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NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY  
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BRANCH

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of )  
DUKE POWER COMPANY, et al. )  
(Catawba Nuclear Station )  
Units 1 and 2 )

**I-EP-38**  
5/10/84

Dockets Nos. 50-413 **OL**  
50-414 **OL**

April 16, 1984

PRE-FILED TESTIMONY OF PALMETTO ALLIANCE  
AND  
CAROLINA ENVIRONMENTAL STUDY GROUP  
ON

NUCLEAR REG...

EMERGENCY PLANNING CONTENTIONS

Docket No. 50-413/414 Official Ex. No. EP-38  
In the matter of Duke, Catawba 197  
Staff \_\_\_\_\_ IDENTIFIED   
Applicant \_\_\_\_\_ RECEIVED \_\_\_\_\_  
Intervenor  \_\_\_\_\_ REJECTED   
Cont'g Off'r \_\_\_\_\_  
Contractor \_\_\_\_\_ DATE 5/10/84  
Other \_\_\_\_\_ Witness \_\_\_\_\_  
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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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Units 1 and 2 ) April 16, 1984

TESTIMONY OF JESSE L. RILEY

1. Q: WHAT IS YOUR NAME?  
A: My name is Jesse L. Riley.
2. Q: WHERE DO YOU LIVE?  
A: In Charlotte at 854 Henley Place.
3. Q: WHOM DO YOU REPRESENT?  
A: I am the spokesperson for the Carolina Environmental Study Group, a party in this proceeding.
4. Q: WITH WHAT WILL YOUR TESTIMONY DEAL?  
A: With the need for emergency planning, for at the least, southwest Charlotte.
5. Q: WHY?  
A: Information provided by the NRC, or by contractors for the NRC, indicates that as the result of a serious accident people of Charlotte, people not in the present Emergency Planning Zone, would be subject to a great number of early fatalities, early injuries, and latent cancer cases. The planning

basis document, NUREG-0396, Figure 1-17, indicates that lacking immediate protective action, a one-day exposure in the radial interval of 10 to 25 miles from the Catawba Plant would, for the mean population density of Charlotte of 2500 persons per square mile, be expected to result in 5 to 40 early fatalities, 350 early injuries. The Siting guidance study, NUREG/CR-2239, specifically projects for the Catawba Plant 100 mean early fatalities for an SST-1 accident and release and 710 mean early injuries. The NRC staff, in the Final Environmental Statement, does a worst case analysis sampling weather sequences actually observed at the Catawba Plant. They find, the possibility of exposing 44,000 persons to over 200 REM, 270,000 persons to over 25 REM, Table 5.11. Under these conditions I anticipate 19,000 fatalities if only the present EPZ is evacuated. However, if there is relocation from 10 to 25 miles from the plant, early fatalities would be reduced to 470, a savings of 18,530. The 19,000 fatalities are conditioned on availability of moderate medical treatment. As there are only 10 radiation beds in Charlotte, it seems that medical treatment would be minimum and 24,000 fatalities projected for minimal medical treatment are a more realistic indication of what would happen in the event of such a release.

Because of the demographics and prevailing wind direction, by far the largest part of these 24,000 fatalities would occur in Charlotte. Another confirmation of high level consequences of an SST-1 accident is given by studies made at Sandia. The worst case SST-1 accident is estimated to result in 42,000 early fatalities, 88,000 early injuries, again presumably the largest part in Charlotte. (Letter report of Committee on Interior and Insular Affairs, Sub-committee on Oversight and Investigations, November 1, 1982.)

6. Q: DOES THE FES ASSERT THAT PEAK CONSEQUENCES OF SUCH MAGNITUDE ARE ACCEPTABLE IN A COST BENEFIT WAY?
- A: Yes. A variety of accident scenarios and weather situations are averaged, after being converted to "risks". In this context risk is the probability of the calculated consequences by an assumed probability of occurrence of the event. The "risk" of the most serious consequence is put as 1 in 100 million reactor operating years.
- Summation of this very small product with other small products leads to the conclusion that there would be about .1 of an early fatality in the full anticipated 80 reactor year operation of the plant.
7. Q: DO WE FIND REASONABLE AND ACCEPTABLE THIS FINDING BY THE STAFF?

A: No. While I believe that the consequence estimates are reasonable and based on actual experience such as the inventories of reactor cores, measurements of half-lives, and radiation intensities for different isotopes and the dosage consequences at Hiroshima and Nagasaki, the same is not true for the probabilities.

I believe that it is generally recognized there are three types of "probabilities". One type is postulational, chances are one in two with a flipped coin will be a head or a tail. Similarly the mathematics of the chance occurrence in a given combination of cards in a deck may be expressed as a probability. Another type of probability is actuarial, based on experience. One's chances of death by automobile accident or injury are well established by many years of actuarial data. The "probability" in the present context differs from these. It reflects on analysis and an estimate. Probabilities of the reactor safety study are based on fault-tree analyses. The accident at TMI-2 invalidates the RSS assumption of no multiple failures including operator error. The fallacy of this approach to "probability" has been shown by actual experience. Before it happened the probability of the TMI-2 accident was zero--it had not been envisaged.

Similarly, the probabilities of Brown's Ferry fire and the FERMI-1 partial meltdown were unenvisaged and hence, had a probability of zero. We simply have no knowledge of all possible scenarios which may lead to a serious release though it must be said that since the occurrence of the aforesaid events the staff has greatly enlarged its contemplation of severe accident sequences. Given only 800 years or so reactor operated experience it is very non-conservative to project 100,000,000 year spans. An additional point ignored by the FES is that even where valid probabilities relating events to time spans are available, indication has been given as to when in the time span the event will occur. Although death by vehicular accident has a probability of about one in 2,000, none of us knows beforehand whether he is going to be one of the victims nor at what moment this will occur.

8. Q: ARE THERE OTHERS WHO SHARE YOUR CONCERNS?

A: Members of the Carolina Environmental Study Group and numerous others who have spoken to me who are not members share this view. I think that it is particularly significant that this concern was expressed by Judge James McMillan of the United States District Court for the Western District of North Carolina in declaring the Price-Anderson Act unconstitutional, CESG v. AEC, Case No.

C-C-73-139, March 31, 1977. Judge McMillan noted that parties to the case, the Atomic Energy Commission, Duke Power Company, and CESG all agreed that severe accidents were possible. The remaining question was one of probability. In regard to probability the Judge concluded "the court is not a bookie:"

The significant conclusion is that under the odds quoted by either side a nuclear catastrophe is a real, not fanciful possibility.

The Court finds without being as rosy optimistic as the Reactor Safety Study, nor as pessimistic as Dr. Kendall, that a core melt at McGuire or Catawba can reasonably be expected to produce hundreds or thousands of fatalities, numerous illnesses, genetic effects of unpredictable degree in nature for succeeding generations, thyroid ailments, and cancers in numerous people, damage to other life and widespread damage to property. Areas as large as several thousand square miles might be contaminated and require evacuation. Since life of individual human beings, as shown in a number of publicized cases involving death or disability, is now being valued in some cases at sums greatly exceeding a million dollars, it would not require death of or serious injury to many people to exceed the \$560,000,000 Price-Anderson Act limitation now in effect, in a day when failure of an earthen dam in sparsely populated Idaho can produce property damage reported by the press at about a billion dollars, is it unreasonable to conclude, as I do, that radioactive pollution of a few hundred square miles of heavily populated Piedmont North Carolina or South Carolina could well produce property damage vastly exceeding the Price-Anderson ceiling.

9. Q: CONSIDERING THESE VIEWS, DO YOU EXPECT THE CATAWBA PLANT TO BE LICENSED TO OPERATE?

A: Yes.

10. Q: WHAT REMEDY DO YOU SEEK?

A: An effective emergency plan for Charlotte. The initial Atomic Safety and Licensing Board admitted CESC/Palmetto Contention 11. This contention permits us to consider an emergency plan which would reach approximately 17 miles from the Catawba Plant but not to 25 miles, the farthest city limit. This 17 mile radius may well be within the purview of the "about ten miles" radius referred to in NUREG 0396. This matter is given consideration by the initial Catawba ASLB's Memorandum and Order of September 29, 1983, pp. 1-5, and in a Memorandum and Order dated December 30, 1983, pp.1 through 5. It should be noted in this connection that the present EPZ reaches to about 13.8 miles south of the Catawba Plant including all of the City of Rock Hill and some of the environs. To the northeast of the Catawba Plant, the EPZ stops at the Charlotte city limit, 9.7 miles from the plant. The prevailing wind direction from the Catawba Plant toward Charlotte is approximately twice the random frequency, which, together with the demography argue for such protection.



CESG would like to see the Planning Zone extend to the 17 mile radius from the plant through Charlotte. This would delineate almost the same area used in the Board's example, an EPZ reaching U.S. 74 and N.C. 16. In the alternative, CESG would choose N.C. 27 in lieu of U.S. 74. A 17 mile radius would also be acceptable and incidentally not reach as far as the Board's example did at its farthest point. At the 17 mile radius, an area of 73 square miles would be added to the present EPZ area of 332 square miles. The present EPZ has a population of 95,000 people. The area proposed for addition has a population of 136,000. The population density in the initial EPZ is 286 people per square mile, that in the southwest Charlotte area under consideration is 1863 people per square mile, or 6.5 times as high a population density. An increase of 22% in area covered results in an increase of 143% in persons covered by the emergency plan. It is clearly the people in the area of southwest Charlotte who contribute most heavily to the estimated early deaths in FES Table 5.1.2. In order to accomplish the relocation which would save the largest proportion of these lives, effective planning will be required.

