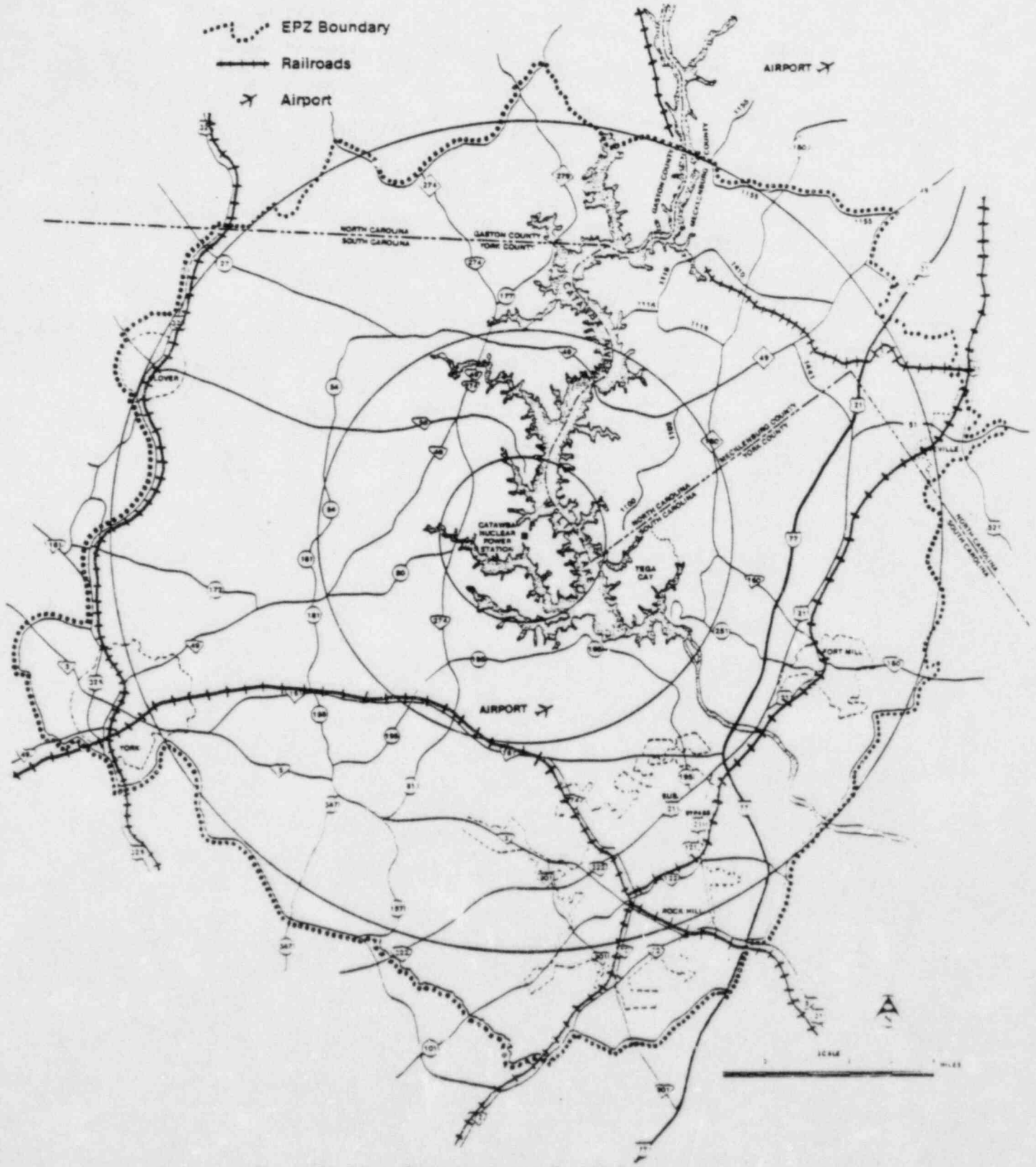

Figure 3. Other Transportation Facilities in the Vicinity of the Catawba Nuclear Power Station

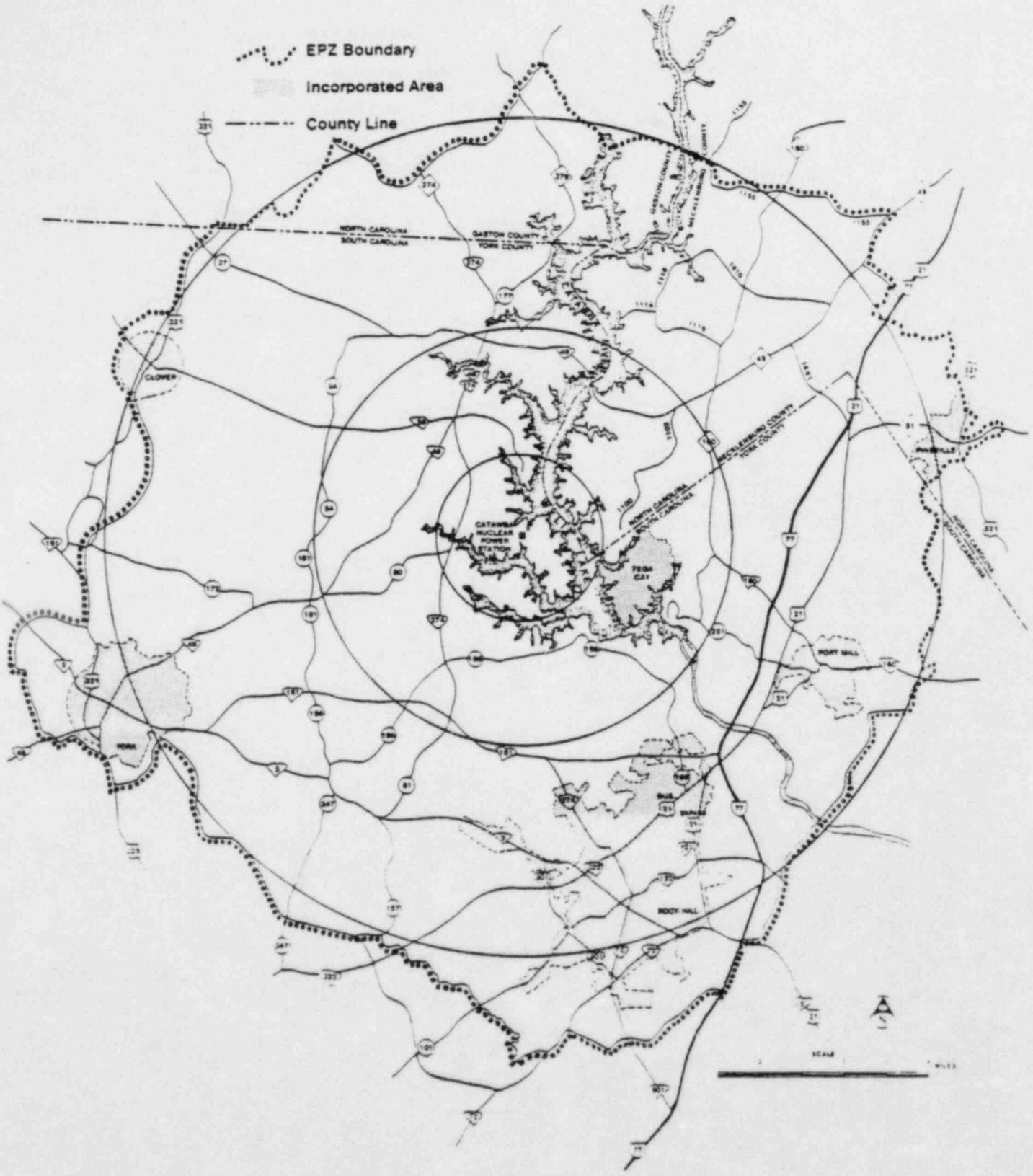

Figure 4. Local Government Jurisdictions

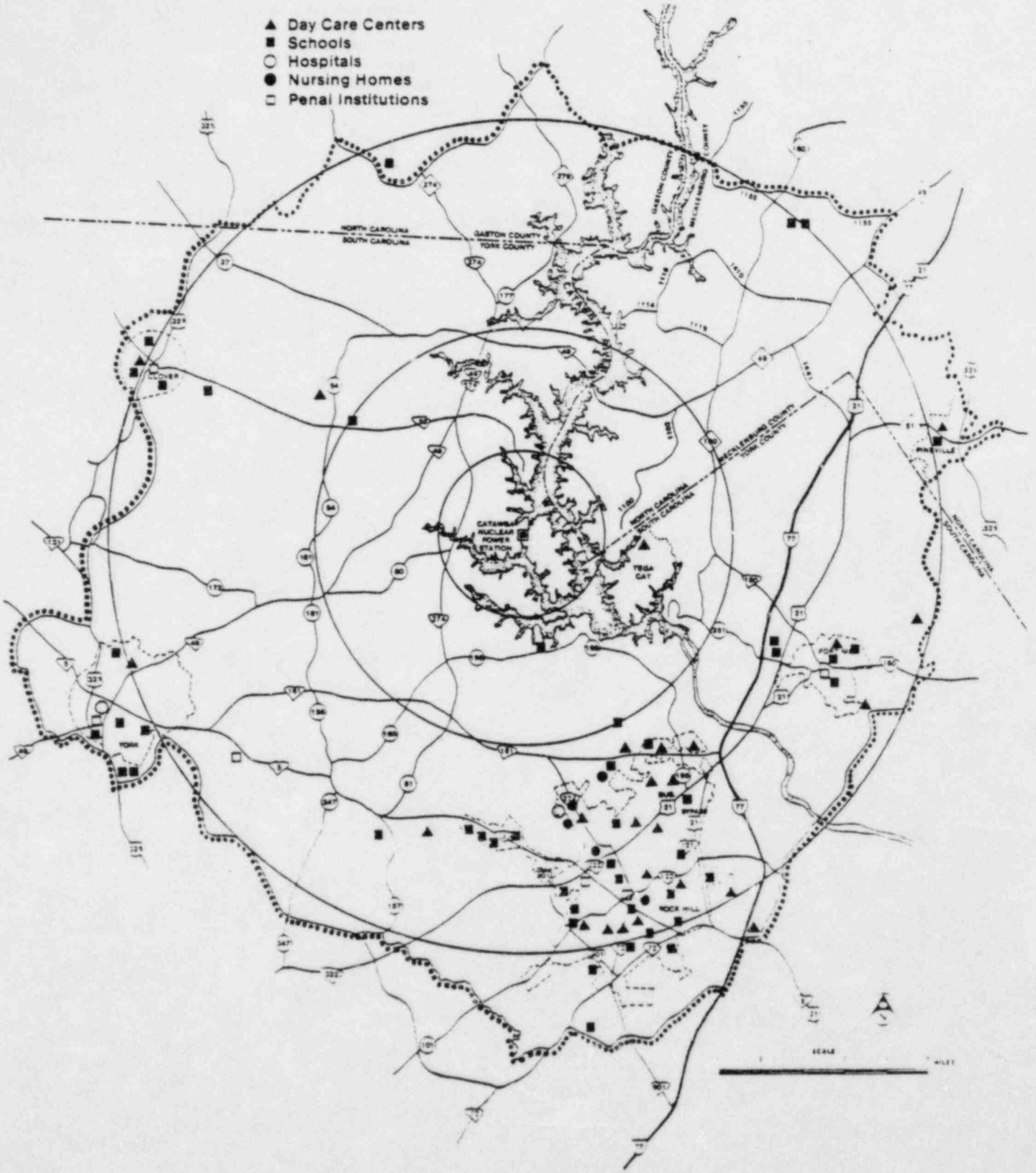

Figure 5. Location of Special Facilities

CHAPTER III. THE EMERGENCY PLANNING ZONE FOR THE CATAWBA NUCLEAR STATION

GUIDELINES FOR DEFINING THE EMERGENCY PLANNING ZONE (EPZ)

Federal regulations[1] define the Emergency Planning Zone (EPZ) as an area of about a 10-mile radius from the nuclear power station. Local preparedness planning concentrates on protecting the population of the EPZ from direct radiation exposure.

In defining the EPZ boundary for any particular site, some general guidelines are observed:[1]

- The EPZ should include approximately the 10-mile radius of the power station. Exclusion of small, lightly populated areas at the 10-mile periphery is permitted when this simplifies the boundary definition.
- The EPZ must be easily identifiable. Rather than strictly following the 10-mile radius, the EPZ boundary should follow nearby natural features (shorelines, streams), man-made features (highways, railroads), governmental, and special district boundaries.
- The EPZ boundary should not split major coherent populations which fall at the 10-mile radius (for example, Clover). Rather, the EPZ boundary should either include or exclude such concentrations in their entirety.
- The EPZ boundary should be regular and consistent, with supportable reasons for including areas. Evacuation of large areas or population groups well beyond the 10-mile radius should be avoided.

THE EPZ BOUNDARY FOR THE CATAWBA NUCLEAR STATION

There are few dominant natural or political boundary features that could serve as portions of the EPZ boundary for the Catawba Nuclear Station. Consequently,

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1. NUREG 0654, Appendix 4.

York, Gaston, and Mecklenburg Counties have identified an EPZ border that is based largely on state and local roads (Figure 6).

The resulting EPZ boundary includes at least the 10-mile radius from the Catawba Nuclear Station, except for some small areas totaling just a few square miles. All the areas within 10 miles of Catawba Nuclear Station, but excluded from the EPZ, contain negligible population.

Six incorporated areas—Clover, Fort Mill, Pineville, Rock Hill, Tega Cay, and York—are included in the Catawba EPZ. No incorporated area is divided by the boundary.

Table 1 summarizes the local governmental jurisdictions within the Catawba EPZ.

SELECTIVE EVACUATION ZONES

The division of the Catawba EPZ into selective evacuation zones (Figure 7) is based on the planning zones as established by the States of South Carolina and North Carolina, as well as the local preparedness agencies of Gaston, Mecklenburg, and York Counties. The radial boundaries for these zones are defined by:

- The state and county lines
- Rivers and streams such as the Catawba River
- Highways, such as York County 81 and South Carolina 161

The circumferential boundaries for these zones are generally defined by local roads.

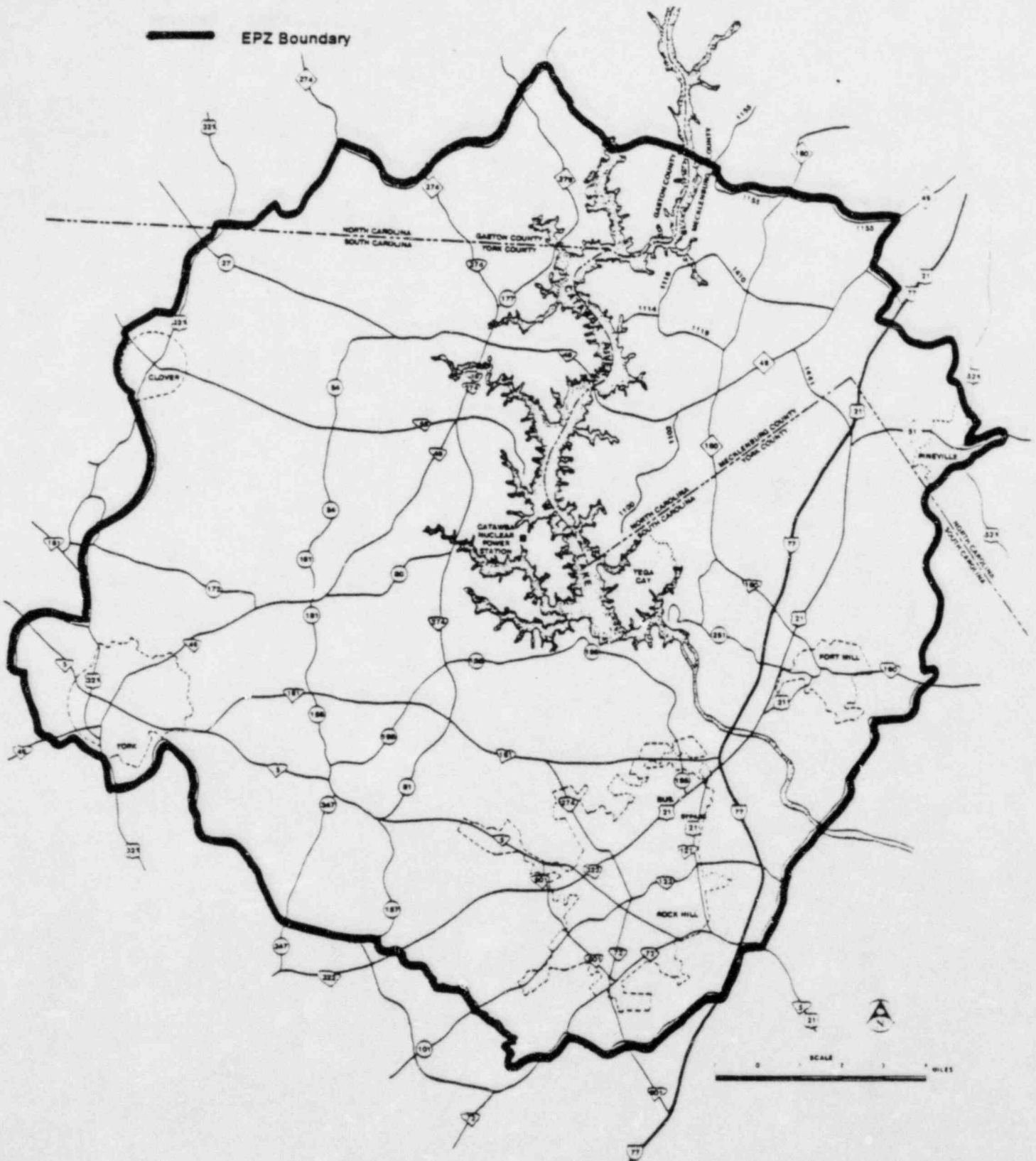

Figure 6. Emergency Planning Zone (EPZ) for the Catawba Nuclear Power Station

TABLE 1. LOCAL GOVERNMENT UNITS WITHIN 10-MILE RADIUS AND EPZ OF THE CATAWBA NUCLEAR POWER STATION

	Portion of Local Government Unit Within	
	10-Mile Radius of Plant	Catawba Nuclear Station EPZ
Counties		
Gaston	Part	Part
Mecklenburg	Part	Part
York	Part	Part
Incorporated Places		
Clover	Part	All
Fort Mill	All	All
Pineville	Part	All
Rock Hill	Part	All
Tega Cay	All	All
York	Part	All

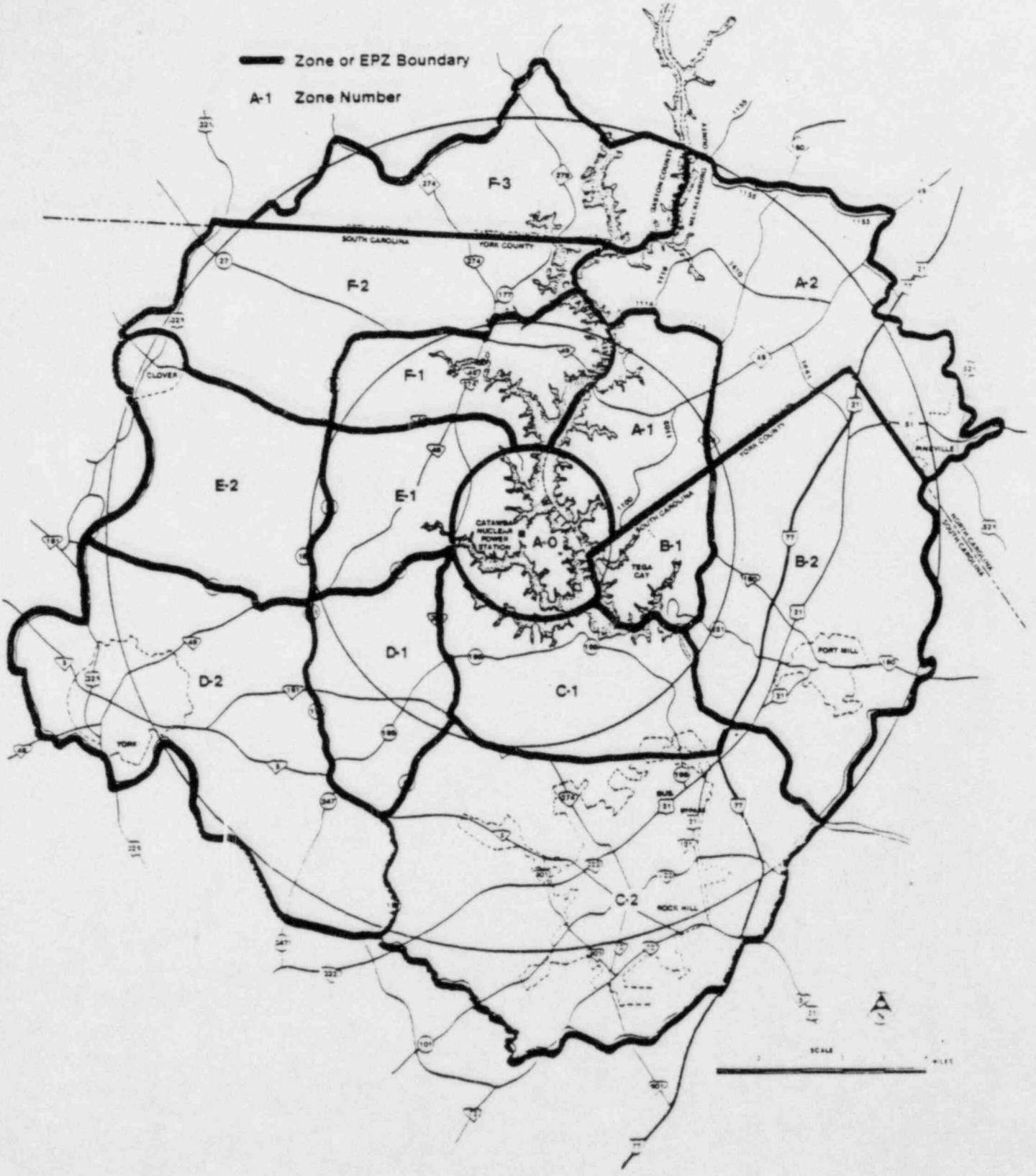

Figure 7. Selective Evacuation Zones
for the Catawba EPZ

CHAPTER IV. POPULATION OF THE CATAWBA EPZ

POPULATION SEGMENTS

Separate evacuation time estimates are made for each of the following three components of population in the Catawba EPZ:

1. Permanent Resident Population – Those persons living full-time in the Catawba EPZ. Two subgroups of permanent residents are recognized:

   - Vehicle-Owning Population – Those permanent residents having a vehicle available for their evacuation from the EPZ.
   - Non-Vehicle-Owning Population – Those permanent residents not having a vehicle available for their evacuation from the Catawba EPZ and who, therefore, must be transported by other means.

   There are an estimated 93,483 permanent residents in the Catawba EPZ (Table 2).

2. Transient Population[1] – Non-residents of the EPZ temporarily within it, primarily for the purpose of recreation. A maximum transient population of 89,669 persons in the EPZ (Table 2) was estimated from base year surveys and forecasts.

3. Special Facility Population[1] – Concentrations of population in institutions. This includes schools, university campus, hospitals, nursing homes, day care centers, and the prison. There is a reported special facility population of 36,134 persons in the EPZ on a weekday when schools are in session (Table 2).

SPECIAL FACILITY POPULATION

Table 3 lists the special facilities in the Catawba EPZ and gives their populations and subarea locations. As indicated in Table 3, the school population accounts for

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1. Some elements of population may be counted twice, both as resident population and as transient/special population. This double-counting is immaterial to the estimates of evacuation time.

TABLE 2. POPULATION OF THE CATAWBA EPZ AND ZONES

Zone	Permanent Resident Population			Transient Population	Special Facility Population
	Vehicle-Owning	Non-Vehicle-Owning	Total		
Central, NC Portion	321	36	357	654	0
Central, SC Portion	327	36	363	5,552	0
Subtotal, 0 to 2 Miles	648	72	720	6,206	0
A-1	476	53	529	10,187	0
B-1	2,368	263	2,631	2,588	24
C-1	5,545	616	6,161	16,827	1,544
D-1	1,273	141	1,414	109	0
E-1	386	43	429	0	0
F-1	2,316	257	2,573	1,582	364
Subtotal, 0 to 5 Miles	13,012	1,445	14,457	37,499	1,932
A-2	4,354	484	4,838	4,073	2,862
B-2	8,794	977	9,771	46,826	3,094
C-2	40,468	4,496	44,964	0	21,031
D-2	8,252	917	9,169	0	4,023
E-2	4,461	496	4,957	0	2,820
F-2	2,390	265	2,655	650	0
F-3	2,405	267	2,672	651	469
TOTAL EPZ	84,136	9,347	93,483	89,699	36,231

TABLE 3. SPECIAL FACILITIES POPULATION
IN THE CATAWBA EPZ

Facility	Population	Location (Zone)
Gaston County Schools		
W.A. Bess	469	F-3
Mecklenburg County Schools		
Steele Creek Elementary	777	A-2
Pineville Elementary	844	A-2
Olympic High	1,176	A-2
York County Schools		
A. O. Jones School	563	B-2
Alternative School	76	C-2
Belleview Elementary	450	C-2
Bethel Elementary School	364	F-1
Career Development Center	862	C-2
Castle Heights Junior High	960	C-2
Catawba School	445	C-1
Clover High School	1,008	E-2
Clover Junior High	596	E-2
Clover Middle School	561	E-2
Ebenezer Avenue Elementary	431	C-2
Ebinport Elementary	417	C-2
Edgewood Center	116	C-2
Episcopal Church Home for Children	62	D-2
Finley Road Elementary	453	C-2
Fort Mill High School	915	B-2
Fort Mill Junior High School	250	B-2
Harold C. Johnson Middle School	1,025	D-2
Jefferson Elementary	715	D-2
Kinard Elementary School	591	E-2
McCelvery Elementary	686	C-1
Mount Gallant Elementary	790	D-2
Northside Elementary	454	C-2
Northwestern High School	1,322	C-2
Oakdale Elementary	448	C-2
Rawlinson Road Junior High	1,251	C-2
Richmond Drive Elementary	452	C-2
Riverview Primary and Elementary Complex	1,292	B-2
Rosewood Elementary	389	C-1
St. Anne's	171	C-2

Table 3, Continued

Facility	Population	Location (Zone)
York County Schools (continued)		
Sullivan Junior High	1,010	C-2
Sunset Park Elementary	458	C-2
Sylvia Circle Elementary	369	C-2
Trinity Christian	324	C-2
Winthrop College	4,881	C-2
York Christian School	140	D-2
York Comprehensive High and Johnson Vocational	1,070	D-2
York Road Elementary	562	C-2
York Technical College	2,850	C-2
Clinton College	275	C-2
Day Care Centers		
Adams Care Center	21	C-2
Child Development Center	62	E-2
Children's Christian	119	C-2
Children's Wonderworld	70	C-2
College Park Nursery	30	C-2
Davis Day Care Center	33	C-2
Ebenezer Day Care Center, Inc.	32	C-2
Emmitt Scott Day Care	85	C-2
Jimmy's Day Care	40	C-2
Kiddie Kollege Child Development Center	200	C-2
LaPetite Academy	75	C-2
LaPetite Academy	47	C-2
Little Fox Nursery	33	B-2
Little Peoples Day Care	60	C-2
Mt. Gallant Day Care	49	C-1
Pine Grove Day Care Center	30	D-2
R. H. Comprehensive Day Care	114	C-2
Tega Cay Day Care	24	B-1
Toddler House Nursery	40	C-2
Wards Wonderland	35	B-2
Wee Care Day Care Nursery	68	C-2
Whiteheads Kiddie Kare	45	C-2
Yours, Mine and Ours	45	D-2

Table 3, Continued

Facility	Population	Location (Zone)
Hospitals		
Divine Savior Hospital	51	D-2
Piedmont Medical Center	160	C-2
Nursing Homes		
Anne's Convalescence Home	62	C-2
Divine Savior Home	51	D-2
Fallaw Residential Care	37	C-2
Meadow Haven Nursing Center	132	C-2
Rock Hill Convalescence Center	141	C-2
Sunshine Homes	10	D-2
Penal Institutions		
Clover Detention Center	2	E-2
Fort Mill Detention Center	6	B-2
Rock Hill Detention Center (Cherry Road)	14	C-2
Rock Hill Detention Center (City Hall)	4	C-2
York County Prison	45	D-2
York Detention Center	6	D-2

almost all of the special facility population. The other special facilities in the EPZ are day care centers, Piedmont Medical Center, Divine Savior Hospital, six nursing homes, and the York County Prison.

POPULATION DISTRIBUTION

The majority of the population in the Catawba EPZ is concentrated in the Rock Hill area. Zone C-2, which includes Rock Hill, has 44,964 residents, or 49 percent of the total residential population of the EPZ. The population center nearest to the Catawba Plant (approximately two miles) is Tega Cay with less than 3 percent of the EPZ population. Another 17 percent of the population lives in the incorporated areas on the fringe of the EPZ—Clover, Fort Mill, Pineville, and York.

York County contains 91 percent of the EPZ residential population (85,087 residents). Mecklenburg County contains another 6 percent (5,724 residents), and Gaston County contains the remaining 3 percent (2,672 residents).

CHAPTER V. THE EVACUATION SEQUENCE FOR THE CATAWBA EMERGENCY PLANNING ZONE (EPZ)

Evacuation is intended to remove the population of the Catawba EPZ as rapidly as possible. Evacuees are directed to designated reception centers where they are screened for radiological exposure. Evacuees are then lodged temporarily, or they go to destinations of their own choosing—primarily homes of nearby relatives and friends.

Wherever possible, the evacuating population will leave the EPZ in private automobiles. Persons without transportation will be transported by buses, ambulances, or other available vehicles.

Most motorists will leave the EPZ by the most direct route; that is, the shortest route out of the EPZ. Traffic direction at some key locations, particularly the U.S. 21 and I-77 interchange near Rock Hill and the intersection of S.C. 901 and S.C. 72, will help balance the traffic volumes on the evacuation routes. Except at those two locations, normal traffic flow will be observed, with streets open to all traffic and functioning in their usual manner.

Separate evacuation time estimates are made for the three population groups identified in Chaper IV: (1) permanent residents, (2) transient population, and (3) special facility population. Each of these groups follow a different procedure in evacuation:

- Permanent Resident Population – The vehicle-owning permanent resident population, after receiving the broadcast instructions to evacuate, assembles by family at home (except for children at school), prepares for evacuating the home, and drives out of the EPZ.

  The non-vehicle-owning permanent resident population prepares for leaving their homes and will then be transported out of the EPZ in buses or other vehicles.

- Transient Population – The transient population, after receiving instructions to evacuate, will assemble the group (if any) that is traveling together, and will drive out of the EPZ, using their private

vehicles. Unescorted children at Carowinds Theme Park will be taken to reception centers in Mecklenburg County by Charlotte Transit System buses.

- Special Facility Population – The school population (public and private) is transported by school bus directly from the schools, and is under control of school staff.

  Persons in institutions (hospitals, nursing homes, etc.) are prepared for evacuation, then transported out of the EPZ in buses, ambulances, emergency vehicles, and possibly other vehicles.

TIME PERIODS IN WHICH EVACUATION MIGHT OCCUR

The procedure for evacuating the Catawba EPZ will vary, depending on the time of day, day of week, and season of the year in which the evacuation occurs. Figure 8 illustrates the combinations of time, day, and seasons that are considered.

Day or Night Evacuation

In general, evacuation is likely to be more difficult in the daytime than in the nighttime.

During the day, there is a relatively large chance that families are not assembled at home but, rather, are dispersed at work, shopping, on personal business, etc. On school days, the school population is not at home for most of the daytime period. Also, more transients are in the EPZ during the day.

In a night evacuation, the notification process would be slowed by people having to wake up and comprehend the evacuation information being broadcast. Also, additional time (relative to the daytime situation) would be required to prepare vehicles for evacuation in the dark. On the other hand, for most of the population, the families would be intact at the time of notification, since schools are not in session and relatively few employees are on the job.

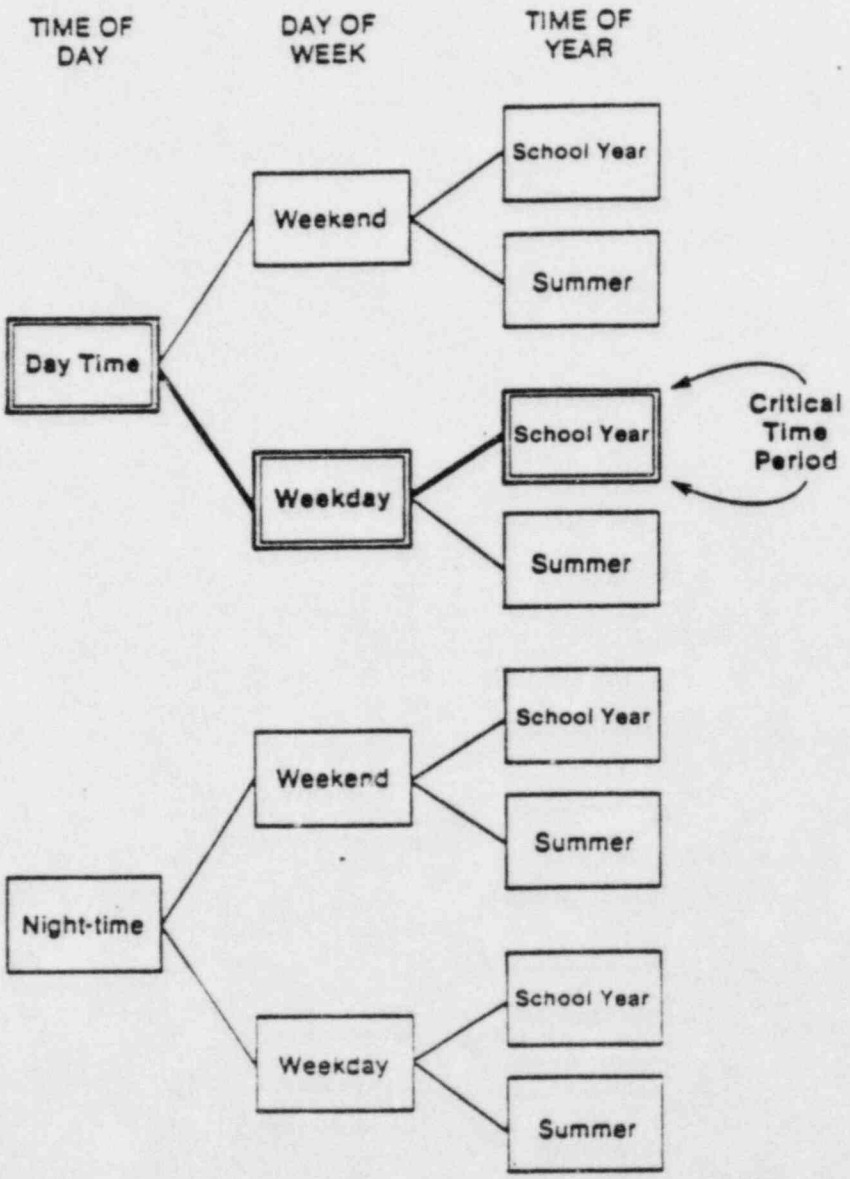

Figure 8. Time Periods In Which Evacuation Can Occur

Weekday or Weekend Evacuation

In general, a weekday evacuation is likely to be more difficult than one on a weekend.

On a typical weekday, much of the population is away from home, mainly at work. During the school year, the school population is also away from home during the day.

On the weekends, on the other hand, a number of peopole are away from the home for reasons other than work or school. However, the assembly of these people at home on a weekend does not present the same problem as assembling them on a typical work and school day, when a much larger percentage is not at home.

School Year or Summer Evacuation

In general, an evacuation during the school year period is more difficult than an evacuation during the summer season. When schools are in session, a weekday evacuation would have to involve evacuation of the school population. Also, the number of employees at work is at a maximum during the school year period when employment activity is at a maximum and few workers are on vacation.

In the summer period, evacuation can be complicated by the presence of non-residents around or on Lake Wylie and at Carowinds. However, these factors cause less difficulty in evacuation than that caused by the school population on a weekday when school is in session.

Critical Time Period Adopted for the Catawba Station Evacuation

In estimating the evacuation time for the Catawba EPZ, the critical time period—the time period for which evacuation is likely to require the most time—is daytime during the school year (Figure 8). During this period, the time needed to assemble family units is likely to be at a maximum since most employees are at

work at this time. Also, the likelihood of being away from home for other reasons (for example, shopping, personal business, etc.) is fairly high during this period. Finally, evacuation during the school year raises issues of school population evacuation which do not exist in other time periods.

POPULATION SEGMENTS TO BE EVACUATED

Separate evacuation time estimates are made for each of the three population groups identified in Chapter IV:

- Permanent Residents, who evacuate either in private automobiles (if they are vehicle-owning population) or are transported out in school buses or other vehicles (if they are non-vehicle-owning)
- Transient Population, who evacuate primarily in private automobiles
- Special Facility Population, who are transported out of the EPZ in school buses, other public vehicles and, in some cases, in private automobiles

Family Units

Families (excluding children in school) evacuate as units. On weekdays, family members return home from their jobs, shopping, etc. On weekends, many families are already assembled and can immediately prepare to leave home. Non-resident families (for example, recreational visitors) are already assembled and evacuate with almost no further preparation.

EVACUATION ACTION STEPS

For each population segment, the evacuation sequence consists of a series of clearly defined actions, performed in a predictable sequence (see Figure 9).

