50-322-OL3
7/9/87
I-SC-15

Suffolk County.
Ex #15
7/9/87

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NUCLEAR REGULATORY COMMISSION

Docket No. 50-322-OL-3 Official Exh. No. 15

In the matter of LILCO

Staff	IDENTIFIED	Shoreham Nuclear Power
Applicant	RECEIVED	Station Unit-1
Intervenor	REJECTED	
Cont'g Off'r		
Contractor	DATE	7-9-87
Other	Witness	
Reporter	Joe Sue Walsh + M Simone	

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of LONG ISLAND LIGHTING COMPANY (Shoreham Nuclear Power Station, Unit 1)	Docket No. 50-322-OL-3 (Emergency Planning)

TESTIMONY OF JAMES H. JOHNSON, JR. AND
SUSAN C. SAEGERT ON BEHALF OF SUFFOLK COUNTY
REGARDING LILCO'S RECEPTION CENTERS
(Evacuation Shadow Phenomenon and Traffic Issues)

I. IDENTIFICATION OF WITNESSES

Q. Please state your name and positions.

(Johnson) My name is James H. Johnson, Jr. I am an Associate Professor of Geography, University of California, Los Angeles. I am also Director of UCLA's Institute for Social Science Research, Environmental and Population Policy Studies Program.

(Saegert) My name is Susan C. Saegert. I am Professor of Psychology and Environmental Psychology at the City University of New York Graduate School.

Q. Briefly summarize your experience and professional qualifications.

A. (Johnson) I received a B.S. in Geography from North Carolina Central University in 1975, an M.S. in Geography from University of Wisconsin - Madison in 1977, and a Ph.D. in Geography from Michigan State University in 1980. Among my areas of expertise are energy policy and planning. In addition, I have conducted extensive research and written numerous articles on evacuation behavior, as well as the public's perception of risk associated with radiological and other hazards.

A copy of my Vita and a more detailed description of my qualifications and professional experience may be found in the Direct Testimony of Stephen Cole, et al. on Behalf of Suffolk County Regarding LILCO's Reception Centers (Planning Basis).

(Saegert) I received a B.A. degree in Government from the University of Texas at Austin, and a Ph.D. in Social Psychology from the University of Michigan. As Professor of Environmental Psychology, my responsibilities include teaching courses and conducting research on environmental stress and environmental cognition.

A copy of my Vita and a more complete description of my qualifications and professional experience may be found in the Direct Testimony of Stephen Cole, et al. on Behalf of Suffolk County Regarding LILCO's Reception Centers (Planning Basis).

(Johnson, Saegert) Except where otherwise indicated, we jointly sponsor this testimony.

II. OVERVIEW

Q. What is the purpose of your testimony?

A. The purpose of our testimony is to address the suitability of the three facilities which are designated as reception centers in Revision 8 of LILCO's Plan. See Plan, at 3.6-7. The LILCO Plan provides that during an accident at the Shoreham plant, residents and transients within the EPZ may be instructed to proceed to the three LILCO reception centers, which are located in the Nassau County villages of Bellmore, Roslyn and Hicksville. The evacuees and vehicles reporting to the reception centers will then be monitored for radiological contamination and, if necessary, they will be decontaminated. See Plan, at 4.2-1; OPIP 3.6.1, at 2.

The procedures for such monitoring and decontamination are described in Revision 8 of the LILCO Plan and a subsequent "draft" revision dated February 20, 1987.[1/] This testimony will address three aspects of the evacuation behavior of the residents of Long Island and the impact of that behavior on the effective operation of LILCO's centers. First, we will testify that the location of the reception centers -- approximately 40 miles from the Shoreham plant -- will cause an increase in the magnitude and geographic extent of the evacuation shadow phenomenon. The result will be an increase in traffic congestion as more people

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1/ All references to the LILCO Plan are to Revision 8 unless otherwise indicated.

attempt to use the road than the limited road capacity on Long Island can handle. This will cause delays in the efforts of EPZ residents to reach the reception centers which could, in turn, result in adverse health effects for those EPZ residents requiring decontamination.