11. Q: ARE THERE OBSTACLES TO EFFECTIVE PLANNING IN THIS REGION?
- A: There is a prospect of high traffic density and possible panic. It is generally recognized that radiation hazard is not identifiable by visual or olfactory indications. At a hint of radioactive disaster, people will tend to flee. There will be confusion and if their panic is a serious one, it will be paid for with a loss of lives.
12. Q: WHAT EMERGENCY PLAN IS USED AT THE PRESENT EMERGENCY PLANNING ZONE?
- A: It is defined and described in the brochure sent to EPZ residents. A siren system has been installed. Instructions have been given that on hearing a steady three-minute siren signal, an individual is to turn on an emergency broadcast and follow the instructions that they are given. Evacuation routes are shown and shelter procedures are described.
13. Q: WOULD YOU LIKE TO SEE THIS SYSTEM EXTENDED IN CHARLOTTE TO A SEVENTEEN MILE DISTANCE FROM CATAWBA?
- A: This would be an improvement over present plans for an emergency response.
14. Q: WHAT IS THE PRESENT PLAN?

A: The "All Hazards Plan for Charlotte" has deficiencies. Foremost is probably the lack of information and instructions for the public. An accident would be dealt with on an ad hoc basis. I cannot visualize providing the necessary instructions to hundreds of thousands of people in a timely way during the course of the accident. It is even less likely for appropriate, individualized instructions, which would relate to location, the time of the release, the magnitude of the release, wind speed and direction indicated.

In a recent successful evacuation for a chemical fire generating toxic fumes and complicated by wind shifts, door-to-door warnings and instructions were given. This is not feasible for up to 136,000 people. It did work for the several thousand people involved. An all-hazards plan is described in seven pages. This contrasts with the hundreds of pages in the North Carolina and South Carolina Emergency Plans for Catawba. A Mecklenburg County Plan alone takes up 50 pages and deals with a much smaller area and a very much smaller number of people than we have under consideration.

15. Q: THEN YOU ADVOCATE THE EXTENSION OF THE PRESENT SYSTEM TO SOUTHWEST CHARLOTTE?

A: No, not if a better system can be devised.

16. Q: WHAT DO YOU SEE AS FAULTS IN THE PRESENT SYSTEM IF IT WERE APPLIED TO SOUTHWEST CHARLOTTE?

A: There are deficiencies in the siren system of notification. The primary deficiency is that it will only operate when there is AC power. Several sequences of serious plant accidents result in the absence of off-site and on-site power. Under such conditions there would be no notification and the majority of radio and television sets would not play. There would be neither alerting nor adequate emergency broadcast system instruction. When sirens do sound, they cannot be depended upon always to reach targets in their normal operating area. In a FEMA sponsored study, Bolt, Beranek, and Neuman point to lens and sound refraction effects which depend on the temperature gradient in the atmosphere and which will determine whether the siren sound propagates in a plane or bends upward, out of hearing. It points out that persons in an automobile are not likely to hear a siren.

It is obvious that weather conditions, howling winds, heavy rain, dense snow layers, well sealed and insulated structures do not conduce to a siren being heard. Deep sleep and impaired hearing reduce a likeliness of effective siren notification. Playing radio, stereo or television, or normal family activities may result in a siren signal being ignored. The CESG survey shows that 20% of the residents of the McGuire EPZ have not heard the siren sound during tests. Other answers show that 60% of a sample of McGuire residents do not know the significance of the siren sound; namely, to seek shelter and tune to the EBS broadcast. Fairly general information which would be required in an EBS message will not make clear to a person near the plume pathway whether it is better to evacuate to, say, the northwest, or the southeast where both options are possible. In a narrow plume, which will develop under conditions of relatively stable air, the plume pathway may be less than two miles wide in Charlotte. The direction of the evacuation could be critical for persons near the pathway. The general EBS message will not make clear which people would be better off sheltering or, being prospectively exposed to no hazard, staying where they are.

17. Q: CAN YOU PROPOSE A MORE SATISFACTORY ALTERNATIVE?

A: Yes. It involves a system of telephonic alerting and notification in which messages would be individually tailored to suit the needs of respondents. It would be supplemented by the EBS system for those away from the phone or unable to reach a phone.

In order to make possible instructions of individual utility, I propose dividing the plan area into quarter sectors,  $5.63^\circ$  of arc at one-mile intervals. Between 10 and 11 miles from the plant the area of such a subdivision would be 1.03 square miles; between 16 and 17 miles from the plant, it would be 1.62 square miles. Superimposing this grid on a map of Charlotte shows that at least one major road, or feeder, runs through each of these approximate square mile areas.

Southern Bell Telephone Company is able to access the phones in each such small area with a specific recorded message. There are four or five central stations in southwest Charlotte, each having the potential for automatically dialing as many as 1700 calls per minute. There are 247,000 telephone subscribers in Mecklenburg County. It is reasonable to estimate 50,000 to 60,000 phones in the proposed planning area. The time to ring these phones will be less than 10 minutes.

Facilities include a special ring as an alert signal. It is possible to preempt all normal calls for an emergency message. The two systems under consideration would be computer actuated. Up to a 17 mile radius, there would be 56 subdivisions as described in the foregoing. Each of these subdivisions could receive an individual message. These messages could be taped or the specific instructions would be pre-taped. In the first system the computer would dial. It would play, as appropriate, either an alerting message, or an instructional message. In the second system the computer would send a non-voice signal to actuate a multi-functional "black box" installed at the subscriber's phone. The actuating signal would be effective whether or not the phone were in use.

18. Q: WOULD PHONE NOTIFICATION BE MORE EFFICIENT THAN SIREN ALERTING AND NOTIFICATION?

A: I think so. As long as a person is near the phone, whether waking or sleeping, listening to radio, stereo or TV, it would be heard and, most probably, answered.

19. Q: WOULD PHONE NOTIFICATION BE MORE EFFECTIVE?

A: Yes. It would make clear which subsections should evacuate and at what time, and in which direction, and which subsections should shelter and for how long and when to leave shelter and relocate. Preferred departure routes would be specified.

20. Q: WOULD WEATHER BE ELIMINATED AS AN ALERTING AND NOTIFICATION FACTOR?
- A: Yes.
21. Q: WHAT ABOUT THE HARD OF HEARING?
- A: Hardness of hearing is already compensated for by amplifier setups or light setups.
22. Q: WOULD PHONE NOTIFICATION BE MORE RELIABLE THAN A SYSTEM DEPENDENT ON AC POWER?
- A: Yes. As said previously, both sirens and most radios and TVs depend on AC power. The phone system is independent of AC power. It operates on a battery supply at 48 volts. These storage batteries can be kept charged by the phone company's generators.
23. Q: WHAT WOULD SUCH A SYSTEM COST?
- A: A computer-dialed, real time system has not been priced by Southern Bell. My impression is that it may cost between 5 and 10 million dollars. The second system would be adapted for multiple uses which would contribute to paying for it. Uses include fire-alarm, burglar alarm, utility meter reading, electrical demand reading, load shedding, and cable TV use monitoring. Southern Bell's part of the system, I am told, would cost about 5.5 million dollars. To use this system,



a subscriber would need the black box which, installed, it is estimated it would cost between \$100 and \$150.

24. Q: HOW SOON COULD SUCH A SYSTEM BE PLACED IN OPERATION?

A: I have been told by the third quarter of 1985.

25. Q: ARE THERE OTHER ADVANTAGES FOR A PHONE NOTIFICATION?

A: Alerting and notification would compensate for the fact that a substantial fraction of the public would not have read instructional material or not remembered the instructions at the time of the event. The messages would be repeated at least once to improve retention. As the accident progressed, and the wind changed, the instructions would be updated. Between updating messages, the phone could receive normal use. During messages, such use would be preempted. The specificity of the messages would also be of reassuring value. A clearly specific message would reduce the likelihood of panic responses, irresponsible rush to cars by people who did not need to evacuate.

26. Q: WOULD THIS BE THE SOLE MEANS OF ALERTING AND INSTRUCTION?

A: No. As said previously, the Emergency Broadcasting System would alert many of those in cars. Other means considered in the Emergency Plan, helicopters with loud speakers, patrol cars with bull horns, etc. could notify those away from phone and radio.

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Units 1 and 2)	)	April 16, 1984

TESTIMONY OF RAY TWERRY

1. Q: WHAT IS YOUR NAME AND ADDRESS?

A: My name is Ray Twerry. I live at 3335 Sunnybrook Ave.
2. Q: WHAT ARE YOUR PROFESSIONAL QUALIFICATIONS?

A: I hold a Master of Science Degree in Mathematical Statistics from the University of Illinois and have completed the coursework for a Doctor of Philosophy in that field at the same school. I have worked as Senior Statistician at the Stanford Research Institute, and have worked extensively as a consultant in mathematics, planning and statistics. I am presently a lecturer in statistics at the Department of Mathematics and Computer Science at the University of North Carolina at Charlotte.
3. Q: WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A: As a resident of east southeast Charlotte, about a dozen miles from the Catawba reactors, I was

interested in assaying the need for emergency plans including notification, evacuation and treatment for my neighborhood. As a professional statistician whose 20 years of industrial experience has included use of computer simulation, I sought pertinent information in the Catawba Final Environmental Statement, NUREG-0921, and in the Sandia Siting Study, NUREG/CR-2339.