Subdividing the evacuation process into these discrete steps improves the accuracy of the estimates of time needed for the entire evacuation. In place of a single estimate of the entire evacuation process, for which data are not available, this

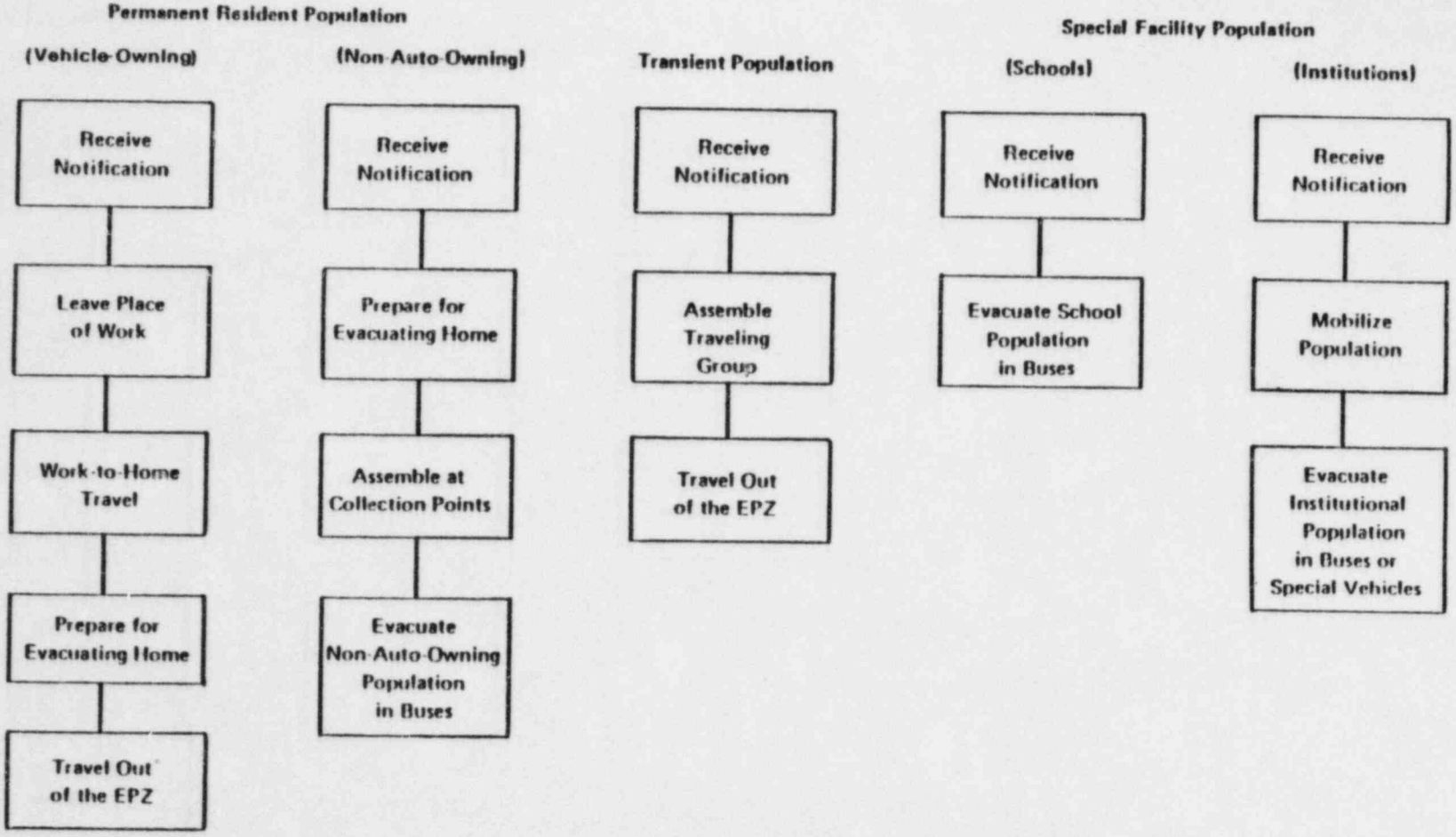

Figure 9. Population Segments and Evacuation Sequences

process permits the estimation of time for each individual step, for which data are more readily available, or for which reasonable esitmates can be made.

Public Agency and Private Steps

Some of the evacuation steps identified in Figure 9 are performed by public agencies or quasi-public bodies, such as volunteer fire departments. For all population groups, the "Receive Notification" action is the responsibility of public agencies. For those persons evacuated by means other than privately owned vehicles, public agencies have the additional responsibility for the actual transportation out of the EPZ; for example, "Evacuate School Population in Buses," "Evacuate Non-Vehicle-Owning Population in Buses," etc. For most populations in institutions, the "Mobilize Population" step is also a public agency resonsibility.

Those action steps not the responsibility of public agencies are done at the initiative of the individuals being evacuated. For the vehicle-owning population, all steps after the initial "Receive Notification" are private actions; that is, they are initiated by the individuals being evacuated. Similarly, some steps in the evacuation of non-vehicle-owning households are private steps.

EVACUATION OF PERMANENT RESIDENT POPULATION (VEHICLE-OWNING)

The following sections describe the sequence of evacuation for the resident vehicle-owning population of the Catawba EPZ during the fall-winter weekday period.

Receive Notification

The first activity in the evacuation process is the notification of the public that an emergency exists. This includes the sounding of sirens, followed by Emergency Broadcast System (EBS) information, and some direct notification by NOAA radio alert.

Various other back-up measures are used to inform the populatoin which might not be reached by the above means. Mobile sirens and public address units will supplement the siren alerting system. Mobile public address units mounted on boats or aircraft will notify boaters on Lake Wylie.

This notification alerts the public that an emergency exists, and that they should tune in to radio and television broadcasts for further information. The notification, by itself, does not inform the public of the nature of the emergency nor of the response that they should make.

Information on the nature of the emergency and instructions on evacuation are given through radio and television broadcasts over cooperating local stations in the Emergency Broadcast System (EBS).

Leave Place of Work

The rate at which area workers will leave their jobs to return home to prepare for evacuation depends on the particular work environment and upon the responsibility level of the worker. It is to be expected that most of the work force will be able to leave their jobs almost immediately, quite similar to a normal departure from work at the end of the workday. A number of workers, however, will require some job "close-down" time in work situations; for example, those that involve chemical processes, construction equipment, or cash registers in retail sales establishments. Supervisory employees, managers, and independent business operators will generally require the greatest amount of time to secure their place of work and to assure that all employees and others on the premises have departed.

Work-to-Home Travel

Travel of the employees from their place of work to home is identical to the daily work-to-home travel pattern. The maximum length for work trips for people living and working in the EPZ is not likely to exceed 20 miles. An average travel speed of 20 to 30 miles per hour is typical for the work-to-home travel for area workers.

This movement of workers, because of the short time over which it occurs, can be expected to cause some traffic congestion similar to that occurring during the twice-daily work travel peak. The road system can handle this volume of traffic with essentially the same level of service as during the peak hours on a typical working day.

Prepare for Evacuating Home

People can be epxected to react differently to any emergency situation, and there is likely to be great differences in the amount of time that residents will spend in preparing to leave their homes. Three factors, in particular, affect the amount of time needed to prepare for evacuating a household:

1. Whether or not adults are at home when notice to evacuate is received. If so, preparation time is shortened (compared to households where no adults are at home) since preparation for evacuation can begin before workers arrive home.

2. Number of children and other dependents at home. These increase the time needed to prepare the household for evacuation.

3. The amount of property to be secured. Farms are the extreme case and may require up to two hours to secure. On the other hand, small households can be prepared for evacuation in minutes.

Travel Out of the EPZ

After households are secure, residents of vehicle-owning households will drive out of the EPZ. Most motorists will use the most direct route available.

Public agencies will give routing advice for this travel, by means of preparedness plans prior to the emergency and through information broadcasts during the actual evacuation. Law enforcement officers will also channel flow of traffic at critical locations as defined in local preparedness plans and in response to actual conditions.

The vehicle-owning resident population will drive to reception centers established outside the EPZ where they will be checked for contamination and reunited with other family members. Evacuees will then either go to a shelter, where they will be lodged temporarily, or to other destinations (homes of friends or relatives) of their own choosing.

During the evacuation, normal traffic operations will prevail. Specifically, roads will continue in two-way operation, traffic signals will continue to function, and so forth. At key locations, mainly intersections, traffic control will be under direction of law enforcement officers or other personnel as designated by local evacuation plans.

On most roads, traffic will flow freely, although at reduced speeds. However, at certain locations and during certain portions of the evacuation period, traffic congestion is expected. The location and extent of this traffic congestion is discussed in Chapter VII of this report.

EVACUATION OF PERMANENT RESIDENT POPULATION (NON-VEHICLE-OWNING)

Receive Notification

The procedure for receiving broadcast information is the same as for vehicle-owning population (above). This includes the sounding of sirens followed by broadcast information and supplemented by mobile public address.

Prepare for Evacuating Home

This step is the same as for vehicle-owning population (above). As in the case of vehicle-owning population, primary facors in the time required for this action or whether or not an adult is at home at the time of notification, the number of dependents to be evacuated, and the extent of property to be secured.

Evacuate Non-Vehicle-Owning Population in Buses

A significant fraction of the non-vehicle-owning population (perhaps as much as 50 percent) will be evacuated as passengers in private vehicles driven by family, neighbors, or friends. This component of the non-vehicle-owning population is considered as part of the vehicle-owning population, and their evacuation procedure follows that of the vehicle-owning population described above.

Persons from non-vehicle-owning households who do not evacuate as passengers in private vehicles will be transported out of the EPZ in publicly owned vehicles, dispatched by the County preparedness agencies.

In York County, South Carolina, and Gaston County, North Carolina, the primary source of vehicles are school buses. Transit buses from Charlotte will be the primary source of vehicles in Mecklenburg County.

EVACUATION OF TRANSIENT POPULATION

Receive Notification

Most of the industrial transient population will be notified by tone alert receivers, telephone calls, and the siren system. Transient recreational visitors around Lake Wylie are notified by the siren system. Some boaters on the lake will be notified by mobile public address systems.

Assemble Traveling Group

The traveling group (usually family) is assembled. Preparations for evacuating (for example, closing a cabin, docking a boat) are made.

Travel Out of the EPZ

After assembling their traveling group, the transient population will drive out of the EPZ using their private vehicles.

Transient population will be directed to a reception center. After clearing the reception center, they will return to their homes outside the EPZ.

Public agencies will give routing advice for this travel through information broadcasts during the evacuation. Law enforcement officers will also direct traffic flows out of the EPZ.

Unescorted children at Carowinds Theme Park will be taken by bus to a reception center in Mecklenburg County where they will be screened for radiological contamination and reunited with their parents.

EVACUATION OF SPECIAL FACILITY POPULATION (SCHOOLS)

Receive Notification

Following the decision to evacuate, the counties notify schools directly of the need for evacuation. This is done through the siren system and telephone calls directly to the schools.

Evacuate School Population in Buses

The school population is transported directly by bus from school to reception centers. An entire school will be transported to the same reception center. School children will not return home prior to evacuation. The picking up of school children at school by their families is discouraged.

All buses normally used within the Catawba EPZ will be used for evacuation. These will be supplemented by buses from outside the EPZ, but within the three-county area.

EVACUATION OF SPECIAL FACILITY POPULATION (INSTITUTIONS)

Receive Notification

Following the decision to evacuate, the local preparedness agencies will notify institutions directly by telephone calls.

Mobilize Population

The institutional population is instructed to evacuate by the staff of that particular institution. Necessary personal effects are assembled. Essential medical records are gathered.

Evacuate Institutional Population in Buses or Special Vehicles

Buses will pick up ambulatory hospital patients, nursing home residents, and other persons not requiring ambulance transportation. These passengers will be transported directly to the alternate relocation facilities.

Non-ambulatory persons will be transported directly from institutions by emergency vehicles normally based within the EPZ, supplemented by emergency vehicles from outside the EPZ.

SUMMARY OF THE EVACUATION PROCESS

In order to examine the "worst case" for which evacuation times are at a maximum, the evacuation is assumed to occur during the daytime during the school year.

Three population groups, having distinctly different evacuation methods, are recognized:

- Permanent residents who will evacuate in private vehicles (if vehicle-owning) or who will be transported in transit vehicles (if non-vehicle-owning)

- Transient population who will evacuate in private vehicles
- Special facility population who are transported out of the EPZ in school buses, public transit buses, other public vehicles and, in some cases, private automobiles

For each population group, the evacuation sequence consists of a number of clearly defined action steps as summarized in Table 4.

TABLE 4. SUMMARY OF EVACUATION ACTION STEPS

Population Segment	Action Steps and Description
Permanent Resident Population (Vehicle-Owning) (All members of households, except school children, having a private vehicle available for evacuation	1. RECEIVE NOTIFICATION, including instructions for evacuating 2. LEAVE PLACE OF WORK 3. WORK-TO-HOME TRAVEL, similar to normal work trip 4. PREPARE FOR EVACUATING HOME (close house, secure property) 5. TRAVEL OUT OF THE EPZ in private vehicles, using most direct routes
Permanent Resident Population (Non-Vehicle-Owning) (Persons not having a private vehicle available for evacuation	1. RECEIVE NOTIFICATION, including instructions for evacuating 2. PREPARE FOR EVACUATING HOME (close house, secure property) 3. EVACUATE NON-VEHICLE-OWNING POPULATION IN BUSES from county school system
Transient Population (Workers, recreational visitors)	1. RECEIVE NOTIFICATION, including instructions for evacuating 2. ASSEMBLE TRAVELING GROUP 3. TRAVEL OUT OF THE EPZ in private vehicles
Special Facility Population (Schools)	1. RECEIVE NOTIFICATION, including instructions for evacuating 2. EVACUATE SCHOOL POPULATION IN BUSES
Special Facility Population (Institutions)	1. RECEIVE NOTIFICATION, including instructions for evacuating 2. MOBILIZE POPULATION, prepare population for evacuation 3. EVACUATE INSTITUTIONAL POPULATION IN BUSES OR SPECIAL VEHICLES

CHAPTER VI. EVACUATION ROUTES

DESIGNATED EVACUATION ROUTES

In the event evacuation is necessary, people in the EPZ will be instructed to leave the area using the fastest route available. No attempt will be made to limit evacuation traffic to a few selected roads (as is sometimes done for security or to channel evacuees to reception centers). Thus, every road out of the EPZ will carry some evacuation traffic. The most significant of these are shown in Figure 10.

To facilitate movement to the reception centers, where location may be unfamiliar to some evacuees, the emergency preparedness officials for Gaston, Mecklenburg, and York Counties and the States of North and South Carolina have designated, or will designate, a series of evacuation routes leading from the EPZ boundary to the reception centers. Maps showing these routes will be widely distributed in the EPZ to guide people expeditiously to their designated reception center.

CAPACITIES OF THE EVACUATION ROUTES

In general, the capacity of an evacuation route is determined by the capacities of its intersections, rather than by the capacity of the road at non-intersection locations. For most of the evacuation routes, the capacity is determined at a critical intersection, or "bottleneck" location. These are locations where: 1) the evacuation route has a high traffic volume, and 2) cross-street traffic volume at the instersection is high, reducing the amount of time available for the major evacuation flow to enter the intersection.

The capacity of an intersection is based on maximum vehicular flow of 1,500 vehicles per lane hourly, with full assignment of the right-of-way (that is, 1,500 vehicles hourly if there is no intersecting traffic).[1] At the critical intersections

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1. Highway Capacity Manual, 1965, Highway Research Board Special Record Number 87.

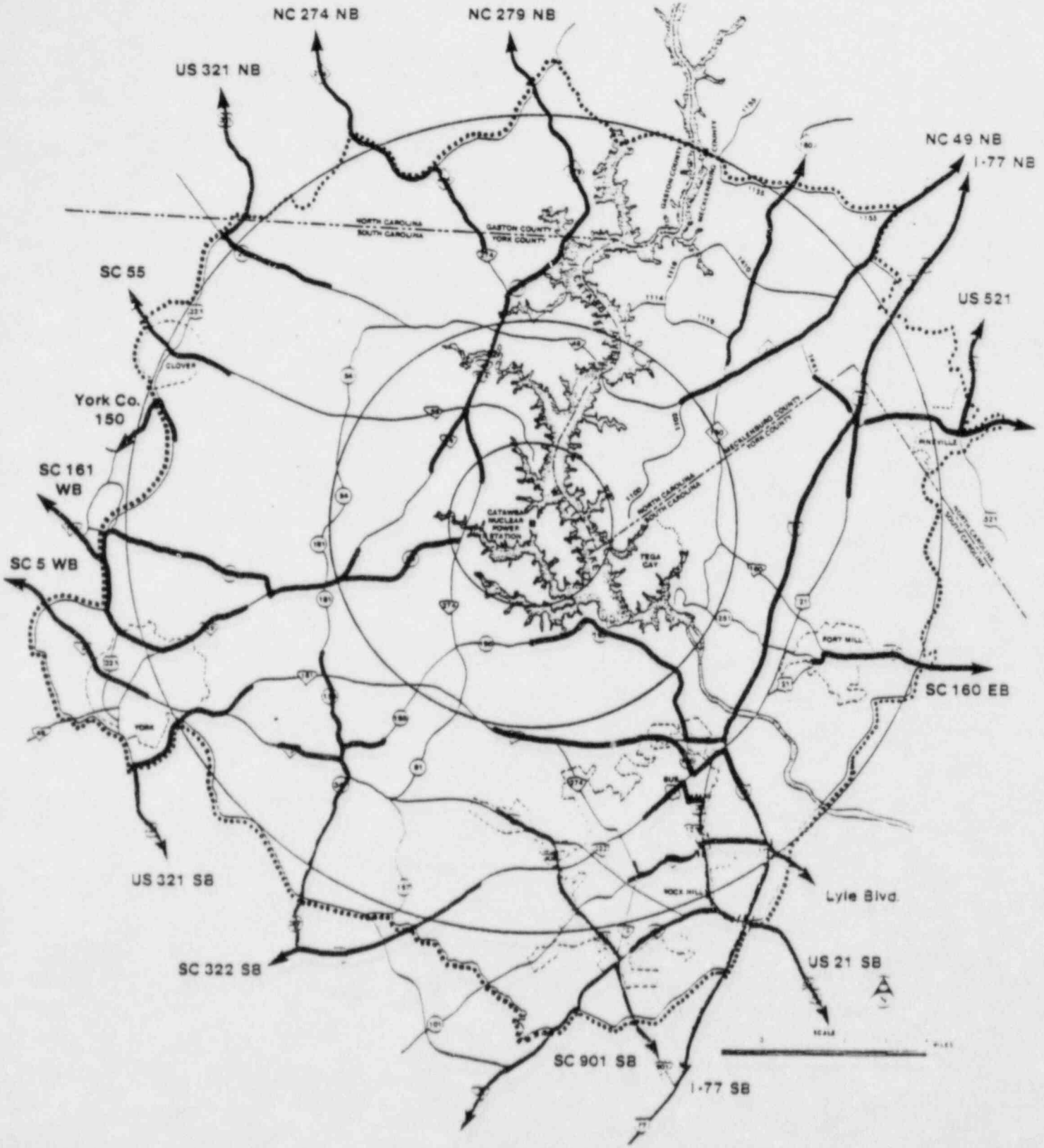

Figure 10. Major Routes Leading out of the EPZ of the Catawba Nuclear Power Station

which are establishing the capacity on the evacuation routes, the total capacity is adjusted downward to 80 percent of the maximum to allow for intersecting traffic. The resulting capacity is 1,200 vehicles per lane per hour.

The capacities of each of 18 major routes out of the EPZ are indicated in Table 5.

EVACUATION TRAVELSHEDS

The travelshed of a particular evacuation route is the "catchment" area of population for that route; that is, the area for which that route is the fastest means of exit from the EPZ.

The travelsheds for the evacuation routes in the Catawba EPZ are determined by extending the major evacuation routes, as identified in Figure 10, so that all of the road systems in the EPZ connect to one or another of the evacuation routes. This process is simple for those sections of roadway immediately adjacent to the major evacuation routes, where it is obvious which sections of roadway feed any given evacuation route. For sections more distant from the major evacuation routes, the evacuation path is not as clear, and routings are made on the basis of travel time estimates. Some sections of roadway are midway between evacuation routes, and are equally well served by two different routes. These areas define the boundaries between the travelshed areas for different evacuation routes as indicated in Figure 11.

DISTRIBUTION OF TRAFFIC TO THE EVACUATION ROUTES

The population of the travelshed area for each evacuation route was determined in two steps. First, the EPZ was subdivided into 160 segments, each defined by its distance and direction from the nuclear station. Census data for 1980 was used to determine the population of each segment. The population within each segment was then apportioned to the routes leading from that segment out of the EPZ. Table 6 shows the population of the travelshed for each of the major routes.

TABLE 5. CAPACITY OF MAJOR EVACUATION ROUTES

Evacuation	Number of Lanes[1]	Type of Road	Outbound Capacity[2]
Lyle Boulevard EB	4	Urban Arterial	2,400
I-77 SB	4	Interstate	3,000
US 21 SB	4	Semi-Rural Arterial[3]	2,400
SC 901 (SC 72) SB	4	Semi-Rural Arterial	2,400
SC 322 SB	2	Rural Arterial	1,200
US 321 SB	2	Rural Arterial	1,200
SC 5 WB	2	Rural Arterial	1,200
SC 161 WB	2	Rural Arterial	1,200
York 150 WB	2	Rural Secondary	1,200
SC 55 WB	2	Rural Arterial	1,200
US 321 NB	4	Rural Arterial	2,400
NC 274 NB	2	Rural Arterial	1,200
NC 279 NB	2	Rural Arterial	1,200
NC 160 NB	2	Rural Arterial	1,200
NC 49 NB	2	Rural Arterial	1,200
I-77 NB	4	Interstate	3,000
US 521 NB	2	Rural Arterial	1,200
SC 160 EB	2	Rural Arterial	1,200

1. Total lanes, both directions.
2. Hourly vehicles, outbound only. Obtained from Highway Capacity Manual, 1965, Highway Research Board Special Report Number 87.
3. Semi-rural areas are characterized by light density development along roadside.
4. SC 901 changes from four to two lanes near EPZ boundary, but SC 72 provides a lane to carry half the traffic the rest of the way out of the EPZ.

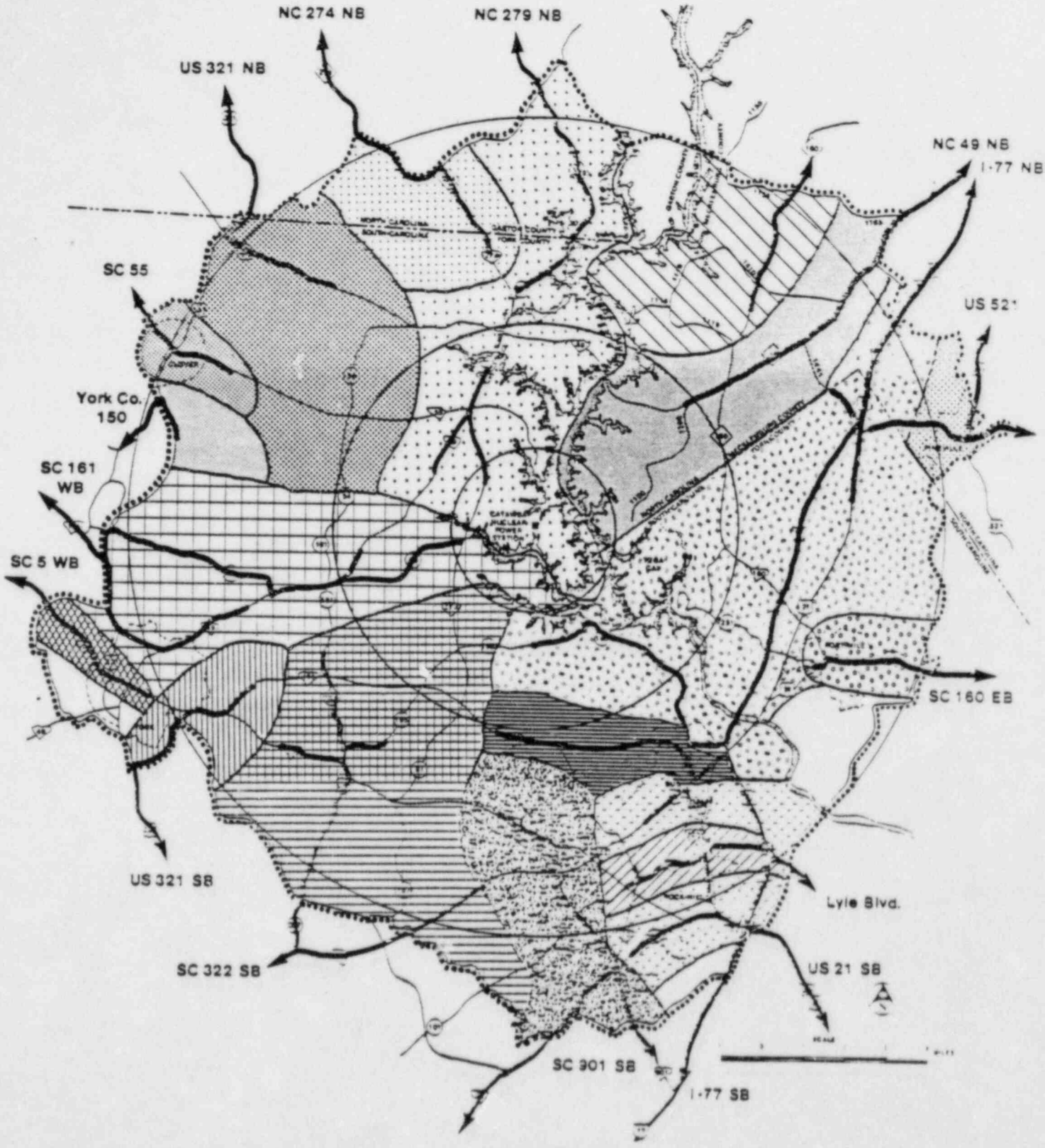

Figure 11. Travel Sheds for Routes Leading Away From the Catawba Nuclear Station

TABLE 6. TRAFFIC VOLUMES AND CAPACITIES FOR MAJOR EVACUATION ROUTES

Evacuation Route	Population Assigned to Route[1]	Vehicles Assigned to Route[2]	Hourly Vehicle Capacity	Hours of Traffic Flow[3]
Lyle Boulevard EB	4,459	1,917	2,400	0.8
I-77 SB	8,079	3,473	3,000	1.2
US 21 SB	15,897	6,835	2,400	2.8
SC 901 (SC 72) SB	13,556	5,829	2,400	2.4
SC 322 SB	5,284	2,272	1,200	1.9
US 321 SB	2,281	980	1,200	0.8
SC 5 WB	1,763	758	1,200	0.6
SC 161 WB	2,468	1,061	1,200	0.9
York 150 WB	1,470	632	1,200	0.5
SC 55 WB	1,286	552	1,200	0.5
US 321 NB	3,275	1,408	2,400	0.6
NC 274 NB	1,068	459	1,200	0.4
NC 279 NB	4,529	1,947	1,200	1.6
NC 160 NB	1,721	739	1,200	0.6
NC 49 NB	2,213	951	1,200	0.8
I-77 NB	10,298	4,428	3,000	1.5
US 521 NB	1,525	655	1,200	0.6
SC 160 EB	4,926	2,118	1,200	1.8

1. Based on apportionment of population (Chapter IV) to the evacuation travelshed areas (Figure 11).
2. Based on vehicle ownership data from the 1980 census (Appendix B).
3. Assumes continuous flow of all traffic assigned to that route.

RELATIONSHIP OF EVACUATION TRAFFIC VOLUMES AND ROUTE CAPACITIES

Table 6 summarizes, for each of the 18 individual evacuation routes, the traffic capacity of the route and the volume of evacuation traffic assigned to that route. The resulting hours of traffic flow are then calculated. This measure does not represent the total evacuation time; for example, it does not include the time needed for notification or for preparing to leave home. Rather, the "Hours of Traffic Flow" statistic is an indication of the level of traffic congestion that can be anticipated on the route.

CHAPTER VII. SUMMARY OF EVACUATION TIME ESTIMATES

CONDITIONS AND TIME PERIODS

Evacuation time estimates are made for two conditions:

1. Fall/winter day, with normal weather conditions. This condition, as explained in Chapter V, represents the "critical" time period for which evacuation times are likely to be at their maximum. The maximum transient population is assumed to be in the EPZ at this time.

2. Fall/winter day, with severe weather conditions (defined as a winter storm, with icy road conditions). This case represents the "critical" time period (as explained in Chapter V) under unfavorable weather conditions which further extend the required evacuation times.

Detailed evacuation times are first calculated for the "fall/winter day" (normal weather) conditions, then adjusted to yield the "fall/winter" day (severe weather) conditions.

METHOD FOR ESTIMATING EVACUATION TIME

Population Segments

Evacuation time is estimated separately for each of the three population groups discussed earlier: (1) permanent resident population, (2) transient population and, (3) special facility population.

These evacuation time estimates assume that effective local preparedness plans are in operation, and that virtually complete coverage of the EPZ population with a prompt alerting and notification system is achieved. This notification time reflects the siren coverage expected with the system already designed.

Action Steps

Each population segment follows a specific sequence of action steps in evacuating the EPZ. (See Chapter V for a detailed discussion of these steps.) The time needed to complete each of these steps is stated as the distribution relating the fraction of the population completing a particular step to the elapsed time after that action step is first started.

Time Required for a Series of Action Steps

The total evacuation time is calculated by linking together the time required to complete the individual steps. The resulting total time for evacuation is calculated (as are the times for the individual steps) as a distribution of time, showing the fraction of the population which completes the total evacuation process within a given amount of elapsed time. The EVACURVE program (Appendix C) is used to compute these elapsed times.

Distribution of the Traffic to the Evacuation Routes

The evacuation traffic is distributed to the available roads out of the EPZ (Chapter VI). Delays due to traffic congestion are calculated, and the evacuation times are adjusted to reflect these delays.

EVACUATION TIME FOR THE PERMANENT RESIDENT POPULATION (VEHICLE-OWNING), FALL/WINTER WEEKDAY, NORMAL WEATHER CONDITIONS

The evacuation sequence for the permanent resident vehicle-owning population includes five steps: (1) Receive Notification, (2) Leave Place of Work, (3) Work-to-Home Travel, (4) Prepare for Evacuating Home and, (5) Drive Out of the EPZ. The time required to complete each of these steps is established. Then, a total evacuation time for the vehicle-owning population is obtained by combining the time required for each of the five action steps.

Receive Notification

Some of the vehicle-owning permanent resident population receives the broadcast information almost immediately; for example, 10 percent of this population is assumed to receive broadcast information in 15 minutes (Table 7). These are individuals who immediately comprehend the notification and promptly tune into the EBS broadcasts. This group also includes individuals already listening to radio and television broadcasts and are, therefore, informed immediately of the emergency and the need to evacuate the EPZ.

TABLE 7. TIME DISTRIBUTION FOR "RECEIVE NOTIFICATION" STEP

Time After Start of Notification	Estimated Percentage of Population Receiving Notification
15 minutes	10
20 minutes	10
25 minutes	30
30 minutes	30
35 minutes	10
40 minutes	5
45 minutes	5

A large fraction of the population of the EPZ is estimated to receive the broadcast information between 20 and 30 minutes after the start of notification. These individuals require several minutes to comprehend the notification, and then several more minutes to tune into the EBS broadcasts.

At the high end of the range, some of the population (10 percent of the total) are assumed to require over 35 minutes to receive the broadcast information. These

are mainly persons not reached immediately by the notification system, not understanding the significance of the siren warning, or without access to a radio or television set. This element of the population is notified, in general, by supplementary methods, such a mobile public address, etc.

It is estimated that all of the population receives the broadcast information within 45 minutes of the start of notification.

Leave Place of Work

It is estimated that a sizeable portion of the permanent resident vehicle-owning population can leave work within 10 minutes after receiving the broadcast information, or after this information is conveyed to them by their employer (Table 8). In general, these are workers not having managerial responsibility or whose jobs do not require shutdown time.

TABLE 8. TIME DISTRIBUTION FOR "LEAVE PLACE OF WORK" STEP

Time After Start of Notification	Estimated Percentage of Workers Leaving Place of Work
10 minutes	50
15 minutes	30
20 minutes	10
30 minutes	5
45 minutes	5

Another large group of workers (an estimated 40 percent of the total) will need between 10 and 20 minutes to leave their place of work. These are employees whose jobs require some shutdown time, and managers who remain until other employees have left.

At the high end of the range, an estimated 5 percent of the workers require over 30 mintues to prepare for leaving work. These individuals are mainly managers, persons responsible for securing cash or property, and persons needed to shut down industrial processes.

All employees complete preparation to leave their place of work within 45 minutes of receiving the broadcast information (Table 8).

Work-to-Home Travel

The time needed for this step is similar to that needed for the daily trip home during the afternoon peak hour. This time depends primarily on the distance from work to home. This distribution of estimated travel-to-home time is for only those workers having their residence and place of work in the EPZ. At the low end of the range, an estimated 50 percent of the workers can complete the trip home within 5 minutes (Table 9). Another large group of workers live within 5 miles of their job and can return home in 10 to 15 minutes. At the upper end of the range, an estimated 20 percent of all employees will need more than 15 minutes for their travel home.

TABLE 9. TIME DISTRIBUTION FOR "WORK-TO-HOME TRAVEL" STEP

Time After Workers Begin to Leave Place of Work	Estimated Percentage of Workers Arriving at Home
5 minutes	50
10 minutes	30
15 minutes	10
20 mintues	10

Some employees working outside the EPZ, particularly at locations near the EPZ boundary, will return home before the EPZ is closed to entering traffic and will

evacuate in the same manner as vehicle-owning households. However, employees who work at some distance outside the EPZ may not be able to enter the EPZ since incoming traffic will be restricted as soon as possible after the start of the evacuation.

Prepare for Evacuating Home

The time needed to prepare for evacuating the home depends on three factors: (1) whether or not an adult member of the household is home at the time of notification, (2) the number of dependents in the household, and (3) the amount of household property to be secured prior to evacuation.

At the low end of the range, an estimated 15 percent of all the vehicle-owning population can prepare for evacuating their households within 20 minutes after the arrival of the workers from their jobs (Table 10). These are generally households with an adult member present at home, with few dependents, and no property to be secured.

TABLE 10. TIME DISTRIBUTION FOR "PREPARE FOR EVACUATING HOME" STEP

Time After Workers Arrive Home	Estimated Percentage of Vehicle-Owning Population Leaving Home
15 minutes	10
20 minutes	5
25 minutes	10
30 minutes	15
35 minutes	15
40 minutes	25
50 minutes	10
60 minutes	5
95 minutes	5

An estimated 80 percent of the vehicle-owning population can prepare to leave home within 40 minutes of the arrival of household workers. These are likely to be households with dependents at home and a typical single-family residence to secure.

At the upper end of the range, an estimated 20 percent of the population requires over 40 minutes to prepare for evacuating their homes. Generally, these are households with more than one dependent and extensive household property to be secured (for example, a farm).

Final Departure Curve

Figure 12 illustrates the distribution of time needed by the EPZ population to complete each of the evacuation steps. The final departure curve (that is, the time needed to complete all action steps except the final driving from the EPZ) is completed at 3 hours, 10 minutes after the start of notificaiton.

Drive Out of the EPZ

The time needed for the final step, "Drive Out of the EPZ," depends on the level of traffic congestion encountered on the specific evacuation route taken. On routes with no traffic congestion, a maximum of 15 minutes is needed to drive out of the EPZ, and for such routes the total evacuation time is 3 hours, 25 minutes (3 hours, 10 minutes as noted in Figure 12, plus 15 minutes driving time). On some routes with traffic congestion, driving times will be determined by traffic delays, as discussed below.

Routing – Most motorists will drive out of the EPZ on the designated evacuation routes as identified in Chapter VI of this report. Some motorists will drive out on roads not designated as evacuation routes.

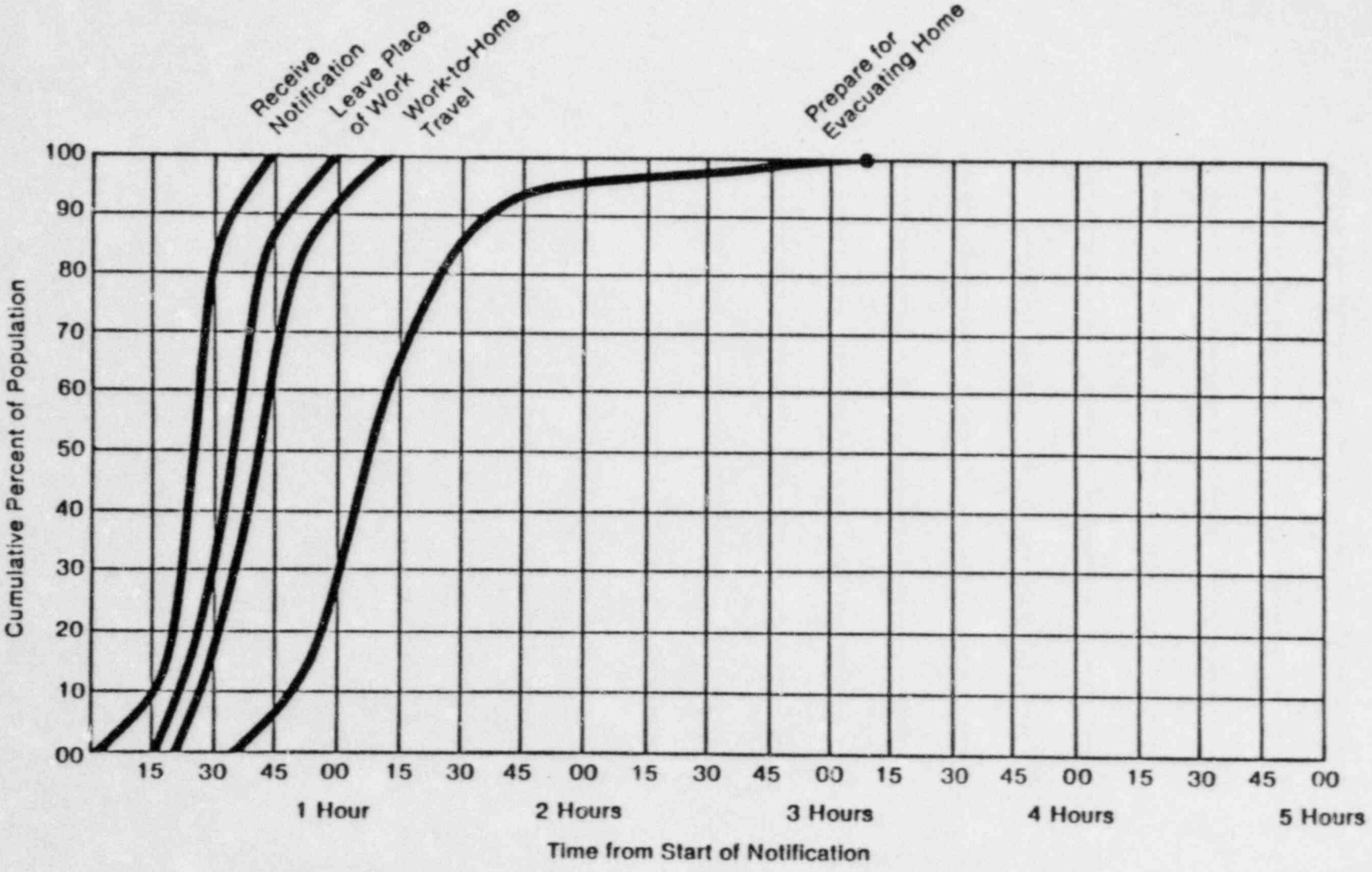

Figure 12. Evacuation Time for the Permanent Resident Population (Auto-Owning)

Public agencies will give routing advice for this travel by means of preparedness plans prior to the emergency and through information broadcasts during the actual evacuation.

Traffic Control – At critical locations–primarily key intersections within the EPZ–traffic will be controlled by State and local law enforcement agencies as established in local preparedness plans. This traffic control will accomplish two purposes: (1) ensure orderly traffic flow at that particular location, and (2) direct motorists to the best available route out of the EPZ.

During the evacuation, normal traffic control will continue, two-way streets will operate in their usual manner as two-way streets, and traffic control devices, such as signals, will continue to function. The only exception will be the replacing of traffic signal control at some key intersections with traffic direction by law enforcement officers.

Method for Analyzing Evacuation Traffic Flows – The evacuation traffic flow is analyzed with a computer program package consisting of two modules:

1. EVACURVE, which calculates the final departure curves (Figure 12) giving the distribution of times at which the vehicle-owning population completes preparations to leave home and enters the road system.

   The EVACURVE module calculates the departure curve from the series of time distributions for completing each step of the evacuation sequence. Statistically, each time distribution for an individual step is a conditional probability distribution; the final departure curve is obtained by computing the joint probability distribution of all the steps.

2. The QUEUE module, which simulates the flow of traffic through the evacuation routes, and identifies the location and extent of traffic congestion.