Second, it is likely that many Nassau County residents living in the vicinity of the reception centers will be concerned by the radiological monitoring and decontamination activities which will occur at the reception center sites. In the event of a Shoreham accident, these "local" residents will also attempt to remove themselves from this perceived hazard. This evacuation of "local" residents will also tend to add to traffic congestion by increasing the "background traffic" in the vicinity of the reception center sites.

Finally, we note that the LILCO Plan assumes that people will take certain complex routes from the EPZ to the reception centers and that certain analyses conducted by LILCO's consultant, KLD, follow this assumption in assessing the capacity of the routes to the reception centers. We disagree with this assumption. In fact, many evacuees will neither proceed to the specific reception centers designated under the LILCO Plan nor follow the routes designated by LILCO. Rather, people are likely to make independent choices as to which reception center they will report to and which routes they will utilize in travelling to a reception center. Therefore, KLD has not properly analyzed

the capacity of the routes leading to the reception centers. As demonstrated by the testimony of the State of New York's traffic experts, analyses conducted without this routing assumption show that there will be greater congestion along certain routes than KLD assumes.

This testimony is submitted to assist the Board in resolving a number of issues, including:

1. Whether transportation and traffic problems might develop as a result of the reception centers' location and their distance from the plume EPZ;

2. Whether the reception centers' locations might create problems in regard to the evacuation shadow phenomenon;

3. The adequacy of evacuation routes to the three reception centers;

4. Whether the proposal to send evacuees to LILCO parking lots could or would ever be implemented in a way to protect public health and safety.

See Memorandum and Order (Rulings on LILCO Motion to Reopen Record and Remand of Colliseum Issues) (December 11, 1986) at 7, 18-19.

III. THE LOCATION OF THE RECEPTION CENTER AND INCREASED ~~EXCAVATION~~ EVACUATION SHADOW

Q. Where are the LILCO reception centers located?

A. They are approximately 40 miles from the Shoreham Plant. In its testimony, LILCO has identified the following pertinent distances:

Reception Center	Miles from Shoreham	Miles from Plume EPZ Boundary
Hicksville	37	27
Roslyn	42	32
Bellmore	41	31

LILCO Testimony at 24.

Q. What effect will the location of the reception centers have on the evacuation shadow in the event of a Shoreham accident?

A. In summary, locating the reception centers approximately 40 miles from the Shoreham plant will expand the area which Long Island residents will perceive to be within the zone of risk in the event of a Shoreham accident. The result of this enhanced risk perception will be to increase both the magnitude and geographical extent of the evacuation shadow phenomenon.

Q. For background purposes, please explain what you mean by the evacuation shadow?

A. In the event of an accident at the Shoreham plant, LILCO may advise some or all of the EPZ residents to take protective actions. For reasons we have discussed in previous testimony, many Long Island residents, both inside and outside the EPZ, may decide to evacuate even though not advised to do so. Residents will make this decision to evacuate because they will perceive themselves to be at risk; this perception of risk is greater in radiological emergencies than in a natural disaster because of the unique properties of radiation and the public's fear of radiation. This phenomenon has been labelled the "evacuation shadow" phenomenon to identify the tendency of people beyond or outside the designated dangerous zone to evacuate voluntarily.