NUREG-0921 quotes an expected value of .0022 for early fatalities per reactor year. This becomes .176 for the expected 80 years of reactor life at Catawba. Since I am in a  $22\frac{1}{2}^\circ$  sector which would receive a plume from Catawba units about 5% of the time, the .176 becomes .035 for the sector that I reside in. The density of population in this sector is at least 10 times greater than the average density for the entire 50 mile radius that the NUREG-0921 study apparently assumed was uniform throughout. Accordingly, the .035 becomes .350 for my sector. The NUREG study estimates that their probabilities used to obtain the initial figure of .0022/reactor year are uncertain by a factor between 10 and 100, so the .35 may be 3.5 to 35 for my sector. The Sandia Study, NUREG/CR-2239, Fig. 2.7.1-3, estimated that for a reactor of the size of Catawba, the lack of "perfect" preparation would increase early fatalities by a factor of over 10 for

a major accident (apparently the main contribution to the expected value .0022), so 3.5 to 35 becomes 35 to 350 early fatalities expected (for just my sector through southeast Charlotte) during the life of the Catawba reactors using the NUREG figures and assuming an imperfect preparation plan.

If one were to convert these early fatality statistics to a dollar equivalent, then at \$1 million per life, we are talking about an expected economic cost of \$35 million to \$350 million just from early fatalities and just in my sector that could be reduced by a factor of about 10 by a realistic preparation for an accident.

Consideration for Charlotte's expected economic costs related to resulting illness would make the economic case even stronger.

Some statistical comments:

(a) The NUREG's estimate that probabilities are low by a factor of 10 to 100 may itself be low. Has the full experience since the Rasmussen Report been quantitatively (rather than subjectively) used to obtain these estimates?

(b) The re-settlement costs of \$125 per person seems low by a factor of  $10^3$  to  $10^5$ .

(c) The lack of medical facilities for treating/screening residents after an accident might be so inadequate as to make Sandia's factor of 10 too low.

4. Q: DOES THAT CONCLUDE YOUR TESTIMONY?

A: Yes.

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TESTIMONY OF PHILIP LAYNE RUTLEDGE

1. Q: WHAT IS YOUR NAME AND ADDRESS?  
A: My name is Philip Layne Rutledge. I live at 140  
Canterbury Road, Charlotte, North Carolina 28211.
  
2. Q: WHAT IS THE PURPOSE OF YOUR TESTIMONY?  
A: I have been asked by Palmetto Alliance and the  
Carolina Environmental Study Group to share the  
results of a random telephone survey conducted in  
January 1984 designed to assess the level of public  
knowledge of appropriate response behavior for  
residents living in three communities located  
within the Emergency Planning Zone for Duke Power  
Company's McGuire Nuclear Station. Such evidence  
bears directly upon the effectiveness of Duke's  
Public Information Program for citizens living and  
working in the Emergency Planning Zone.

3. Q: WHY IS THIS SURVEY RELEVANT TO EMERGENCY PLANNING FOR THE CATAWBA NUCLEAR STATION?

A: Since emergency planning for Catawba is largely prospective, I have sought information which would allow us to make constructive recommendations to improve, if necessary, the emergency planning program for the Catawba Nuclear Station. Duke has operated its McGuire Nuclear Station, which is located about ten miles northwest of the Charlotte city limits, for several years. Presumably the population near Duke's McGuire Facility has been exposed to Duke Power Company's Public Information Program over this period. Duke's program at McGuire is subject to the same requirements, objectives, and evaluation criteria as will be applicable to the emergency planning program for the Catawba facility.

I have every reason to believe that the level of public knowledge resulting from Duke's Catawba Public Information Program will be similar to that which exists for the McGuire facility so long as its Public Information Program remains essentially the same.

4. Q: DESCRIBE THE SURVEY AND ITS RESULTS.

A: The telephone survey was performed in January 1984. In order to assess the level of public awareness of appropriate response behavior in an emergency, a telephone survey was conducted in of households residing in the McGuire Emergency Planning Zone. The survey questions, methodology, and results are described in a report entitled, "Public Preparedness for an Accident at McGuire: A Survey of Mecklenburg County Residents Living Within Ten Miles of the McGuire Nuclear Plant," which is appended to and made a part of my testimony. On the basis of the survey, I conclude that serious questions exist as to the effectiveness with which Duke Power Company has accomplished the public information planning objective of informing the public on how they will be notified and what their initial actions should be in the event of an emergency at the McGuire Nuclear Facility. Based on the survey results, the overwhelming pattern reveals that a large percentage of people do not possess even the basic information needed for effective response behavior to a nuclear emergency.



5. Q: WHAT RECOMMENDATIONS DO YOU HAVE TO IMPROVE THE EFFECTIVENESS OF THE PUBLIC INFORMATION PROGRAM FOR THE CATAWBA NUCLEAR STATION?

A: Based in part on the survey results, I have suggested a number of constructive changes to improve the level of public knowledge of appropriate response behavior. Such changes include improvements in the management, editorial content, and means of dissemination for the public information program. These recommendations are contained in a second attachment to my testimony. Both the survey report and recommendations were presented in March 1984 to the Charlotte-Mecklenburg Emergency Management Planning Review Committee which presently has under study improvements in emergency planning for the City and County. A representative of Duke Power Company attended the committee meeting and obtained a copy of this study.

6. Q: DOES THIS CONCLUDE YOUR TESTIMONY?

A: Yes, it does.

PUBLIC PREPAREDNESS FOR AN  
ACCIDENT AT MCGUIRE

A SURVEY OF MECKLENBURG COUNTY RESIDENTS  
LIVING WITHIN 10 MILES OF THE  
MCGUIRE NUCLEAR PLANT

by the Carolina Environmental Study Group

written by Philip Rutledge

CESG  
P. O. Box 9491  
Charlotte, NC 28299

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## INTRODUCTION

Two years ago, the Atomic Safety and Licensing Board issued the final safety approval for the McGuire Nuclear Station, just northwest of Charlotte. At that time, the licensee, Duke Power Company, satisfied the licensing judges that the emergency plans designed to protect the health and safety of the public would be effective.

An essential part of these emergency plans is the Duke Power Company emergency planning brochure, which is required to be mailed to every household inside the emergency planning zone (EPZ) for the McGuire plant. This brochure, which is updated annually, is intended to supply vitally important information to the public. By reading and retaining the information in this brochure, the public is supposed to find out (1) how they will be notified if there is an emergency; (2) how to respond; (3) how and where to evacuate if necessary; (4) how schoolchildren attending school at the time will be attended to; and, (5) how evacuation resources will be used to help homebound and disabled citizens in need.

Because of the potentially devastating consequences if there is an accident at the McGuire plant, Duke Power Company is legally and morally obliged to provide certain life-saving information to everyone at risk and to periodically assess the effectiveness of how well this information has been understood and retained.

The purpose of this survey was to independently test the effectiveness of this public information program. From January 12, 1984 through January 28, a telephone survey of 112 randomly selected households within the McGuire plant EPZ was conducted. Equal numbers of male and female heads of household were interviewed using the questionnaire appended to this report.

The survey was designed and administered by volunteers associated with the Carolina Environmental Study Group, a Charlotte non-profit educational organization. The project director was Philip Rutledge, who conducted all but 15 of the telephone interviews himself.

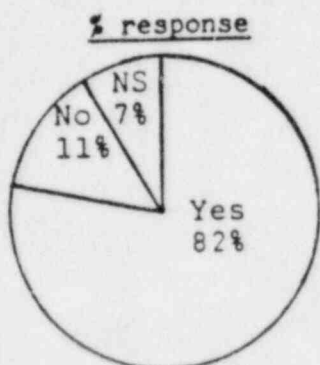
## SUMMARY OF PRINCIPAL FINDINGS

1. Overall, the level of understanding of the emergency response plan is poor, despite distribution of a brochure designed and mailed to residents within the EPZ by Duke Power Company.
2. More than one-fifth of the respondents were not aware that they were living within the EPZ. Only 66% of the total sample could recall receiving the brochure within the last 12 months. The proportion of the entire sample who read all of the last emergency planning material distributed to them is 32%. Thus, the message got through to only one out of every three people surveyed.
3. Although 77% of the sample knew they were supposed to be alerted about an emergency through the warning sirens, 18 of these people (or 21%) said they could not hear or have never heard the warning sirens during a drill.
4. Only 40% of all respondents noted that their first response upon hearing the warning siren should be to turn their radio or television on for more information. If you add in those who said they would seek more information in other ways, then 51% of the total sample indicated they would seek some type of information after hearing the warning sirens. Of the remainder, 89% said they either weren't sure what they would do or would flee -- or both. Only 6 respondents, or 5% of the total sample, said they would seek more information first and knew where to go if they were told to evacuate.
5. Many parents of schoolchildren intend to pick their children up at their school if there is an emergency. This could impede traffic flow during an evacuation.
6. Some respondents who are familiar with aspects of the emergency plan stated that they object to or do not intend to follow some parts of the plan. This would lessen the capacity of the emergency response plan to work in a safe and efficient manner.
7. Less than half of the total sample (47%) said that they felt they had enough information to adequately respond to a nuclear emergency.
8. Most respondents (60%) said they need more information about what to do in case of an emergency.
9. The proportion of the sample who believe there is only a slight chance of having to evacuate is about 45%, compared with about 41% who believe the chance is moderate to high. An analysis of these responses indicates that satisfaction with present response information and stated need for more information are related to the perceived likelihood that such information may be needed some day. This is significant because the emergency brochure states in the preface that such likelihood is "extremely small". The more the reader accepts this viewpoint, the more likely the reader may be unconcerned with the quality of the information because it is believed that such information will never need to be used. Thus, the brochures give out a double message: the important information you are about to read will (probably) never be needed.