   Inputs to the QUEUE module are the evacuation network and the distribution of traffic onto this network. The program then calculates the arrival and departure of traffic at all locations throughout the evacuation network. This simulation is iterative, being repeated for 15-minute intervals of the evacuation period.

The QUEUE module identifies locations at which traffic congestion occurs, and calculates the extent of such congestion. Measures which are computed include the time period over which congestion occurs at a particular location, the maximum delay experienced by a vehicle passing through any congested location and the extent (distance) of congestion on the evacuation road network.

Traffic Congestion – The QUEUE program shows that on 6 of the 18 major routes out of the EPZ, the road capacities exceed the rate at which vehicles leave households. On these routes, there is no congestion at any point in the evacuation process, and the time needed to drive out of the EPZ is determined solely by the free-flow travel time.

On 11 of the 18 major routes, traffic back-ups (queues) will form during some part of the evacuation process. These are caused as the vehicle-owning population completes the necessary preparations to leave thier homes and enters the street system at a rate greater than the capacity of that street system to carry them. As a consequence, traffic begins to back up, starting at critical intersections, where:

1. Substantial volumes of evacuating traffic converge onto the evacuation route

2. The capacity of the evacuation rotue is restricted by a bridge, ramp, pavement width, etc.

3. Cross street traffic is substantial, reducing the amount of time available for the movement of evacuating traffic at that point

Traffic congestion first appears as the volume of traffic entering the street system begins to increase sharply, at about 1 hour, 40 minutes after the start of notification. Once started, congestion spreads rapidly in the upstream direction, blocking traffic attempting to enter the evacuation route from side roads. In the worst case, congestion spreads generally throughout an area, with all arterial and collector streets and even some local streets blocked.

During the period in which this congestion is occurring, the rate of evacuation is fixed by the capacity of the street system and is no longer determined by the rate at which the population finishes preparations to leave their households. Motorists

leaving their homes and entering the street system during such a period are simply "stored" in traffic queues in the street system.

Possible Levels of Traffic Congestion – Three possible conditions of traffic congestion are analyzed in Figure 13. In the instance with no traffic congestion (Type "A" in Figure 13), the departure from the EPZ depends solely on the rate at which people prepare to leave their households and drive, in a free-flow manner, out of the EPZ. At no point in the evacuation period does traffic congestion slow this progress out of the EPZ. Seven routes out of the Catawba EPZ have this pattern of traffic flows.

On routes where traffic congestion occurs (Types "B" and "C" in Figure 13), traffic congestion appears when the rate of vehicles entering the street exceeds the capability of the street to carry them. Congestion continues to build as long as the rate of vehicles entering the street system continues to exceed the vehicular capacity of the evacuation route.

At some point in the evacuation process, the rate at which vehicles enter the street system reaches a maximum and begins to decrease.

Congestion begins to diminish as the rate of vehicles entering the street system begins to fall below the capacity of the evacuation route to carry them. This decrease in traffic congestion continues until the queues disappear and free traffic flow is restored on the evacuation route.

In less severe instances of congestion (Type "B" in Figure 13), this occurs before the population has finished preparations to leave home. From the point at which congestion ends until the completion of evacuation, the rate of evacuation is once again determined by the rate at which households complete their preparation to leave home and enter the street system. Eight routes out of the Catawba EPZ have this traffic pattern.

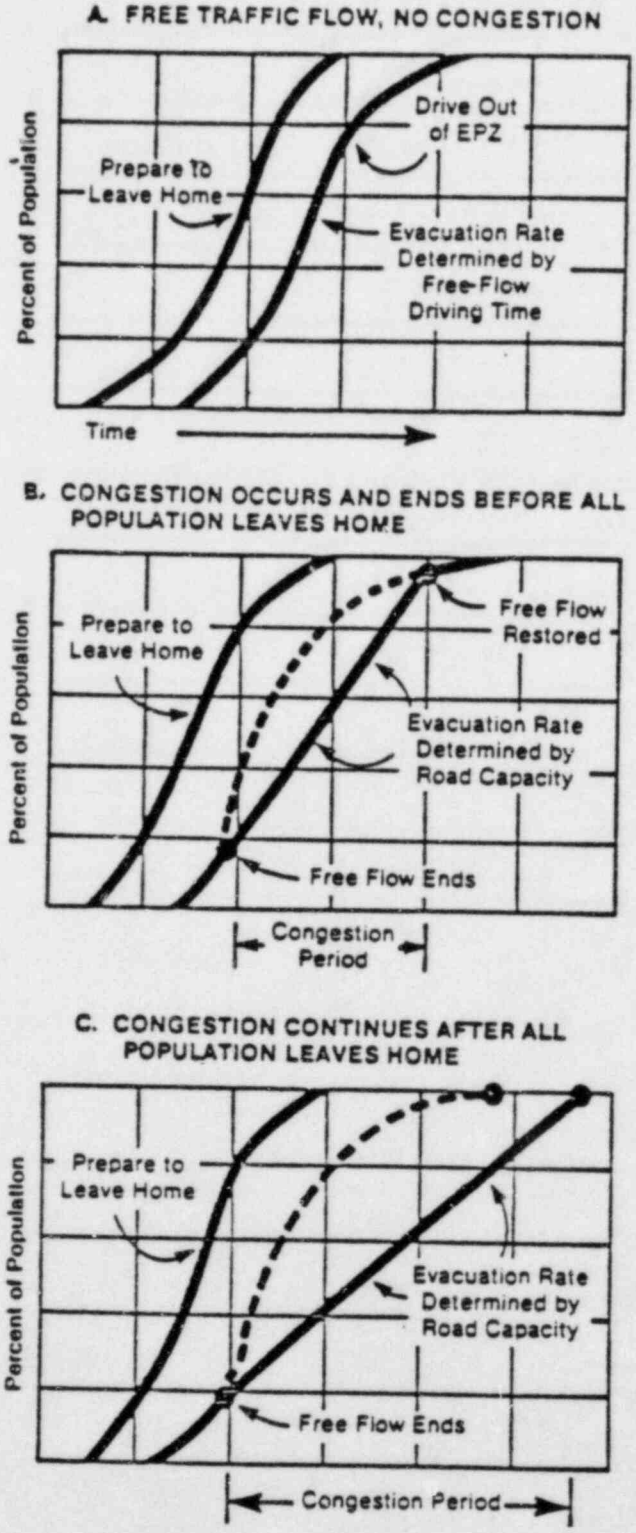

Figure 13. Possible Levels of Traffic Congestion

In the more severe instances of congestion (Type "C" in Figure 13), the traffic back-ups continue even after all the population has completed preparations to leave home. In this type of congestion, the back-ups are too large to be discharged before all population has completed preparations to leave home. In this case, evacuation times are no longer dictated by the time at which preparations for leaving home plus a free-flow driving time but, rather, by the traffic capacity of the evacuation route. Three routes out of the Catawba EPZ have this traffic pattern.

Location of Traffic Congestion – Figure 14 illustrates the location of traffic congestion in the Catawba EPZ, and indicates the extent of the anticipated congestion when it is at a maximum. As indicated in Figure 14, the greatest traffic cognestion occurs on US 21 southbound in Rock Hill.

Summary of Evacuation Times for the
Permanent Resident Population (Vehicle-Owning)

Of the total of 18 major evacuation routes in the Catawba EPZ, 14 have a total evacuation time of 3 hours and 25 minutes (Figure 14). This evacuation time occurs on routes where there is either no traffic congestion at all, or where there is some traffic congestion which ends before all the resident population completes preparations to leave home.

On the remaining three routes, the evacuation time reflects a level of congestion that is not dissipated by the time that the population has completed preparations to leave home. On those routes, congestion continues after the population has completed preparations to leave home, and this congestion then determines the total evacuation times. Evacuation time for US 21 is 4 hours, time for I-77 is 3 hours 45 minutes, and SC 901 is 3 hours 30 minutes.

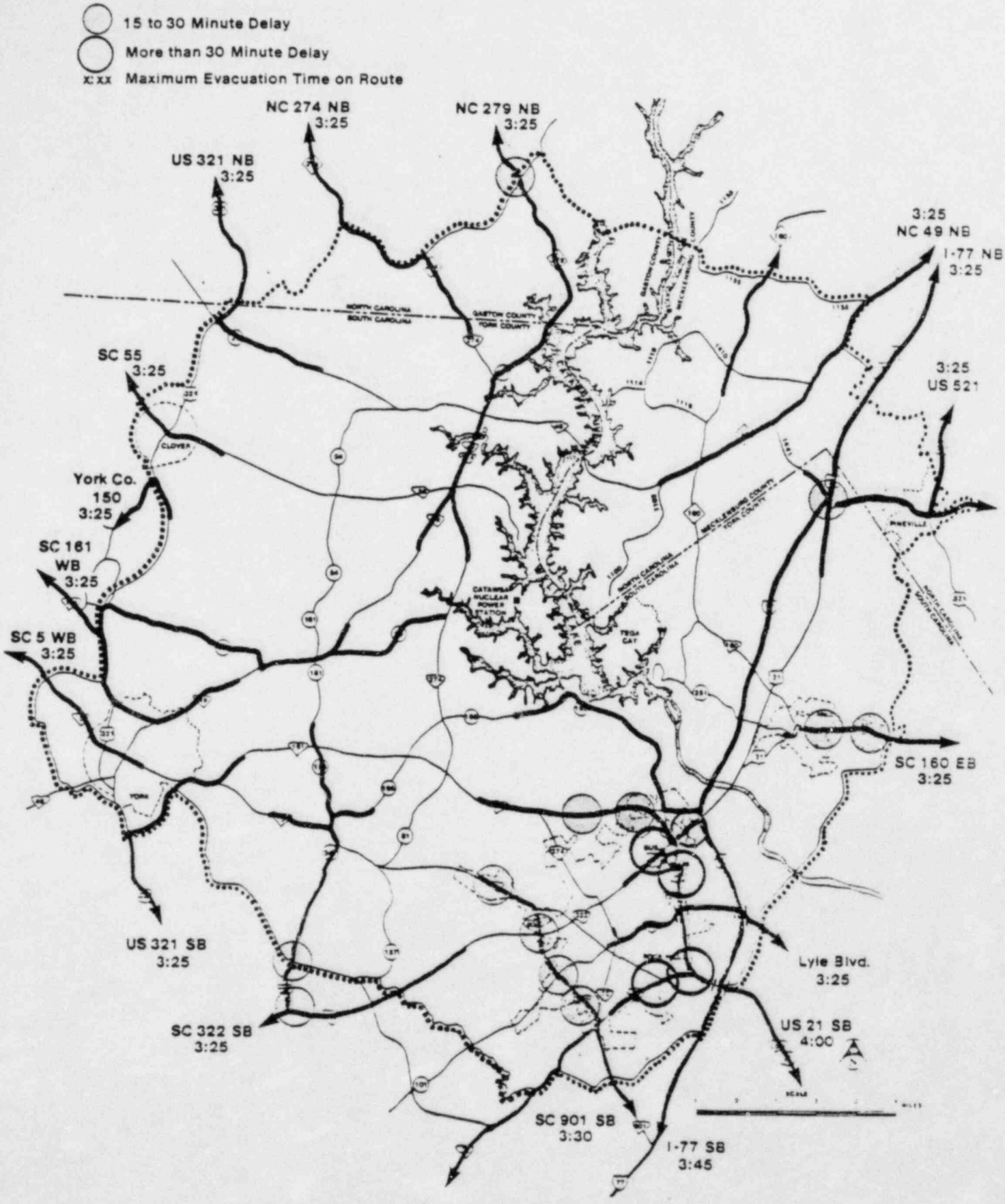

Figure 14. Traffic Congestion Summary

EVACUATION TIME FOR THE PERMANENT RESIDENT POPULATION (NON-VEHICLE-OWNING)

The evacuation of the non-vehicle-owning population includes three steps: (1) Receive Notification; (2) Prepare for Evacuating Home; and (3) Evacuate Non-Vehicle-Owning Population in Buses. The time required to complete each of these steps is established, and the total time for the evacuation of the non-vehicle-owning population is obtained by combining the time required for each of the steps.

Receive Notification

Notification times and the explanation for these times are the same as for the permanent resident vehicle-owning population discussed above. All of the non-vehicle-owning population is notified within 45 minutes of the start of notification.

Prepare for Evacuating Home

The time needed to prepare for evacuating the home depends on: (1) whether or not an adult member of the household is home at the time of notification; (2) the number of dependents in the household; and (3) the amount of household property to be secured before the family can evacuate.

It is estimated that 20 percent of the non-vehicle-owning population can prepare to leave home within 20 minutes of receiving notification to evacuate (Table 11). Typically, these are small households with few dependents and no property to secure before leaving.

At the upper end of the range, it is estimated that 50 percent of the non-vehicle-owning population needs 30 to 45 minutes to prepare for leaving home. These are generally households with a dependent at home and a residence to secure before leaving.

TABLE 11. TIME DISTRIBUTION FOR "PREPARE FOR EVACUATING HOME" STEP FOR NON-VEHICLE-OWNING POPULATION

Time After Receiving Notification	Estimated Percentage of Population Completing Preparations to Leave Home
15 minutes	10
20 minutes	10
25 minutes	10
30 minutes	20
35 minutes	20
40 minutes	20
45 minutes	10

Evacuate Non-Vehicle-Owning Population in Buses

A bus fleet large enough to carry the non-vehicle-owning population in less than two round trips per bus out of the EPZ is assumed in estimating the evacuation time. Local plans call for this fleet to be drawn from school buses from York, Mecklenburg, and Gaston Counties, other nearby counties, and from the public transit system in Charlotte.

It is estimated that one-half of the non-vehicle-owning population can be evacuated by 2 hours and 5 minutes after the start of notification (Table 12). The remainder of the non-vehicle-owning population is estimated to be evacuated by 3 hours after the start of evacuation.

TABLE 12. TIME DISTRIBUTION FOR "EVACUATE NON-VEHICLE-OWNING POPULATION IN BUSES" STEP

Time After Start of Notification	Estimated Percentage of Non-Vehicle-Owning Population Evacuated in Buses
1 hour, 45 minutes	25
2 hours, 5 minutes	25
2 hours, 25 minutes	25
3 hours	25

Summary of Evacuation Times for the Permanent Resident Population (Non-Vehicle-Owning)

The time required for completion of the various steps in the evacuation of the non-vehicle-owning population is summarized in Figure 15. The determining factor in the time needed for the evacuation of the non-vehicle-owning population is the time needed for this population to complete preparations for leaving home and to assemble at the collection points.

EVACUATION TIME FOR THE TRANSIENT POPULATION

The evacuation sequence for the transient population includes three steps: (1) Receive Notification, (2) Assemble Traveling Group, and (3) Drive Out of the EPZ. The time required to complete each of these steps is established. A total evacuation time for the transient population is obtained by combining the time required for each of the three action steps.

Receive Notification

Notification times and the explanation for these times are the same as for the permanent resident vehicle-owning population discussed previously. All of the

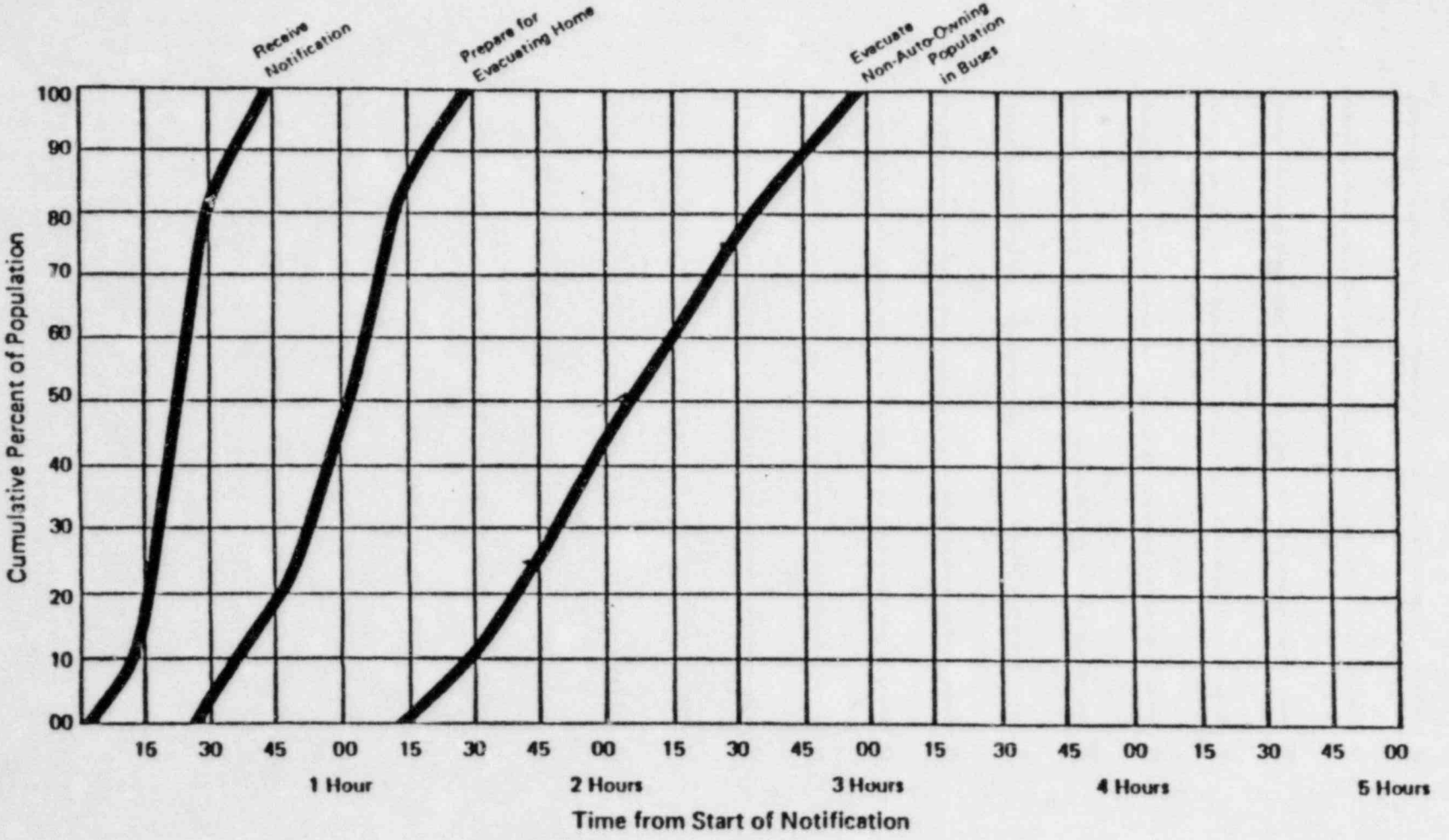

Figure 15. Evacuation Times for the Permanent Resident Population (Non-Auto-Owning)

transient population is assumed to be notified within 45 minutes of the start of notification.

Assemble Traveling Group

The traveling group (usually family or co-workers) is assembled and prepared for evacuation. It is assumed that some groups (for example, employees at work) can assemble and prepare for evacuation almost immediately. This is reflected in the distribution in Table 13, which estimates that 50 percent of the transient population can assemble their traveling group and prepare to depart within 15 minutes after receiving instructions to evacuate.

TABLE 13. TIME DISTRIBUTION FOR "ASSEMBLE TRAVELING GROUP" STEP FOR TRANSIENT POPULATION

Time After Receiving Notification	Estimated Percentage of Population Assembling Traveling Group
10	20
15	30
20	30
30	20

At the other end of the distribution, some transient groups will require up to an estimated 30 minutes to assemble their groups and prepare to evacuate. Examples of this situation are residents at seasonal homes at Lake Wylie who would have to complete certain preparations, such as securing boats and cabins, before evacuating the area.

Drive Out of the EPZ

After assembling their traveling group and completing preparations to evacuate, the transient population will drive out of the EPZ using their private vehicles.

In evacuating the EPZ, the transient population will encounter free-flow traffic conditions (i.e., no congestion) throughout their trip out of the EPZ. This is a result of the small size of the transient population and the early stage at which they begin to evacuate. All transient population is evacuated from the EPZ before the major part of the traffic build up from the permanent resident population begins to occur.

Summary of Evacuation Times for the Transient Population

It is estimated that some of the transient population in the EPZ evacuates within 45 minutes of the start of notification (Figure 16). The transient population is estimated to complete their trips out of the EPZ at 1 hour and 45 minutes after the start of notification.

Unusual Concentrations of Transients

In some situations, unusually large concentrations of transient population may be present within the EPZ at: (1) Carowinds Theme Park and (2) PTL grounds in York County.

Evacuation times were estimated for both locations, under assumption of their maximum reported attendance. For both locations, maximum reported attendances can be evacuated in less than the 3 hours and 25 minutes of the required time for vehicle-owning households in a congestion-free evacuation). Consequently, it can be established that evacuation of unusual concentrations of transient population for Carowinds or PTL will not result in extending evacuation times beyond that required by permanent resident population.

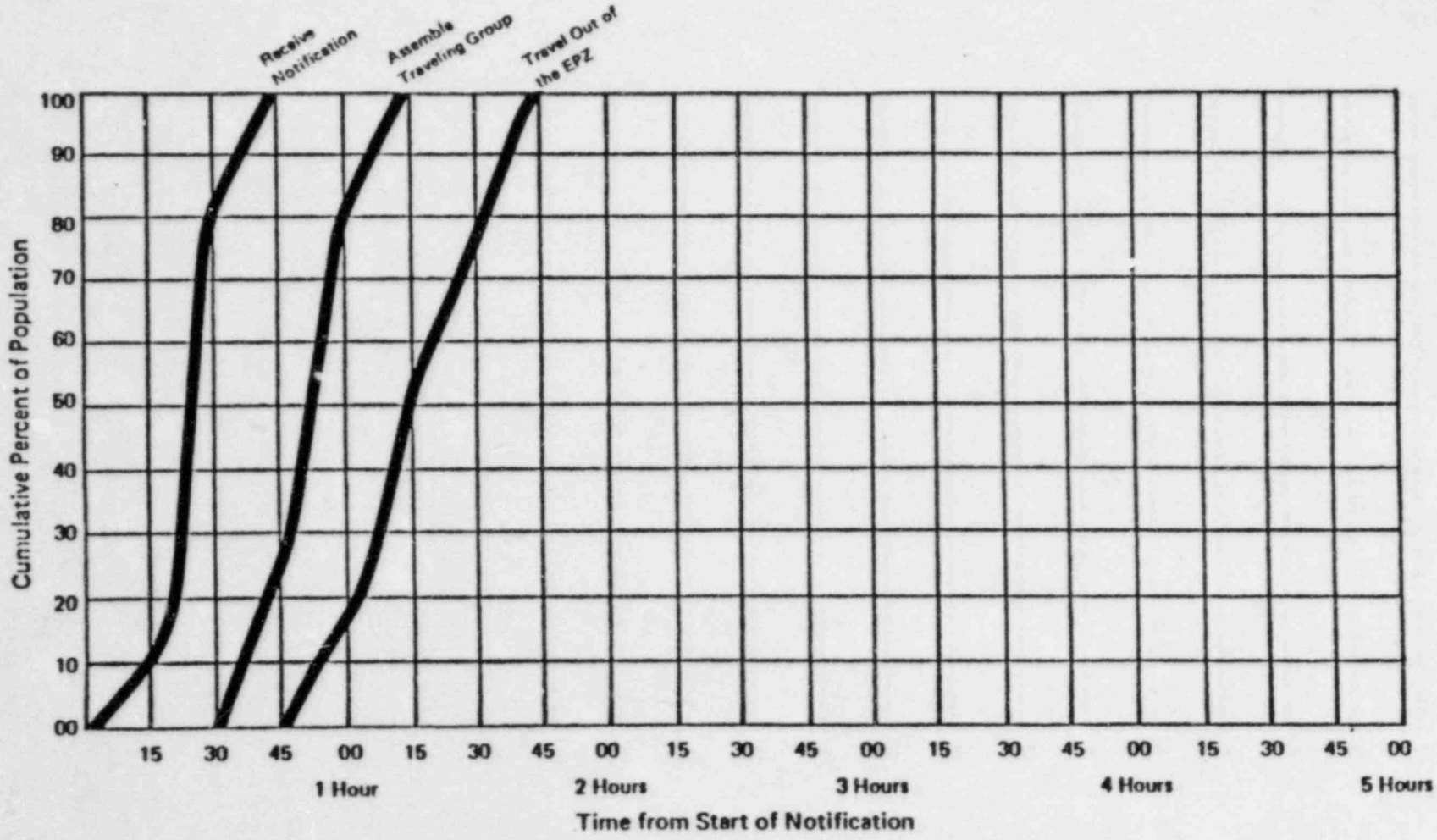

Figure 16. Evacuation Times for the Transient Population

EVACUATION TIME FOR THE SPECIAL FACILITY POPULATION (SCHOOLS)

The evacuation sequence for the school population includes two steps: (1) Receive Notification and (2) Evacuate School Population in Buses.

Receive Notification

School administrations will be notified immediately through radio and telephone calls. Student bodies will then be notified immediately through school public address systems. After notification, preparation to leave the school premises is almost immediate (similar to a routine fire drill).

The majority of the school population is assumed to be notified within 15 minutes of the start of notification (Table 14). All school population is assumed to be notified within 25 minutes of the start of notification.

TABLE 14. TIME DISTRIBUTION FOR "RECEIVE NOTIFICATION" STEP FOR SCHOOL POPULATION

Time After Start of Notification	Estimated Percentage of Population Receiving Notification
10 minutes	10
15 minutes	40
20 minutes	20
25 minutes	10

Evacuate School Population in Buses

The determining factor in the time needed for evacuation of the school population in buses is the time required for mobilizing the bus fleet and bringing buses to the schools.

A bus fleet sufficiently large to carry the entire school population is assumed in estimating the evacuation time. This fleet will be drawn from York, Mecklenburg, and Gaston Counties, and from other nearby counties if necessary.

As indicated in Table 15, an estimated 20 percent of the school population can be transported out of the EPZ within 1 hour after the start of notification. These students are transported in vehicles in regular use in the school districts in the EPZ and which can be readily mobilized. Another 60 percent of the school population is assumed to be transported out of the EPZ by 1 hour and 30 minutes after the start of notification.

TABLE 15. TIME DISTIBUTION FOR "EVACUATE SCHOOL POPULATION IN BUSES" STEP

Time After Start of Notification	Estimated Percentage of School Population Evacuated by Bus
60 minutes	20
1 hour, 15 minutes	35
1 hour, 30 minutes	25
1 hour, 45 minutes	20

The students evacuated in these later stages are those riding in buses which are brought from outside the EPZ.

All students are evacuated from the EPZ within 1 hour and 45 minutes after start of notification.

The distribution of the evacuation time for the school population is given in Figure 17.

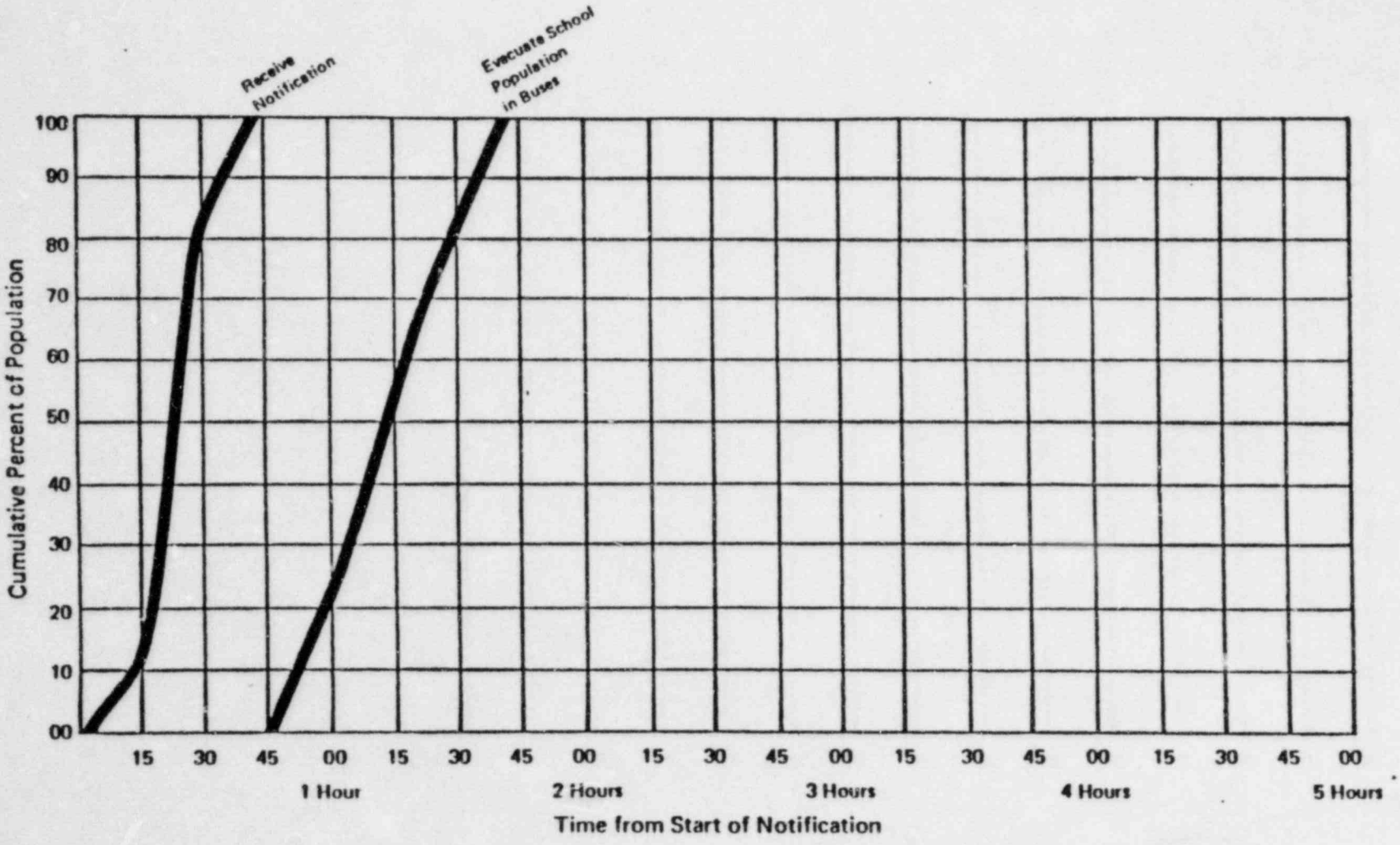

Figure 17. Evacuation Times for the Special Facilities Population (Schools)

EVACUATION TIME FOR THE SPECIAL FACILITY POPULATION (INSTITUTIONS)

The evacuation of the population in institutions involves three steps: (1) Receive Notification; (2) Mobilize Population; and (3) Evacuate Institutional Population in Buses or Special Vehicles. The time time needed to complete each of these steps is established, and the total time for the evacuation of the population in institutions is obtained by combining the time required for each of the three steps.

Receive Notification

Notification time is the same as for the vehicle-owning population discussed above. All of the population in institutions is assumed to be notified within 45 minutes after the start of notification.

Mobilize Population

For a significant part of the population in institutions, mobilization can be accomplished almost immediately after notification of the need to evacuate. For example, it is estimated that 70 percent of the population in institutions can be mobilized to evacuate within 20 minutes after the start of notification (Table 16). This element of the population is typically ambulatory patients in hospitals.

TABLE 16. TIME DISTRIBUTION FOR "MOBILIZE POPULATION" STEP FOR POPULATION IN INSTITUTIONS

Time After Receipt Of Notification	Estimated Percentage Of Population in Institutions Mobilized
10 minutes	30
20 minutes	40
30 minutes	30

At the upper end of the range, it is estimated that 30 percent of the population in institutions requires up to 30 minutes for mobilization (Table 17). Typically, these

are non-ambulatory patients in hospitals, or other persons (such as prisoners in jails) for whom special treatment is necessary.

Evacuate Institutional Population in Buses or Special Vehicles

A fleet of buses and emergency vehicles (ambulances, rescue vehicles, vans, etc.) large enough to carry out the institutionalized population of the EPZ in a single round trip (buses) and two round trips (emergency vehicles) is assumed in estimating the evacuation times. The fleet of emergency vehicles will be drawn from operators in the EPZ and surrounding areas.

It is estimated that 50 percent of the ambulatory population in institutions can be evacuated by bus by 1 hour and 35 minutes after the start of notification. The remainder of the ambulatory population can be evacuated by 2 hours (Table 17).

It is estimated that 50 percent of the non-ambulatory population can be evacuated by emergency vehicle by 1 hour and 50 minutes after the start of notification. The remainder of the non-ambulatory population can be evacuated by 2 hours and 45 minutes (Table 17).

TABLE 17. TIME DISTRIBUTION FOR "EVACUATE INSTITUTIONAL POPULATION IN BUSES AND SPECIAL VEHICLES" STEP

Time After Start of Notification	Estimated Percent of Population in Institutions Evacuated in Buses and Special Vehicles
Ambulatory Persons (by bus)	
1 hour, 35 minutes	50
2 hours	100
Non-Ambulatory Persons (by emergency vehicle)	
1 hour, 50 minutes	50
2 hours, 45 minutes	100
Total, Institutional Population	
1 hour, 35 minutes	50
2 hours, 45 minutes	100

The estimated time required for the completion of the individual steps in the evacuation of the combined institutional population (both ambulatory and non-ambulatory) is summarized in Figure 18. The determining factor in the time needed to evacuate the institutional population group is the time needed to complete two round trips out of the EPZ by the special vehicle fleet, mainly ambulances.

A special vehicle (bus and ambulance) fleet large enough to evacuate the popualtion in institutions in one and two trips, respectively, is critical to achieve the total evacuation time of 2 hours and 45 minutes for this population segment. If a sufficiently large bus and ambulance fleet could not be mobilized and additional trips out of the EPZ were needed (even by only a few of the vehicles), the total evacuation time for the population in institutions would increase by approximately 1 hour, to 3 hours and 45 minutes after the start of notification.

SUMMARY OF EVACUATION TIMES FOR NORMAL CONDITIONS

Table 18 summarizes the evacuation times for normal conditions. As indicated in this table the evacuation times vary according to the population segments considered. The maximum evacuation time for the entire EPZ, established by the time needed for the "Permanent Resient (Vehicle-Owning)" segment of the population, is 4 hours.

EVACUATION TIMES UNDER SEVERE WEATHER CONDITIONS

Severe weather conditions for the Catawba Nuclear Power Station EPZ are defined as a severe winter storm, with accumulations of snow or ice on the roadways within the EPZ.

Severe weather conditions affect the evacuation process by reducing road capacities, due to slower vehicle speeds and a reduction in vehicular capacity at intersections. Typically, under adverse winter weather conditions, an intersection functions at only 60 percent of its normal capacity.[1]

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1. Due to increase in headway between vehicles.

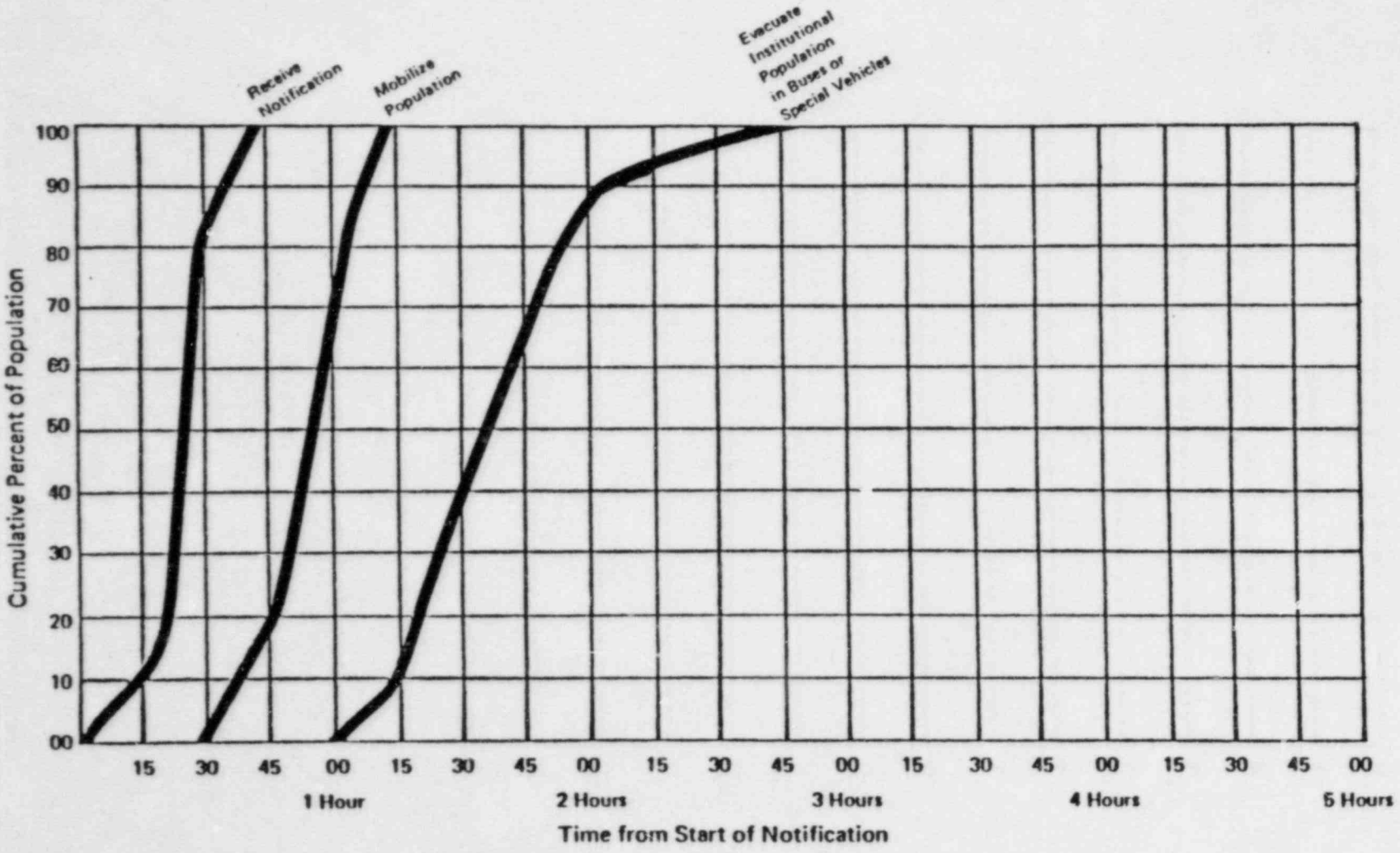


Figure 18. Evacuation Times for the Special Facility Population (Institutions)

TABLE 18. SUMMARY OF EVACUATION TIMES

Zones	Permanent Population	Permanent Population Vehicles	Transient Population	Transient Population Vehicles	Evacuation Capacity per Hour (Major Routes)	Notification Time	Preparation Time	Permanent Population Response Normal Conditions	Permanent Population Response Adverse Conditions	Transient Population Response Normal Conditions	Transient Population Response Adverse Conditions	General Population Evacuation Time – Normal Conditions	General Population Evacuation Time – Adverse Conditions	Confirmation Time	Special Population Evacuation Time – Normal Conditions	Special Population Evacuation Time – Adverse Conditions
Within Two Miles																
North Carolina	357	154	654	233	1,200	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
South Carolina	363	156	5,552	1,982	2,400	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
All Zones	720	310	6,206	2,215		(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
Within Five Miles																
A-1	529	227	10,187	3,637	1,200	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
B-1	2,631	1,131	2,588	924	1,200	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	1:45	2:30
C-1	6,161	2,649	16,827	6,007	1,200	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	1:45	2:30
D-1	1,414	608	109	39	2,400	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
E-1	429	184	0	0	3,600	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	(5)	(5)
F-1	2,573	1,106	1,582	563	3,600	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	1:40	2:30
All Zones	13,737	5,905	31,293	11,172		(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	1:40	2:30
Within Ten Miles																
A-2	4,838	2,080	4,073	1,454	4,800	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	2:45	4:15
B-2	9,771	4,201	46,826	16,717	4,200	(1)	(2)	(3)	(3)	(4)	(4)	3:25	4:00	1:40	2:45	4:15
C-2	44,964	19,335	0	0	11,400	(1)	(2)	(3)	(3)	(4)	(4)	4:00	6:15	1:40	2:45	4:15
D-2	9,169	3,943	0	0	4,800	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	2:45	4:15
E-2	4,957	2,132	0	0	4,800	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	2:45	4:15
F-2	2,655	1,142	650	232	6,000	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	2:45	4:15
F-3	2,672	1,149	651	232	2,400	(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	1:40	2:30
All Zones	79,026	33,982	52,220	18,635		(1)	(2)	(3)	(3)	(4)	(4)	3:25	3:25	1:40	2:45	4:15

1. See distribution in Table 7.
2. See distributions in Tables 8 and 9.
3. See distributions in Tables 10 and 11.
4. See distribution in Table 13.
5. No special facilities in these zones.