The existence of the evacuation shadow phenomenon is based on studies of the actual response of people to the accident at Three Mile Island ("TMI") and the potential responses of Long Island residents to an accident at the Shoreham Plant. At TMI, the Governor of Pennsylvania instructed pregnant women and preschool children within 5 miles of the malfunctioning reactor to evacuate, and instructed everyone else within 10 miles to stay indoors. This protective action advisory should have precipitated the evacuation of only about 3500 people.2/ Post-accident surveys established, however, that as many as 200,000 people

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2/ M.K. Goldhaber and J.E. Lehman, "Crisis evacuation during the Three Mile Island nuclear accident," A paper presented at a meeting of Am. Publ. Health Assoc. (Montreal Quebec) (1982).

within a 25 mile radius mile radius of the TMI reactor actually evacuated.3/ Surveys performed on Long Island show that similar results should be expected if a Shoreham accident occurs.4/

Q. Why will the location of the reception centers increase the evacuation shadow phenomenon?

A. Evacuees escaping any disaster attempt to find a "safe" place of refuge, be it a public shelter or a relative's home. Evacuees invariably define a "safe" refuge as one that puts a reasonable amount of distance between them and the disaster. In non-nuclear emergencies, the process of identifying a "safe" place of refuge is aided by the presence of environmental cues

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3/ C.B. Flynn, Three Mile Island telephone survey; preliminary report of procedures and findings. U.S. Nuclear Regulatory Commission, Washington, D.C. (1979); K. Barnes, J. Brosius, S. Cutter and J.K. Mitchell, Responses of impacted population at Three Mile Island nuclear reactor accident; an initial assessment, Discussion Paper No. 13, Department of Geography, Rutgers University, New Brunswick, New Jersey (1979); S.D. Brunn, J.H. Johnson and D.J. Ziegler, Final Report on a Social Survey of Three Mile Island Area Residents, Department of Geography, Michigan State University (1979).

4/ (Johnson) Dr. Stephen Cole and I, along with others, conducted a large survey of approximately 2,600 Long Island residents in the spring of 1982. We posited three different scenarios of accidents at the Shoreham plant and found in each case that there would be a large evacuation shadow. Some of the results of this research were published. See e.g. D.J. Zeigler and J. H. Johnson, Jr. "Evacuation Behavior in Response to Nuclear Power Plant Accidents," Prof. Geogr. 36 (May 1984) at 207-215. Surveys commissioned by LILCO in 1982 and carried out by William Johnson Associates and Yankelovich, Skelly, and White also found that there would be very substantial evacuation shadows in case of a nuclear accident at the Shoreham plant. In addition, two surveys in 1982 for Newsday, included questions aimed at assessing the size of the evacuation shadow and obtained similar results. Finally, a recent survey conducted by Dr. Cole once again confirmed that people are likely to evacuate in the event of a Shoreham emergency.

which geographically define the extent of the hazard. Research has shown that the ability to confirm official warnings through direct sensory evidence, like winds associated with a hurricane, is a critical determinant in determining the extent of evacuation from natural disasters.5/ In a nuclear reactor emergency, however, environmental cues are unlikely to exist. Unlike the situation in other disasters, where physical phenomenon such as flood waters or noxious gases from accidental explosions provide cues, radiation is an ambiguous hazard.6/ In other words, radiation provides no cues since it is, for the most part, imperceptible to the senses except in doses sufficient to induce radiation sickness. In the absence of direct sensory evidence, the locations of the decontamination centers will become one of the primary objective factors defining the geographical extent of the area at risk in the minds of Long Island residents.

In light of the above, the current location of the reception centers establishes the place of safe refuge as about 40 miles from the origin of the danger - the Shoreham plant. This will increase the public's perception of the area at risk to include areas far beyond the EPZ. Indeed, because people will be told to seek refuge at locations 40 miles from the source of the

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5/ R.W. Perry, M. K. Lindell and M.R. Green, Evacuation Planning in Emergency Management (1981).

6/ K.T. Erikson, "Human Response in a Radiological Accident," The Indian Point Book: A Briefing of the Safety Investigation of the Indian Point Nuclear Power Plants (1982).

emergency, many of the people in the area between the Shoreham plant and the reception centers (i.e., the 0-40 mile region) will perceive that their communities are unsafe because the "safe refuge" centers are still farther from the source of the emergency. The result of this expanded perception of risk will be a greater evacuation shadow.