In summary, this survey suggests that many people are ill-prepared for an emergency in the event of a serious accident at the McGuire nuclear plant. Despite several years of experience, public education efforts have not produced adequate results. If a serious accident were to occur at the McGuire nuclear plant, a substantial amount of panic and spontaneous flight would probably occur due to widespread ignorance of appropriate response behavior. This ignorance reflects the failure of public education efforts and makes doubtful the safe and efficient implementation of the emergency plan. Improvements are needed in both the quality of response information and the quality of efforts to disseminate this information.

DETAILED RESULTS: THE QUESTIONS AND RESPONSES

Question 1: HAVE YOU HEARD OF AN EMERGENCY EVACUATION ZONE SURROUNDING THE MCGUIRE NUCLEAR STATION?

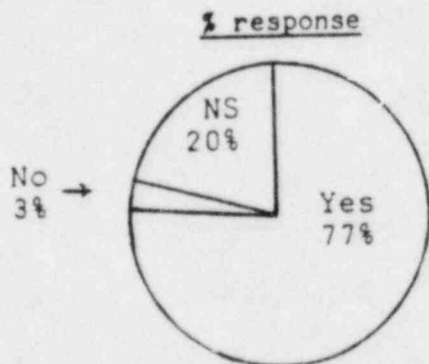


Number

Yes	92
No	12
*NS	8
	<hr/>
	112

\*NS - not sure

Question 2: ARE YOU PRESENTLY LIVING WITHIN THE EMERGENCY PLANNING ZONE?

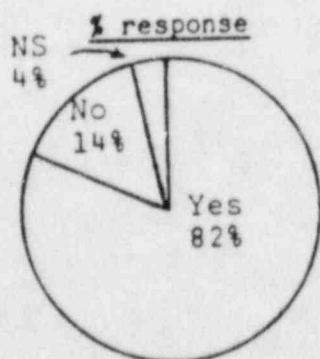


Number

Yes	86
No	3
*NS	23
	<hr/>
	112

(All respondents were residents within the EPZ)

Question 3: HAVE YOU HEARD OR RECEIVED ANY INFORMATION ABOUT WHAT TO DO IN CASE OF AN ACCIDENT OR EMERGENCY AT THE MCGUIRE PLANT?

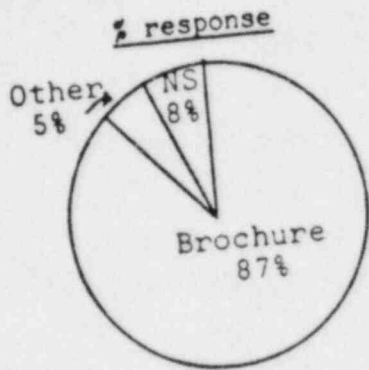


Number

Yes	92
No	16
*NS	4
	<hr/>
	112

Question 4: (IF YES) FROM WHOM HAVE YOU RECEIVED INFORMATION? (LIST)

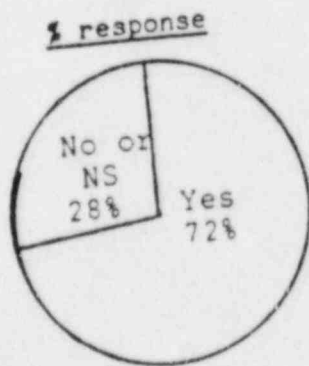
Responses were categorized as follows:



	Number
Duke Power brochure	81
Other	5
NS	<u>7*</u>
	93

\*One respondent who answered "not sure" to question 3 mentioned they may have seen something on TV about it.

Table 4.1: Percentage of all respondents who received the brochure.



	Number
Yes	81
No, NS	<u>31</u>
	112

The emergency planning brochure is required to be sent to all households within the EPZ.



Question 4a: ABOUT WHEN DID YOU LAST RECEIVE ANY INFORMATION ABOUT WHAT TO DO IN A NUCLEAR PLANT EMERGENCY? (LIST)

Responses were categorized as follows:

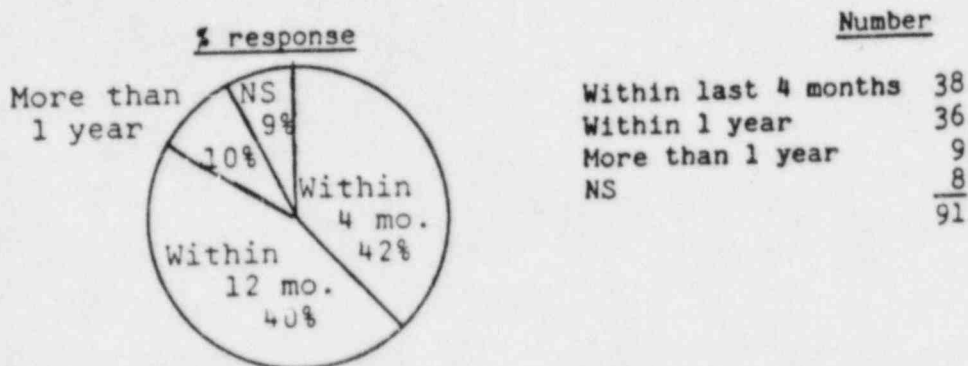
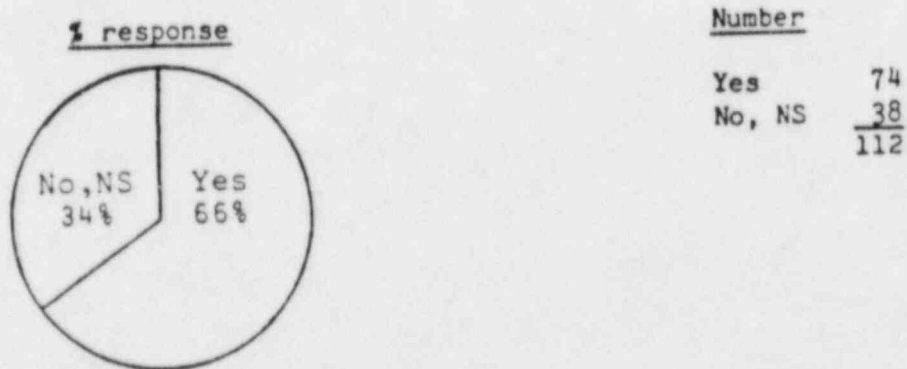
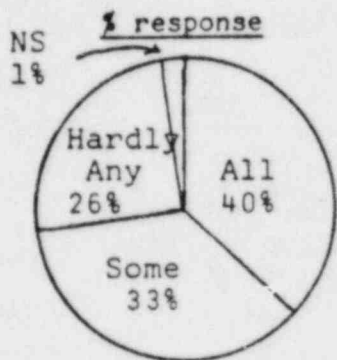


Table 4.2: Percentage of all respondents who recalled receiving a brochure within the last 12 months.



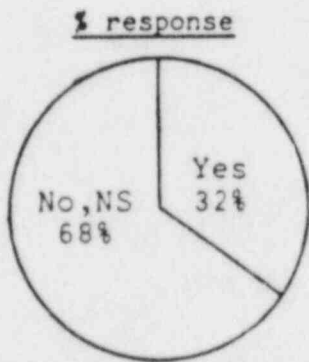
Households within the EPZ are required to receive emergency information at least once per year.

Question 4b: DID YOU READ ALL OF THE MATERIAL, SOME OF IT, OR HARDLY ANY OF IT?



	<u>Number</u>
All	36
Some	30
Hardly Any	23
NS	1
	<u>90</u>

Table 4.3: Percentage of all respondents who received emergency response material and read all of it.

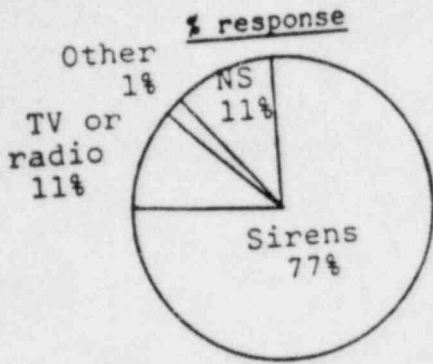


	<u>Number</u>
Yes	36
No, NS	76
	<u>112</u>

Some respondents who did not read all of the last brochure said they had read all of a prior brochure. However, the most recent brochure will often contain updated and important new information which may be missed by these respondents.

" but we read all of the prior material."

Question 5: IF THERE IS AN EMERGENCY, HOW DO YOU THINK YOU WILL FIND OUT ABOUT IT? (LIST)



Number

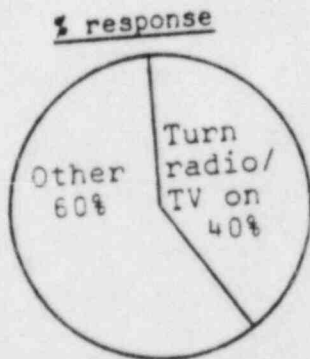
Siren	86
TV or Radio	12
Other	2
NS	12
	<u>112</u>

For those who mentioned the warning sirens, 21% complained they could not hear or have never heard the warning sirens during a drill.