Reflecting this reduction in capacity in the EPZ road system results in the adverse condition time estimates as indicated in Table 18. As indicated in this table, the time for the evacuation of the entire EPZ becomes 6 hours and 15 minutes under adverse conditions.

SUMMARY OF TIMES FOR SELECTIVE EVACUATIONS

Table 18 shows the times needed for the selective evacuation of the subareas within the EPZ. In the evacuation of most of the subareas, traffic congestion is not a factor, and the evacuation time depends only on the rate at which the resident population prepares to leave home. Thus, for most of the subareas, the selective evacuation time is 3 hours and 25 minutes under normal conditions.

For some of the subareas, the evacuation time is determined by the extent of the traffic congestion present. The maximum evacuation time under normal conditions for any subarea is 4 hours for any group of subareas containing Zone C2.

VIII. CONFIRMATION OF EVACUATION

INTRODUCTION

"Confirmation" of evacuation measures the extent of compliance with the evacuation order. Confirmation is conducted by local preparedness agencies, beginning at about the time that evacuation is estimated to be substantially completed.

PLANNED APPROACH TO CONFIRMATION

Local plans for the confirmation process call for public safety agencies (fire and police departments), working at the direction of the Emergency Operations Centers (EOC's) of all counties within the EPZ, to assess the level of effectiveness of the evacuation.

In the initial stages of evacuation, the confirmation process is intended to establish if the public is comprehending the notification and is, therefore, beginning to react. Intitial confirmation assessments will consist of reports from emergency workers, traffic control officers, observations of patrolling officers and aerial observations of traffic flows.

At later stages in the evacuation, the confirmation process will establish the rate at which the public is complying with evacuation orders. The results of the confirmation process at this stage will guide the EOC's in directing remedial measures, such as intensified notification, additional EBS bulletins or door-to-door patrolling. At later stages in the evacuation, EOC's may request that local response agencies perform some of the following specific confirmation activities.

- Observe outbound traffic flows and report on traffic volumes
- Count arrivals at reception centers and report on the results
- Secure detailed reports from traffic control officers and perimeter control officers

- Conduct limited door-to-door canvasses to determine extent of evacuation

TIME REQUIRED FOR CONFIRMATION

The time required for confirmation depends on the degree of assurance desired. For example, a survey of 100 percent of the EPZ population would assure a completely accurate measure of the success of the evacuation. On the other hand, such a survey would be lengthy and costly in terms of resources that would be needed for other resource activities occurring at that time. Partial surveys of the EPZ population (samples) can offer a sufficiently high degree of reliability without incurring the cost of a full survey of EPZ population.

At the 95-percent confidence level, an accuracy of $\pm$2 percent can be obtained with a survey of 900 households. This indicates that in a survey of 900 households, there is a 95 percent assurance that the estimated fraction of population evacuated is within 2 percent of the "true" fraction evacuated (as would be established with a 100 percent survey of all EPZ households).

The time required for a "door-to-door" canvass yielding the accuracy described above is 1 hour, 40 minutes. The time is based on participation by 30 public safety personnel (fire or police) canvassing 30 households over a period of 1 hour, 40 minute. It is assumed that, in most instances, this canvassing would be performed in conjunction with other planned emergency response activities (for example, security patrolling of evacuated areas, patrolling for persons without transportation, etc.).

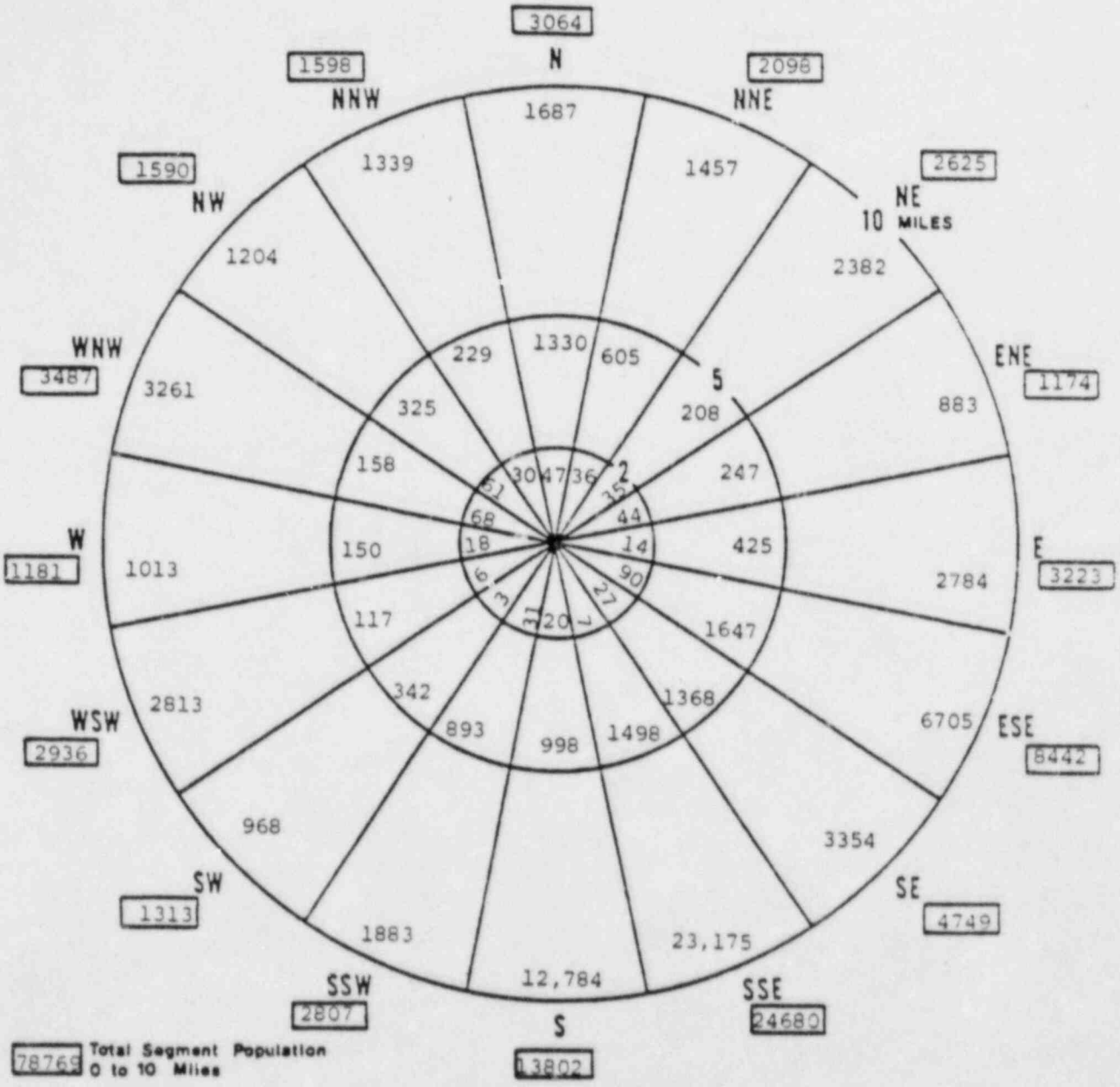
APPENDIX A
POPULATION BY 22.5 DEGREE SECTORS

INTRODUCTION

This appendix includes the folloiwng distributions, arranged into 22.5 degree sectors and within 2, 5 and 10 miles of the Catawba Nuclear Station:

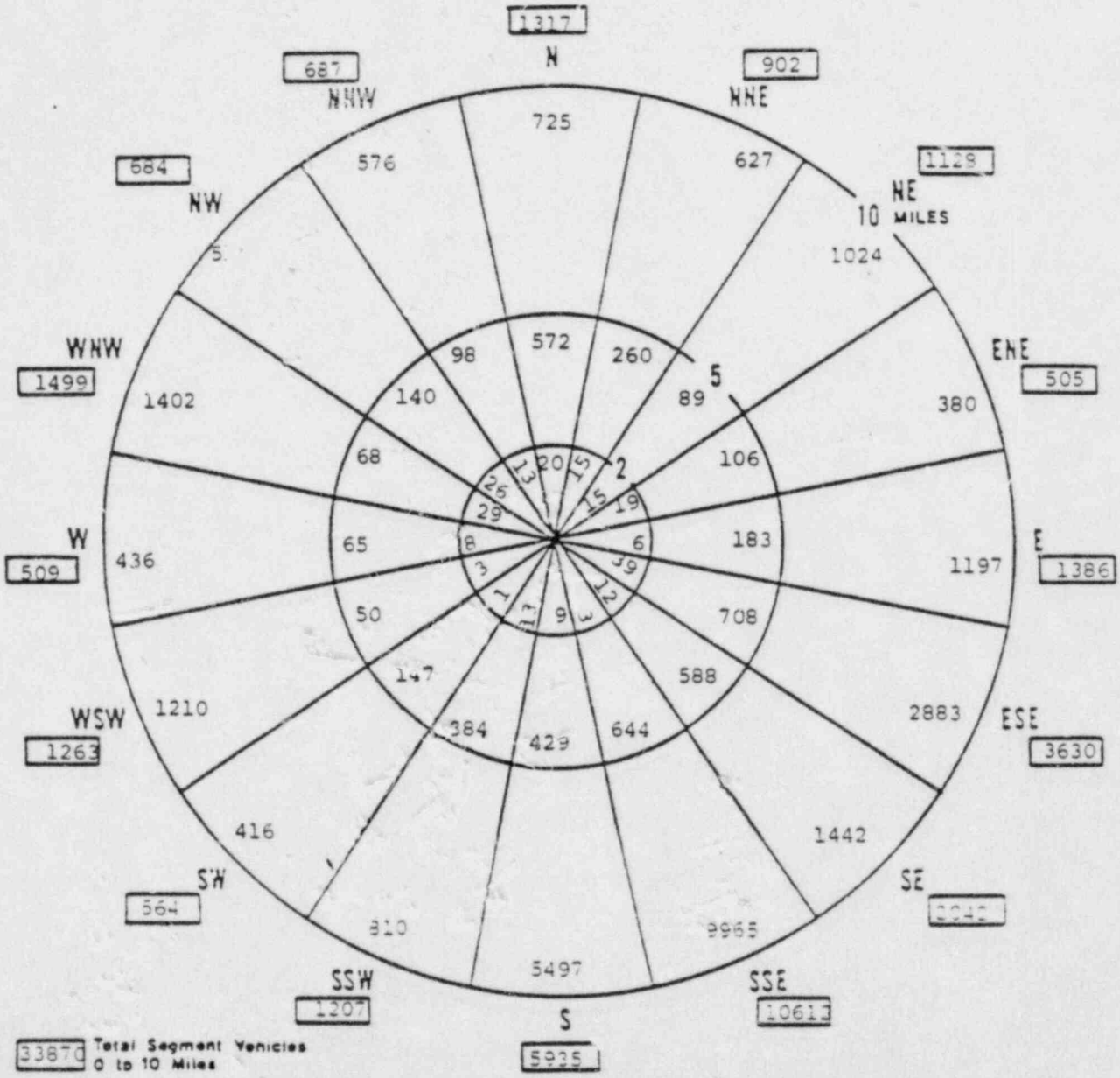
1. Permanent population
2. Estimated evacuation vehicles of the permanent population
3. Estimated transient population
4. Estimated evacuation vehicles of the transient population

Exhibit A-1. Permanent Population by Sector



POPULATION TOTALS			
RING, MILES	RING POPULATION	TOTAL MILES	CUMULATIVE POPULATION
0-2	537	0-2	537
2-5	10,540	0-5	11,077
5-10	67,692	0-10	78,769

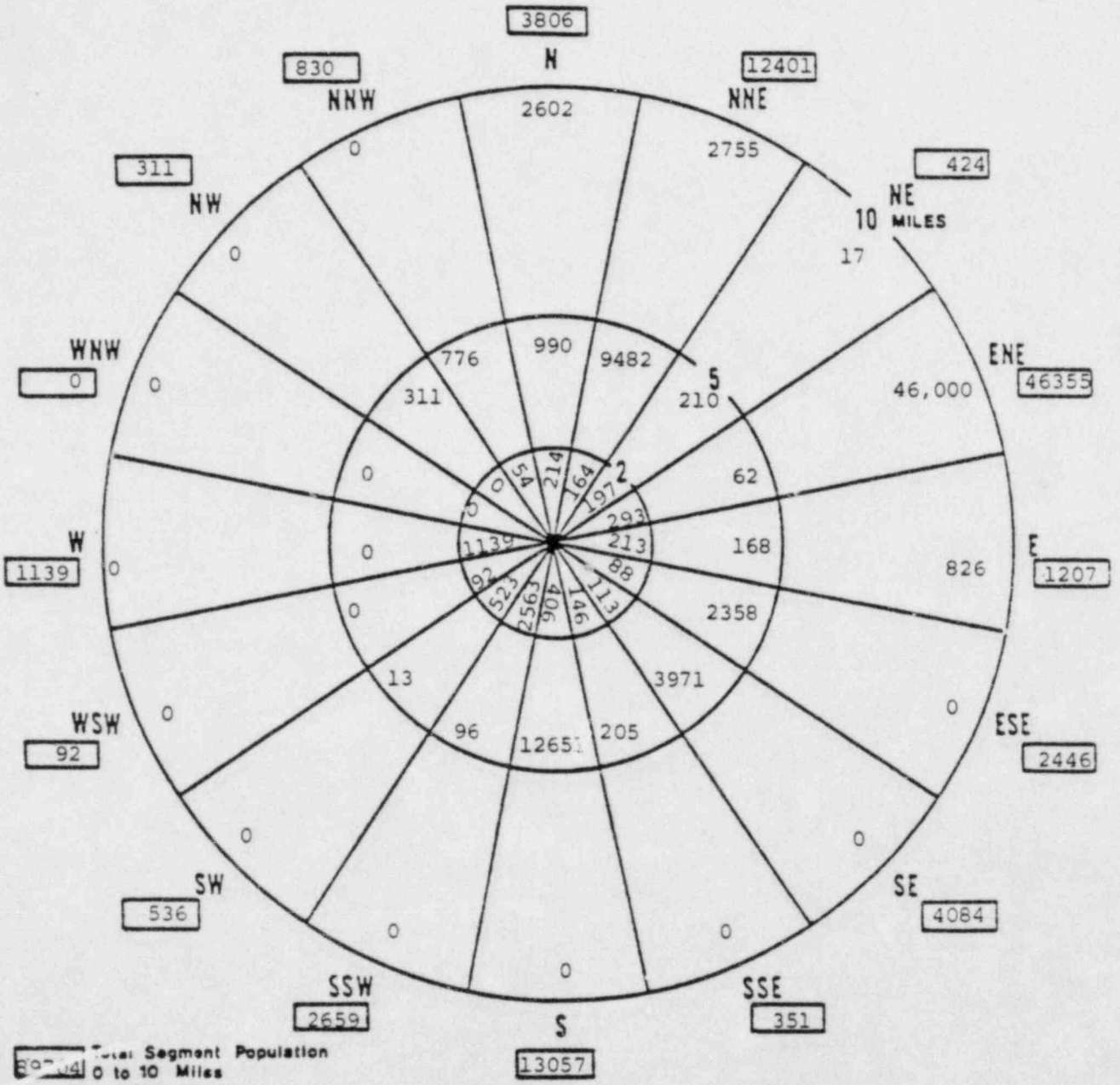
Exhibit A-2. Estimated Evacuation Vehicles of Permanent Population



33870 Total Segment Vehicles 0 to 10 Miles

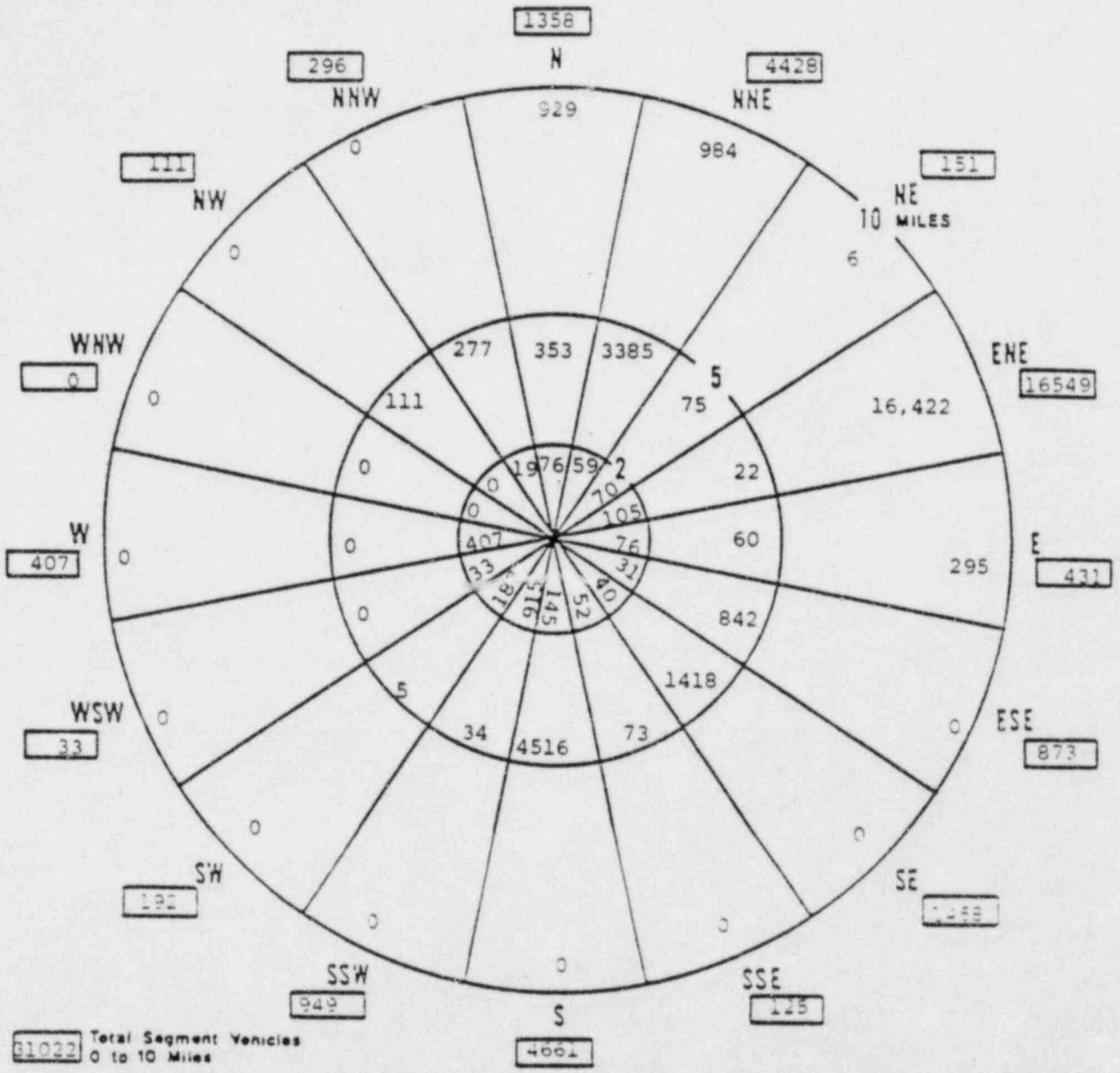
VEHICLES TOTALS			
RING MILES	RING VEHICLES	TOTAL MILES	CUMULATIVE VEHICLES
0-2	231	0-2	231
2-5	4,531	0-5	4,762
5-10	29,108	0-10	33,870

Exhibit A-3. Estimated Maximum Transient Population



POPULATION TOTALS			
RING, MILES	RING POPULATION	TOTAL MILES	CUMULATIVE POPULATION
0 - 2	6,206	0 - 2	6,206
2 - 5	31,298	0 - 5	37,504
5 - 10	52,200	0 - 10	89,704

Exhibit A-4. Estimated Evacuation Vehicles of the Maximum Transient Population



VEHICLES TOTALS			
RING MILES	RING VEHICLES	TOTAL MILES	CUMULATIVE VEHICLES
0 - 2	[illegible]	0 - 2	[illegible]
2 - 5	[illegible]	0 - 5	[illegible]
5 - 10	18,636	0 - 10	[illegible]

APPENDIX B

DERIVATION OF NON-VEHICLE-OWNING POPULATION AND NUMBER OF CARS USED FOR EVACUATION

The number of non-vehicle-owning households in the Catawba EPZ is derived on the basis of the three-county vehicle ownership pattern as obtained from the 1980 census.

VEHICLE OWNERSHIP IN 1980

The vehicle ownership pattern for Gaston, Mecklenburg, and York Counties, as derived from the 1980 census, is shown below:

Vehicles Owned by Households	Percentage of Households			
	Gaston County	Mecklenburg County	York County	Weighted Average for EPZ
0	10	10	10	10
1	32	34	30	30
2	38	38	40	40
3 or more	20	18	20	20

As indicated in the above table, 10 percent of the households in the three-county area do not own a vehicle.

On the basis of the postulated household vehicle usage, the average number of vehicles per household used for evacuation is 1.30. On average, this represents a vehicle occupancy of 2.33 persons per vehicle.

APPENDIX C

DESCRIPTION OF EVACPLAN MODELS USED IN THE ANALYSIS OF EVACUATION TIMES

The PRC EVACPLAN package used for the analysis of evacuation times consists of two modules:

1. EVACURVE module, which establishes the rate at which the population of the risk area completes preparations to evacuate and enters (or attempts to enter) the relocation road network.

2. QUEUE module, which simulates the flow of traffic out of the EPZ, portrays the impact of traffic control measures employed, and identifies the location, extent and severity of any traffic congestion that occurs during the relocation process. The QUEUE module computes the total time needed for evacuation, on a route-by-route basis.

These modules incorporate features particularly important in the analysis of evacuation times:

1. Dynamic – The EVACPLAN program recognizes that the entire process changes continuously as evacuation proceeds. For example, the rate of discharge of vehicles onto the roadway is neither a single event nor a steady rate, but rather is a distribution that varies with the elapsed time after the start of evacuation.

   In a similar manner, traffic congestion does not occur in a regular manner throughout the area and throughout the entire evacuation process, but rather it appears at different locations and for different durations at these locations. Also, the severity of traffic congestion varies sharply from location to location, even within a single evacuation route.

2. Behavior-based – The EVACPLAN program recognizes that the population of the risk area will not evacuate as a single body, with the entire population completing one step of the process (for example, the population will proceed at its own pace, with different portions of the population at various stages of the evacuation sequence at any given time.

3. Probabilistic – The EVACPLAN program recognizes that the time distributions for completing each of the various relocation steps are, in the statistical sense, conditional probability, distributions, contingent on completion of the previous steps. Total departure times—that is, the times needed for the entire preparation process—are

derived by computing the joint probability distribution from the individual time distributions for each step.

4. Sensitive to control measures – The EVACPLAN model can reflect the full range of measures that might be employed to improve the evacuation traffic flow. This range includes actions to regulate the flow of traffic onto the road system (demand measures), actions to increase the available road capacity for relocation flows (supply measures), and actions to improve the capacity of the available roads (traffic control measures).

THE EVACURVE MODULE

The EVACURVE module calculates the "departure curve" for the EPZ population; that is, the distribution of time needed for the EPZ population to complete preparations to evacuate. The departure curve, therefore, also defines the rate at which the EPZ population enters (or attempts to enter) the evacuation route system.

The EVACURVE module calculates the departure curve from a series of time distributions needed to complete each step of the evacuation sequence. Statistically, the time distribution for each individual step is conditional probability distribution; the final departure curve is calculated by computing the joint probability distribution of all the component steps.

Inputs to the EVACURVE Module

The series of action steps which comprise the evacuation sequence is identified. The time distribution required to complete each individual step of the evacuation sequence will be established. Methods for establishing these distributions will be based on local preparedness plans, projections of shut-down times by employers and institutions (such as schools), driving time to return home and distribution of time needed for securing households as derived from evacuation studies for nuclear power plants and natural disasters.

The time distributions for each step are characteristically in the "S-curve" form. This reflects the behavioral realities of the risk area population; that is, some of the population will complete a particular step rapidly (the low "tail" of the curve),

most of the population will complete the step in times which cluster around the center of the distribution (the steep central portion of the curve), and a small part of the population will require a very long time for the step (the "tail" at the high end of the distribution.

Computation Procedure for the EVACURVE Module

The EVACURVE module summarizes the input time distributions for the individual action steps of the evacuation sequence (Exhibit C-1).

The final departure curve is displayed in graphical and tabular form (Exhibits C-2 and C-3).

THE QUEUE MODULE

The QUEUE module begins with the evacuation road network (that is, the system of roads available for evacuation) the distribution of population onto this network. The QUEUE module then simulates the traffic flow through the evacuation road network. This simulation is iterative; that is, it is repeated for small increments of time. Consequently, the status of traffic congestion is calculated at each time interval, and the dynamic aspects of traffic flow and congestion can be traced.

Inputs to the QUEUE Module

Inputs to the QUEUE program are:

1. Road network used for evacuation. This includes the major evacuation routes, branches to these routes (evacuation subroutes), and points at which the population enters the evacuation route system (loading points).

2. Departure curve for the risk area population, which gives the rate at which the population enters the road system. The departure curve is the direct output of the EVACURVE module as described above.

3. Traffic flow parameters to reflect the capacity of the roads in the relocation network.

Exhibit C-1. Example of Input Time Distributions for Evacurve Module of PRC Evacplan Program

INPUT DISTRIBUTIONS
DAY-WEEKEND-WINTER
(VALUES IN PERCENT POPULATION)

TIME FROM START OF NOTIFICATION	RECEIVE MESSAGE
0: 5	0.0
0:10	0.0
0:15	10.00
0:20	10.00
0:25	30.00
0:30	30.00
0:35	10.00
0:40	5.00
0:45	5.00
0:50	0.0
0:55	0.0
1: 0	0.0
1: 5	0.0
1:10	0.0
1:15	0.0
1:20	0.0
1:25	0.0
1:30	0.0
1:35	0.0
1:40	0.0
1:45	0.0
1:50	0.0

TIME FROM RECEIPT OF INFORMATION	LEAVE WORK
0: 5	0.0
0:10	50.00
0:15	30.00
0:20	10.00
0:25	0.0
0:30	5.00
0:35	0.0
0:40	0.0
0:45	5.00
0:50	0.0
0:55	0.0
1: 0	0.0
1: 5	0.0
1:10	0.0
1:15	0.0
1:20	0.0
1:25	0.0
1:30	0.0
1:35	0.0
1:40	0.0
1:45	0.0
1:50	0.0

TIME AFTER LEAVING WORK	TRAVEL HOME
0: 5	50.00
0:10	30.00
0:15	10.00
0:20	10.00
0:25	0.0
0:30	0.0
0:35	0.0
0:40	0.0
0:45	0.0
0:50	0.0
0:55	0.0
1: 0	0.0
1: 5	0.0
1:10	0.0
1:15	0.0
1:20	0.0
1:25	0.0
1:30	0.0
1:35	0.0
1:40	0.0
1:45	0.0
1:50	0.0

TIME AFTER ARRIVAL HOME	PREPARE EVACUATE
0: 5	0.0
0:10	0.0
0:15	10.00
0:20	5.00
0:25	10.00
0:30	15.00
0:35	15.00
0:40	25.00
0:45	0.0
0:50	10.00
0:55	0.0
1: 0	5.00
1: 5	0.0
1:10	0.0
1:15	0.0
1:20	0.0
1:25	0.0
1:30	0.0
1:35	5.00
1:40	0.0
1:45	0.0
1:50	0.0

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Exhibit C-2. Example of Plotted Distribution of Final Departure Curve from Evacurve Module of PRC Evacplan Program

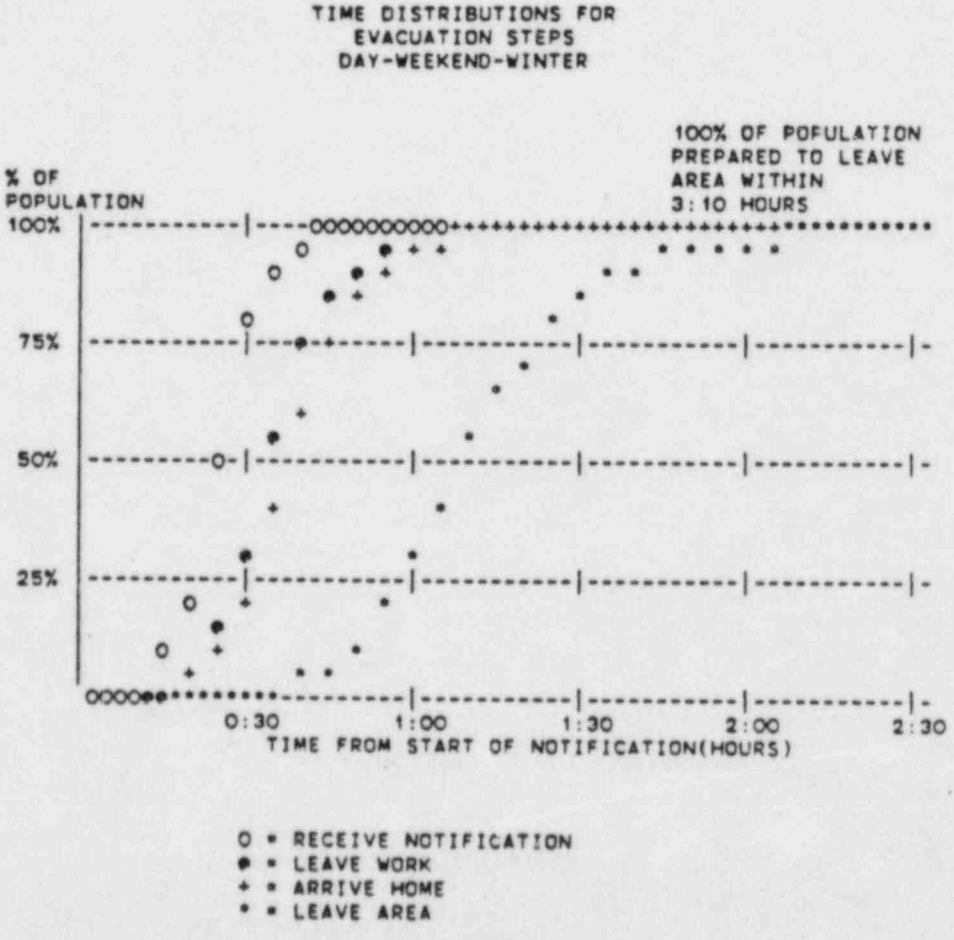

Exhibit C-3. Example of Final Departure Curve (Tabular Form) from Evacurve Module of PRC Evacplan Program

FINAL EVACUATION DISTRIBUTION
DAY-WEEKEND-WINTER
(VALUES IN PERCENT)

	MINUTES					
TIME	5	10	15	20	25	30
0: 0	0.0	0.0	0.0	0.0	0.0	0.25
0:30	0.67	1.76	3.49	5.31	7.62	9.78
1: 0	11.70	12.09	10.83	8.95	7.02	5.23
1:30	3.67	2.52	1.66	1.14	0.89	0.99
2: 0	1.18	1.06	0.76	0.54	0.34	0.18
2:30	0.12	0.10	0.05	0.03	0.02	0.01
3: 0	0.00	0.00	0.0	0.0	0.0	0.0
3:30	0.0	0.0	0.0	0.0	0.0	0.0
4: 0	0.0	0.0	0.0	0.0	0.0	0.0
4:30	0.0	0.0	0.0	0.0	0.0	0.0
5: 0	0.0	0.0	0.0	0.0	0.0	0.0
5:30	0.0	0.0	0.0	0.0	0.0	0.0
6: 0	0.0	0.0	0.0	0.0	0.0	0.0
6:30	0.0	0.0	0.0	0.0	0.0	0.0
7: 0	0.0	0.0	0.0	0.0	0.0	0.0

NOTE: TIME IS IN HOURS AND MINUTES AFTER START OF NOTIFICATION. A POINT ON THE DISTRIBUTION IS FOUND BY ADDING THE COLUMN "MINUTES" TO THE ROW "TIME".

The evacuation route network within the EPZ is coded into a form needed for entry into the QUEUE program. This coding process consists of:

1. Designating the major evacuation routes. The number of such routes depends on the specific corridor being considered: typically, there are two to five major evacuation routes in any given corridor.

2. Designating the subroutes; that is, the roads that feed traffic onto the major evacuation routes. The number of subroutes also depends on the specific corridor being considered; typically, there are two to four subroutes for each major relocation route.

3. Establishing the loading points, locations at which relocation traffic is assumed to be generated and at which it enters the relocation road system. Loading points are an abstraction of the actual road system, representing concentrations of households, workplaces, etc. Typically, a total of 10 to 15 loading points is established for each of the major evacuation routes.

Computation Procedure for the QUEUE Module

The QUEUE program calculates, for each time interval, the arrival and departure of traffic at all locations throughout the evacuation road system. Arrival rates of traffic are determined by:

1. The output of the EVACURVE module, which establishes for all evacuation routes the rate at which traffic enters (or attempts to enter) the evacuation road system, and

2. The loading of traffic onto the individual evacuation routes. This loading is made on the basis of population concentrations and special activity centers.

The rate of discharge of traffic through intersections is determined by:

1. The available lanes of roadway

2. The traffic flow rate, typically 1,200 vehicles per hour on each departure lane for surface roads, and 1,800 per lane on freeways. Traffic flow rates can be adjusted to reflect adverse conditions or other obstacles to free traffic flow.

Traffic queues at any given location are discharged at a rate proportional to their magnitude; i.e., the longer a queue the greater its priority at the intersection

where the queue originates. This algorithm simulates the traffic control that would be achieved by a competent traffic control officer on duty at such locations.

The QUEUE program identifies locations at which congestion occurs and calculates the extent of such congestion. Measures which are computed include the length (time) of the period over which congestion persists at particular locations, the maximum delay experienced by a vehicle passing through any congested location, and the extent (distance) of congestion on the relocation road network.

Outputs of the QUEUE Module

A summary of all evacuation routes is prepared (Exhibit C-4).

For each evacuation route, a summary status report is prepared (Exhibit C-5).

A detailed tabular report of each congested location at which congestion occurs is prepared (Exhibit C-6).

Exhibit C-4. Example of Summary of Evacuation Times by Route, from Queue Module of PRC Evacplan Program

EVACUATION ROUTE SUMMARY

ROUTE	POPULATION	VEHICLES	TIME TO EVACUATE (HOURS)
SC 183 WEST	5174	2224	3:25
SC 11 SOUTH	6222	2675	3:30
US 123 WEST	2506	1077	3:25
SEC RTE 63	2340	1006	3:25
SC 59	7021	3019	3:45
SEC RTE 21	3900	1676	3:25
US 76 SOUTH	10880	4678	3:25
US 123 EAST	7541	3242	3:25
SC 93	4514	1941	3:25
SC 183 EAST	2663	1145	3:25

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Exhibit C-5. Example of Evacuation Route Status Report, from Queue Module of PRC Evacplan Program

ROUTE SUMMARY
SC 11 SOUTH

INTER-SECTION	START OF QUEUE (PERIOD)	END OF QUEUE (PERIOD)	TOTAL PEAK QUEUE(VEH)	PEAK QUEUE LENGTH(VEH)	MAX DELAY (PERIODS)	TIME
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	6	7	14	9	0	6
4	6	8	83	65	0	6
5	5	9	167	151	1	7
6	5	9	159	157	1	8
7	5	10	252	246	1	8
8	5	11	213	213	1	9
9	5	13	490	488	2	10

MAX. TIME TO EVACUATE= 3:30 HOURS

INTERSECTIONS:

1=SC 11 & SEC RTE 145
2=SC 11 & SEC RTE 129
3=SC 11 & SEC RTE 94
4=SC 11 & SEC RTE 198
5=SC 11 & SEC RTE 34
6=SC 11 & SEC RTE 131
7=SC 11 & SEC RTE 133
8=SC 11 & SEC RTE 60
9=SC 11 & SC 28

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Exhibit C-6. Example of Tabular Report for Specific Congested Location, from Queue Module PRC Evacplan Program

INTERSECTION: SC 11 & SEC RTE 198
ROUTE: SC 11 SOUTH
TIME PERIOD: 6

LEG	ARRIVALS (VEH)	DEPART (VEH)	QUEUE (VEH)	QUEUE LENGTH (MILES)
1	205		65	0.3
2	51		18	0.1
3		300		
4	0		0	0.0
TOTAL	256.	300	83	0.4

TOTAL ARRIVALS: 256. VEHICLES
TOTAL BACKLOG: 39. VEHICLES

NOTE: LEG 1=MAIN APPROACH LEG
LEGS 2,4=SIDE APPROACH LEGS
LEG 3=EXIT LEG

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Missing from this packet:

EPC 9 BASSIOUNI ATTACHMENT B

This Attachment can be reviewed in the office of:

Albert V. Carr, Jr.
Duke Power Company
Charlotte, NC
Room PB 5105

Prepared for
Duke Power Company

Summary of Method for Estimating Evacuation Timing for Catawba Nuclear Station Emergency Planning Zone

Prepared by
PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22102

March 1984

METHOD FOR ESTIMATING EVACUATION TIMES

The series of activities preceding departure in an evacuation is determined. This series of activities varies depending on the population group studied.

A time distribution is compiled for each of the series of steps. These time distributions are linked statistically, giving a composite time for the entire population to prepare for evacuation.

Departing traffic is then assigned to the local street system, according to the minimum time travel path to reach their designated shelter area. Population without an automobile available are assigned to available buses.

Traffic flow is simulated through the use of a computer program, and locations and severities of traffic congestion are noted.

Total evacuation times are compiled by combining departure times with travel times from the EPZ (Emergency Planning Zone).