Q. What will be the result of an expanded evacuation shadow phenomenon?

A. The number of people evacuating will certainly increase, and the resulting increase in evacuees attempting to use the limited east-west roadway capacity available on Long Island will lead to greater traffic congestion. This increased congestion will likely result in long delays for evacuees attempting to reach the reception centers, and as a consequence, delays in monitoring and decontamination. Moreover, the increased number of evacuees means that more people will report for monitoring, since survey evidence shows that many voluntary evacuees will in fact report to the reception centers for monitoring.7/

7/ See the Direct Testimony of Stephen Cole, et al. on Behalf of Suffolk County Regarding LILCO's Reception Centers (Planning Basis) (April 13, 1987).

Q. In the LILCO testimony on this issue, LILCO witness Mileti has stated that risk zones are defined by emergency information, not the positioning of the reception centers. LILCO Testimony at 25. Do you agree with this?

A. We do not believe Mr. Mileti's theory is correct. First, this theory ignores research which shows that ~~spacial~~ spatial considerations, such as distance from a nuclear hazard, are an extremely important determinant of human behavior in the event of a nuclear accident.8/ Moreover, Dr. Mileti's theory assumes the issuance of good emergency information, which among other things, requires a credible source of information. However, there is little dispute that LILCO has almost no credibility as a source of information on Long Island.9/ Therefore, in the event of a Shoreham accident, the geographic location of safe havens will be an even more significant factor as people formulate their perceptions of the area of risk and then act on those perceptions. Finally, even if one were to assume that LILCO is credible and issues good emergency information, this will not completely negate the effects of the public's pre-existing concerns about radiation. Thus, the location of the centers will clearly have the tendency to increase substantially the number of evacuees.

8/ Johnson & Zeigler, "Distinguishing Human Responses to Radiological Emergencies," Econ. Geog. 59 (Oct. 1983).

9/ See Direct Testimony of Stephen Cole et al. Regarding LILCO's Reception Centers (Planning Basis) (April 13, 1987). Work done by LILCO witness Dr. Lindell concludes that compliance with emergency instructions requires that those instructions came from a credible source. Id.

In short, the distance of the reception centers from the Shoreham plant will be a very significant factor in defining the area of risk to be far greater than if the reception centers were closer to Shoreham.

Q. In the LILCO Testimony, LILCO witness Mileti also contends that the evacuation shadow phenomenon will not increase because reception centers are likely to be perceived as "solutions" and that shadow areas, having indistinct boundaries, fall off "dramatically" as distance increases. LILCO Testimony at 25. Do you agree with this?

A. No. Dr. Mileti is unclear when he states that the reception centers will be perceived as "solutions." Although it is true that reception centers will be perceived as safe places for evacuees to go to and thus the "solution" to a problem, that does not negate the fact that the area between the reception centers and the plant will be viewed as a risk area. It is only natural that if people are told that a safe place is at a certain geographic location, locations short of that location will be perceived as an area of risk. This will increase the evacuation shadow. The fact that shadow areas have no clearly defined boundaries is simply an irrelevant consideration. Shadow areas are defined by perceptions of risk, which are greatly influenced by the perception of where a safe harbor exists. Thus, if anything might serve to provide a boundary to the shadow area, it will be the 40-mile limit established by the "safe" reception centers.

Likewise, if by stating that the "area of risk falls off amatically as distance increases" Dr. Mileti is implying that e evacuation shadow will be insignificant at distances much yond EPZ boundaries, he is refuted by the evidence. At TMI, e evacuation shadow began to fall off only gradually with reasing distance from the accident site. Similar patterns ve been found in Long Island. The drop off rate can now be pected to be even more gradual (i.e., nowhere near "dramatic") to the great distance between the Shoreham plant and the ption centers. Moreover, it should be noted that while the portion of evaucating households gradually declines with dis-ce from the accident site, the increase in population density one moves east on Long Island causes the absolute number of cuees to increase "dramatically" with each additional mile.10/

Q. LILCO witness Mileti also contends that the TMI recep-n center was little used and that therefore the location of LILCO reception centers will not increase the evacuation low in a Shoreham accident. LILCO Testimony at 25. Do you ee with this?