"We can't hear the sirens... we were in the drill and it was a failure."

Question 6: IF YOU HEARD THE WARNING SIRENS AT THE MCGUIRE PLANT, WHAT WOULD YOU DO? (LIST)

The appropriate response is to seek more information -- specifically to turn radio or TV on for information and instructions. Responses were categorized as follows:



Number

Turn radio/TV on	45
Other	67
	<u>112</u>

Table 6.1: Percentage of all respondents who would seek information by attempting to verify sirens in some way or who would contact someone for information or help.

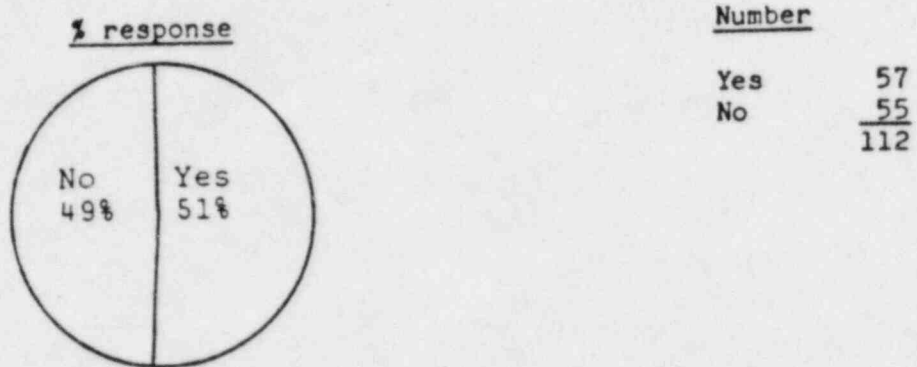


Table 6.2: Responses to warning sirens by respondents who did not mention seeking more information or verification, in raw numbers.

Don't know/not sure	10	} Don't Know N=23	} Don't Know or flee N=49
Don't know but would gather family	4		
Don't know but would flee	8	} N=35	
Don't know, would gather family and flee	1		
Would flee	16		
Gather family and flee	10		
Gather family	1		
Do nothing/stay put	4		
Other	<u>1</u>		
	<u>55</u>		

Table 6.3: Percentage of confusion and/or flight response among respondents who did not mention seeking more information or verification.

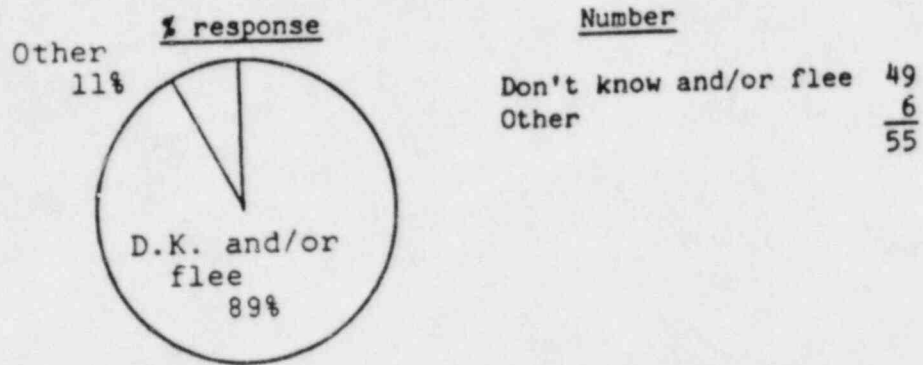
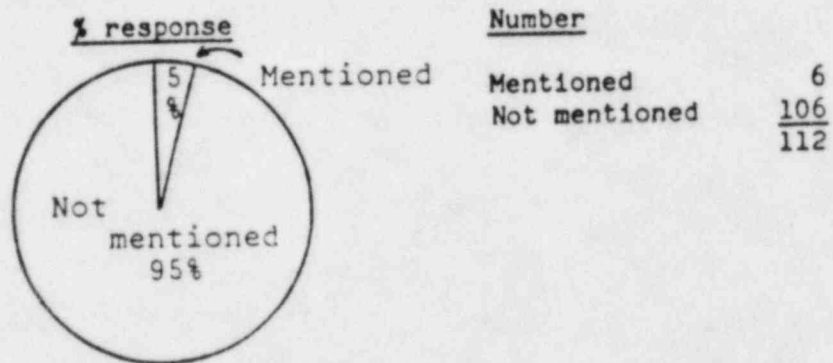
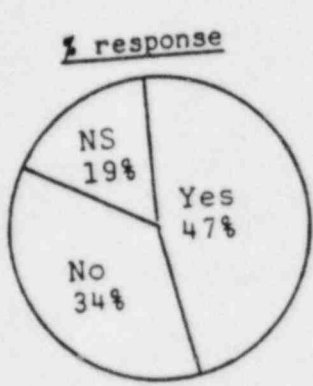


Table 6.4: Percentage of all respondents who mentioned they would respond to the warning siren by seeking more information and had a clear idea of where to go if they were told to evacuate.



Question 7:

DO YOU FEEL THAT YOU HAVE ENOUGH INFORMATION FOR YOURSELF AND YOUR FAMILY TO ADEQUATELY RESPOND TO AN EMERGENCY AT THE MCGUIRE PLANT?



Number

Yes	53
No	38
NS	21
	<u>112</u>

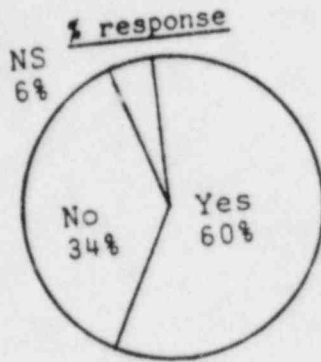
Some respondents who feel they have enough information may have an oversimplified understanding of how to respond during an emergency, premised on the idea that there is very little you can do except flee.

"Yes, what can you do? You can only leave -- that's all there is to it."

"Yes, get in my car and drive in the opposite direction. It's very simple."

" what else can we do?"

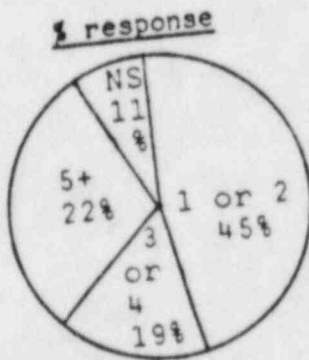
Question 8: DO YOU FEEL YOU NEED MORE INFORMATION ABOUT WHAT TO DO IN CASE OF AN EMERGENCY AT THE PLANT?



Number	
Yes	67
No	38
NS	7
	<u>112</u>

Some respondents who felt they needed more information felt the emergency brochure was inadequate and suggested additional informational resources such as closet door posters or better utilization of the media.

Question 9: ON A SCALE OF 1 TO 10, WITH 1 BEING VERY SLIGHT AND 10 BEING VERY GREAT, WHAT DO YOU THINK ARE THE CHANCES OF YOU HAVING TO EVACUATE THE AREA? (LIST)



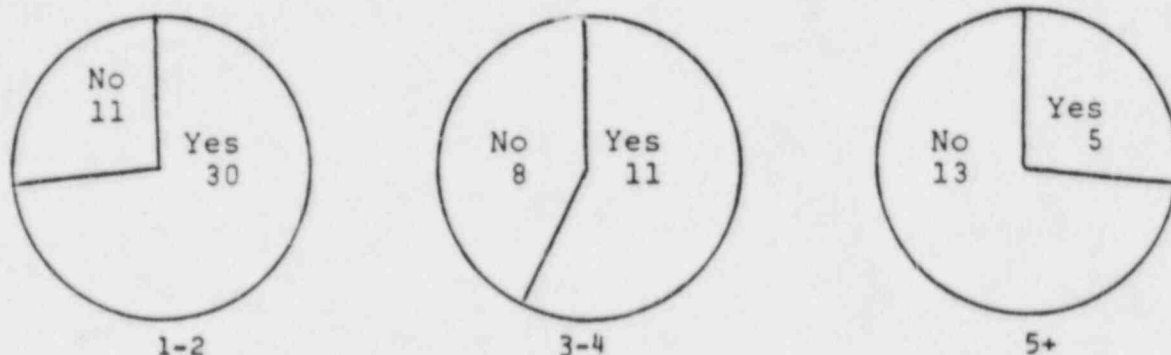
Number	
1-2	50
3-4	21
5+	25
NS	16
	<u>112</u>

The purpose of the above question was to provide an estimate of perceived evacuation likelihood, or in practical terms, how likely respondents feel they will have to use the information on emergency response contained in the emergency brochure.

Tables 9.1 and 9.2 compare the responses to question 9 with whether they feel they have enough response information (question 7) and whether they feel they need more information (question 8).

Table 9.1: Comparison between respondents' estimate of evacuation likelihood (question 9) and whether respondents feel they have enough emergency response information (question 7), in raw numbers.\*

"Do you feel that you have enough information for yourself and your family to adequately respond to an emergency at the McGuire plant?"