Population Segments

Five population segments are identified in this analysis:

1. Auto-owning residents are those residents of the EPZ with a private automobile available in the emergency zone. Auto-owning resident population includes all members from households where an automobile is owned and where at least one automobile is within 30 minutes of home on a typical workday. Certain non-auto-owning individuals (for example, elderly persons living with or near other family members) can depend on auto-owning households for transportation, and are therefore, included in auto-owning population.

2. Non-auto-owning residents are EPZ residents who do not own an automobile in their household, and do not have assured transportation from some other household. Also, some auto-owning households are, for parts of the day, without an automobile within 30 minutes and are, therefore, considered to be non-auto-owning.

3. Transients are non-residents of the EPZ who are in the EPZ at the time of evacuation. Typically, transients are either employees at EPZ locations or visitors to recreational facilities in the EPZ.

4. School population consists of all students in school (K-college) within the EPZ.

5. Special facility populations consist of hospital patients, nursing home residents, and jail imates.

Basis of the resident population estimates is the 1980 census. Car ownership data is from the census and supplementary surveys conducted in the EPZ. School population is furnished by school districts. Institutional population is obtained by survey from the individual institutions.

Departure Activities

The series of discrete departure activity steps identified for the EPZ population are shown in Exhibit 1. These steps are patterned on the guidelines first issued in Appendix 4 to NUREG 0654 and reflect the different methods of evacuation for the various population groups.

Time Distributions for Departure Activities

Time distributions for departure steps are built up from the following sources:

- Notification times are based on the times mandated by NRC and FEMA for the notification of EPZ population.

- Departure times from work place are based on typical shutdown times. These times recognize that a longer time will be required for certain personnel (for example, managers).

- Driving times for the return to households are based on distance and travel speeds. Typically, travel speeds reflecting daily rush-hour conditions are used in this analysis.

- Preparation for leaving households is based on a time-and-motion analysis for a simulated emergency departure from various sizes of households. An upper bound to this range is defined by the times required for the evacuation of a family farm.

  A computer program (EVACURVE) is used to obtain the joint probability distribution of the individual time distributions.

- Driving times are estimated by the use of a traffic simulation model (the QUEUE model) that considered the loading of traffic onto a route and the capacity of that route.

- Transportation times for persons dependent on public vehicles are determined by calculating the number of round trips needed by these vehicles, computing their travel distance and speed, and compiling the resulting travel times.

The EVACURVE Model

The EVACURVE module calculates the "departure curve" for the EPZ population; that is, the distribution of time needed for the EPZ population to complete preparations to evacuate. The departure curve, therefore, also defines the rate at which the EPZ population enters (or attempts to enter) the evacuation route system.

The EVACURVE module calculates the departure curve from the series of time distributions needed to complete each step of the evacuation sequence. Statistically, the time distribution for each individual step is conditional probability distribution; the final departure curve is calculated by computing the joint probability distribution of all the component steps.

The time distributions for each step are characteristically in the "S-curve" form. This reflects the behavioral realities of the risk area population; that is, some of the population will complete a particular step rapidly (the low "tail" of the curve), most of the population will complete the step in times which cluster around the center of the distribution (the steep central portion of the curve), and a small part of the population will require a very long time for the step (the "tail" at the high end of the distribution.

The EVACURVE module summarizes and displays the input time distributions for the individual action steps of the evacuation sequence. The final departure curve is displayed in graphical and tabular form.

The QUEUE Model

The QUEUE module begins with the evacuation road network (that is, the system of roads available for evacuation) and the distribution of population onto this network. The QUEUE module then simulates the traffic flow through the evacuation road network. This simulation is iterative; that is, it is repeated for small increments of time. Consequently, the status of traffic congestion is calculated at each time interval, and the dynamic aspects of traffic flow and congestion can be traced.

Inputs to the QUEUE program are:

1. Road network used for evacuation. This includes the major evacuation routes, branches to these routes (evacuation subroutes), and points at which the population enters the evacuation route system (loading points). Routes are obtained from the local emergency plans. Route branches and loading points are established by designating the "travelshed" for each evacuation route, identifying feeder routes within the travelshed and assigning population within the travelshed to the appropriate feeder route. Routing decisions are based on minimum travel time.

2. Departure curve for the risk area population, which gives the rate at which the population enters the road system. The departure curve is the direct output of the EVACURVE module as described above.

3. Traffic flow parameters to reflect the capacity of the roads in the relocation network. For surface routes, a traffic capacity of 1,200 vehicles per lane per hour was used. This capacity reflects intersection departure capacity, which is the determining factor in the road capacity under evacuation conditions and is based on the 1965 Highway Capacity Manual. For interstate routes, a capacity of 1,800 vehicles per hour per lane is used. This capacity is based on the 1965 Highway Capacity Manual.

The evacuation route network within the EPZ is coded into a form needed for entry into the QUEUE program. This coding process consists of:

1. Designating the major evacuation routes. The number of such routes depends on the specific corridor being considered; typically, there are two to five major evacuation routes in any given corridor.

2. Designating the subroutes; that is, the roads that feed traffic onto the major evacuation routes. The number of subroutes also depends

on the specific corridor being considered; typically, there are two to four subroutes for each major relocation route.

3. Establishing the loading points, locations at which relocation traffic is assumed to be generated and at which it enters the relocation road system. Loading points are an abstraction of the actual road system, representing concentrations of households, workplaces, etc. Typically, a total of 10 to 15 loading points is established for each of the major evacuation routes.

The QUEUE program calculates, for each time interval, the arrival and departure of traffic at all locations throughout the evacuation road system. Arrival rates of traffic are determined by:

1. The output of the EVACURVE module, which established for all evacuation routes the rate at which traffic enters (or attempts to enter) the evacuation road system, and

2. The loading of traffic onto the individual evacuation routes. This loading is made on the basis of population concentrations and special activity centers.

The rate of discharge of traffic intersections is determined by:

1. The available lanes of roadway

2. The traffic flow rate, typically 1,200 vehicles per hour on each departure lane for surface roads, and 1,800 per lane on freeways. Traffic flow rates can be adjusted to reflect adverse conditions or other obstacles to free traffic flow.

Traffic queues at any given location are discharged at a rate proportional to their magnitude; i.e., the longer a queue the greater its priority at the intersection where the queue originates. This algorithm simulates the traffic control that would be achieved by a traffic control officer on duty at such locations.

The QUEUE program identifies locations at which congestion occurs and calculates the extent of such congestion. Measures which are computed include the length (time) of the period over which congestion persists at particular locations, the maximum delay experienced by a vehicle passing through any congested location, and the extent (distance) of congestion on the relocation road network.

The QUEUE model then produces the following outputs:

1. A summary of all evacuation routes
2. For each evacuation route, a summary status report
3. A detailed tabular report of each location at which congestion occurs

RESULTS OF EVACUATION TIME ANALYSIS

The time required for total evacuation of the Catawba Nuclear Station EPZ is four hours. This maximum time is determined by the time required to clear the EPZ on the most congested evacuation route (US 21, southward out of Rock Hill).

The maximum evacuation time of four hours is for auto-owning residential population, evacuating in their own vehicles. Estimated evacuation times for other population segments, as reported in the Evacuation Time Estimates, are less than this. These times are reported by popualation group and by evacuation sector, in the Catawba Nuclear Station Evacuation Analysis, Evacuation Time Estimates, Final Report.

Evacuation times vary according to Evacuation Sector (Zone), County, and State. For most evacuation zones, the maximum evacuation time is 3 hours and 25 minutes. This time reflects the evacuation, by the automobile-owning population, under traffic conditions that have either no congestion or alternatively, that have congestion which subsides prior to the time that all residents have prepared to leave home.

A total of three evacuation routes have traffic congestion that continues after all residents have prepared to evacuate and have entered the street system. On these routes, the total evacuation time is determined by the congestion. The maximum case of such congestion is on the US21/SC5 evacuation route, serving evacuation zone C-2. For this route, the evacuation time (noted previously as the maximum time for the entire EPZ) is 4 hours.

The QUEUE computer program identified the location and severity of traffic congestion throughout the EPZ, and these locations are reported in the Evacuation Time Estimate. With respect to impact on evacuation times, two distinctly different types of congestion are noted:

1. In some instances, congestion appears at a location, but dissipates prior to the time that all residents of the EPZ have completed preparations to leave home. In such instances, the congestion will delay some evacuees, but will determine the maximum time for evacuation.

2. In the instances of heavier congestion, congestion continues until after all population has finished preparations to leave home. In such instances, evacuation times are determined by the extent and duration of congestion.

SENSITIVITY OF EVACUATION TIMES

Estimated evacuation times will vary according to a number of factors, the most important of which include:

1. Weather conditions
2. Availability of public transportation (buses) for the evacuation of population without automobile transportation
3. Evacuee behavior
4. Voluntary (Shadow) Evacuation

Evacuation times were computed for adverse weather conditions, and these times are reported in the Evacuation Time Estimates. Adverse weather conditions are defined as severe winter weather occurring on a regularly recurring basis in the EPZ. It should be clearly understood that adverse weather cases are not "worst case" situations, for example, 100-year storms, floods, etc.

In the event of such "worst case" events during an actual evacuation, time estimates could be revised accordingly (for example, reflecting closed roads) and decisions as to the feasibility of evacuation as a protective measure would be made.

The sensitivity of evacuation times to school bus availability was examined in detail in a separate analysis. Certain types of evacuee behavior (for example, speeding or disregard for normal traffic control devices) could affect the estimated evacuation times. However, no decrease in projected times was assumed for this type of changed behavior.

"Voluntary" evacuation of persons outside the EPZ could result in congestion that hinders the evacuation of EPZ population. This effect was examined in detail in _____ for the urbanized area or Charlotte, North Carolina, immediately to the north of the EPZ. One detailed analysis was found that voluntary evacuation by Charlotte residents showed that it is extremely unlikely that voluntary evacuation would increase the time required to evacuate the EPZ.

Prepared for
Duke Power Company

Adequacy of Planning for School Population Evacuation

Catawba Nuclear Station Emergency Planning Zone

Prepared by
PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22102

March 1984

ADEQUACY OF PLANNING FOR SCHOOL POPULATION EVACUATION

CATAWBA NUCLEAR STATION EMERGENCY PLANNING ZONE

DRAFT

Prepared for:

DUKE POWER COMPANY

by

PRC ENGINEERING
1500 Planning Research Drive
McLean, Virginia 22102

March 1984

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LIST OF EXHIBITS

INTRODUCTION

This report examines the adequacy of planning for the evacuation of school population in response to a radiological emergency at the Catawba Nuclear Power Station (CNS). Our evaluation is based on review of the school director's written plans, numerous discussions with school personnel, and comparison of their plans with those in place around other nuclear power plants. In the interest of conservatism, this assessment is based on evacuation of the entire Emergency Planning Zone (EPZ) while schools are in session, even though partial evacuation is far more likely. The evacuated area includes parts of Gaston and Mecklenburg Counties in North Carolina and part of York County in South Carolina. This analysis covers students in elementary, middle, and high schools; all schools—private as well as public—are included.

Locations of schools and school districts in the EPZ are summarized in Exhibit 1. Populations for schools within the EPZ are listed in Exhibit 2.

SCHOOL DISTRICT PLANS

Each school district has devleoped its own plan for evacuating its schools. Although there are small differences among the plans, they are similar in most respects. The principal features of the plans are as follows:

- Redundant Notification Systems. Each county has developed a telephone communications chain that transmits word of an alert or emergency at CNS to all affected school principals and district staff. In addition, each school in the EPZ and each district office will have a tone alert radio that continuously monitors the Emergency Broadcasting System and relays all emergency notification messages, including notices of alerts and emergencies at CNS.

- Self-Sufficiency. Each school district will carry out its evacuation using its own resources. Transportation will be by district school buses and their regular drivers. These will be supplemented by the student- and faculty-owned vehicles parked at the schools. Faculty members will supervise the students at predesignated locations ("staging areas") outside the EPZ until they are picked up by parents. In most cases, the staging areas are schools within the same school district. Some districts will need assistance from the state school

Exhibit 1. Location of Schools and Districts

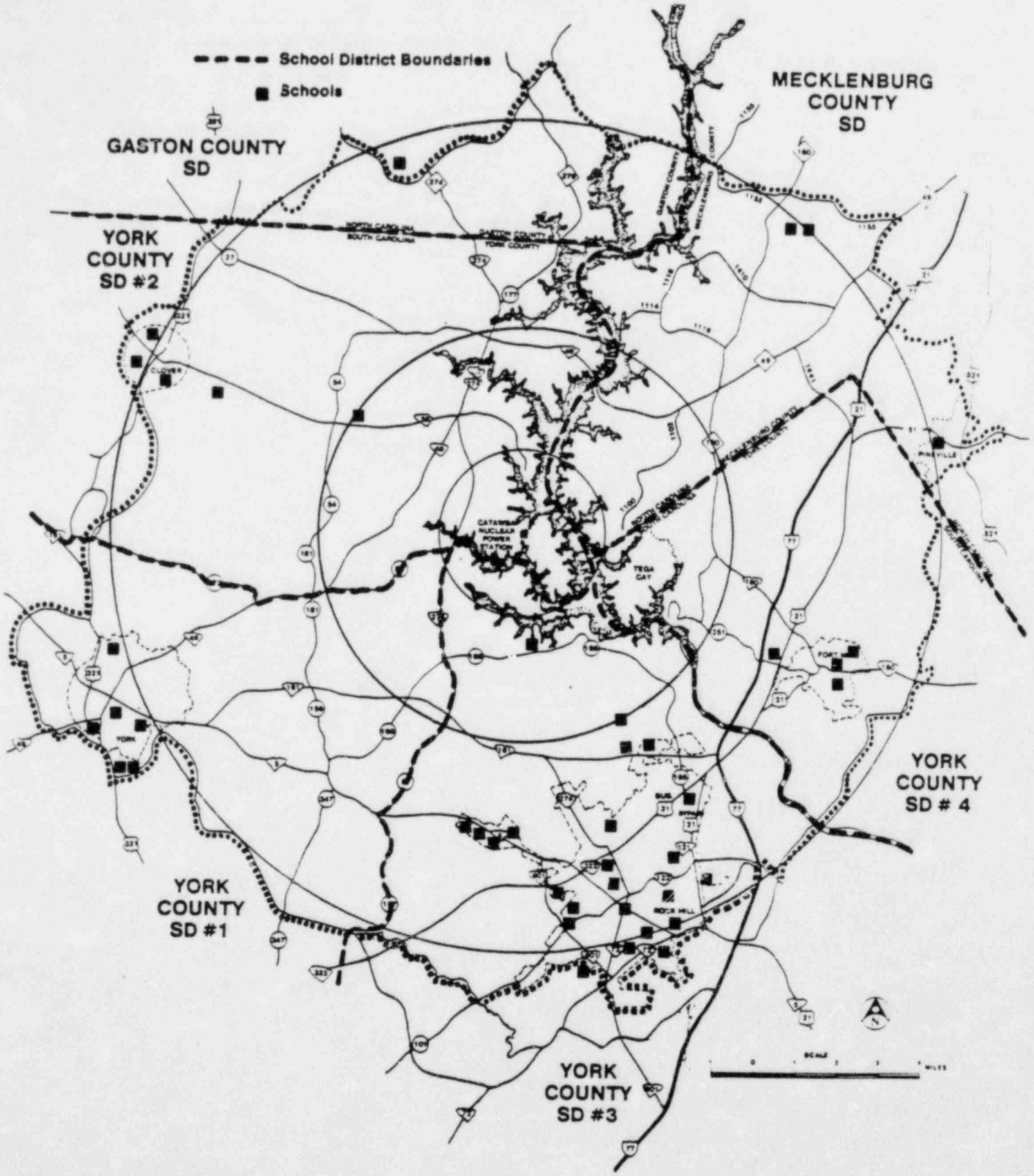


EXHIBIT 2. SCHOOL POPULATION IN THE CATAWBA EPZ

Facility	Population[1]	Location (Zone)
Gaston County Schools		
W.A. Bess[2]	469	F-3
Mecklenburg County Schools		
Steele Creek Elementary	764	A-2
Pineville elementary	849	A-2
Olympic High	1,205	A-2
Total	2,818	
York County Schools		
York School District #1		
Education Service Center	33	D-2
Episcopal Church Home	42	D-2
Harold C. Johnson Middle School	1,085	D-2
Jefferson Primary School	626	D-2
McCelvey Elementary School	777	D-2
York Comprehensive High School	1,076	D-2
Total	3,639	
Clover School District #2		
Bethel Elementary School	364	F-1
Clover High School	1,008	E-2
Clover Junior High School	596	E-2
Clover Middle School	561	E-2
Kinard Elementary School	591	E-2
Total	3,120	
Rock Hill School District #3		
Belleview Elementary School	500	C-2
Castle Heights Junior High School[2]	1,100	C-2
Catawba School[3]	445	C-1
Career Development Center	325	C-2
Ebenezer Elementary School	450	C-2
Ebinport Elementary School	400	C-2
Edgewood Center	100	C-2
Finley Road Elementary School	500	C-2
Mt. Gallant Elementary School	680	C-1

Exhibit 2, Continued,

Facility	Population[1]	Location (Zone)
Northside Elementary School	450	C-2
Northwestern High School	1,300	C-2
Rawlinson Road Junior High School	1,100	C-2
Richmond Drive Elementary School	450	C-2
Rock Hill Alternative Center	90	C-2
Rock Hill Christian Academy[3]	100	C-2
Rosewood Elementary School	480	C-2
St. Anne's Catholic School[3]	180	C-2
Sullivan Junior High School	1,300	C-2
Sunset Park Elementary School	450	C-2
Sylvia Circle Elementary School	250	C-2
Trinity Crhistian School[3]	360	C-2
Westminister Christian School[3]	250	C-2
York Road Elementary School	350	C-2
Total	11,610	
Fort Mill School District #4		
Fort Mill High School	915	B-2
Fort Mill Middle School—Campus I	563	B-2
Fort Mill Middle School—Campus II	250	B-2
Riverview Complex	1,292	B-2
Total	3,020	
York County Total	20,281	
EPZ TOTAL	23,563	

1. Includes staff. Actual number of evacuees would be smaller due to absentees.
2. School outside EPZ but to be evacuated.
3. Private school

bus maintenance supervisor for emergency repairs, law enforcement agencies for traffic control at the staging areas, owners of certain schools and churches to be used as staging areas, and the Red Cross for sheltering of children not picked up by parents. All these arranngements are already in place.

- Speedy Evacuation. The school district plans provide for evacuating all schools within five miles of CNS within one hour and fifteen minutes of an evacuation order. Evacuation times for the remaining schools would range between one hour and two and a half hours, depending on the location. No bus would have to make more than two trips.

- Prompt Reunification of Families. The common objective of the various plans is to return children to the custody of their parents as quickly as possible. Therefore, most students will initially be taken to staging areas outside of, but convenient to, the areas under evacuation. Booklets distributed to parents each school year will identify the staging area for each school and this information will be repeated over radio and television during an evacuation. If any children have not been picked up by the time the evacuation is essentially completed, the unclaimed children will be bused to a Red Cross shelter and turned over to the Red Cross.

- Regular Training of School Personnel. To ensure that they are familiar with their role in an evacuation, each year every faculty member and bus driver will be issued a copy of the district's evacuation plan.

For more details see the complete school district plans included as appendices to this study.

ADEQUACY OF RESOURCES FOR EVACUATION OF THE SCHOOL POPULATION

The school district evacuation plans summarized above make use of the following resources:

- Privately-owned vehicles and their drivers
- School buses, drivers, and fuel
- Buildings to be used as staging areas
- Personnel to supervise the students

This portion of our report examines adequacy of each of the resources.

Privately-Owned Vehicles

There are normally over 2,000 privately-owned vehicles at schools in the EPZ. Assuming each carries an average of four people, they represent a resource capable of moving about 8,400 people, more than a third of the school population. Some of these vehicles might not be available for transportation to the staging areas, however. If the car at the school were the only car available to a family living in the area under evacuation, the student or faculty member with the car might choose to take the car home and evacuate his family rather than evacuating students first. In such cases, the car would leave the school carrying only one person instead of four. We expect that the overwhelming majority of student and faculty will participate in eacuating students. But because the participation rate is uncertain, we have determined the bus requirements based on three alternative participation rates. Exhibit 3 shows the results for each school district.

School Buses

The school districts plan to use only their own buses normally stationed at locations near the schools to be evacuated. The second column of Exhibit 4 shows the number of buses each district plans to use in the evacuation. The district plans are conservative in that they use fewer buses than the districts have available. If any of the planned buses were unavailable or had mechanical problems, the districts could replace them with their "activity buses" (used for field trips) and vans. An additional backup is spare buses kept at the bus maintenance shops. There are 18 spares at the shop serving York County Districts 1, 2, and 3.

Comparing the second and third column of Exhibit 4 shows that three of the school districts plan to evacuate their students with just one trip per bus. The other three districts each plan to have about 60 percent of their buses make a second trip.

EXHIBIT 3. ROLE OF PRIVATELY OWNED VEHICLES (POVs) IN SCHOOL EVACUATION

Jurisdiction	Maximum EPZ School Population	Number of POVs	If 100 Percent Participation			If 75 Percent Participation			If 50 Percent Participation		
			People Carried in POVs	People Carried in Buses	Busloads	People Carried in POVs	People Carried in Buses	Busloads	People Carried in POVs	People Carried in Buses	Busloads
Gaston County	469	23	92	377	6	75	394	6	58	411	6
Mecklenburg County	2,818	316	1,264	1,554	23	1,185	1,633	24	1,106	1,712	25
York County											
District #1	3,639	385	1,540	2,239	32	1,251	2,528	36	962	2,817	41
District #2	3,120	307	1,228	1,892	27	998	2,122	31	768	2,352	34
District #3	11,610	803	3,212	8,398	120	2,610	9,000	129	2,007	9,603	138
District #4	3,020	288	1,152	1,868	27	936	2,084	30	720	2,300	33

Notes:

School Population not adjusted for normal absenteeism.

Busloads calculated assuming 70 people/bus.

EXHIBIT 4. BUS SUPPLY AND DEMAND DURING A SCHOOL EVACUATION

Jurisdiction	School District Plans		Busloads to be Carried (from Exhibit 3)	Number of Buses Required to Make Second Trip
	Buses Used	Bus Trips		
Gaston County	8	8	6	0
Mecklenburg County	51	51	23-25	0
York County				
District #1	39 (+5 minis)	39 (+5 minis)	32-41	0
District #2	27	45	27-34	0-7
District #3	94 (+11 minis)	153 (+9 minis)	120-138	26-44
District #4	23	38	27-33	4-10

*Includes Rock Hill Christian Academy bus (1 trip) and 2 minis (1 trip); Catawba School mini (2 trips); and Trinity Christian School bus (2 trips).

Comparing the planned bus trips (column 3) with the required bus trips (column 4) estimated in Exhibit 3, we observe that the school districts are all planning more trips than absolutely necessary. There are several reasons for this. One district assumed buses would be filled only to their normal seating capacity with no standees. Some districts chose to minimize their dependance on privately-owned vehicles. Several plan to send partially full buses out of the area rather than sending them to a second school to be completely filled before leaving the EPZ.

Since drivers are normally with their buses (at a high school, in most cases), there is not likely to be a shortage of drivers. In addition to the regular drivers, the school districts have substitute drivers who routinely take over when a regular driver is out sick. These substitutes, or teachers, could be used for any bus whose driver was not available.

The districts have carefully reviewed their fuel situation and none will need to refuel buses before ordering the evacuation. Bus maintenance personnel are always on duty during school hours and will be standing by throughout the evacuation to handle emergency repairs if needed.

Buildings Serving as Staging Areas

Each school distict has arranged for space in buildings outside the EPZ for evacuated students to wait to be picked up by their families. Some of these staging areas are churches, but most are schools. Students normally attending those schools and living outside the EPZ will be taken home (as when schools close early because of snow) to make room for the evacuated students. Evacuated students driving their own cars will be released with instructions to rendezvous with their families at a point outside the EPZ.

Exhibit 5 shows the origin and number of evacuees assigned to each of the staging areas. School district officials have examined each of the locations listed and are satisfied that they can hold the assigned number of evacuees.

EXHIBIT 5. STAGING AREAS FOR SCHOOL EVACUEES

Location	Number of Evacuees	Evacuated Schools Using Staging Areas
Gaston County		
Ashley Junior High School	469	W.A. Bess
Mecklenburg County		
University of North Carolina at Charlotte	2,818	Olympic, Steele Creek, Pineville
York County		
York School District #1		
Sharon Elementary School (and adjacent church), with overflow to Hickory Grove Elementary School	3,639	Education Service Center, Episcopal Home, Harold C. Johnson, Jefferson, McCelvey, York Comprehensive
Clover School District #2		
Bethany Elementary School (and adjacent Bethany ARP church)	3,120	Bethel, Clover High, Clover Junior High, Clover Middle, Kinard
Rock Hill School District #3		
Rock Hill High School	3,425	Mt. Gallant, Ebinport, Career Development Center, Rosewood, York Road, Alternative School, Castle Heights
Independance Elementary	1,300	Sullivan Junior High
Oakdale Elementary	850	Edgewood Center, Finley Road, Sylvia Circle
Lesslie Elementary	950	Bellview, Northside
Catawba Baptist Church	2,400	Northwestern, Rawlinson Road
Hopewell Presbyterian Church	700	Ebenezer, Westminster

Exhibit 5, Continued

Location	Number of Evacuees	Evacuated Schools Using Staging Areas
Mt. Holly Methodist Church	630	Sunset Park, St. Anne's
Southside Baptist Temple	1,255	Richmond, Trinity, Catawba
(To be determined)	100	Rock Hill Christian Academy
Fort Mill School District #4		
Indian LandElementary	1,292	Riverview Complex
Indian Land School	1,728	Fort Mill High, Fort Mill Middle School (both campuses)

Supervisory Personnel

The staff at the schools serving as staging areas will stay at their schools. In addition, some districts plans for the staff from the evacuated schools to stay at the staging areas. Either group alone would provide adequate supervision for the evacuated students. In districts where churches will be used as staging areas, the plans call for the staff of the evacuated schools to supervise the students in the churches.

TIME TO EVACUATE THE SCHOOL POPULATION

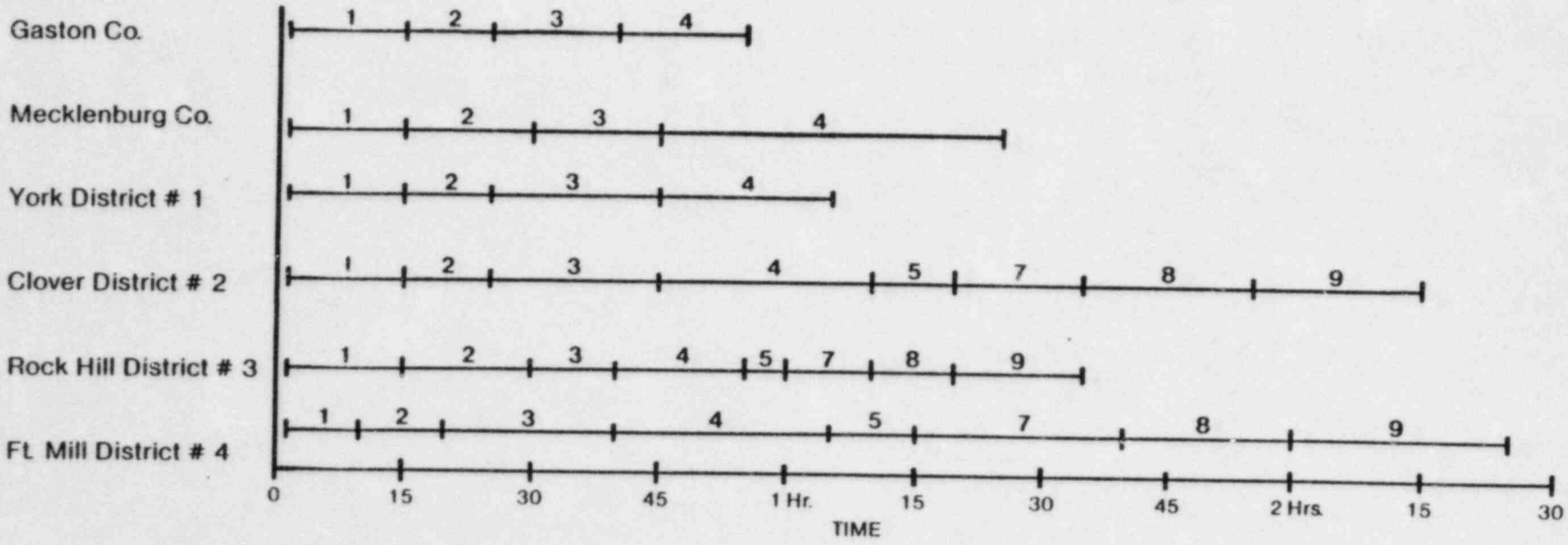
Evacuating the school population entails the following steps:

1. Mobilize buses and drivers
2. Travel to schools (first trip)
3. Load evacuees (first trip)
4. Travel to staging areas (first trip)
5. Unload (first trip)
6. Refuel (if necessary)
7. Travel to schools (second trip)
8. Load evacuees (second trip).
9. Travel to staging area (second trip)

By summing conservative estimates of the time required to complete each step, one gets a very conservative estimate of the overall evacuation time. This was done separately for each school district. In most cases, the times to complete each step were estimated by the school officials who developed the school district plans.

Exhibit 6 shows the time estimates for each school district. The evacuation time estimates vary from 55 minutes to 2 hours and 25 minutes. the variations are due primarily to differences in the number of trips made and in the distances traveled. The entire school evacuation would be complete in 2 hours and 25 minutes.

Exhibit 6. Derivation of School Evacuation Times



Key to Steps Shown

1. Mobilize buses and drivers
2. Travel to schools (first trip)
3. Load evacuees (first trip)
4. Travel to staging area (first trip)
5. Unload (first trip)
6. Refuel (if necessary)
7. Travel to schools (second trip)
8. Load (second trip)
9. Travel to staging area (second trip)

As Exhibit 1 shows, there are only three schools within five miles of the plant. They would all be completely evacuated during the first bus trip by their districts. Students from the Mt. Gallant and Catawba schools would be delivered to their staging areas within the first hour. Students from Bethel Elementary would arrive at their staging area about 15 minutes later.

Several of the school districts plan to mobilize their buses when an alert is declared and to station the buses at the EPZ schools. Thus, if evacuation were necessary, the students at the schools could immediately be loaded and moved. This would cut 20 to 30 minutes off the evacuation time.

CONCLUSION

The school district plans for evacuating EPZ schools are both feasible and effective. They have sufficient resources to carry out their plans and have arranged for spare buses, maintenance, backup drivers, staging facilities, and supervision for the students. Most students would be out of the EPZ in an hour and a half. A conservative estimate of the time to evacuate all the EPZ schools is two hours and 25 minutes.

APPENDIX A

CHARLOTTE-MECKLENBURG SCHOOL
DRAFT EVACUATION PLAN

OPERATIONAL PROCEDURES FOR SCHOOLS LOCATED WITHIN PLANNING RADIUS OF CATAWBA NUCLEAR STATION

I. PURPOSE

The purpose of this procedure is to outline the steps and to identify resources necessary to ensure a timely response for evacuation of schools located within the ten-mile Emergency Planning Zone (EPZ) for Catawba Nuclear Station.

II. SCOPE

This procedure will address only the schools located in EPZ and the procedures necessary to evacuate, transport, and account for students and staff that are to be or have been evacuated.

III. OBJECTIVES

A. The objectives of these procedures are as follows:

1. To ensure alerting schools in a timely manner to possible conditions at Catawba Nuclear Station
2. To identify resources necessary for evacuation of facilities
3. To identify primary shelter location
4. To identify primary evacuation routes
5. To identify additional resources and to update plan on an annual basis, or as necessary, and to ensure all components of procedures are in a ready status

IV. SCHOOLS

A. Olympic High School
4301 Sandy Porter Road
Charlotte, N C 28210
Principal: James W. Emerson

Population: 1,205
Operational Zone: A-5
Planning Zone: A-2
Telephone: 704-588-0254

B. Steele Creek Elementary School
Gallant Lane, Route 2
Charlotte, N C 28210
Principal: Harold Clawson

Population: 764
Operational Zone: A-5
Planning Zone: A-2
Telephone: 704-588-2300

C. Pineville Elementary School
Lowery Street
Pineville, N C 28134
Principal: Robert C. Marshall

Population: 849
Operational Zone: A-10
Planning Zone: A-3
Telephone: 704-889-2311

V. INITIATING PROCEDURES

A. Alert and Notification

Upon proper notification and confirmation that an incident has occurred at Catawba Nuclear Station, each school's principal, or authorized designee, shall implement, and/or activate, with the assistance of local government, the following action:

1. Alert and notify the following in order shown:
   a. County Warning Point at 374-3333 (24-hour phone)
   b. Superintendent of Schools, or Assistant at 379-7135
   c. Safety Director, Charlotte-Mecklenburg Schools (CMS) at 379-7205
   d. Transportation System (CMS) at 366-8374
2. The primary means of alerting will be the telephone. In addition, CMS Transportation System will dispatch a minimum of one radio-equipped vehicle to operate as back-up communications to each school in EPZ.
3. The alert and notification process will include any internal procedures that are not in conflict with the basic plan or supporting procedures.
4. Upon notification, the County Warning Point, Superintendent of Schools, Safety Director, CMS, and Transportation System, CMS,

will put resources on standby to assist in implementing the steps outlined in these procedures.

B. Evacuation and Transportation

1. Based on time constraints and severity of accident/incident at Catawba Nuclear Station, the authority to evacuate the schools will be as follows:
   a. School principal, or designee
   b. Superintendent or Area Superintendent, CMS
   c. School representative in Emergency Operating Center (EOC)
   d. Operations Chief in EOC
   e. County Warning Point representative
2. It is the responsibility of each school's principal to develop internal procedures for evacuation of school facility. Assistance for evacuation will be available from school resources, and from local government resources upon request. The internal plan or procedure developed can not be in conflict with basic planning document.
3. School buses will be the primary means of transportation. In addition, activity buses, and other supporting vehicles, will be used. Students driving to schools will be permitted to drive their own cars out of the area. The principal will inform student drivers to proceed in their own vehicle to shelter location.
4. Teachers and other staff personnel will drive their own vehicles to shelter location and assist principals and CMS staff in accountability of students; however, there is to be at least one

staff member assigned to each bus load of students that are being evacuated.

5. The following numbered buses are located at schools in the ten-mile EPZ:

   a. Buses located at Olympic High School:

12	118	211	263	420	526	B14
73	167	251	322	441	542	B16
92	173	252	383	517	560	B65

   b. Buses located at Steele Creek or available to Steele Creek:

15	119	206	357	B45
95	157	299	458	
100	169	320	B44	

   c. Buses located at Pineville or available to Pineville:

58	116	139	164	247	323
93	123	145	186	254	346
94	129	152	244	270	

6. Fifty-one buses are available with a maximum arrival time of thirty minutes. With a student population of 2,818, the fifty-one buses are more than adequate to transport students for evacuation.

   a. City Department of Transportation buses will be used as backup transportation.

   b. All buses will be loaded to maximum, safe capacity, and will be used in most efficient manner.

7. Evacuation routes from schools to primary shelter will be as follows:

   a. Olympic High School - Sandy Porter to N.C. 49, north on N.C. 49 to Interstate 85 North to primary shelter at University of North Carolina at Charlotte (UNCC). Driver can also stay on N.C. 49 if so desired.

b. Steele Creek Elementary School will use same route as described in 7.a. above for Olympic High School.

c. Pineville Elementary School will use U.S. Highway 521 North to N.C. 49 North to UNCC.

8. If primary route is blocked, the driver will make the decision about using an alternate route. If assistance is needed, using the best available method, contact County Police at 374-3333, or 911. Do not stop bus inside the ten-mile EPZ to request assistance. See attached map #1 for ten-mile EPZ boundary.

C. Shelter

1. The primary shelter location is the UNCC facility. ALL students, staff, and school support personnel are to report to this shelter.
2. If the primary shelter is full, directions will then be given to another facility; however, everyone must report to UNCC first.
3. Students living outside the ten-mile EPZ boundary but attending one of the three schools listed in IV. will proceed to shelter with school population.
4. Students attending a school outside the ten-mile EPZ boundary but live inside the ten-mile EPZ will immediately report this information to teacher.
5. Students identified in C.4 above will stay in school until school closes, or until picked up by parent or guardian. The principal of the school will ensure that student is either picked up by parent or guardian, or is transported to primary shelter location.
6. The principal, staff, and support personnel will report to shelter manager and provide information as requested or provide assistance

in shelter operations as this assistance relates to the schools.

7. Parents or guardians will report to shelter to pick up student; however, parents or guardians are NOT to drive through or attempt to drive into the ten-mile EPZ once the zone is secure.

D. General Concerns and Guidelines

1. Once a student bus driver has left the ten-mile EPZ, the bus driven by student will not be permitted to re-enter the area. Adult bus drivers may re-enter the area, on a voluntary basis, only if the bus has no student passengers.

2. The Transportation System of CMS will use either South Mecklenburg High School or Quail Hollow Junior High School as a staging area to have resources on standby. These resources, as a minimum, should include the following:

   a. Tow truck - one only

   b. Gasoline truck - one only

   c. Mechanics with truck - two each

   d. School buses with drivers - five

3. Each school principal of schools within ten-mile EPZ should develop school's own internal procedures and have a response team to carry out the components of these procedures, as well as other supporting components of basic planning document.

4. The procedures, both internal and otherwise, should be exercised to ensure workability and to identify any weaknesses on an annual basis.

5. It is the responsibility of school system personnel to notify the

Charlotte-Mecklenburg Emergency Management Office of any changes in school population and resources, and any other school-related data that would have a direct bearing on this document.

VI. APPROVAL

Submitted:

_____
L. Wayne Broome
Charlotte-Mecklenburg Emergency Management Office

_____
Jay M. Robinson
Superintendent of Charlotte-Mecklenburg Schools

_____
Joseph E. Green, Safety Director
Charlotte-Mecklenburg Schools

_____
James W. Emerson, Principal
Olympic High School

_____
Harold Clawson, Principal
Steele Creek Elementary School

_____
Robert C. Marshall, Principal
Pineville Elementary School

APPENDIX B

YORK SCHOOL DISTRICT 1

DRAFT EVACUATION PLAN

EVACUATION PLAN

I. PURPOSE

To establish procedures to effect a controlled evacuation of those schools in School District I located in the 10-mile Emergency Planning Zone (EPZ) of the Catawba Nuclear Station (CNS).

II. SITUATION

There exist the remote possibility that a radiological incident could occur at the Catawba Nuclear Station. The high probability also exists, that any incident would be an escalating incident, with ample time available to warn the public. Should the wind be in the direction of schools located in this district during a radiological incident, an evacuation could be ordered by the Governor. Should this occur, York Comprehensive High School (including Floyd D. Johnson Vocational Center), Harold C. Johnson Middle School, McCelvey Elementary School, and Jefferson Primary School would be evacuated.

III. ASSIGNMENTS

A. Corbett Gibson is designated as the lead coordinator for this plan. In his absence Kenneth Love will assume this role. Elements of this plan that require coordination are the responsibility of the lead coordinator.

B. The School Principals of York Comprehensive High School (including Floyd D. Johnson Vocational Center), Harold C. Johnson Middle School, McCelvey Elementary School, Jefferson Primary School and administrators at Education Service Center and Episcopal Church Home will serve as the coordinator for his/her school. Each principal/administrator, or his/her designee, will be the point of contact for any instructions regarding an evacuation order.