A. No. The reception center experience at TMI is an propriate basis for comparison, since at TMI there was no r to report to reception centers, and no mention of

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D.J. Zeigler and J.H. Johnson Jr. "Evacuation Behavior in onse to Nuclear Power Plant Accidents," Prof. Geogr. 36 1984).

monitoring.11/ In the event of a Shoreham accident, where an EBS message would direct people to go to reception centers for shelter (if needed) or monitoring, the reception centers would clearly serve to define the zone of risk and thus enhance the evacuation shadow. Furthermore, when Dr. Mileti states that such centers are little used in "any evacuation," he is confusing the purpose of those shelters in natural disasters (i.e. to provide shelter) with the purpose of LILCO's reception centers (i.e. to provide shelter, monitoring and decontamination if necessary.) Dr. Mileti has seemingly ignored the fact that LILCO will be advising EPZ residents to report to the reception centers. His suggestion that under those circumstances the reception centers will be "little used" suggests that he no longer believes that the public will follow LILCO's instructions.

11/ This can be seen from the following text of Governor Thornburgh's order:

> Based on advice of the chairman of the NRC [Nuclear Regulatory Commission], and in the interests of taking every precaution, I am advising those who may be particularly susceptible to the effects of radiation - that is, pregnant women and pre-school children - to leave the area within a 5-mile radius of the TMI facility until further notice. We have also ordered the closing of any schools within this area. I repeat that this and other contingency measures are based on my belief that an excess of caution is best. Current readings are no higher than they were yesterday. However, the continued presence of radioactivity in the area and the possibility of further emissions lead me to exercise the utmost caution.

Mr. Rogovin and G. Frampton, Three Mile Island: A Report to the Commissioners and to the Public (1980).

IV. EVACUATION FROM AROUND THE RECEPTION CENTERS

Q. What effect will the the reception centers have on the communities surrounding the reception centers?

(Johnson)

A. In the event of a Shoreham accident, people from the surrounding community will perceive the reception centers as a threat, and many will evacuate from the areas around the reception centers.

Q. What is the basis for that conclusion?

(Johnson)

A. By designating the Hicksville, Bellmore, and Roslyn facilities as reception centers, LILCO is transforming these sites into what have been characterized as locally unwanted land-uses ("LULU").12/ A LULU is a facility which the public may acknowledge is needed in society, but toward which the prevailing attitude is generally one of "any place but here," "not on my street," or "not-in-my backyard." LULUS have included such facilities as hazardous waste disposal sites. Adverse public reactions to a LULU result largely from the perceived negative external effects on the health and safety of the local residents.

12/ F. J. Popper, "LP/HC and LULUS: the political uses of risk analysis in land use planning," Risk Analysis, (Vol., III 1983) at 255-263.

It is well established that the public perceives radiation and its associated hazards with particular dread. The Hicksville, Bellmore, and Roslyn facilities will be designated as the receiving place for people who may be contaminated by radioactive materials. Decontamination will take place both inside and outside the reception center structures, and radioactive wastewater and solids will accumulate there during the accident. Because of these facts, many residents of the surrounding communities will perceive a threat to their health and that of their families.

Q. What will be the effect of the Roslyn, Hicksville and Bellmore facilities being perceived as LULUs?

(Johnson)

A. People will attempt to evacuate from the area surrounding the reception centers, a process which is likely to cause congestion around each reception center and further delay the arrival of evacuees. Data previously collected during the survey conducted on Suffolk County's behalf show that even before LILCO prepared to use three facilities located in Nassau County as monitoring and decontamination centers, much of the population in communities surrounding the reception centers would evacuate in the event of a general emergency at Shoreham.

The areas surrounding the reception centers are densely populated, and in the case of the Hicksville facility, there is also substantial commercial development surrounding the facility.