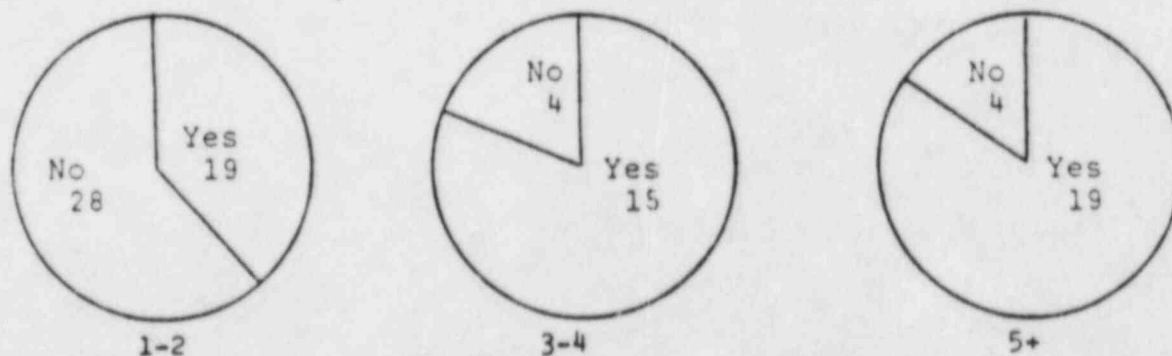


Respondents' 1-10 estimation of evaluation likelihood.

\*chi-square is significant at .05 level. ("Not Sure" responses were omitted).

Table 9.2: Comparison between respondents' estimate of evacuation likelihood (question 9) and perceived need for more information (question 8) in raw numbers.\*

"Do you feel that you need more information about what to do in case of an emergency at the plant?"



Respondents' 1-10 estimation of evaluation likelihood.

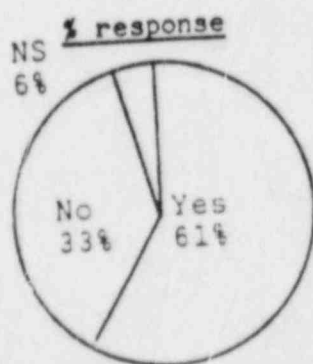
\*chi-square is significant at .01 level. ("Not Sure" responses were omitted).



Results from tables 9.1 and 9.2 indicate that respondents who feel that the likelihood of evacuation is slight tend to be more satisfied with the information they have and tend to feel they do not need additional information. Conversely, as the respondents' estimation of evacuation likelihood increases, so does their feeling that they do not have enough information to respond, as well as their desire for more information.

These responses suggest that satisfaction with present information and perceived need for more information are related to the likelihood that such information may be needed some day. This is significant because the emergency response brochures state in the preface that the likelihood of ever needing to use such information is "extremely small". Brochure readers receive a double message suggesting the information is important but that they will probably never need to use the information. The more the reader accepts the latter point, the less concerned the reader may be with the quality of the information. This may partly explain why many respondents who did receive response information lacked knowledge about appropriate response behavior -- they are unconcerned about it because they are confident such information will never be needed.

Question 10: DO YOU FEEL THAT YOU HAVE AN ADEQUATE UNDERSTANDING OF THE EFFECTS OF RADIATION?



<u>Number</u>	
Yes	68
No	37
NS	7
	<hr/> 112

## DISCUSSION

An emergency plan will work only if the public is adequately informed. Widespread ignorance of even the basic appropriate response to hearing the warning sirens--seeking more information as a first course of action demonstrates that the current public education program is not working. The foundation for this program is the Duke Power Company emergency response brochure.

There are several additional findings which are noteworthy. During an emergency, practically all parents will wish to seek their children. In this survey, 13 parents of schoolchildren said they intend to drive to their children's schools to pick them up during a nuclear emergency. Another 4 parents said they will at least consider doing this. One parent intends to pick both of her schoolchildren up, even though they are in schools which are five miles apart within the EPZ. While some parents did not know what they were supposed to do about their schoolchildren, others insisted they would disregard instructions not to pick their schoolchildren up. According to one parent, "this is probably the wrong decision but I'd do it anyway." This suggests the very real possibility that if the crisis occurs during school hours, worried parents--even worried informed parents--may cause problems with traffic flow, which will not be set up to handle this contingency.

The second finding, related to the first, is that at least 17 respondents raised concerns or objections which suggest they may not follow directions. These concerns or objections involve refusing to follow their planned evacuation route, refusing to evacuate, fleeing no matter what the authorities say, and picking up schoolchildren despite instructions not to.

These responses reveal a significant likelihood that some citizens do not feel that particular aspects of the emergency plan will work. Consequently, they appear willing and prepared to do what they think they should do--not what the instructions say. In other cases there is a notable sense of futility and frustration. According to one elderly woman, "I'll stay right here! I'm elderly and alone. Someone would have to come and get me but I will not allow a stranger to rescue me or have my name on a list! There's little I can do."

Similar expressions of frustration and futility were raised by a wide array of respondents, including people familiar with the plan who have participated in previous drills, people who can't hear the sirens, people who are scared, pessimistic, or even fatalistic, and senior citizens. The following comments reveal this frustration:

"I don't have a way out--no car--and I'm not sure what to do. This area is mostly senior citizens and most of us don't know what to do."

"I'm scared. I don't know what to do."

"I know what we're supposed to do but I don't feel it will work."

"There's got to be something done about this poor planning."

"...I feel pretty hopeless."

"I try to blot it out of my mind."

"I don't know the first thing to do! Nobody has informed me about anything!"

In some cases, these concerns reflect knowledge about the adequacy

(or inadequacy) of the emergency plan itself. In other cases, they reflect a failure to satisfy the public's right to have needed information. This not only produces cynicism toward government and responsible authorities--it seriously undermines the ability of the plan to work.

The key ingredient in any emergency plan is the behavior of the public. The level of public knowledge and public attitudes are the two crucial variables which will determine the success of the plan. Where the public responds to an emergency plan from a position of ignorance and distrust of authorities (and 'their' plans) then panic, flight, frustration, and rule-breaking will result. More people will be injured and more will die. Thus, there is an interactive relationship between public attitudes toward the emergency plan and the effectiveness of the plan itself--just as there is an interactive relationship between public knowledge of the plan and the effectiveness of the plan.

This survey reveals that there is low public knowledge of the emergency plan and there are critical attitudes toward the plan, both of which will undermine its effectiveness. Fortunately, in many cases public attitudes toward emergency planning will change for the better as public knowledge increases. An effective public information program may produce this two-fold effect and will doubtless save more lives during a nuclear emergency. Such a program will require better quality information and a better effort to disseminate this information than has been made so far.

## METHODOLOGY

Using the 1983 Charlotte phone book, it was estimated that approximately 5440 residential phone numbers are listed for the Mecklenburg communities of Huntersville, Davidson, and Cornelius. These are towns located inside the McGuire EPZ. To achieve a minimum number of 100 respondents, it was estimated that about 300 phone numbers would be needed because of 'no answers', disconnections, refusals, difficulty locating the head of the household, etc. Using a table of random numbers, an arbitrary number less than 18 was selected. Beginning with this number, every 18th number thereafter was selected until reaching the end of the list. This yielded 305 phone numbers.

The addresses listed with these numbers were also copied so that they could be used, if necessary, to verify that the respondent lived within the EPZ. Various charts and an EPZ police patrol map for Mecklenburg County were also used to verify residence location. All addresses were checked. If it was determined that a potential or actual survey respondent lived outside of the EPZ then the number was voided. Two completed surveys were later voided for this reason. (Both respondents lived within a few hundred yards of the EPZ).

Heads of households were targeted and equal numbers of male and female heads were interviewed. The research instrument used was the questionnaire appended to this report. The survey began on January 12 and went through the 28th. Three volunteer interviewers were trained for the survey, although most of the interviews were performed by the project director. Every phone number was tried an average of three times before giving up. The survey yielded 112 respondents, or 2% of the households in our target area.

It is likely that our phone number selection method undersampled poorer population groups as well as transients such as students, who may be less likely to have their own phones. Attempts to generalize the results to the target area population would be correct within the range of plus or minus 10% at the 95% confidence level.

DEMOGRAPHICS

<u>Occupation</u>						
<u>prof/tech/mgr</u>	<u>clerk/sales/service</u>	<u>skilled labor</u>	<u>labor</u>	<u>retired</u>	<u>housewife</u>	<u>unemp</u>
$\frac{8}{21}$ (24)	$\frac{8}{20}$ (23)	$\frac{8}{13}$ (15)	$\frac{8}{8}$ (9)	$\frac{8}{22}$ (25)	$\frac{8}{11}$ (12)	$\frac{8}{1}$

<u>Education</u>					
<u>0-6</u>	<u>7-11</u>	<u>H.S.</u>	<u>some col.</u>	<u>col. grad.</u>	<u>post-</u>
$\frac{8}{6}$ (7)	$\frac{8}{17}$ (19)	$\frac{8}{33}$ (37)	$\frac{8}{19}$ (21)	$\frac{8}{12}$ (13)	$\frac{8}{12}$ ( )

<u>Age</u>		
<u>20-35</u>	<u>36-60</u>	<u>61+</u>
$\frac{8}{28}$	$\frac{8}{46}$	$\frac{8}{27}$

<u>Race</u>	
<u>white</u>	<u>non-white</u>
$\frac{8}{94}$	$\frac{8}{6}$

\*\* 34% of all respondents had toured the McGuire plant.

\*\* 17% of all respondents or their spouses had employment associations with Duke Power Company.