IV. CONCEPT OF OPERATIONS

Each of the four affected schools will evacuate using school buses and private vehicles. Episcopal Church Home will use its vans and private vehicles located at each cottage to evacuate. Escort will be by the York City Police. School convoys will proceed via State Highway 49 to Sharon Elementary School. Sharon Elementary School will serve as the Reception Center for evacuees. Evacuees will be registered at the Sharon Elementary School Reception Center and if necessary assigned a shelter location for any prolonged stay. The Reception Center will be staffed by personnel of the Emergency Welfare Service. The school's staff will assist, along with security personnel, in crowd control. The Reception Center will serve also as an assembly point for pick up by parents whose residence is outside the 10-mile EPZ. For those who live within the area being evacuated, they will be assigned shelter as a family group.

V. SCHOOLS

	Students	Staff	Buses	Private Vehicles
York Comprehensive High School	1,000	76	2	237
Harold C. Johnson Middle School	1,025	60	17	47
McCelvey Elementary School	725	52	11	50
Jefferson Primary School	575	51	8	39
Episcopal Church Home	36	6	3(Church Home Vans)	6
* Education Service Center	25	8	3(2 minibuses plus 1 regular)	6

* Itinerant personnel (teachers, social workers, nurses, psychologist) will assist as assigned in school where they're working at time of evacuation notice and then go by POV to Sharon Elementary School Reception Center.

VI. TASKS

A. LEAD COORDINATOR

The Lead Coordinator, or his alternate, will be notified by telephone, tone alert radio or other means by competent authority of the evacuation order. Upon notification the Lead Coordinator will:

1. Authenticate the evacuation order by calling the unlisted telephone number furnished by the York County Emergency Preparedness Director
2. Notify district Director of Transportation of the evacuation order
3. Notify each school Principal, the Director of Special Services, and Administrator of Episcopal Church Home of the evacuation order
4. Notify the principal, Sharon Elementary School, that an evacuation is in progress
5. Notify district Business Manager/Administrative Assistant for Support Services who in turn will notify maintenance personnel of their assigned schools (maintenance personnel will be assigned to carry two-way radio to schools in city of York to provide additional communications between district office and schools being evacuated. Radio carriers will then proceed to Sharon Elementary School Reception Center when schools are evacuated in York).
6. Notify the York City Police and request convoy assistance to Sharon Reception Center
7. Notify the York County Emergency Preparedness Agency when evacuation of all schools is completed

B. DISTRICT DIRECTOR OF TRANSPORTATION

1. Maintain and keep current a list of available school buses
2. Insure that bus drivers are briefed on the contents of this plan
3. Make available any school vehicles for transportation of evacuees from Sharon Elementary School Reception Center to shelters if necessary

C. SCHOOL PRINCIPALS

Each School Principal will:

1. Be responsible for the evacuation of his/her school when notified by the Lead Coordinator
2. Designate staff personnel who will insure that all students and staff have vacated all buildings and grounds
3. Maintain and keep current a list of privately owned vehicles (POV's)
4. Insure that POV drivers are briefed on the contents of this plan
5. Designate someone to act as the convoy leader if York City Police are not available. (Do not wait on Police escort if school evacuation is complete. Proceed directly to the Sharon Reception Center.)

6. Designate staff personnel to assist in the evacuation of his/her school and in monitoring crowd control at the Sharon Reception Center

7. Notify the Lead Coordinator that your school evacuation is completed and that you are proceeding to the Sharon Reception Center

D. TEACHERS

Each teacher will:

1. Complete and keep current a registration form on each student. (Registration Forms will be furnished by the Department of Social Services.)

2. Be responsible for transporting registration forms to Sharon Reception Center. Once there, forms are to be delivered to registration personnel, assuring there is one form for each student evacuated, no more, no less

3. Notify the principal when classroom is evacuated and all students are accounted for

4. Brief his/her class on evacuation procedures contained in this plan

VII. SHARON ELEMENTARY SCHOOL RECEPTION CENTER

The Reception Center is a key element in the evacuation process during any manmade or natural emergency. It serves as a focal point for control and other purposes. It is the responsibility of the York County Emergency Welfare Service to operate the Reception Center to include; registration of evacuees; shelter assignments; monitoring of evacuees and vehicles for radiological contamination; decontamination, if necessary; providing medical care for evacuees and providing basic personal needs for evacuees. Should an evacuation be ordered, a state of emergency is in fact, in effect. If an evacuation is ordered the principal, Sharon Elementary School will:

1. Dismiss the student population from Sharon and Hickory Grove Elementary Schools

2. Retain staff personnel to organize space, desks, telephone manning, as an example, to assist Emergency Welfare personnel. (All the above should be coordinated with the York County EPD Director and County EWS.)

3. Be, or designate, the person to act as the point of contact between Sharon School and EWS. (Consider relief for this person should it become a lengthy operation.)

ATTACHMENT 1, ALERT LIST, YORK SCHOOL DISTRICT I, EVACUATION PLAN

Name	Title	Telephone Number
Corbett Gibson	Assistant Superintendent	684-9916 (office) 684-2698 (home)
Kenneth Love	Business Manager/Administrative Assistant	684-9916 (office) 222-3975 (home)
Nathaniel Davis	Director of Transportation	684-2336 (office) 222-7370 (home)
Bob Harrison	Principal, York Comprehensive High School	684-2336 (office) 684-6541 (home)
Wilbert Holmes	Principal, Harold C. Johnson Middle School	684-4451 (office) 327-6378 (home)
Bill Plaxco	Principal, McCelvey Elementary School	684-2311 (office) 684-4079 (home)
Bobbie Johnson	Principal, Jefferson Primary School	684-2381 (office) 222-9780 (home)
Colvin Stephenson	Principal, Sharon and Hickory Grove Elementary	927-7137 (office) 925-2144 (office) (home - unlisted)
Lillian Nance	Director of Special Services	684-9326 (office) 684-3980 (home)
George O'Neal	Administrator, Episcopal Church Home	684-4011 (office) 366-1838 (home)

APPENDIX

CLOVER SCHOOL DISTRICT 2

DRAFT EVACUATION PLAN

CLOVER SCHOOL DISTRICT #2 OF YORK COUNTY

EMERGENCY PREPAREDNESS PLAN

Natural Disaster

In the event of any natural disaster such as hurricanes, tornadoes, etc., all schools in the Clover School District will be available for use by the York County Emergency Preparedness Director. Schools will be opened as shelters at the Director's request.

Catawba Nuclear Plant Emergency

The action to be taken will be determined by the emergency level:

1. Unusual Event - If the level of the event is classified as unusual event and the students are in school, the Clover School District will close school and send all students and personnel home just as is done in the case of inclement weather closings.* (If the warning is given before 6:30 A.M., schools will remain closed and buses will not operate.)
   *Exception: Students living in the two (2) mile radius area of the Catawba Station will be sent by bus to the Bethany pick-up site.

2. Alert - Buses will be moved from Clover High School to Bethany and Clover Junior High so that evacuation for Site Area Emergency can be implemented immediately.

3. Site Area Emergency - All students will be directed to the Bethany School pick-up site. The following order of evacuation will be used:

(6 buses) A. Buses will leave Clover High School and proceed to Bethel School. All students at Bethel will be moved by bus to Bethany School.

(12 buses) B. High School students will board buses and be taken to the Bethany School pick-up site.*
* Students that come to school in automobiles will be dismissed as soon as the buses to be used at Bethel have cleared the parking area.

Clover High School personnel will be dismissed as soon as all buses and student vehicles have left the school grounds.

(9 buses) C. Buses will leave Clover High School and proceed to Clover Junior High School. All students will be moved to the Bethany pick-up site.

*One bus will be sent to the Day Care Center and will transport all 3 and 4 year olds to the Bethany pick-up site.

D. Eighteen of the buses used to transport Bethel and Clover High students to Bethany will be sent to Kinard Elementary School and Clover Middle School to transport these students to

the Bethany pick-up site. Clover Middle School and Kinard Elementary School personnel will be dismissed as soon as all buses have left the school grounds.

4. General Emergency - Same procedures as Site Area Emergency.

This plan to move all students to the Bethany School pick-up site also includes the following contingency options:

A. Four regular school buses, two district activity buses and two district-owned (12 passenger) vans are being held for emergency use (assigned buses having mechanical problems, students being left in the initial evacuation phase, etc.)

B. This plan also includes evacuation of all students enrolled. It is unlikely that 100% of the pupils enrolled will be in attendance; however, the plan of evacuation is based on this possibility.

C. The main evacuation route will be Highway 55. However, all bus drivers have been made thoroughly familiar with alternate routes to Bethany School in the event that Highway 55 is too congested.

D. Parents will be required to notify the school where their child attends, in writing, if the parents plan to pick their child up at the school rather than the Bethany pick-up site. This will be discouraged but will be included in the plans. Vehicles as described in (A) will make clean-up sweeps approximately one hour after the initial pick-ups and any students still at the schools will be taken to the Bethany pick-up site.

School principals and assistant principals will remain at the schools until all pupils are off the school campus.

E. All buses sent to evacuate students from Bethel and Clover High will be loaded to the maximum 60 passenger limit. Any bus with less than capacity will proceed to the Clover Junior High School/District Office Evacuation Operations Center. At that point, the bus will either be loaded with additional students or instructed to proceed to Bethany.

F. Field Trips - Students on field trips west of the Clover Junior High/District Office Operations Center will be taken to the Bethany pick-up site and the buses will then return to the Clover Junior High/District Office Operations Center.

Students on field trips east of the Clover Junior High/District Office Operations Center will be routed to the operations center and then transported to the Bethany pick-up site.

G. The bus for handicapped students will make regular pick-ups and proceed to the Bethany pick-up site.

H. If buses are on routes when the emergency sirens are sounded, all drivers will be instructed to immediately return to the nearest school to their location for instructions.

I. The District Office Operations Center will remain open until ordered to close by the York County Emergency Preparedness Director.

APPENDIX D

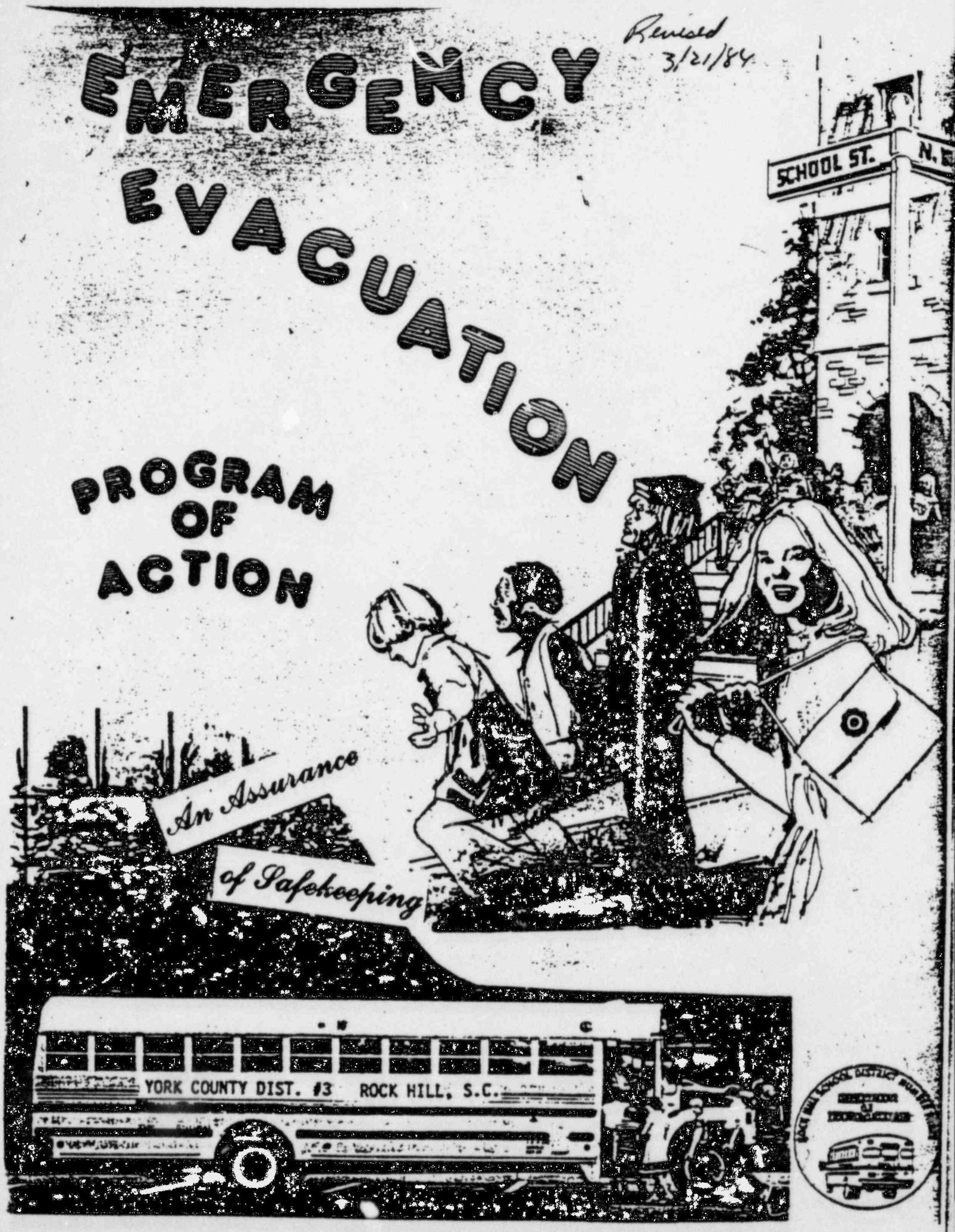
ROCK HILL SCHOOL DISTRICT 3

DRAFT EVACUATION PLAN

Revised
3/21/84

EMERGENCY EVACUATION

PROGRAM OF ACTION



EMERGENCY TELEPHONE NUMBERS

ROCK HILL SCHOOL DISTRICT THREE

Administration Office	324-5360	
Director of Transportation	324-4028	
Northwestern Area Coordinator	328-9814	328-6118
Rock Hill High Area Coordinator	324-0221	324-3100

YORK COUNTY

Emergency Management (Civil Defense)	328-6171
Sheriff's Office - York	684-9261
- Rock Hill	327-2021
County Manager - York	684-9261

CITY OF ROCK HILL

Police	327-4114
Fire Department	327-4111
Emergency Rescue Squad	327-4111

MEDICAL CARE

Ambulance	329-1111	329-1234

S.C. STATE

Highway Patrol	366-7668	327-2021

OTHER

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

METHOD OF NOTIFYING BUS DRIVERS AND SCHOOLS

IN CASE OF ALERT

The Rock Hill School District Three Administrative Office staff will serve as the primary source of alerting schools once an alert is received from the County Emergency Preparedness Agency. The order of calls shall be as follows:

1. The first call shall be to the following transportation personnel:

Operations Center --	George Hampton --	324-4028
Northwestern High --	Nancy Race --	328-9814
Rock Hill High --	Jim Anderson --	324-0221

2. The second call will go to the individual schools affected by the emergency:

TWO MILE EVACUATION

Mt. Gallant Elementary	-	Zone C-1	- 329-1200	329-1333
Rock Hill High	-	Beyond Limit	- 324-3100	324-1700

FIVE MILE EVACUATION

(All Above)

Ebinport Elementary	-	Zone C-2	- 366-7213	366-9995
Rosewood Elementary	-	Zone C-1	- 366-4612	366-3554
Rock Hill High	-	Beyond Limit	- 324-3100	324-1700

TEN MILE EVACUATION

(All Above)

Belleview Elementary	-	Zone C-2	- 324-4725	328-9084
Ebenezer Elementary	-	Zone C-2	- 327-3972	328-9074
Finley Road Elementary	-	Zone C-2	- 328-0949	328-9078
Northside Elementary	-	Zone C-2	- 327-4376	327-9929
Richmond Drive Elem.	-	Zone C-2	- 366-1013	366-1601
Sunset Park Elem.	-	Zone C-2	- 327-2175	328-9083
Sylvia Circle Elem.	-	Zone C-2	- 327-4700	328-9082
York Road Elementary	-	Zone C-2	- 328-8264	327-3692
Alternative School	-	Zone C-2	- 328-1624	328-0439
Rawlinson Rd. Jr. High	-	Zone C-2	- 328-2451	327-3329
Sullivan Junior High	-	Zone C-2	- 366-8181	366-5242
Northwestern High	-	Zone C-2	- 328-6118	328-9986
Career Development Ctr.	-	Zone C-2	- 327-2003	327-6990
Castle Heights Jr. High	-	Beyond Limit	- 324-3165	324-3946
Edgewood Center	-	Beyond Limit	- 327-7061	328-9077
Independence Elementary	-	Beyond Limit	- 324-0622	324-1209
Lesslie I Elementary	-	Beyond Limit	- 324-0100	324-0103
Lesslie II Elementary	-	Beyond Limit	- 324-0531	324-0505
Oakdale Elementary	-	Beyond Limit	- 327-5926	328-9079

3. The third call will alert all administrators involved in the operation of the emergency.

NUCLEAR EVACUATION PLAN

Table of Contents

York County School District Three
(Rock Hill, S.C.)

PROPOSED SCHOOL EVACUATION PLAN

CATAWBA NUCLEAR STATION AREA

This draft will need to be discussed with administrative staff and principals involved to be certain the evacuation procedure is workable. We welcome any changes that will enable us to move students and staff safer and quicker in case of an emergency. This information will need to be reviewed and evaluated frequently to be certain it is kept up to date.

The following information indicates the organizational pattern for command responsibilities, methods of alert, transportation of pupils, evacuation routes and location of students attending school inside and outside of the ten mile radius of Catawba Nuclear Station, methods of notification of bus drivers, bus schedules and police assistance. Also, included is a memorandum to parents of bus drivers and consent forms.

The Emergency Operation Center

The Emergency Operation Center will be located at Rock Hill City Hall in the basement Civil Defense Center and it will be under the direction of the York County Director of General Services. The first six (6) to eight (8) hours are directed locally to allow the State Emergency Response Team enough time to relocate and establish their controls.

The total emergency plan for the county will give each household, business establishment, school, etc., complete directions for evacuation. (Certain groups are assigned to specific zones to alert people of conditions by public address systems. Back-up units will be used in case of problems.) This plan, ideally, will allow four (4) hours for students to complete evacuation of the 10 mile area. However, we would want to move all of our students and staff members out of the area as safely and quickly as possible.

Evaucation Time Frames

First Phase:

60 minutes to Interim Staging Centers
120 minutes to Crisis Flight Shelter

Second Phase:

95 minutes to Interim Staging Centers
120 minutes to Crisis Flight Shelter

ROCK HILL SCHOOL DISTRICT NUMBER THREE

DISASTER PREPAREDNESS

AN EMERGENCY EVACUATION PROPOSAL

(A Proposal for Alternative Mobility and Relocation of Reception Centers)

The Rock Hill School District Three Director of Transportation requests the following alterations and reestablishing of Reception Centers for evacuation zones C-1 and C-2. Please note that the ten-mile evacuation radius passes through the inter-city of Rock Hill such that its maximum extent excludes the following facilities:

INTERIM CENTERS	SCHOOL LOCATION	INTERIM CENTERS	CHURCH LOCATION
1	Oakdale Elementary	6	Southside Baptist (21-Bypass South)
3	Rock Hill High	2	Catawba Baptist (21-Bypass South on Catawba Church Rd.)
4	Independence Elementary	7	Hopewell Presbyterian (21-Bypass South)
5	Lesslie Elementary	8	Mt. Holly Methodist (Hwy. 901 or Mt. Holly Road South)

Proposed Alterations

1. There will be three plans for disaster evacuation; namely, The Two-Mile Plan, The Five-Mile Plan and The Ten-Mile Plan.

2. The above listed schools will be excluded from these three evacuation plans.

3. The SCHOOLS and CHURCHES above will be Interim Staging Centers.

4. The Lewisville Shelter Centers will be activated for the General Public and/or any non-school related citizens.

5. The school children would be dispersed from the above listed schools to the following location priorities if further distance is required:

    1- Area churches, facilities of sufficient size and accessibility between Rock Hill and Lancaster or Chester depending upon wind direction.

    2- The cities of Lancaster and Chester should further distance be required. The movement would be at right angles to the existing prevailing winds rather than to attempt to "outrun" any drifting or suspended fallout.

Update Monitors

As the ingredients of this plan are reviewed, corrections, improvements and any other additions appropriate to the efficiency of implementation will be installed. Suggestions for the enhancement of the above are therefore both welcome and solicited.

GENERAL OVERVIEW OF MASS EVACUATION PLAN

1. The Director of Transportation and the Area Coordinators of Transportation will have full authority of bussing operations.

2. State owned busses will be dispatched to all schools involved. This will be done on the first notification unless specific directions are given contrary-wise.

3. District activity busses will be held at the Operations Center. Substitute drivers from Northwestern High or Maintenance Personnel will drive the activity busses should such be needed for school evacuation.

4. Busses and drivers will remain at their assigned locations and upon loading, leave immediately to the District Three Interim Staging Centers or until further directions are received from Department of Transportation officials or the School Principal.

5. Each bus will be loaded as full (over-full) as possible (sitting, standing, etc.). The task is to move all students as quick as possible. Comfort is not a factor of consideration. District activity busses and vans will be used to "trouble-shoot". They will remain at the Operations Center for directions.

6. The Director of Transportation and the Area Coordinators will remain at their offices until all required evacuation is completed.

7. Back-up personnel in full charge when initial designated authorities (See #1 above.) are absent.

   Director of Transportation
   Area-Coordinators - Assistant High School (Transportation)
   Principals

8. All maintenance personnel would travel immediately to the Operations Center and report to Mr. Oates for directions.

9. Teachers will accompany their students for supervisory purposes.

10. School secretaries will upkeep and carry lists of students by Home Room and absentees to the District Interim Staging Centers with the students. Upon arrival teachers and secretaries will take a roll call and phone to the Director of Transportation to report "All Accounted For" or those unaccounted for.

11. Principals (Assistant Principals) will check their facilities (classrooms, restrooms, locker rooms, gyms, closets, cafeteria areas, etc. - all areas) and then will leave by their personal cars.

YORK COUNTY SCHOOL DISTRICT THREE

INTERIM AND CRISIS FLIGHT

EVACUATION CENTER ASSIGNMENTS

Pick-up Center #1	Oakdale Elementary Center	Crisis Flight Shelter
	Edgewood Center Finley Road Elementary Sylvia Circle Elementary	Highway 72 South to Chester, S. C.
Pick-up Center #2	Catawba Baptist Church	Crisis Flight Shelter
	Northwestern High School Rawlinson Road Junior High	Highway 72 Chester, S. C.
Pick-up Center #3	Rock Hill High Center	Crisis Flight Shelter
	Ebinport Elementary Mt. Gallant Elementary Rosewood Elementary York Road Elementary Alternative Center Career Development Center	I-77 South to Richburg, S.C.
Pick-up Center #4	Independence Elementary Center	Crisis Flight Shelter
	Sullivan Junior High	I-77 South to Richburg, S.C.
Pick-up Center #5	Lesslie Elementary Center	Crisis Flight Shelter
	Belleview Elementary Northside Elementary	Hwy 21 East to Hwy 5-East to Hwy 521 - South to Lancaster, S. C.
Pick-up Center #6	Southside Baptist	Crisis Flight Shelter
	Richmond Drive Elementary	Hwy 21 East to Hwy 5-East to Hwy 521 - South to Lancaster, S. C.
Pick-up Center #7	Hopewell Presbyterian	Crisis Flight Shelter
	Ebenezer Ave. Elementary	Hwy 21 East to Hwy 5-East to Hwy 521 - South to Lancaster, S. C.
Pick-up Center #8	Mt. Holly Methodist	Crisis Flight Shelter
	Sunset Park Elementary	Hwy 901 -South to Richburg, S. C.

BUS SCHEDULES

Busses in the designated areas are picking up their students from about 6:00 a.m. to 9:00 a.m. and 1:00 p.m. to 4:00 p.m. Therefore, busses would be available to evacuate students only during the time span from 9:00 a.m. to 1:00 p.m.

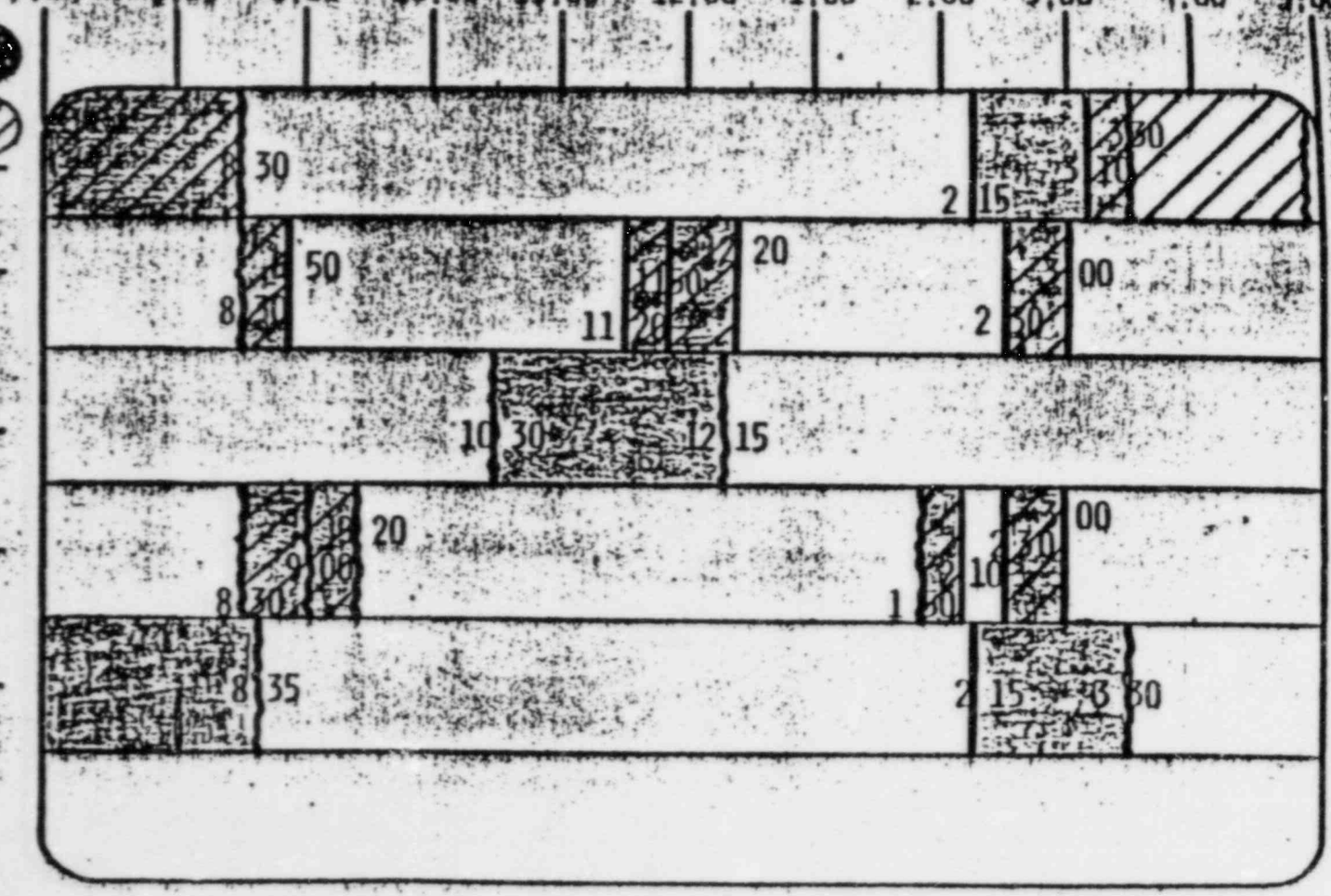
AM-ALERT: Drivers will complete their bus routes should an alert happen while their regular bus routes are being run in the morning. All drivers would then return their busses to Rock Hill High School or Northwestern High School. Edgewood Center busses would report to Edgewood only and evacuate those students to Oakdale Elementary School immediately.

PM-ALERT: Should an alert occur while regular bus routes are being run in the afternoon, drivers would return immediately to their first PM routing school for further directions. Principals would telephone the Area-Coordinators to let them know which busses are at their schools when the busses return.

SCHOOL BUS MOBILIZATION DAILY NORMS

A CHRONOGRAPHICAL FLOW-DIAGRAM

DEPARTMENT OF TRANSPORTATION
YORK COUNTY SCHOOL DISTRICT THREE



G. M. HAMPTON - DIRECTOR

AREA CO-ORDINATORS RESPONSIBILITIES
FOR FULL EVACUATION ACTION

First Evacuation Trip:

Northwestern Co-ordinator

Upon First Alert:
- Send 7 busses to Mt. Gallant Elem.
- Send 6 busses to Ebinport Elem.
- Send 17 busses to Rawl. Rd. Jr. High

Rock Hill High Co-ordinator

Upon First Alert:
- Send 7 busses to Rosewood Elem.
- Send 6 busses to Richmond Dr. Elem.
- Send 20 busses to Northwestern High
- Send 5 busses to York Road Elem.
- Send 7 busses to Finley Road Elem.
- Send 6 busses to Ebenezer Ave. Elem.
- Send 4 busses to Sylvia Circle Elem.

Second Evacuation Trip:

Northwestern Co-ordinator goes to Castle Heights

Upon Arrival:
- Send 2 busses to Alternative School

Rock Hill High Co-ordinator:
- Send 20 busses to Sullivan Jr. High
- Send 6 busses to Northside
- Send 7 busses to Belleview
- Send 6 busses to Sunset Park

Bus Drivers At The Following Schools Will Return Their Busses To Castle Heights Jr. High School On 72-Bypass South.

Oakdale Elementary School
Hopewell Presbyterian Church
Catawba Baptist Church
Mt. Holly Methodist Church
Southside Baptist Temple
Lesslie Elementary School
Independence Elementary School
Rock Hill High School (Last)

CATAWBA NUCLEAR EVACUATION PLAN

SOURCE, SCHOOL PRIORITY, ALLOTMENT AND SHELTER DESTINATION ASSIGNMENTS

(FROM) SOURCE	(TO) FIRST TRIP	BUSSES NEEDED	(TO) INTERIM DESTINATION
NWHS	MT. GALLANT ELEM.	9	ROCK HILL HIGH SCHOOL
NWHS	EBINPORT ELEMENTARY	6	ROCK HILL HIGH SCHOOL
NWHS	RAWL. RD. JR. HIGH	17	CATAWBA BAPTIST CHURCH
NWHS	CAREER DEVEL. CENTER	5 = 37	ROCK HILL HIGH SCHOOL
RHHS	ROSEWOOD ELEMENTARY	7	ROCK HILL HIGH SCHOOL
RHHS	RICHMOND DR. ELEMENTARY	6	SOUTHSIDE BAPTIST TEMPLE
RHHS	NORTHWESTERN HIGH	20	CATAWBA BAPTIST CHURCH
RHHS	YORK ROAD ELEMENTARY	5	ROCK HILL HIGH SCHOOL
RHHS	FINLEY ROAD ELEMENTARY	7	OAKDALE ELEM. SCHOOL
RHHS	EBENEZER AVE. ELEM.	6	HOPEWELL PRESBYTERIAN CHURCH
RHHS	SYLVIA CIRCLE ELEM.	4 = 55 / 92	OAKDALE ELEM. SCHOOL

BUSSES TO RETURN FOR SECOND TRIP

(ST. ANNE'S & ST. MARY'S INCLUDED)

EVACUATION INTERIM CENTERS RETURN BUSSES TO:

(FROM) SOURCE	SCHOOL	BUSSES NEEDED	(TO) INTERIM CENTER
RHHS	Sullivan Junior High	20	Independence Elementary School
Oakdale	Sunset Park Elementary	6	Mt. Holly Methodist Church
Hopewell Presbyterian	Northside Elementary	6	Lesslie Elementary School
RHHS	Ballaview Elementary	7	Lesslie Elementary School
	R.H. Alternative Center	2	Rock Hill High School
	Castle Heights Jr. High	17	Rock Hill High School
	*St. Anne's (S. Jones Ave.)	2	Mt. Holly Methodist Church
	*St. Mary's (Crawford Rd.)	1 = 58	Mt. Holly Methodist Church

WHEN ALL ROUTES COMPLETED → All bus drivers will go immediately to Castle Heights Junior High School on Hwy 72 Bypass South.

STUDENTS MOVED AND SCHOOL BUS LOCATIONS AFTER SECOND TRIP

3425	ROCK HILL HIGH SCHOOL - 22	2400	CATAWBA BAPTIST CHURCH - 20
1300	INDEP. ELEM. SCHOOL - 20	450	HOPEWELL PRESBY. CHURCH- 0
850	OAKDALE ELEM. SCHOOL - 2	450	MT. HOLLY METH. CHURCH - 9
950	LESSLIE ELEM. SCHOOL - 13	450 / 10275	SOUTHSIDE BAPT. TEMPLE - 6

ALL BUSSES GO TO CASTLE HEIGHTS JR. HIGH - 92

TWO MILE EVACUATION PLAN

This information will provide you with school name, the Civil Defense Zone in which the school is located, the proposed evacuation route, and the Interim Staging Center.

SCHOOLS EFFECTED: MT. GALLANT ELEMENTARY (ZONE:C-1)

UPON ALERT:
A. SEND BUSSES TO MT. GALLANT ELEMENTARY AND HOLD STAND-BY STATUS.

B. ALERT ROCK HILL HIGH SCHOOL OF STAND-BY

EVACUATION PLAN: MT. GALLANT ELEMENTARY STUDENTS WILL BE EVACUATED TO ROCK HILL HIGH SCHOOL.

EVACUATION ROUTE: FOLLOW MT. GALLANT (195) (EAST) TO HWY 21 BYPASS (AT HOLIDAY INN). TURN RIGHT (SOUTH) ON HWY 21 BYPASS TO HWY 6 (OLD LESSLIE HWY). TURN RIGHT (SOUTH) ON HWY 6 TO CEL-RIVER ROAD (HWY 50). TURN RIGHT ON CEL-RIVER ROAD (HWY 50) TO ROCK HILL HIGH SCHOOL.

CATAWBA NUCLEAR FACILITY

FIVE MILE EVACUATION PLAN

This information will provide you with school name, the Civil Defense Zone in which the school is located, the proposed evacuation route, and the Interim Staging Center.

SCHOOL	ZONE	EVACUATION ROUTE
Mt. Gallant Elementary	C-1	Follow Mt. Gallant Road (Hwy 195) Northeast to Hwy 21 Bypass (near Holiday Inn). Turn right (East) on Hwy 21 Bypass to Old Lesslie Hwy (Rd. 6). Turn right (East) on Old Lesslie Hwy (Rd. 6) to Celriver Road (Hwy 50). Turn right on Celriver Rd. (Hwy 50) South to Rock Hill High School.
Ebinport Elementary Rosewood Elementary	C-2	Follow Celanese Bypass (Hwy 161 - North) to Mt. Gallant Road (Hwy 195). Turn right on Mt. Gallant Road (Hwy 195) Northeast to Hwy 21 Bypass. Turn right (East) on Hwy 21 Bypass to Old Lesslie Hwy (Rd. 6). Turn right (East) on Old Lesslie Hwy (Rd. 6) to Celriver Rd. (Hwy 50). Turn right (South) on Celriver Rd. (Hwy 50) to Rock Hill High School.

CATAWBA NUCLEAR FACILITY

TEN MILE EVACUATION PLAN

This information will provide you with school name, the Civil Defense Zone in which the school is located, the proposed evacuation route, and the Interim Staging Center.