See photographs which are Exhibits 3-6 attached to the Direct Testimony of David T. Hartgen and Robert C. Millspaugh on Behalf of the State of New York Regarding LILCO's Reception Centers (April 13, 1987). Residents and workers are likely to sense that the area surrounding the reception center is not safe, and will therefore attempt to leave the area. In many cases, these people will use roads and intersections over which evacuees attempting to reach these reception centers will travel. The result will be greater "background" traffic around the three sites. This will increase traffic congestion and delay the arrival of evacuees for monitoring and decontamination.13/ Thus, LILCO will be unable to provide monitoring to EPZ evacuees within the approximately 12-hour time limit established by NUREG 0654 Section J.12.

Q. LILCO's witnesses argue that for local residents the reception centers will be perceived as a "solution" not a problem. LILCO Testimony at 23. Do you agree?

(Johnson)

A. No. This statement is unexplained. The reception centers may indeed be considered solutions for the evacuating public, but they will not be considered "solutions" for people living around the reception centers, whose lives will be disrupted by an influx of hundreds of thousands of potentially

13/ See Direct Testimony of David T. Hartgen and Robert C. Millspaugh on Behalf of the State of New York Regarding LILCO's Reception Centers (April 13, 1987).

contaminated peopled and vehicles. People around the reception centers will perceive the reception centers as hazards and many, acting on this perception, will leave the area.

V. ASSIGNMENT OF RECEPTION CENTERS AND EVACUATION ROUTES

Q. Please state your concerns about LILCO's assignment of reception centers and evacuation routes to EPZ residents.

A. LILCO has divided the Shoreham EPZ into 19 evacuation subzones. Plan, Appendix A. The residents within each subzone are assigned to a specific reception center, and are assigned routes to take to those centers. Thus, two evacuation subzones are assigned to the Bellmore reception center, 10 subzones are assigned to the Hicksville reception centers, and seven evacuation subzones are assigned to Roslyn reception center. OPIP 4.2.3, at 15.

Our concern is not with the fact that such assignments have been made, but rather that in assessing the suitability of the reception centers and the ability of the routes to handle evacuating traffic, LILCO and its consultant, KLD, have assumed that all people will go to the reception center they have been assigned and that they will follow their designated routes. See LILCO Testimony, Attacnments M and S. This assumption is unfounded. In fact, many people will go to reception centers other than the one assigned or take non-designated routes.

Q. What is the basis for your conclusion?

A. Research shows that people will act based on their perception of what will be best for themselves and their families. In the event of a Shoreham accident, people may have ideas different from LILCO's as to which reception centers to report to and the route to take in reporting. Such decisions would vary based on a multitude of factors, including where people were located when they heard the order to evacuate or which reception center site they are familiar with. Moreover, in reaching the decision as to which reception centers to report to, some people may heed LILCO brochure maps while others will find their own routes -- either because they do not have road maps or find them too complex. In addition, to the extent that LILCO relies on residents to be familiar with what subzone they are in, people will have no concept of their subzone because such divisions are not well defined for the EPZ population.

The result of this behavior is that neither LILCO nor its consultant can rely on people reporting to the reception center designated in the Plan, or using the route designated by LILCO for travel to that reception center. Such variations from the complex LILCO Plan routing scheme will cause traffic congestion, overloading at particular reception centers and further delays in monitoring.

VI. CONCLUSIONS

Q. Please state your conclusions.

A. The reception center scheme does not adequately account for three aspects of evacuee behavior which will cause lengthy delays in monioring and decontamination. First, the location of the reception centers will cause a substantial expansion in evacuation shadow. Second, the reception centers themselves constitute locally unwanted land uses, which will cause people surrounding the recepion center to evacuate, thus increasing background traffic. Finally, people will not necesarily follow the evacuation routes assigned, nor go to the reception centers designated in the LILCO plan. Each of these phenomenon will cause traffic congestion, delays in monitoring, and overcrowding at reception centers.

Q. Does his conclude your tesimony?

A. Yes.