MCGUIRE SURVEY

Hello. My name is \_\_\_ and I am with the Carolina Environmental Study Group, a local research organization looking into the emergency evacuation policies concerning the McGuire nuclear plant. We are doing a survey of your area and selected your phone number randomly from the local phone book. We just have a phone #, not your name. It is important that we ask the m / f head of your household a few questions about your ideas on emergency evacuation. It should only take a few minutes. Would you mind helping us out? (if yes) If you have any questions about this survey I'll be glad to answer them for you after we're through. Are you ready to begin? (Do NOT re-word or interpret questions for the respondent--if they are confused write out answer or confusion.)

1) Have you heard of an emergency evacuation zone surrounding the McGuire nuclear plant? Yes No Don't Know/Not Sure

2) Are you presently living within the emergency evacuation zone? Yes No DK/NS

3) Have you heard or received any information about what to do in case of an accident or emergency at the McGuire plant? Yes No DK/NS

4)(If yes) From whom have you received information? (list) \_\_\_\_\_  
\_\_\_\_\_ DK/NS

About when did you last receive any information about what to do in a nuclear plant accident or emergency? (list) \_\_\_\_\_  
\_\_\_\_\_ DK/NS

Did you read all of the material, some of it, or hardly any of it? All Some Hardly Any DK/NS

5) If there is an emergency, how do you think you will find out about it? (list) \_\_\_\_\_ DK/NS

6) If you heard the warning sirens at the McGuire plant, what would you do? (list) \_\_\_\_\_  
\_\_\_\_\_ DK/NS

7) Do you feel that you have enough information for yourself and your family to adequately respond to an emergency at the McGuire plant? Yes No DK/NS

8) Do you feel that you need more information about what to do in case of an emergency at the plant? Yes No DK/NS

9) On a scale of 1 to 10, with 1 being very slight and 10 being very great, what do you think are the chances of you having to evacuate the area? (list) \_\_\_\_\_ DK/NS

(Just one more question)

10) Do you feel that you have an adequate understanding of the effects of radiation? Yes No DK/NS

That was the last question. Would you mind if I asked you some background questions?

occupation \_\_\_\_\_ spouse's occupation \_\_\_\_\_

education \_\_\_\_\_ age \_\_\_\_\_ race \_\_\_\_\_ zip code \_\_\_\_\_

To help us in our analysis, we need to have an idea where you live. Do you live within the city limits of Huntersville, Davidson, or Cornelius? Yes No DK/NS

(if no or DK) Would you mind identifying the nearest street intersection to your residence? \_\_\_\_\_

About how close are you to this intersection? \_\_\_\_\_

Thank you very much for your help. Would you like to receive a copy of the results after they are tabulated? (if yes) May I have your address?  
\_\_\_\_\_

## RECOMMENDATIONS

1. There is a conflict of interest when the same corporation which built and promotes the McGuire Plant also designs, weighs, and ultimately determines most of the emergency planning information the public receives as well as how they receive it. This compromises the public's right to a balanced approach toward planning and poses the danger of lulling the public into a false sense of security.

Greater public participation in decisions about what to include in public information programs, including the brochure, will assure a more balanced approach toward emergency planning. A PUBLIC DECISION-MAKING COMMITTEE SHOULD BE ESTABLISHED TO PERFORM MOST OF THE PUBLIC INFORMATION FUNCTIONS NOW PERFORMED ALMOST EXCLUSIVELY BY DUKE POWER COMPANY. The committee should be comprised of representatives of Duke Power Co., government officials, ordinary citizens, and representatives of organizations whose concerns for public health and safety are well documented. Input should be openly encouraged from everyone and decisions should be made in meetings open to the general public. Particular input should be encouraged from educational and other groups within the EPZ. This will also stimulate greater public awareness of these issues.

2. Public education efforts about emergency planning for the EPZ population are required to be financed primarily by Duke Power Company, although these costs are ultimately charged to the ratepayers. TO ENSURE THAT THESE FUNDS ARE NOT CONTROLLED BY ANY ONE PARTISAN BODY, THEY SHOULD BE DEPOSITED IN A "COMMUNITY CHEST" ON AN ANNUAL BASIS AND INTENDED SPECIFICALLY FOR THE PUBLIC INFORMATION PROGRAM. Their use would be determined by a public decision-making body such as the one already discussed.
3. The emergency response brochure is currently the primary instrument used to reach the public. However, it is easy to misplace or lose these pamphlets. A BETTER PRIMARY INSTRUMENT MIGHT BE A UTILITY OR CLOSET DOOR POSTER WHICH CAN BE HUNG IN A PERMANENT LOCATION WHERE THE WHOLE FAMILY CAN ALWAYS FIND IT.
4. There is a clear need to STRENGTHEN THE INVOLVEMENT OF EDUCATIONAL GROUPS, CIVIC GROUPS, AND THE MEDIA IN DISSEMINATING INFORMATION. Such involvement will increase the visibility of the information. One example is to repeat periodic public service announcements by the media.
5. EMERGENCY PLANS SHOULD BE REVIEWED AND UPDATED ANNUALLY USING RESULTS OF SURVEYS performed by an independent research firm responsible to a public body. Although the Federal Emergency Management Agency (FEMA) is supposed to perform annual surveys immediately after the drills, very few have actually been performed. With greater public insistence such a survey might be regularly performed in our local EPZ's. Duke Power Company also conducts surveys of EPZ populations and may be willing to share their information with the public.

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

TESTIMONY OF ARLENE BOWERS ANDREWS

1. Q. WHAT IS YOUR NAME AND ADDRESS?

A. Arlene Bowers Andrews, 1017 Wando Street, Columbia, SC 29205

2. Q. WHAT IS THE PURPOSE OF YOUR PRESENT COMMENTS?

A. I have been asked by Palmetto Alliance and the Carolina Environmental Study Group to assess the adequacy of the brochure "Catawba Nuclear Station Emergency Plan 1984 Edition" as a plan for protective individual and collective action in case of an emergency.

3. Q. WHAT ARE YOUR QUALIFICATIONS?

A. I have completed all but the dissertation for a Ph.D. in Clinical—Community Psychology at the University of South Carolina. As part of my training I have studied crisis intervention with a particular interest in the impact of disaster on communities; I am also familiar with the field of environmental psychology, which examines the effects of the physical and social environments on individual behavior. I also have the degree of Master of Social Work with an emphasis in community intervention and am currently a part-time faculty member at the College of Social Work at the University of South Carolina. I have been the administrator of two agencies serv-



ing individuals in crisis, having been the founding Executive Director for both the Council on Child Abuse and Neglect, Inc. and SISTERCARE, Inc.: Services for Abused Women. I have provided training and supervision in crisis intervention to staff and volunteers and have written a manual on crisis intervention with abused women.

4. Q. IN YOUR OPINION, HOW ARE PEOPLE LIKELY TO RESPOND TO A STATE OF ALERT OR EMERGENCY AT A NUCLEAR POWER STATION?

A. A state of alert or emergency at a nuclear power plant is potentially an event which could precipitate psychological crises for a large number of individuals. Psychological crisis, which is a normal response to a threatening event, is characterized by emotional upset and irrational behavior. In the case of a nuclear power plant accident the threat perceived by the individual may be due to a range of factors such as anxiety about how the emergency will progress, anticipated health effects of radiation exposure, disruption in normal life routine due to relocation or separation from loved ones, anticipated loss of property value, or fear of the unknown. The perception of threat can lead to heightened arousal and to protective, life-saving responses; or it can precipitate maladaptive responses leading to a state of psychological crisis. How an individual responds depends on a number of personal and social factors, including such factors as how the individual normally copes with stress and how prepared he or she is to deal with sudden change. It must be emphasized that any normally functioning individual may experience a degree of

psychological crisis in response to an unanticipated event such as a community disaster.

5. Q. HOW DOES PSYCHOLOGICAL CRISIS AFFECT AN INDIVIDUAL?

A. The individual entering into a state of crisis will experience a rise of inner tension, exhibit signs of unpleasant affect (such as anger or grief), and display disorganized functioning. The individual will have difficulty processing information and making necessary judgements to lead to adaptive behaviors. In the case of an alert or an emergency such adaptive behaviors would be those that enhance the safety of the individual, persons who are dependant on him or her, and the general public. Maladaptive behaviors would be those that increase the likelihood of harm to self or others. Studies of community disasters indicate that man's behavior under stressful circumstances is difficult to predict; in some cases, large groups of people have spontaneously cooperated and responded adaptively to the threat; in other cases, confusion and disorientation on a broad scale have occurred.

6. Q. HOW CAN EMERGENCY PLANNING PREVENT PSYCHOLOGICAL CRISIS?

A. A major goal of emergency planning is to prevent psychological crises by promoting positive emotional coping skills, clarity of thought, and prompt appropriate action among individuals so that masses of people will act in a cooperative and coordinated manner. An effective emergency plan will reduce confusion and promote a sense of competence and personal control by individuals in response to their perceived threat. Critical components of an effective emergency plan are simple, clear information about specific behaviors the in-

individual should perform and accurate, easily accessible information about helping resources during the state of emergency.