SCHOOL	DISASTER ZONE	EVACUATION ROUTE
Mt. Gallant Elementary	C-1	Travel East on Mt. Gallant Rd. (195) to Celanese Bypass. Turn left (North) on Celanese Bypass (161) to Hwy 21 (Cherry Road). Turn right (West) on Hwy 21 to Old Lesslie Hwy (Hwy 6). Turn right (East) on Hwy 6 to Celriver Rd. (Hwy 50). Turn right (South) on Hwy 50 to Rock Hill High School.
Rosewood Elementary	C-1	Go to Celanese Bypass (161). Turn left (North) on Celanese Bypass to Hwy 21 (Cherry Road). Turn right (West) on Hwy 21 to Old Lesslie Hwy (Hwy 6). Turn right (East) on Hwy 6 to Celriver Road (Hwy 50). Turn right on Hwy 50 to Rock Hill High School.
Alternative Center	C-2	Follow Hwy 5 (East) (Black Street) to Hwy 72 Bypass. Turn left (North) on Hwy 72 Bypass to Firetower Road (Hwy 710). Turn right (East) on Firetower Road to Rock Hill High School.
Career Development Center	C-2	
York Road Elementary	C-2	
Northwestern High School	C-2	Follow Hwy 5 (South) to Heckle Blvd. (901). Turn right (South) on Heckle Blvd. to Hwy 72. Turn right on Hwy 72 to Hwy 21. Turn right (East) on Hwy 21 to Catawba Church Road (Hwy 143). Turn right (East) on Catawba Church Road to Catawba Baptist Church.
Rawlinson Road Jr. High	C-2	
Edgewood Center	C-2	Follow Heckle Blvd. to Saluda Street. Turn right (South) on Saluda Street to Hwy 72 Bypass. Bare right (South) on Hwy 72 Bypass to Country Club Road. Turn left on Country Club Road to Oakdale Elementary School.
Finley Road Elementary	C-2	
Sylvia Circle Elementary	C-2	

SCHOOL	DISASTER ZONE	EVACUATION ROUTE
Ebenezer Ave. Elementary	C-2	Follow Oakdale Ave. (South) to E. White Street. Turn left on E. White Street to Hwy. 72 Bypass. Turn left (Northeast) on Hwy. 72 Bypass to Hwy. 21 Bypass. Turn right on Hwy. 21 Bypass (South) to Hopewell Presbyterian Church.
Sullivan Junior High	C-2	Follow Cherry Road to Hwy. 21 Bypass. Turn right on Hwy. 21 Bypass to Old Lesslie Highway (6). Turn right on Old Lesslie Highway (6) to Celriver Road (50). Turn right on Celriver Road (50) to Independence Elementary School.
Belleview Elementary	C-2	Follow Hwy. 21 South to Hwy. 31. Bear right and turn left on Hwy. 31 to Lesslie Elementary.
Northside Elementary	C-2	
Sunset Park Elementary	C-2	Follow Heckle Blvd. (East) to Hwy. 72 Bypass. Turn right on Hwy. 72 Bypass to Hwy. 901 (Mt. Holly Road). Turn left on Mt. Holly Road (Hwy. 901 South) to Mt. Holly Methodist Church.
Castle Heights Jr. High	C-2	Follow Fire Tower Road (Hwy. 710) East to Rock Hill High School.
Richmond Drive Elementary	C-2	Follow Cherry Road to Hwy. 21 Bypass. Turn right on Hwy. 21 Bypass (South) to Southside Baptist Temple.
St. Anne's (South Jones Ave.)	C-2	Follow Heckle Bypass to Hwy 72. Turn right on Hwy 72 Bypass to Mt. Holly Road (Hwy 901). Turn left (South) on Mt. Holly Road to Mt. Holly Methodist Church.
St. Mary's (Crawford Road)	C-2	

SCHOOL EVACUATION MOBILITY CHART

ROCK HILL SCHOOL DISTRICT THREE

School	Student Population	Load Per Bus	Busses Needed	Source of Busses	First Evacuation Center	Clearing Time (Min.)	Crisis Flight Shelters	Clearing Time (Min.)
Belleview Elementary	500	75	7*	RHHS	Lesslie Elem. School	Second Trip 95	Lancaster	140
Ebenezer Elementary	450	75	6	RHHS	Hopewell Presbyterian Ch.	60	Richburg	120
Ebinport Elementary	400	75	6	NWHS	Rock Hill High School	60	Richburg	120
Edgewood Center	100	12	8 Mini	Edgewood	Oakdale Elem. School	60	Chester	120
Finley Road Elementary	500	75	7	RHHS	Oakdale Elem. School	60	Chester	120
Mt. Gallant Elementary	680	75	9	NWHS	Rock Hill High School	60	Richburg	120
Northside Elementary	450	75	6*	Hopewell Pres. Ch.	Lesslie Elem. School	Second Trip 95	Lancaster	140
Northwestern High	1300	65	20	NWHS	Catawba Baptist Church	60	Richburg	120
Rawl. Rd. Jr. High	1100	65	17	NWHS	Catawba Baptist Church	60	Chester	120
Richmond Dr. Elementary	450	75	6	NWHS	Southside Baptist Temple	60	Richburg	120
R. H. Alternative Center	90	65	2*	RHHS	Rock Hill High School	Second Trip 95	Chester	120
CDC (Vocational)	325	65	5	NWHS	Rock Hill High School	60	Chester	120
Rosewood Elementary	480	75	7	RHHS	Rock Hill High School	60	Richburg	120
Sullivan Junior High	1300	65	20*	RHHS	Ind. Elem. School	Second Trip 95	Richburg	120
Sunset Park Elementary	450	75	6*	Oakdale	Mt. Holly Methodist Ch.	Second Trip 95	Lancaster	140
Sylvia Circle Elementary	250	75	4	RHHS	Oakdale Elem. School	60	Chester	120
York Road Elementary	350	75	5	NWHS	Rock Hill High School	60	Richburg	120
Castle Hts. Jr. High	1100	65	17	Catawba Baptist	Rock Hill High School	95	Richburg	120
St. Anne's Catholic Ch.	150	75	2	Oakdale	Mt. Holly Methodist Ch.	95	Richburg	120
St. Anne's Catholic Ch.	30	75	1	Oakdale	Mt. Holly Methodist Ch.	95	Richburg	120
	10455		153					

Total Busses in District - 93 Assignments: 56 + 0 at RHHS 0 + 37 at NWHS

Busses Normally on Campus: 30 + 0 at RHHS 0 + 28 at NWHS

3 + at CDC 23 + 9 Adult Homes

0 + 6 at Edgewood (Mini) 4 + 3 Adult Homes (Mini)

Student Vehicles at High Schools: NWHS 800 Registered 400 on Campus (Estimate)

RHHS 800 Registered 400 on Campus (Estimate)

STATE SCHOOL BUS SEATING CAPACITIES

YORK, CLOVER, ROCK HILL

1983-84

POTENTIAL BUSSES AVAILABLE

	Regular Buses	Mini Buses	Total Buses	County Spares
York	42	5	47	4
Clover	30	2	32	2
Rock Hill	93	13	106	12
	165	20	185	18

SEATING CAPACITIES

	Regular Bus	Route Enroll.	20-Day Sample	Mini-Bus	Route Enroll.	20-Day Sample	Total	Route Enroll.	20-Day Sample
ork	2316	2750	2440	112	80	72	2428	2830	2812
lover	1842	1730	1635	30	18	17	1872	1728	1652
ock Hill	5238	6800	6351	256	160	160	5494	6960	6511
	9396	11280	10426	398	258	249	9794	11538	10975

CATAWBA NUCLEAR PLANT EVACUATION PLAN
ROCK HILL SCHOOL BUS DRIVER PERMISSION FORM

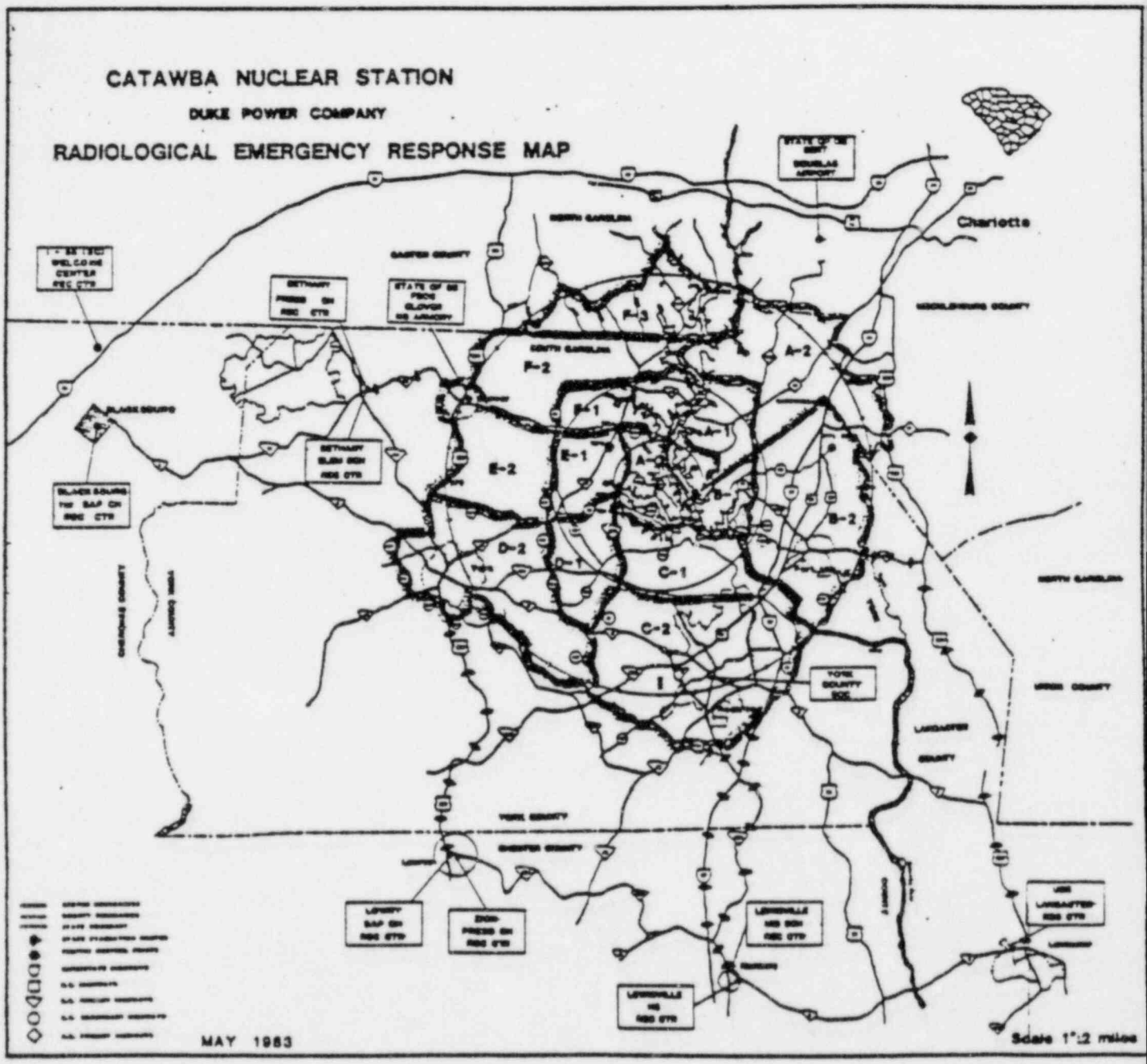
I, _____, CONSENT TO DRIVE A SCHOOL BUS IN CASE OF AN EMERGENCY EVACUATION AT THE CATAWBA NUCLEAR PLANT.

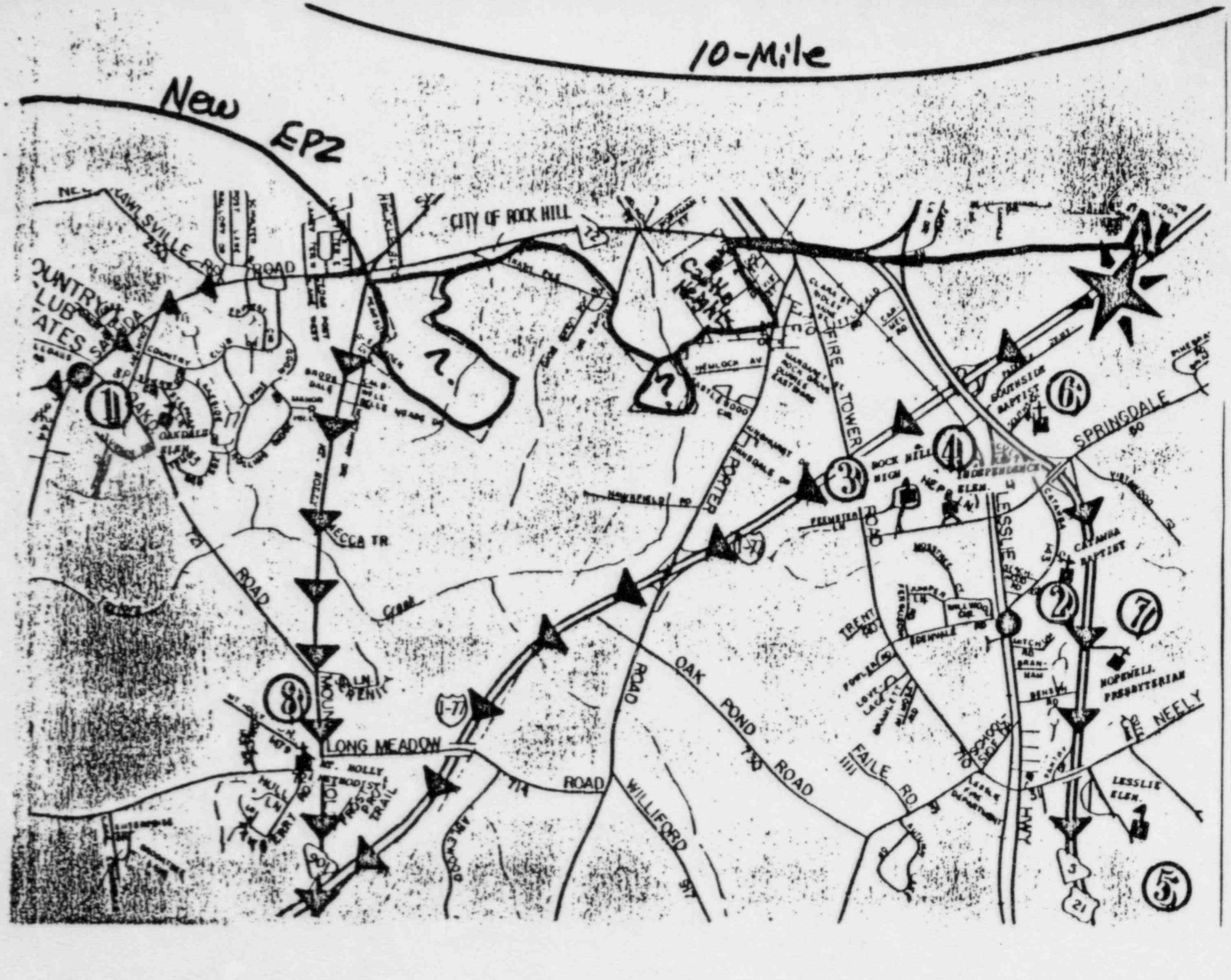
MY CHILD HAS MY PERMISSION TO DRIVE A SCHOOL BUS IN CASE OF AN EMERGENCY EVACUATION AT THE CATAWBA NUCLEAR PLANT.

_____ _____

DATE SIGNATURE OF PARENT/GUARDIAN

PARENT, PLEASE KEEP TOP COPY FOR YOUR RECORDS AND RETURN BOTTOM COPY FOR OUR RECORDS.


CATAWBA NUCLEAR STATION
DUKE POWER COMPANY
RADIOLOGICAL EMERGENCY RESPONSE MAP
Charlotte
MAY 1983
Scale 1"=2 miles


10-Mile
New EPZ
CITY OF ROCK HILL
COUNTRY CLUB ESTATES
RAWLSVILLE ROAD
FIRE TOWER
PORTER ROAD
SPRINGDALE
SOUTHSIDE BAPTIST
ROCK HILL HIGH
INDEPENDENCE ELEM.
LESSLIE HWY
CATAWBA BAPTIST
HOPEWELL PRESBYTERIAN
NEELY
LESSLIE ELEM.
OAK POND ROAD
FAILE RD
WILLIFORD ROAD
LONG MEADOW ROAD
MT. HOLLY METHODIST
MECCA TR.
HEMLOCK AV
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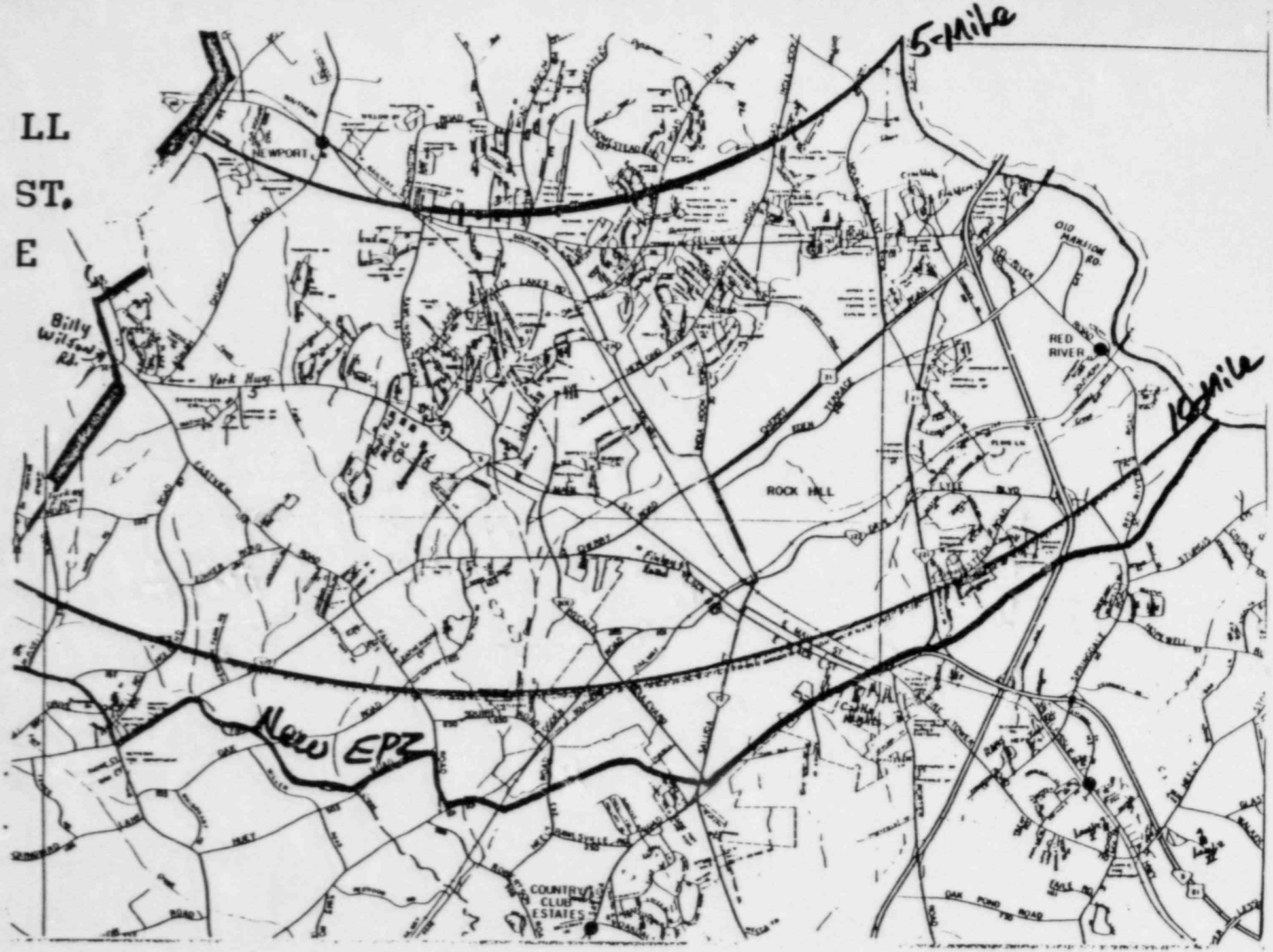
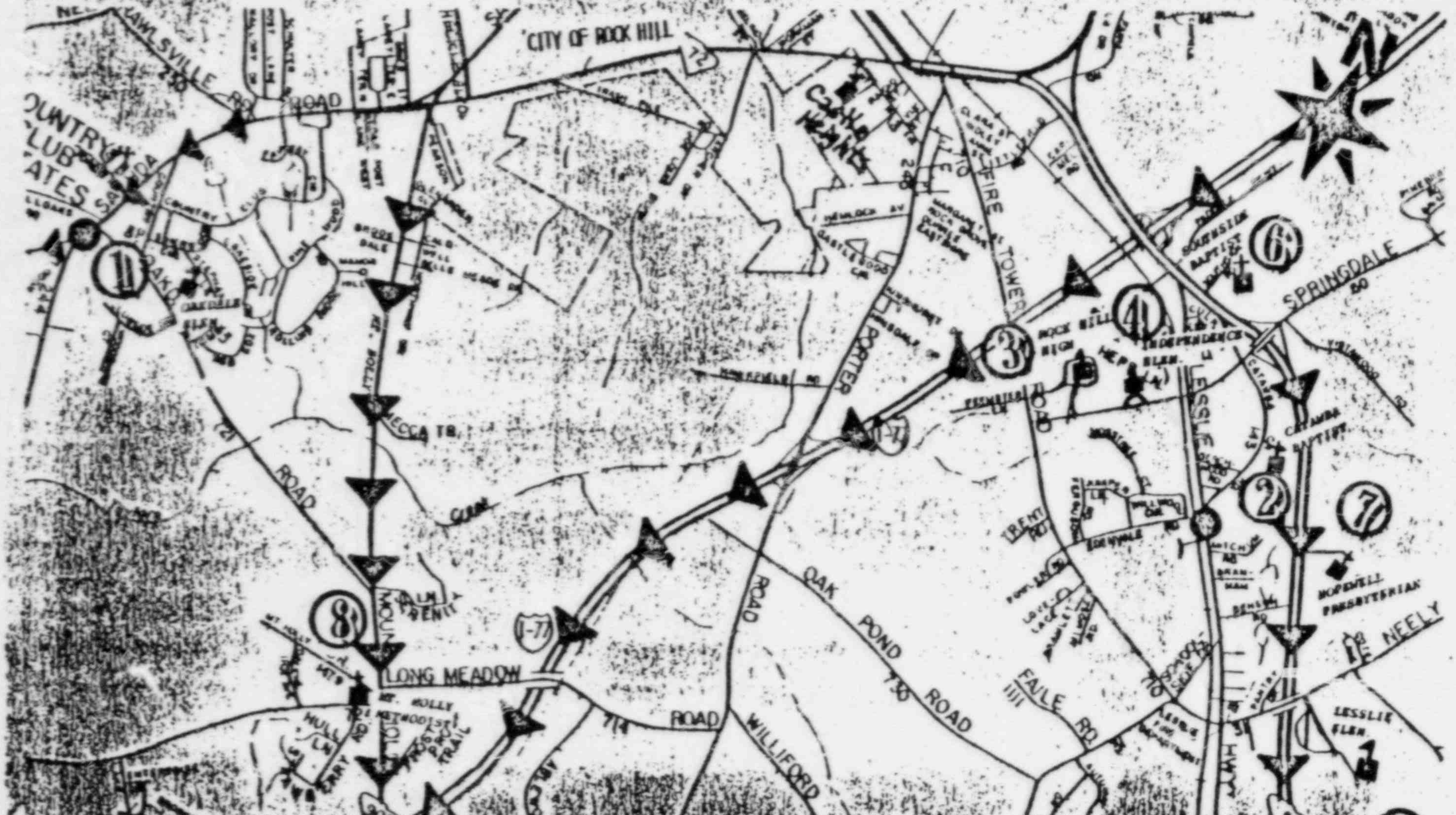

LL
ST.
E
5-Mile
10-Mile
NEWPORT
Billy Wilson Rd.
York Hwy.
ROCK HILL
RED RIVER
OLD MANSION RD.
New EPZ
COUNTRY CLUB ESTATES
OAK POND RD.


CITY OF ROCK HILL
COUNTRY CLUB ESTATES
RAWLSVILLE RD
ROAD
FIRE TOWER
PORTER
ROAD
OAK POND ROAD
WILLIFORD
FAULE RD
LESSLIE
HWY
SPRINGDALE
NEELY
LONG MEADOW
ROCK HILL HIGH
INDEPENDENCE
SOUTHSIDE BAPTIST
HOPEWELL PRESBYTERIAN
MT. HOLLY METHODIST
LESSLIE ELEM.
CATAWBA BAPTIST
MECCA TR.
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APPENDIX E
FORT MILL SCHOOL DISTRICT 4
DRAFT EVACUATION PLAN

Evacuation Plan

Fort Mill School District # 4 operates 23 buses on regular routes. In addition, we normally have two spare buses and one mini bus. Of the regular route buses, eight are classed as 60 passenger buses and 15 are rated at 54 passenger. The mini bus is rated for 16 passengers.

For the purpose of an emergency evacuation, the following assumptions are made.

1. 60 passenger buses can carry 75 students.

2. 54 passenger buses can carry 67 students.

3. Evacuation calculations will not be based on using spare buses since they may not be available. The CDC bus will be considered as unavailable. The mini bus will be considered unavailable.

4. District activity buses will be considered unavailable. This will give us the worst possible situation. The number of students moved per unit of time will improve if any of the buses considered unavailable become available.

Under the worst possible situation, the 1,275 students from Riverview Complex and the 230 students from Campus II of the middle school can be moved at one time. It is estimated that no more than one half of the high school students would require bus transportation. Private vehicles can carry 450-500 students to Indian Land. The 530 students at Campus I of the Middle School and the balance (400) of the high school students would be picked up in the second load. The 54 passenger buses would be used for this second load since they require less fuel and could possibly make the second trip without refueling.

The eight 60 passenger buses would be available to the County Transportation Supervisor after the first load. The remaining fourteen 54 passenger buses would be available after the second load.

All evacuation from Fort Mill would travel along Doby's Bridge Road to Indian Land. Students in grades K-5 will be taken to Indian Land Elementary School. Students in grades 6-12 will go to Indian Land School. As discussed, assistance from law enforcement will be required to cross Hwy. 521 to the elementary school.

The Superintendent of Indian Land Schools will dismiss his students when the evacuation order is given. He will retain as much of his staff as possible to assist with supervision of Fort Mill students. Fort Mill will place one adult on each bus to supervise students in route. The balance of the available staff will be sent to Indian Land in their private vehicles.

Lancaster County Bus Maintenance Shop will provide for refueling either at Indian Land or at Fort Mill High School, depending on gas schedule, day of week, and time of day.

It is understood that Indian Land can not serve as a shelter because of proximity to the EPZ. This location will remain open for approximately four hours after the arrival of the first evacuees to allow parents to pick-up their students. When this location closes, remaining students will be transported by Disaster Prepardness to a satisfactory shelter. (Where?)

A more precise time schedule will be worked out for transportation considering variables for gassing and time of day pending the acceptability of this plan.

Assumptions Underlying Departure Times for Evacuation of the

Catawba Nuclear Station Emergency Planning Zone

Prepared for:

Duke Power Company

Prepared by:

PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22102

December 1983

Assumptions Underlying Departure Times for Evacuation of the

CATAWBA NUCLEAR STATION EMERGENCY PLANNING ZONE

Prepared for:

Duke Power Company

Prepared by:

PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22101

December 1983

TABLE OF CONTENTS

LIST OF EXHIBITS

I. GENERAL METHODOLOGY FOR DETERMINING DEPARTURE TIMES

INTRODUCTION

As suggested by Appendix 4 of NUREG 0654, the estimate of time required for preparing to evacuate is based on estimating the time distributions for a series of discrete steps which comprise the preparation process. This approach involves the following procedures:

- Pre-evacuation activities on the part of EPZ population are categorized into a series of discrete steps.
- A time distribution is calculated for each activity step. This distribution defines the rate at which the EPZ population completes the individual step.
- The time required for the completion of ALL of the steps by ALL of the population is derived by combining the individual distributions in a statistically correct manner.

POPULATION GROUPS

Separate departure time estimates are made for each of the major components of population in the Catawba EPZ:

- Permanent Resident Population – Those persons living full time in the Catawba EPZ. Two subgroups of permanent resident population are recognized:
  - Vehicle-Owning Population – Those permanent residents having a vehicle available for their evacuation from the EPZ.
  - Non-Vehicle-Owning Population – Those permanent residents not having a vehicle available for their evacuation from the Catawba EPZ and who, therefore, must be transported by other means.
- Transient Population – Non-residents of the EPZ, temporarily within it, primarily for the purposes of recreation or work.
- Special Facility Population – Concentrations of population in locations other than households. Two subgroups of special facility population are identified:
  - Population in Schools – All students in schools, colleges, or any other educational institution at the time of evacuation.

- Institutional Population – All population in non-school institutions (hospitals, nursing homes, day care centers, prison) at the time of evacuation.

DEPARTURE STEPS

Exhibit 1 summarizes the departure steps for the various categories of EPZ population. The definition of the steps is patterned on the directions given in Appendix 4 to NUREG 0654. Additional steps were designated for population subgroups not originally envisioned in Appendix 4 to NUREG 0654.

Departure steps are somewhat dependent on time of day, day of week, and season of year. Consequently, some do not apply at all times. However, for the critical time period (the fall/winter weekday period for which preparation times are at a maximum) all of the evacuation steps designated in Exhibit 1 apply.

EVACUATION STEPS: PERMANENT RESIDENT POPULATION (VEHICLE-OWNING)

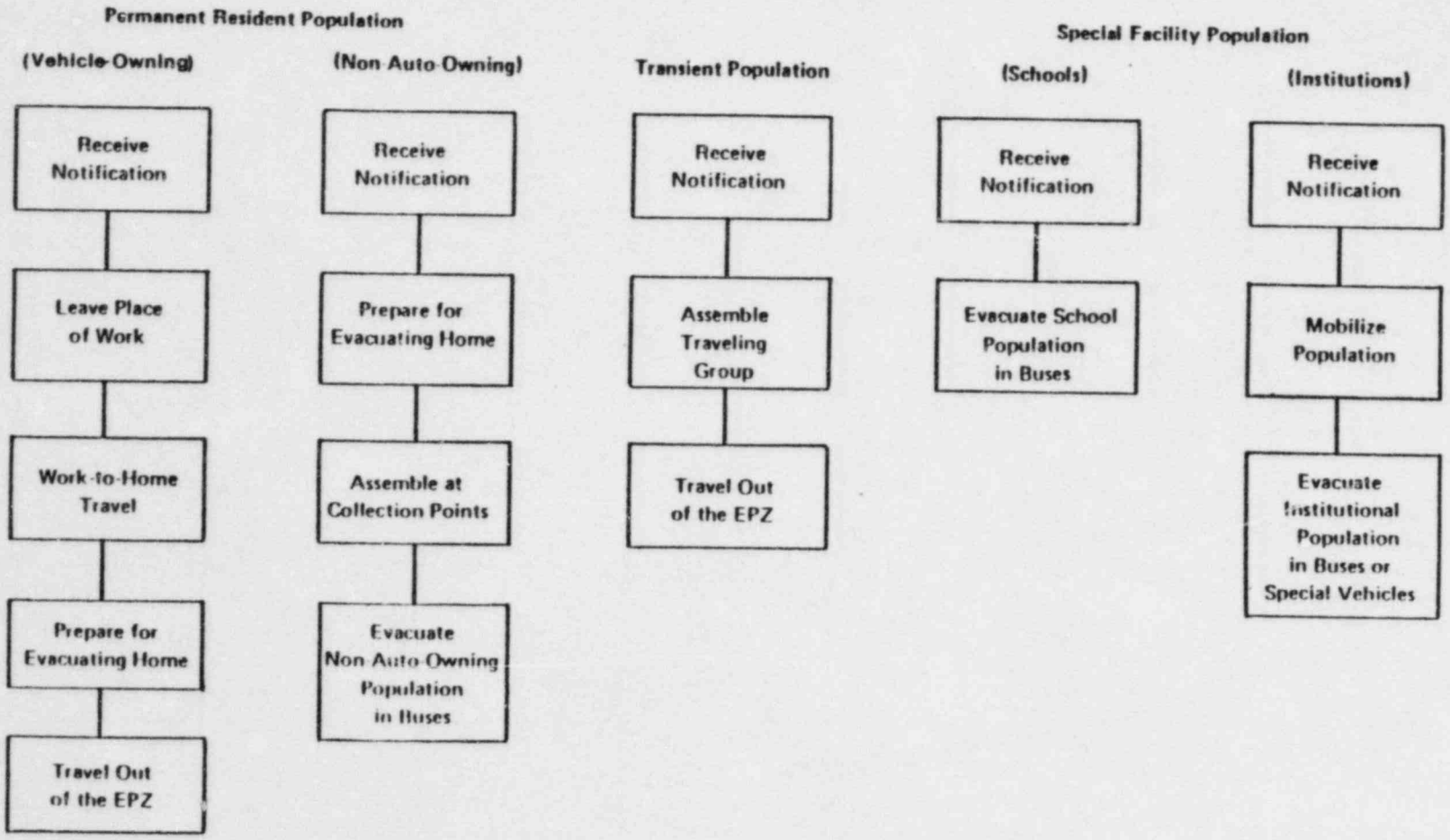
Receive Notification

The first activity in the evacuation process is the notification of the public that an emergency exists. This includes the sounding of sirens, followed by Emergency Broadcast System (EBS) information, and some direct notification by NOAA radio alert.

Various other back-up measures are used to inform the population which might not be reached by the above means. Mobile sirens and public address units will supplement the siren alerting system. Mobile public address units mounted on boats or aircraft will notify boaters on Lake Wylie.

This notification alerts the public that an emergency exists, and that they should tune in to radio and television broadcasts for further information. The notification, by itself, does not inform the public of the nature of the emergency nor of the response that they should make.

Exhibit 1. Population Segments and Evacuation Sequences



Information on the nature of the emergency and instructions on evacuation are given through radio and television broadcasts over cooperating local stations in the Emergency Broadcast System (EBS).

Leave Place of Work

The rate at which area workers will leave their jobs to return home to prepare for evacuation depends on the particular work environment and upon the responsibility level of the worker. It is to be expected that most of the work force will be able to leave their jobs almost immediately, quite similar to a normal departure from work at the end of the workday. A number of workers, however, will require some job "close-down" time in work situations; for example, those that involve chemical processes, construction equipment, or cash registers in retail sales establishments. Supervisory employees, managers, and independent business operators will generally require the greatest amount of time to secure their place of work and to assure that all employees and others on the premises have departed.

Work-to-Home Travel

Travel of the employees from their place of work to home is identical to the daily work-to-home travel pattern. The maximum length for work trips for people living and working in the EPZ is not likely to exceed 13 miles.

This movement of workers, because of the short time over which it occurs, can be expected to cause some traffic congestion similar to that occurring during the twice-daily work travel peak. The road system can handle this volume of traffic with essentially the same level of service as during the peak hours on a typical working day.

Prepare for Evacuating Home

People can be expected to react differently to any emergency situation, and there are likely to be great differences in the amount of time that residents will spend in

preparing to leave their homes. Three factors, in particular, affect the amount of time needed to prepare for evacuating a household:

- Whether or not adults are at home when notice to evacuate is received. If so, preparation time is shortened (compared to households where no adults are at home) since preparation for evacuation can begin before workers arrive home.

- Number of children and other dependents at home who increase the time needed to prepare the household for evacuation.

- The amount of property to be secured. Farms are the extreme case and may require up to one and one-half hours to secure. On the other hand, small households can be prepared for evacuation in minutes.

Travel Out of the EPZ

After households are secure, residents of vehicle-owning households will drive out of the EPZ. Most motorists will use the most direct route available.

Public agencies will give routing advice for this travel, by means of preparedness plans prior to the emergency and through information broadcasts during the actual evacuation. Law enforcement officers will also channel flow of traffic at critical locations, as defined in local preparedness plans and in response to actual conditions.

The vehicle-owning resident population will drive to reception centers established outside the EPZ where they will be checked for contamination and reunited with other family members. Evacuees will then either go to a shelter, where they will be lodged temporarily, or to other destinations (homes of friends or relatives) of their own choosing.

During the evacuation, normal traffic operations will prevail. Specifically, roads will continue in two-way operation, traffic signals will continue to function, and so forth. At key locations, mainly intersections, traffic control will be under direction of law enforcement officers or other personnel as designated by local evacuation plans.

On most roads, traffic will flow freely, although at reduced speeds. However, at certain locations and during certain protions of the evacuation period, traffic congestion is expected.

EVACUATION OF PERMANENT RESIDENT POPULATION (NON-VEHICLE-OWNING)

Receive Notification

The procedure for receiving broadcast information is the same as for vehicle-owning population (above). This includes the sounding of sirens followed by broadcast information and supplemented by mobile public address.

Prepare for Evacuating Home

This step is the same as for vehicle-owning population (above). As in the case of vehicle-owning population, primary factors in the time required for this action are whether or not an adult is home at the time of notification, the number of dependents to be evacuated, and the extent of property to be secured.

Evacuate Non-Vehicle-Owning Population in Buses

A significant fraction of the non-vehicle owning population (perhaps as much as 50 percent) will be evacuated as passengers in private vehicles driven by family, neighbors, or friends. This component of the non-vehicle-owning population is considered as part of the vehicle-owning population, and their evacuation procedure follows that of the vehicle-owning population described above.

Persons from non-vehicle-owning households, who do not evacuate as passengers in private vehicles, will be transported out of the EPZ in vehicles dispatched by the County preparedness agencies.

In York County, South Carolina and Gaston County, North Carolina, the primary source of vehicles are school buses. Transit buses from Charlotte will be the primary source of vehicles in Mecklenburg County.

EVACUATION OF TRANSIENT POPULATION

Receive Notification

Most of the industrial transient population will be notified by tone alert receivers, telephone calls, and the siren system. Transient recreational visitors around Lake Wylie are notified by the siren system. Some boaters on the lake will be notified by mobile public address systems.

Assemble Traveling Group

The traveling group (usually family) is assembled. Preparations for evacuating (for example, closing a cabin, docking a boat) are made.

Travel Out of the EPZ

After assembling their traveling group the transient population will drive out of the EPZ using their private vehicles.

Transient population will be directed to a reception center. After clearing the reception center, they will return to their homes outside the EPZ.

Public agencies will give routing advice for this travel through information broadcasts during the evacuation. Law enforcement officers will also direct traffic flows out of the EPZ.

Unescorted children at Carowinds Theme Park will be taken by bus to a reception center in Mecklenburg County where they will be screened for radiological contamination and reunited with their parents.

EVACUATION OF SPECIAL FACILITY POPULATION (SCHOOLS)

Receive Notification

Following the decision to evacuate, the counties notify schools directly of the need for evacuation. This is done through the siren system, tone alerts, and telephone calls directly to the schools.

Evacuate School Population in Buses

The school population is transported directly by bus from school to reception centers. An entire school will be transported to the same reception center. School children will not return home prior to evacuation. The picking up of school children at school by their families is discouraged.

All buses normally used within the Catawba EPZ will be used for evacuation. These will be supplemented by buses from outside the EPZ, but within the three-county area.

EVACUATION OF SPECIAL FACILITY POPULATION (INSTITUTIONS)

Receive Notification

Following the decision to evacuate, the local preparedness agencies will notify institutions directly by telephone calls.

Mobilize Population

The institutional population is instructed to evacuate by the staff of that particular institution. Necessary personal effects are assembled. Essential medical records are gathered.

Evacuate Institutional Population in Buses or Special Vehicles

Buses will pick up ambulatory hospital patients, nursing home residents, and other persons not requiring ambulance transportation. These passengers will be transported directly to the alternate relocation facilities.

Non-ambulatory persons will be transported directly from institutions by emergency vehicles normally based within the EPZ, supplemented by emergency vehicles from outside the EPZ.

II. DERIVATION OF TIME DISTRIBUTIONS FOR DEPARTURE STEPS

PERMANENT RESIDENT POPULATION

Receive Notification

The time distribution for the "Receive Notification" step is predicated on:

- Meeting the requirements of NUREG 0654 for notification of virtually 100 percent of the EPZ population within 45 minutes after the start of notification
- A siren system meeting all the requirements of warning systems as set forth in NUREG 0654, and with at least an 80 percent reliability factor
- "Feedback" to indicate where siren failure occurs and procedures for backup notification in areas affected by siren failure
- Effective EBS messages in conjunction with the siren alerting system

The time distribution projected for notification of the Catawba EPZ has been further confirmed through analysis of an alerting simulation model (developed after the original projections were made). The model confirms that a properly functioning siren and backup system will yield a notification time distribution consistently better (i.e., requiring less time for most of the population) than originally projected.

Leave Place of Work

The projected time distribution for leaving place of work is based on the following stipulations:

- Employees will not abandon work places precipitously but, rather, will close down as rapidly as possible in an orderly and controlled manner. This is in contrast to the immediate and uncontrolled departure from work places that would characterize a more immediate emergency, such as a fire or explosion.

- Customers and other visitors on the premises will be notified in accordance with the establishment's procedure for emergency closing. These procedures typically allow for a 5-to-10 minute period for completion of business.

- Managerial personnel will remain until workers and other visitors have cleared the premises.

- Close-down procedures necessary for safety or security will be performed as usual. Other normal closing activities (for example, cleaning) will be suspended.

- Departure time from the premises is predicated on normal walking speeds.

- Internal notification (within the premises) is comparable to that which would be exercised in a more immediate emergency (for example, fire). This level of alerting, dictated by existing codes and insurance ratings, assures the notification of 100 percent of building occupants within five minutes of receipt of notification from the public alerting system in the EPZ.

- Departure times will reflect the level of the responsibility of the individual employee, as outlined in Exhibit 2.

Work-to-Home Travel

Work-to-home travel times are based on standardized trip length frequency distributions (TLFD's), as developed from home interview surveys throughout United States urban areas of all sizes. These distributions have proven to be predictable and stable for comparably sized areas and are an accepted feature of quick-response travel estimation procedures.

A maximum travel time of 20 minutes is adopted for a worker with both residence and work place within the EPZ. This travel time corresponds to a distance of over 13 miles and, in light of the population distribution in the EPZ, represents a reasonable upper bound for work trips fully contained in the EPZ.

Work-to-home travel times incorporate a traffic level of service comparable to that occurring daily during the a.m. and p.m. peak traffic hours. These travel speeds, associated with Level of Service "C" as defined in the 1965 Highway

EXHIBIT 2. DERIVATION OF TIMES FOR "LEAVE PLACE OF WORK" STEP

	Work Force Component	Percent of Work Force	Maximum Time for Leaving Place of Work
(1)	Nonmanagement	50	10 minutes
(2)	First Line Supervision	30	15 minutes
(3)	Middle Management	10	20 minutes
(4)	Special (security, proprietor, etc.)	10	30-45 minutes

Capacity Manual are 45 miles per hour for rural highways and 22 miles per hour in urbanized areas.

Prepare for Evacuating Home

The time needed to prepare for evacuating the home varies with three factors: (1) whether or not an adult member of the household is home at the time of notification, (2) whether or not there are dependents in the household and, (3) the amount of household property to be secured prior to evacuation.

Exhibit 3 shows the possible combination of factors that determine the time needed for preparation to evacuate the home. Exhibit 3 identifies the UPPER bound of the time distribution for each population segment of the household populations; i.e., the times required for all households of given characteristics to prepare for evacuation.

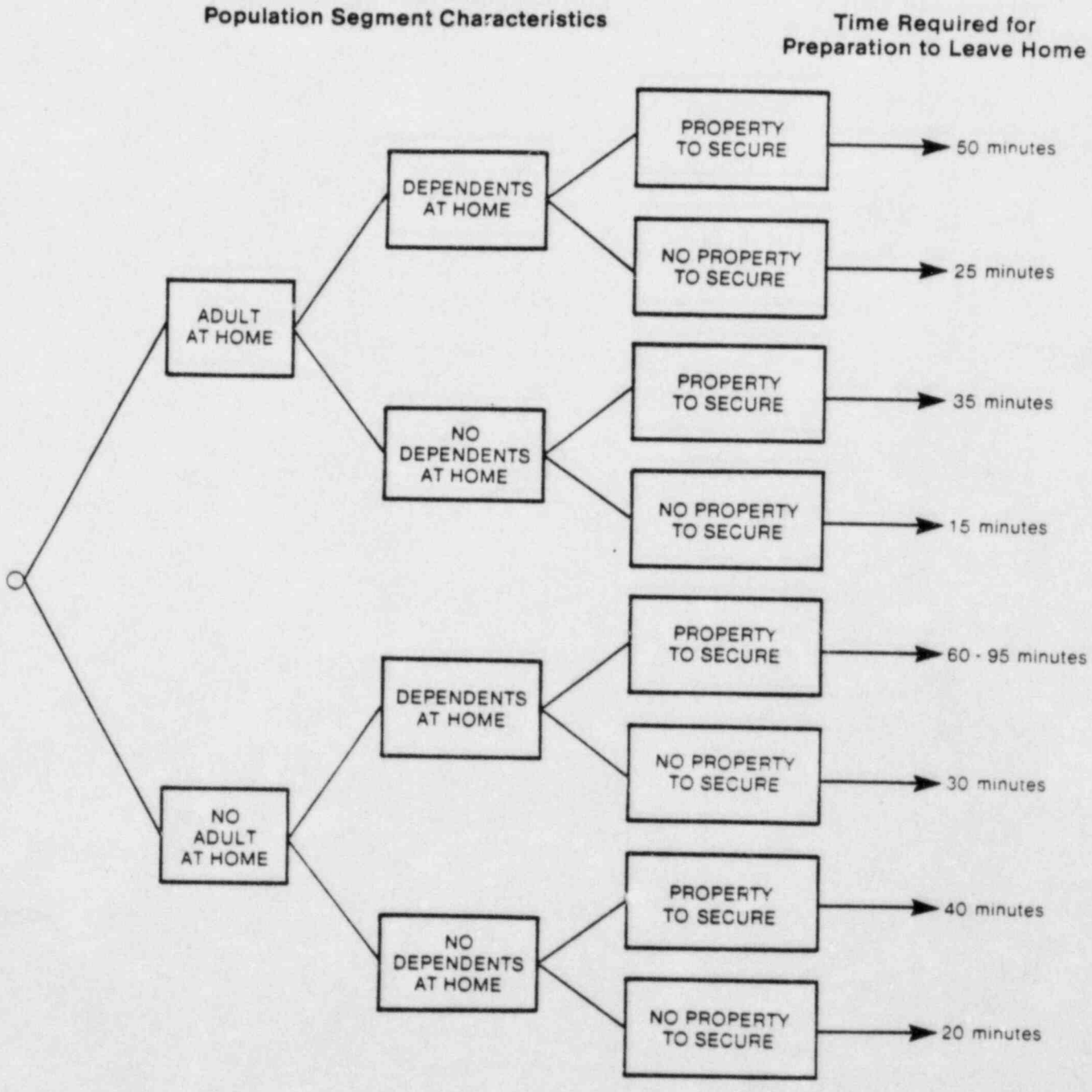
The times for each population segment are derived through time and motion analysis procedures, using standardized components of activity (for example, "Load Vehicle," "Lock House," etc.). A factor of 150 percent was then applied to computed times to reflect "over-preparation"; that is, preparation measures in excess of those instructed by the EBS broadcasts or by other information in possession of the household.

Travel Out of the EPZ

Two distinct conditions can prevail with respect to travel out of the EPZ:

- No Traffic Congestion – On evacuation routes with no traffic congestion, a maximum of 15 minutes is needed to drive out of the EPZ. This figure is based on a maximum straight-line evacuation travel distance of 11 miles, a circuity factor of 1.1, and an average travel speed of 50 mph. This maximum time reflects a departure from the immediate vicinity of the plant, and with almost all of the evacuation travel accomplished on rural highways. Highway travel speeds reflect the free-flow conditions as defined by Level of Service "B" in the 1965 Highway Capacity Manual.

Exhibit 3. Derivation of "Prepare for Evacuating Home" for Vehicle-Owning Households



Evacuation, under free-flow conditions from any of the built-up areas within the EPZ, requires less than the maximum of 15 minutes described above. For example, evacuation from the northwest sector of Rock Hill, requiring a routing through continuously urbanized areas, will require 12 minutes, based on a straight-line travel distance of 4 miles, circuity factor of 1.2, and 25 mph average speed (reflecting the free-flow condition for urban arterial streets) associated with Level of Service "B" in the 1965 Highway Capacity Manual.

- With Travel Congestion – On evacuation routes with travel congestion, travel times are not determined by the free-flow travel speeds (above) but, rather, by the extent of the congestion incurred on the route. This congestion is identified and analyzed through the use of the QUEUE model, a computerized analytical technique which simulates the flow of traffic through the evacuation routes.

The QUEUE Model for Simulating Traffic Congestion – The QUEUE begins with the evacuation road network (that is, the system of roads available for evacuation) and the distribution of population onto this network. The QUEUE model then simulates the traffic flow through the evacuation road network. This simulation is iterative; that is, it is repeated for small increments of time. Consequently, the status of traffic congestion is calculated at each time interval, and the dynamic aspects of traffic flow and congestion can be traced.

Inputs to the QUEUE program are:

- Road network used for evacuation. This includes the major evacuation routes, branches to these routes (evacuation subroutes), and points at which the population enters the evacuation route system (loading points).

- Departure curve for the risk area population, which gives the rate at which the population enters the road system.

- Traffic flow parameters to reflect the capacity of the roads in the relocation network.

The evacuation route network within the EPZ is coded into a form needed for entry into the QUEUE program. This coding process consists of:

- Designating the major evacuation routes. The number of such routes depends on the specific corridor being considered; typically, there are two to five major evacuation routes in any given corridor.

- Designating the subroutes; that is, the roads that feed traffic onto the major evacuation routes. The number of subroutes also depends on the specific corridor being considered; typically, there are two to four subroutes for each major relocation route.

- Establishing the loading points, locations at which relocation traffic is assumed to be generated and at which it enters the relocation road system. Loading point are an abstraction of the actual road system, representing concentrations of households, work places, etc. Typically, a total of 10 to 15 loading points is established for each of the major evacuation routes.

The QUEUE program calculates, for each interval, the arrival and departure of traffic at all locations throughout the evacuation road system. Arrival rates of traffic are determined by:

- The departure rate which establishes for all evacuation routes the rate at which traffic enters (or attempts to enter) the evacuation road system

- The loading of traffic onto the individual evacuation routes. This loading is made on the basis of population concentrations, and special activity centers.

The rate of discharge of traffic through intersections is determined by:

- The available lanes of roadway

- The traffic flow rate, typically 1,200 vehicles per hour on each departure lane for surface roads, and 1,800 per lane on freeways. Traffic flow rates can be adjusted to reflect adverse conditions or other obstacles to free traffic flow.

Traffic queues at any given location are discharged at a rate proportional to their magnitude; i.e., the longer a queue the greater its priority at the intersection where the queue originates. This algorithm simulates the traffic control that would be achieved by a competent traffic control officer on duty at such locations.

The QUEUE program identifies locations at which congestion occurs and calculates the extent of such congestion. Measures which are computed include the length (time) of the period over which congestion persists at particular locations, the maximum delay experienced by a vehicle passing through any congested location, and the extent (distance) of congestion on the relocation road network.

Possible Levels of Traffic Congestion – Three possible conditions of traffic congestion are analyzed in Exhibit 4. In the instance with no traffic congestion, (Type "A" in Exhibit 4), the departure from the EPZ depends solely on the rate at which people prepare to leave their housholds and drive, in a free-flow manner, out of the EPZ. At no point in the evacuation period does traffic congestion slow this progress out of the EPZ. Seven routes out of the Catawba EPZ have this pattern of traffic flows.

On routes where traffic congeston occurs (Type "B" and "C" in Exhibit 4), traffic congestion appears when the rate of vehicles entering the street exceeds the capability of the street to carry them. Congestion continues to build as long as the rate of vehicles entering the street system continues to exceed the vehicular capacity of the evacuation route. At some point in the evacuation process, the rate at which vehicles enter the street system reaches a maximum and begins to decrease.

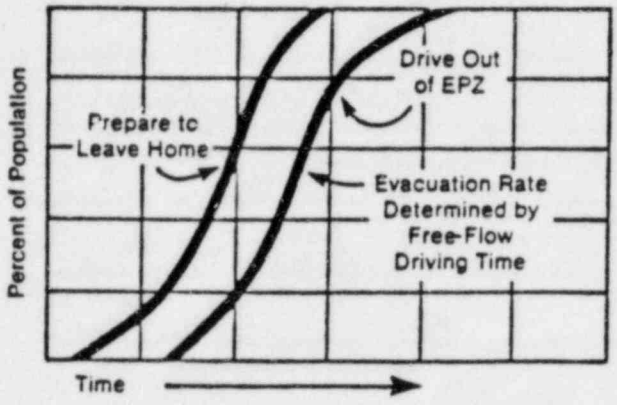
Congestion begins to diminish as the rate of vehicles entering the street system begins to fall below the capacity of the evacuation route to carry them. This decrease in traffic congestion continues until the queues disappear and free traffic flow is restored on the evacuation route.

In less severe instances of congestion (Type "B" in Exhibit 4), this occurs before the population has finished preparations to leave home. From the point at which congestion ends until the completion of evacuation, the rate of evacuation is once again determined by the rate at which households complete their preparation to leave home and enter the street system. Eight routes out of the Catawba EPZ have this traffic pattern.

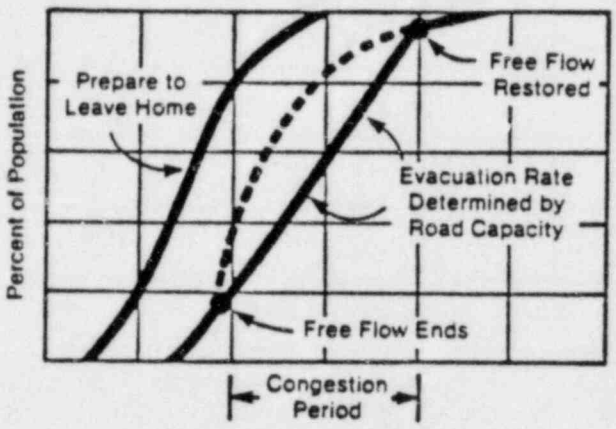
In the more severe instances of congestion (Type "C" in Exhibit 4), the traffic backups continue even after all the population has completed preparations to leave home. In this type of congestion, the backups are too large to be discharged before all population has completed preparations to leave home. In this case, evacuation times are no longer dictated by the time at which preparations for leaving home

Exhibit 4. Possible Levels of Traffic Congestion

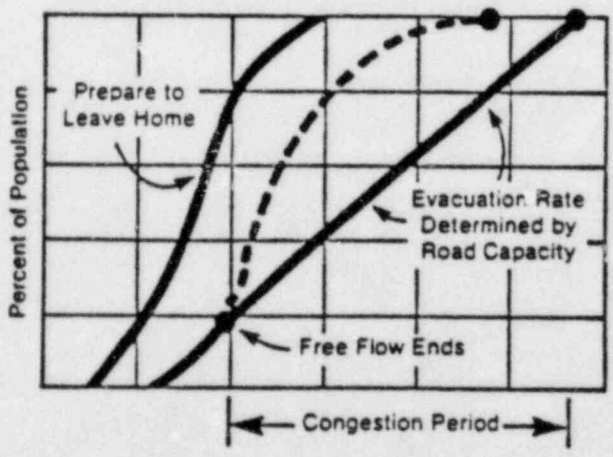
A. FREE TRAFFIC FLOW, NO CONGESTION



B. CONGESTION OCCURS AND ENDS BEFORE ALL POPULATION LEAVES HOME



C. CONGESTION CONTINUES AFTER ALL POPULATION LEAVES HOME



are completed but, rather, by the traffic capacity of the evacuation route. Three routes out of the Catawba EPZ have this traffic pattern.

PERMANENT RESIDENT POPULATION (NON-VEHICLE-OWNING)

Receive Notification

The derivation of the time distribution of the "Receive Notification" step is described previously for the "Permanent Resident Population (Vehicle Owning)" segment of EPZ population.

Prepare for Evacuating Home

The time needed to prepare for evacuating the home varies with three factors: (1) whether or not an adult member of the household is home at the time of notification, (2) whether or not there are dependents in the household and, (3) the amount of household property to be secured prior to evacuation.

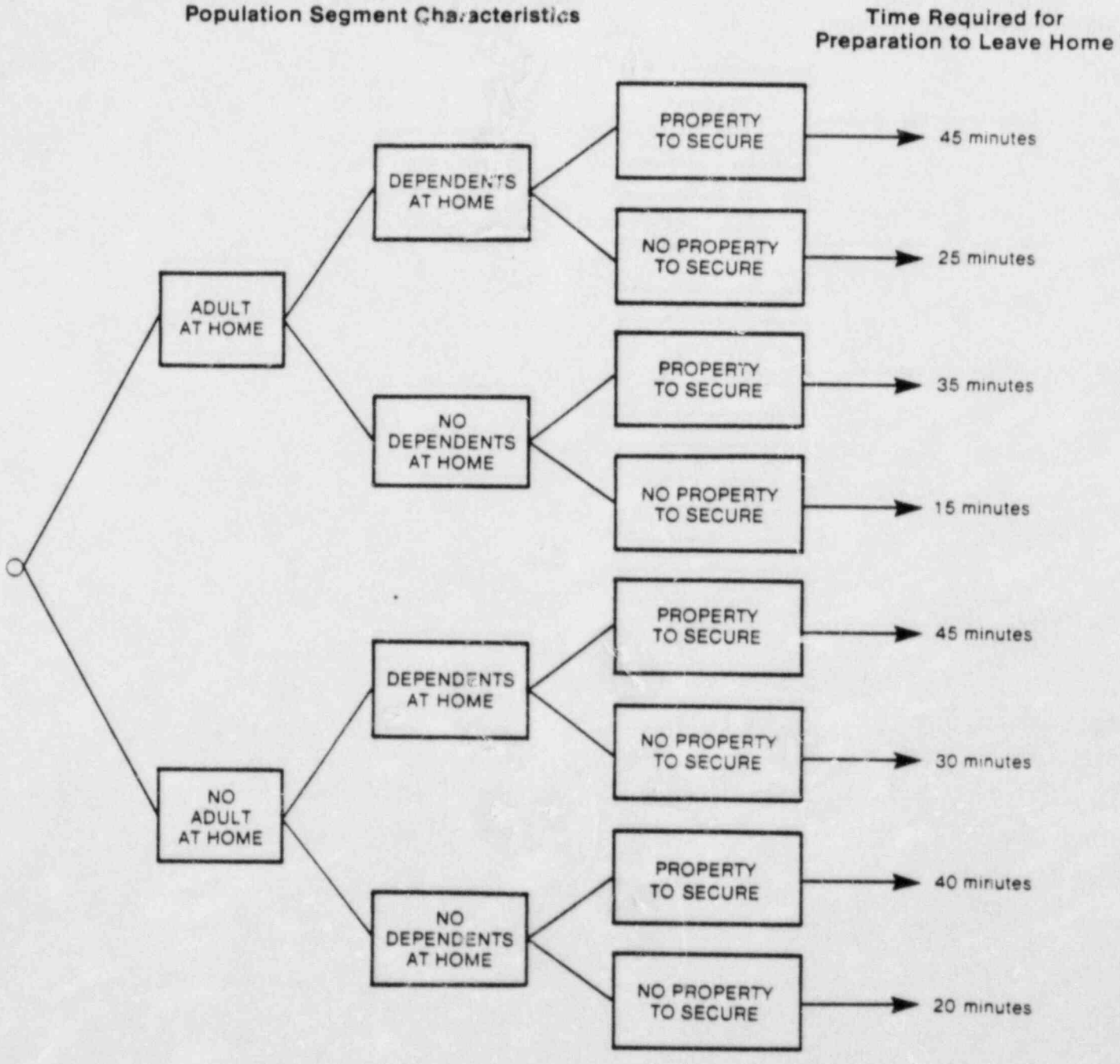
Exhibit 5 shows the possible combinations of factors that determine the time needed to evacuate the home. Exhibit 5 identifies the UPPER limit of the time distribution for each type of household; that is, the times required for ALL of the households of given characteristics to prepare for evacuation.

The times for each population segment are derived through time and motion analysis procedures using standardized components of activity (for example, "Lock House," etc.). A factor of 150 percent was applied to the raw computed times to reflect "over-preparation"; that is, preparation measures in excess of those instructed by EBS broadcasts or by other information in possession of the households.

In general, "Non-Vehicle-Owning" households require less time to prepare for evacuation than do "Vehicle-Owning" households. This reflects:

- Less activity on the part of non-vehicle-owning households; for example, such households have no vehicle to load

Exhibit 5. Derivation of "Prepare for Evacuating Home" for Vehicle-Owning Households



- Less property to be secured by non-vehicle-owning households, in comparison to vehicle-owning households

Assemble at Collection Points

A maximum walking distance of one mile from any non-vehicle-owning household to the nearest collection point is stipulated. At a walking speed of 3 feet per second, this yields a maximum access time of 30 minutes. Another 20 minutes spent waiting for the bus gives a total of up to 50 minutes for this step. A minimum access time of 10 minutes is based on the evacuees residing very close to a collection point and having only a 10 minute wait for the pickup.

The distribution of access (i.e., walking and waiting) times for all non-vehicle-owning households is arrayed evenly between the maximum and minimum points as defined above.

Evacuate Non-Vehicle-Owning Population in Buses

The process of transporting non-vehicle-owning population from assembly points in buses is defined by four separate steps (Exhibit 6). Minimum and maximum times are stipulated for each step as indicated in Exhibit 6.

Total Evacuation Times for Non-Vehicle-Owning Population

The time required for the evacuation of all non-vehicle-owning population is determined by combining the distributions for the individual steps. Critical path analysis is used to analyze the impact of overlapping activities.

TRANSIENT POPULATION

Receive Notification

The derivation of the time distribution for this step is described previously for the "Permanent Resident Population (Vehicle-Owning)" segment of the EPZ population.

EXHIBIT 6. DERIVATION OF TIMES FOR "EVACUATE NON-VEHICLE-OWNING POPULATION IN BUSES" STEP

	Activity	Time Required for Activity	
		Minimum	Maximum
(1)	Notify bus system operators, (public and private)	10 minutes	20 minutes
(2)	Drive buses into EPZ	30 minutes (15 miles @ 30 miles per hour)	50 minutes (18 miles @ 22 miles per hour)
(3)	Boarding runs	10 minutes (single stop)	30 minutes (three stops)
(4)	Drive out of EPZ	20 minutes (7 miles @ 22 miles per hour)	(35 minutes (13 miles @ 22 miles per hour)
TOTAL		1 hour, 10 minutes	2 hours, 15 minutes

Assemble Traveling Group

For the most part, transient travel groups are families engaged in social/recreational activities. A minimum assembly time of 10 minutes and a maximum assembly time of 30 minutes is stipulated for the assemblage of transient travel groups. Basis of these times are projections by recreation facility operators (public and private).

Travel Out of the EPZ

A minimum travel time of 15 minutes and a maximum travel time of 30 minutes is stipulated for travel out of the EPZ by transient population. These travel times are based on free-flow travel conditions, corresponding to Level of Service "B" in the 1965 Highway Capacity Manual; specifically, 50 miles per hour on rural highways and 22 miles per hour in urban areas. Free-flow conditions are stipulated because transient evacuation occurs well before the evacuation of permanent population and is completed before the appearance of traffic congestion resulting from the evacuation of permanent resident population.

Carowinds Park and the PTL Campground

Most of the transients at Carowinds Park consist of families and other groups having their own transportation. For those people, notification time would be negligible because Carowinds would be notified directly by the local authorities as soon as a decision to evacuate was made. Carowinds would then use its public address system to immediately notify all park employees and visitors.

The next step is getting the visitors out of the park and into their cars. Carowinds management states that this normally takes 20 minutes to 1 hour, but for a capacity crowd it would require 2 hours to 2 hours and 30 minutes.

The third step is driving out of the parking lot. Careful study of the exits from the parking lot and the capacity of the connecting roads revealed that in an emergency

the lot could be cleared in 1 hour and 35 minutes even when filled to capacity. This estimate is based on a parking lot capacity (including grassy areas used for overflow) of 5,600 vehicles, three lanes of exiting traffic, and the presence of police traffic control. Thus, even with a capacity crowd, the lot would be cleared before the last visitors departed the park to the lot.

The final step for the Carowinds visitors is to drive out of the area. Since Carowinds is very near the edge of the EPZ and is served by several main roads, the driving time of of the are would be negligible except for the effects of congestion. The traffic leaving Carowinds will be distributed among three roads leading out of the EPZ: I-77, NC 49, and NC 51. The QUEUE model results discussed earlier indicate that congestion would be negligible on NC 51 and would dissipate on the other two routes within 2 hours of the start of evacuation. Therefore, the first people leaving Carowinds may experience some delay in driving out of the EPZ, bus visitors leaving at least two hours after the start of evacuation should require no more than 15 minutes to get across the EPZ boundary.

Thus, the time to evacuate the groups with transportation from Carowinds would be determined primarily by the time to clear the park and would in no case exceed 2 hours and 45 minutes.

A smaller portion of the Carowinds visitors would be people without transportation, primarily unescorted children dropped off earlier in the day by their parents. These people will be picked up by bus and taken to a reception center just as the institutional special facility population. The discussion of the bus evacuation of the institutional population also applies to these carless Carowinds evacuees.

Evacuation of the PTL campground is not a problem in the opinion of the campground management. Everyone coming onto the property has his own transportation, and campground personnel are prepared to quickly notify campers and other visitors if evacuation is called for. Local officials will directly notify the campground management as soon as a decision to evacuate the area is made. Based on a maximum notification time of 30 minutes and a maximum time of 45

minutes to pack up and drive off the PTL property, the PTL visitors should be en route out of the EPZ at about the same time as most of the EPZ residents.

SCHOOL POPULATION

Receive Notification

The direct notification of schools by radio and telephone will yield a minimum notification time of 10 minutes and a maximum notification time of 25 minutes. These times are compiled on the basis of time and motion analysis procedures for a series of individual actions, on the part of school staff, for the notification of school population.

Evacuate School Population in Buses

The process of transporting students out of the EPZ in school buses is defined by four separate steps (Exhibit 7). Minimum and maximum times are stipulated for each step.

Total Evacuation Times for School Population

The time required for the evacuation of all school population is determined by combining the distributions for individual steps. Critical path analysis is used to analyze the impact of overlapping activities.

INSTITUTIONAL POPULATION

Receive Notification

The derivation of the time distribution for this step is described previously for the "Permanent Resident Population (Vehicle Owning)" segment of the EPZ population.

EXHIBIT 7. DERIVATION OF TIMES FOR "EVACUATE SCHOOL POPULATION IN BUSES" STEP

	Activity	Time Required for Activity	
		Minimum	Maximum
(1)	Mobilize on-site buses	10 minutes	(Not relevant; in maximum case, no buses are on premises)
(2)	Load buses	5 minutes	10 minutes
(3)	Drive buses to school	(Not relevant; in minimum case, buses are already at school)	50 minutes (18 miles @ 22 miles per hour)
(4)	Drive out of EPZ	20 minutes (7 miles @ 22 miles per hour)	35 minutes (13 miles @ 22 miles per hour)
TOTAL		35 minutes	1 hour, 35 minutes

Mobilize Population

Minimum and maximum times are based on estimates furnished by operators of nursing homes, hospitals, and correctional institutions. A maximum mobilization time of 30 minutes is projected; preparation times in excess of 30 minutes are construed as an indication of non-compliance with evacuation orders. This is supported by the fact that mobilization times for more immediate emergencies (for example, fire) are required by code, regulations, and institutional policies to be no greater than five to ten minutes.

Evacuate Institutional Population in Buses and Special Vehicles

The process of transporting the institutional population out of the EPZ by bus is defined by four separate steps (Exhibit 8). Minimum and maximum times are stipulated for each step.

In a similar manner, the process for transporting the institutional population out of the EPZ in special vehicles is defined by seven steps (Exhibit 8). Minimum and maximum times for each step are stipulated.

EXHIBIT 8. DERIVATION OF TIMES FOR "EVACUATE INSTITUTIONAL POPULATION IN BUSES AND SPECIAL VEHICLES" STEP

	Activity	Time Required for Activity: Minimum	Time Required for Activity: Maximum
BUS SEQUENCE			
(1)	Notify bus system operators, (public and private)	10 minutes	20 minutes
(2)	Drive bus into EPZ	30 minutes (15 miles @ 30 miles per hour	50 minutes (18 miles @ 22 miles per hour)
(3)	Board buses	10 minutes	15 minutes
(4)	Drive out of EPZ	20 minutes (7 miles @ 22 miles per hour)	35 minutes (13 miles @ 22 miles per hour)
TOTALS		1 hour, 10 minutes	2 hours, 0 minutes
SPECIAL VEHICLE SEQUENCE			
(1)	Notify special vehicles (ambulance, rescue vehicles)	5 minutes	10 minutes
(2)	Drive into EPZ	25 minutes (12 miles @ 30 miles per hour)	40 minutes (20 miles at 30 miles per hour)
(3)	Load vehicles	5 minutes	10 minutes
(4)	Drive to reception center	25 minutes (9 miles @ 22 miles per hour)	30 minutes (11 miles @ 22 miles per hour)
(5)	Return to EPZ	25 minutes (9 miles @ 22 miles per hour)	30 minutes (11 miles @ 22 miles per hour)
(6)	Load vehicles	5 minutes	10 minutes
(7)	Drive out of EPZ	25 minutes (9 miles @ 22 miles per hour)	30 minutes (11 miles @ 22 miles per hour)
TOTAL		1 hour, 55 minutes	2 hours, 40 mintues

Prepared for
Duke Power Company

-EPC 14/15 KULASH ATTACHMENT E -

Catawba Nuclear Station Evacuation Analysis

Evacuation Time Estimates for Carowinds and Heritage USA

PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22102

March, 1984

TABLE OF CONTENTS

INTRODUCTION

This report summarizes the results of detailed analysis of the evacuation of two major concentrations of transient population in the Emergency Planning Zone (EPZ) for the Catawba Nuclear Station in York County South Carolina.

(1) Carowinds Park
(2) Heritage, USA

CAROWINDS PARK

The Carowinds Park is located on Carowinds Boulevard, just west of I-77. Immediate access from the park is on to Carowinds Boulevard.

At peak attendance, it is estimated that two hours would be needed to get visitors from the park to the parking lot. The procedure would be the same one followed for a normal closing, which takes between 20 minutes and one hour with a normal size crowd. This time estimate does not include time for giving free passes for a return visit. If the situation allows time for pass distribution, they would most likely be distributed on the exit roads as people are driving out, not at the park gate.

The main parking lot and adjacent grassy areas will hold about 5,600 cars, the equivalent of four and two-thirds lane hours. Two lanes are normally used for exiting the lot, so about two hours and twenty minutes would be required to empty the lot when full.

Two additional lanes may be pressed into service to shorten this time. One leads from the main lot to Carowinds Boulevard, intersecting Carowinds Boulevard at a point about 0.2 mile northwest of the main entrance. A hairpin turn would be required to get onto it directly from the main parking lot. If one of these lanes were used as a third exit lane, the time to clear the parking lot would drop to about 1 hour and 35 minutes.

The time to clear the parking lot depends on the capacity of the road system outside the park to accommodate the two, three, or four lanes of traffic leading from the main parking lot. It appears that the roads could only accommodate three lanes of traffic, so there would be no point in using a fourth lane to exit the parking lot. The three lanes away from the park would be as follows:

1. Northwest on Carowinds Boulevard to NC 49, then north on NC 49

3. Southeast on Carowinds Boulevard to I-77 southbound

Carowinds evacuees traveling southeast on Carowinds Boulevard could leave the EPZ via I-77, going either north or south. The northern route is shorter, but presumably numerous Carowinds visitors from South Carolina will want to head toward their homes rather than toward North Carolina. (Even some EPZ residents may choose to go home and pack or pick up other family members before leaving the EPZ.) Drivers wishing to go north on I-77 will be permitted to use the ramp normally used by traffic coming north on U.S. 21, in addition to the ramp normally used by traffic from Carowinds. If there is no big crowd at Heritage, USA, Carowinds evacuees will also be permitted to proceed on US 21 beyond I-77. (Otherwise, that route would be blocked to allow the Heritage, USA evacuees full use of US 21 and NC 51.)

Since the flow out of the parking lot will start almost as soon as the Carowinds staff begins directing people out of the park, it appears that the traffic congestion in the parking lot will have dissipated by the time the park itself is completely empty. (This assumes three lanes of traffic leaving the lot.) The expected time to evacuate the park is, therefore, about two hours. Another fifteen minutes may be required for the Carowinds staff to leave. In total, then, the last person would leave Carowinds after about 2 hours and 15 minutes.

The foregoing estimate makes the important assumption that there will be firm traffic control on the roads near the park, so that there is minimal interference between the lanes of traffic. The evacuation time would be longer if, for example, cars leaving Carowinds Boulevard 0.2 mile northwest of the main entrance were permitted to turn left and cut across the other two lanes of exiting traffic to get to I-77.

Once outside the Park, evacuating traffic may encounter (and further contribute to) traffic congestion. However, there is adequate "excess" capacity on the three evacuation routes used by Carowinds traffic (I-77 NB, I-77 SB and NC 49 NB) to permit evacuation of all Carowinds traffic without extending the 4-hour evacuation time projected for the resident population of the EPZ.

Both I-77 north and N.C. 49 have evacuation times of 3 hours and 25 minutes for EPZ residents. Peak day Carowinds traffic might extend this to 4 hours if few of the Carowinds visitors go south on I-77. If at least a quarter of them use I-77 south, however, the evacuation time on I-77 north and N.C. 49 would not be lengthened.

HERITAGE, USA

Heritage USA, a multi-use recreational/residential community, is located on US 21 about 3 miles south of its interchange with I-77 in York County, South Carolina.

Detailed emergency plans prepared by Heritage staff deal with the management of evacuation traffic internal to the site. These plans call for the direction of all evacuating traffic on to US 21 at the main entrance to Heritage.

Maximum vehicle population for Heritage is estimated at 2,400 vehicles. This vehicle population occurs with virtual full use of all marked parking spaces within Heritage. For special events, greater vehicle populations may be present on the grounds. However, because of the infrequent and non-recurring nature of these events, their evacuation estimates should be treated as special cases, and not be used as a guideline for evacuation times under normal operating conditions.

Once outside Heritage USA grounds, evacuating traffic will be directed onto two evacuation routes out of the EPZ.

(1) US 21 southbound to SC 160, and then on SC 160 eastbound out of the EPZ

(2) US 21 northbound to SC 74, and then eastbound on SC 74/NC 51 and out of the EPZ on either NC 51 or US 521.

Once outside Heritage USA, evacuating traffic may encounter (and further contribute to) traffic congestion. However, there is adequate "excess" capacity on the two evacuation routes used by Heritage USA traffic (US 21/SC 160 and US 21/SC 74/NC 51) to permit evacuation of all Heritage traffic prior to the evacuation time of 3 hours, 25 minutes projected for resident population of the EPZ using these routes. It can be concluded, therefore, that Heritage USA evacuation will not delay the evacuation of EPZ residents beyond 3 hours, 25 minutes, nor will any Heritage USA visitor be longer than 3 hours, 25 minutes in clearing the EPZ (even if detained by traffic congestion outside Heritage).

EPC 14/15 KUMASH ATTACHMENT F

Prepared for
Duke Power Company

Catawba Nuclear Station
Evacuation Analysis

Transport-Dependent Population

PRC Engineering
1500 Planning Research Drive
McLean, Virginia 22102

April, 1984

TABLE OF CONTENTS

INTRODUCTION

This paper identifies the categories and magnitudes of transport dependent population within the Emergency Planning Zone (EPZ) for the Catawba Nuclear Station in York County, South Carolina.

Transport-dependent population is defined as population within the EPZ that would require government-provided transportation in the event of a radiological emergency at the Catawba Nuclear Station. The components of total population that are transport-dependent vary with time of day, day of week, and season. Consequently, the magnitude of transport dependent population will vary accordingly.

COMPONENTS OF THE TRANSPORT-DEPENDENT POPULATION

Households that do not own vehicles are the primary source of transport-dependent population in the EPZ. Surveys indicate that most of the population from such households can depend on friends and relatives for transportation in emergecy situations. However, some residents of non-vehicle-owning households would have no means of transportation (except government-provided transportation) in the event of an emergency at the Catawba Nuclear Station.

People in vehicle-owning households may also be transport dependent if they are at home when all the family vehicles are far away. We assume that if the family vehicles are all more than half an hour from home, there is a significant risk that the driver would not be able to return home in a timely manner to evacuate family members there. Most of these people would be evacuated by friends and relatives, but some would rely on government.

Insitutional population consists of occupants of schools, nursing homes, hospitals, and prisons in the EPZ. Only the hospital and nursing home occupants are considered to be transport-dependent because the schools and penal institutions have plans and adequate resources to evacuate their entire populations. (See separate report on school evacuation.)

DAILY, WEEKLY, AND SEASONAL VARIATIONS IN TRANSPORT-DEPENDENT POPULATION

In non-vehicle-owning households, adults and preschool children are considered to be transport dependent at all times (Exhibit 1). School students, while at school, are not transport dependent since their transportation out of the EPZ is assured by the school evacuation procedures. Outside school hours, school students are considered to be part of the transport-dependent population.

In vehicle-owning households with transport-dependent population, adults at home and preschool children are considered to be transport-dependent during work hours (i.e., when the family vehicle is being used for travel to work). School-age population from such households is considered to be transport-dependent for that period of the day between dismissal from school and the end of normal work hours.

Institutional population (nursing homes and hospitals) is considered to be transport-dependent at all times.

MAGNITUDE OF THE TRANSPORT-DEPENDENT POPULATION

To determine the size and location of the population that would need government-provided transportation, Duke Power did the following:

- Contacted the management of every hospital, nursing home, and penal institution in the EPZ to determine the number of evacuees.
- Arranged for an independent market research firm to survey a sample of EPZ residents to determine the number who would need government help to evacuate.

As mentioned earlier, the contact with penal institutions revealed that they were self-sufficient. Therefore, their populations are excluded from this analysis.

The contacts with hospitals and nursing homes revealed that a maximum of 654 patients would have to be evacuated (see Exhibit 2). The management of those insitutions stated that if time permitted, many of their patients would be

EXHIBIT 1. COMPONENTS OF THE TRANSPORT-DEPENDENT POPULATION

	Non-Work Hours	Work Hours (Weekdays)	
		School in Session	School Out
Households Not Owning a Vehicle			
Adults	X	X	X
Preschool	X	X	X
School Age	X		X
Households Owning Vehicles			
Adults		X	X
Preschool		X	X
School Age			X
Hospitals and Nursing Homes	X	X	X

EXHIBIT 2. HOSPITAL AND NURSING HOME POPULATIONS IN THE EPZ

Facility	Population
Hospitals	
Devine Savior Hospital	51
Piedmont Medical Center	160
Total	211
Nursing Homes	
Anne's Convalescence Home	62
Bolin's Nursing Home	10
Divine Savior Home	51
Fallaw Residential Care	37
Meadow Haven Nursing Center	132
Rock Hill Convalescence Center	141
Sunshine Homes	10
Total	443

discharged to evacuate with their families, so that the number requiring government transportation might be less than 654.

The survey of EPZ households was conducted by telephone, except that households without telephones were surveyed face-to-face. The survey showed that between 2,800 and 3,800 people would need government transportation, depending on the season and time of day. Additional people would be at home without family cars, but they felt they could count on friends and relatives for emergency transportation.

As discussed earlier, the number of people at home needing government-provided transportation varies depending on whether schools and workplaces are operating. The smallest number, 2,861, occurs when school is in session. Over 90 percent of those people are adults and preschoolers in households that do not own cars. The remainder are adults and preschoolers in households where the workers in the household have taken the family cars to jobs more than half an hour from home.

If school is not in session, the 2,861 adults and preschoolers are joined by 898 school children, bringing the total to 3,759. Outside of work hours, the car-owning households have their cars at home, so the total drops to 3,384. Exhibit 3 summarizes these results.

The survey also revealed that about 70 percent of the households needing government transportation live inside municipalities. Comparisons among municipalities showed no statistically significant difference among them regarding the fraction of people dependent on government transportation to evacuate.

TRANSPORTATION RESOURCES REQUIRED

The last line of Exhibit 3 is an estimate of the number of buses needed to evacuate the people requiring government-provided transportation. The estimate is high because some of the hospital and nursing home patients would be moved in ambulances or other special vehicles rather than in buses. Also, some of them

EXHIBIT 3. PEOPLE REQUIRING BUS TRANSPORTATION[1] TO EVACUATE

	Non-Work Hours	Work Hours (Weekdays)	
		School in Session	School Out
Households Not Owning a Vehicle			
Adults	1,688	1,688	1,688
Preschool	975	975	975
School Age	722	0	722
Households Owning Vehicles			
Adults	0	111	111
Preschool	0	88	88
School Age	0	0	176
Total at Home	3,385	2,862	3,760
Hospitals and Nursing Homes[2]	654	654	654
Total People	4,039	3,516	4,414
Total Busloads	62	49	67

[1] Excludes schools and penal institutions, which can provide their own transportation.

[2] Includes patients who would be carried in ambulances and other special vehicles. Some may also be transported by their families.

[3] Based on 50 adults (and school children, if any) per bus. Preschoolers seated on adults' laps.

might be transported by their families. The number of buses required is only about a quarter of the EPZ school bus fleet. Since the entire EPZ school bus fleet (driven by volunteer firemen) could be made available for evacuating the transport dependent, there is no doubt that adequate buses are available to carry the people who would need them.