Individuals in crisis tend to be vulnerable and responsive to suggestion, actively seeking help from authoritative sources. Information during this period will serve as a stimulus to evoke a response; if the information is worded inappropriately, it will illicit a maladaptive response. Individuals will be exposed to numerous sources of information in addition to the written emergency plan brochure and emergency broadcasts; interpersonal rumors and popular media are two examples. In choosing which source of information to follow, the individual is likely to respond to that which is clear and authoritative. Thus the information prompting individual action through the emergency plan brochure should be written and presented in a way that is immediately comprehensible, decisive and directive. Ambiguity generated by conflicting sources of information should be reduced by the clarity of the official emergency information.

7. Q. DOES THE BROCHURE ADEQUATELY PROMOTE EFFECTIVE EMERGENCY MANAGEMENT BY INDIVIDUALS?

A. The brochure, "Catawba Nuclear Station Emergency Plan 1984 Edition" as presently designed does not provide the clarity and direction needed by individuals in a state of anxiety and potential psychological crisis. The reader of the brochure is confronted with a broad range of information; it is not immediately clear what action the individual is to take in an emergency. Initial information about what to do and who will help in case of an emergency is embedded in

lengthy text about the power plant and radiation. For example, on page 4 the directions for how to protect oneself in an emergency begin at the end of paragraph 6. The need for special action by pregnant women and children under six appears in a subsequent paragraph. Such information is not easy to find in the brochure. It should be presented so that it will be immediately noticed. Action steps to be taken in an emergency do not appear until the latter half of the brochure, beginning on page 8. If the purpose of the brochure is to promote a coordinated plan of action in case of emergency, than the emergency information should be the primary focus of the brochure.

The following general recommendations are offered to promote the development of a more effective brochure:

- 1) Information on what to do in case of an emergency should appear at the beginning of the text. The sections entitled "How It Works," "Radiation . . . A Fact of Life," "About Radiation" and "Nuclear Terms" should be placed in an appendix and amended to delete information that is not relevant to an emergency. Information about what to do in an emergency that is currently embedded in the text of these sections should be incorporated into the emergency sections of the brochure.
- 2) The information about what to do in case of an emergency should be clear and repetitive where necessary.
- 3) The information about helping resources in case of an emergency should be clear and repetitive where necessary. The brochure is vague about who will be in charge in case of an emergency. It is

implied at the beginning that the county emergency management office is a source to contact, but reference is also made in the brochure to the Duke Power Company, to fire, police, and rescue units, and to "state authorities" who would distribute radioprotective drugs. Individuals can receive information from emergency broadcast stations, but they can also be expected to seek help and information. The phone numbers of the emergency management offices should be repeated where relevant (for instance, in the section on "Special Help for the Handicapped," "If I Hear the Siren . . . ," "What If I Don't Have Transportation . . . .").

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of )  
DUKE POWER COMPANY, et al. ) Dockets Nos. 50-413  
(Catawba Nuclear Station ) 50-414  
Units 1 and 2) April 16, 1984

TESTIMONY OF RUTH WANZER PITTARD

1. Q: WHAT IS YOUR NAME AND ADDRESS?  
A: Ruth Wanzer Pittard, Box 2284, Davidson, North Carolina 28036.
2. Q: WHAT IS THE PURPOSE OF YOUR TESTIMONY?  
A: I have been asked by Palmetto Alliance and the Carolina Environmental Study Group to assess the effectiveness of Duke Power Company's brochure, "Catawba Nuclear Station Emergency Plan, 1984 Edition", in accomplishing the objective of informing the affected public regarding how they will be notified and what their actions should be in the event of an emergency at the Catawba Nuclear Station.

3. Q: WHAT ARE YOUR QUALIFICATIONS?

A: For the last ten years I have worked as the Director of Audio Visual Services at Davidson College in Davidson, North Carolina. I have a Bachelor of Science Degree in English Education from East Carolina University and have completed graduate courses at the University of North Carolina at Charlotte in Audio Visual Instruction. In my work I am responsible for the design, production, and presentation of all audio-visual materials for classroom or instructional purposes requested by faculty, students, or staff at the college. In addition, I am often asked to assist in the design and production of such materials for community and service organizations as a volunteer.

4. Q: IN YOUR OPINION WHAT IS THE OBJECTIVE OF THE PUBLIC INFORMATION MATERIALS OF DUKE POWER COMPANY WHICH YOU HAVE REVIEWED?

A: I am informed that the U. S. Nuclear Regulatory Commission and the Federal Emergency Management Agency have established planning objectives for a public information program required to be conducted by Duke Power Company in order to safely operate its Catawba Nuclear Station. I have reviewed the document NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power

Plants," which sets forth the relevant planning objectives and evaluation criteria at Part II G which appear relevant to the public information program. The first criteria there reads as follows:

"Each organization shall provide for periodic dissemination of information to the public regarding how they will be notified and what their actions should be in an emergency. This information shall include, but not necessarily be limited to: (a) educational information on radiation, (b) contact for additional information, (c) respiratory protection, (d) sheltering, (e) evacuation routes.

"Means for accomplishing this dissemination may include, but are not necessarily limited to: information in the telephone book; periodic information in utility bills; posting in public areas; and publications distributed on an annual basis.

I understand the Duke brochure I have reviewed to be the primary vehicle for disseminating this information to the affected public. In my opinion the primary objective, then, is to effectively inform the public regarding how they will be notified and what their actions should be in an emergency.



5. Q: IN YOUR OPINION, HOW EFFECTIVELY HAS THE DUKE BROCHURE ACCOMPLISHED THIS OBJECTIVE?

A: I do not believe that they have effectively accomplished this objective.

6. Q: PLEASE EXPLAIN.

A: To answer your question, let me use two terms: "Required message", and "design theme". The "required message" is that message required by the planning objective of the Public Information Program. The NRC and FEMA require that the Emergency Planning Public Information Program inform people about how they will be notified and what their initial action should be in the event of an emergency. This is "the required message", and it should be the objective of the Public Information Program to disseminate this message. The "design theme" is that theme communicated by the physical placement or layout of the information presented to the reader as well as the language mode used to communicate the message. The message communicated to the reader is affected by both the verbal statement and the design theme in which the message is presented.

A number of factors may affect the design theme of a text, such as (1) the location of the required message within the text; (2) the consistency or repetitiveness of the required message; (3) the use

and variety of means used to state the required message (for example, verbal reinforced by a pictogram or illustration may be more effective than either means alone); (4) boldness of print; (5) the use of colors (for example, green and blue are "cool and calm" colors, while red and orange are "alarm" colors); (6) the degree to which the required message is set off from the body of the text; (7) the actual volume of material to be read; and, (8) the language mode used in the text. (For example, the use of active language versus passive-descriptive language.)

These are some of the design factors which will influence how and even whether the required message is read, interpreted, and retained.

In order to accomplish the goal of effectively communicating the required message, the design theme must be clearly consistent and compatible with this required message; otherwise, at the required message will be competing with or obscured by a design theme which may be communicating a secondary message instead of enhancing the required message.

In my opinion effective communication of the required message here, in the context of an Emergency Planning Public Information Program, necessitates use of a simple, coherent, and consistent message written in a bold and decisive

manner which is immediately apparent. Such information should be written in an action-oriented mode which communicates appropriate actions to be taken by the reader. It should utilize bold "alarm" colors such as red and orange and should be supported with pictograms or illustrations to reinforce the printed message. All secondary, and therefore peripheral information, should follow the required message and be placed in the body of the text. It should be cautioned, however, that the text itself should be short and to the point; therefore, any secondary information which does not directly contribute to communicating the required message should be omitted.

I have examined the Catawba Nuclear Station's Emergency Plan Brochure, 1984 edition. In my opinion, the design theme used in this brochure clearly and consistently obscures, rather than enhances the required message of the Emergency Planning Public Information Program.

To begin with, the brochure is weighty, which scares people away from reading it. The information materials should be short and to the point. The required message must be immediately apparent in the introduction of the material and it is important that the design theme enhance this message. The Catawba brochure violates both of these criteria.

In the brochure the required message is located in the body of the text toward the end of the brochure under sections dealing with how one will learn about an emergency and what to do if sirens are heard. This information should have been placed at the very beginning, such as on the outside cover, boldly written, using "alarm" colors in such a way that the focus of the readers' attention is on appropriate response actions or behavior.

An examination of the design theme used in Duke's brochure shows that the theme emphasized is not the appropriate theme, rather the design theme enhances the point that Duke Power Company is concerned about safety at its nuclear plant rather than emphasizing the required message dealing with appropriate response actions which readers need to know. For example, the first message the reader receives is, "We Want You to Be Prepared." This is followed by pages of information written in the descriptive or passive language mode about how the plant works, radiation as a fact of life, etc. The colors used in the brochure are blues and greens which are "calm" and not "alarm" colors; and when the reader finally gets to the pages containing the required message there are no colors used at all. Instead, the required message appears on pages containing only dense and gray text.

Thus, the design theme is inconsistent with the required message which is to inform people about how they will be notified and what their initial actions should be in an emergency. The result of using a design theme which does not support the required message is that this message is lost or obscured by the secondary message which is emphasized by the design theme--that Duke is concerned about safety.

7. Q: WHAT ARE YOUR RECOMMENDATIONS?

A: I recommend that this Licensing Board require improvements in the public information program to insure that the required message is effectively communicated. The present brochure is clearly inadequate and should be modified or replaced by information materials which utilize design criteria to effectively communicate this required message. I will be pleased to assist in the re-design of such materials.

8. Q: DOES THAT CONCLUDE YOUR TESTIMONY?

A: Yes.