NRC Staff Comments on the Presentations at the June 28, 1983
Meeting of the Shoreham Commission

prepared by

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1. The Probabilistic Risk Assessment of the Shoreham Plant

Neither version of the probabilistic safety study of Shoreham, prepared by LILCO's contractors, has been reviewed by the NRC, although we expect it to be submitted for review in August. Therefore, the NRC cannot comment on the accuracy of Shoreham risk predictions, although we can judge the plausibility of the results in comparison with risk assessments of other nuclear plants prepared for or reviewed by the NRC.

Results quoted by both LILCO and Suffolk County from the Shoreham probabilistic safety study do appear to be plausible. Note, however, that the state-of-the-art in predicting reactor risk is not such that precise projections can be made, either of accident likelihood or consequences. It is common to find that reactor risk assessments somewhat underestimate accident likelihood and overestimate accident consequences. Thus it is not surprising that Suffolk County's consultant, Dr. Budnitz, suggests employing a core melt accident frequency (one core melt accident per 5000 reactor years) somewhat above the LILCO predictions, and that LILCO's consultant, Dr. Rogers, suggests employing a model of release severity that is reduced from conventional (WASH-1400) models. Both are plausibly correct.

The NRC staff concurs in some but not all of Dr. Rogers comments to the Shoreham Commission. It is widely agreed within the technical community that the WASH-1400 predictions of releases are pessimistic in some respects. The NRC staff has a major research program under way to develop a better predictive model for release magnitudes ("source terms").

II. Characteristics of Reactor Accident Radiological Risk

The radiological severity of a reactor accident is a sensitive function not only of the quantity of fission products released but also of the weather at the time. Conditions that minimize the atmospheric dilution and dispersion of the plume are worst, i.e., very low wind speeds and low turbulence. Even the most severe release, occuring at a time of medium to high wind speeds and high turbulence will not give rise to early fatalities off site.

Generally, doses are projected to be highest very close to the plant and to decline rapidly with distance. The great majority of early fatalities (if any) are projected within a few miles of the plant. Two factors can give rise to exceptions, however. If the release is a very hot plume, plume rise due to its bouyancy can carry it over the near-by terrain. It may not "touch down" for some miles. Rain can scrub the plume of many particulate or soluble fission products and thus give rise to concentrated areas of contamination - potentially giving high doses - at some distance from the plant. Those phenomena are responsible for the predictions that early fatalities might occur beyond ten miles, though this is quite unlikely even if a particularly severe release were to occur.

Very high levels of contamination, i.e., those with the potential for early fatalities, cannot occur over large areas of land. If the atmospheric dispersion of the plume does not concentrate the contamination in one or more narrowly circumscribed "hot spots" then the contamination will be too dilute to give lethal doses. Much the same is true of early injuries, though the area so contaminated may be greater as the threshold for early injury (about 50 rem) is less than that for early fatalities (several hundred rem). Latent casualties (cancers appearing in subsequent decades and genetic effects in successive generations) are not so concentrated. Even the survivor of a near lethal dose of radiation does not stand a high individual probability of incurring a latent health effect. However, as latent casualties are not thought to have threshold dose levels, they may occur - in extremely dilute form - in the very large population subject to slightly elevated radiation doses in the tens to hundreds of miles down wind of a large release.

Where high doses are projected, immersion in the plume is projected to contribute less to total dose than the continued exposure to contaminated ground after plume passage. This has several implications for emergency preparedness. Avoidance of the path of the plume, shortly after it has passed, is nearly as important as the avoidance of immersion in the plume. For those exposed to the plume or moving into contaminated areas, the length of their stay, and the shielding factors prevailing for them are highly influential on their total dose and their prospects for adverse health effects.

No dose is ever projected to be so high that it kills directly. Rather, the projected "early fatalities" are a consequence of immune deficiences caused by radiation damage; uncontrolled infection is generally the immediate cause of the projected early fatalities. Supportive medical treatment, of the kind provided to subjects of non-radiogenic immune deficiencies, and commencing within about 20 days of exposure, can substantially reduce the number of early fatalities.

Accidents that stop short of severe core damage cannot give rise to particularly large releases. Virtually all of the public health risk posed by nuclear reactors originates in core damage or meltdown accidents. Some core damage or meltdown accidents can be well contained and mitigated, so that they do not result in substantial releases. Some core melt accident scenarios can give rise to very large releases. Those that do so within a few hours of the accident onset tend to be worse than those that take ten or more hours to develop. Radioactive decay and other physical processes tend to reduce the severity of releases that take a long time to develop from onset to release. It is generally possible to identify the symptoms of an accident in progress and to prognosticate the prospect of a release, although this cannot be done with exactitude or with certainty. Reactor operators are much better trained to do this today than they were before the accident at Three Mile Island.

A knowledge of plant status, as an accident evolves, and of the prevailing weather can be used to make a prognosis of possible offsite outcomes. This information can be used to tailor offsite emergency response to the particulars of the situation.

III. Comments on LILCO and Suffolk County Characterizations of Emergency Preparedness and Risk

A. Suffolk County authorities and consultants argue that an emergency plan cannot be developed that would eliminate casualties from all of the possible reactor accidents. The NRC agrees: emergency preparedness can reduce but not eliminate public health risk associated with reactor accidents. It is not the intent of the NRC's emergency preparedness regulations - nor is it theoretically possible at any reactor site - to develop a plan that would assure that no one receives a dose in excess of the protective action guidelines (PAG's) for any release, regardless of timing or severity. See also Section IV below.

B. Suffolk County has identified some reasons to believe that emergency planning for Shoreham is more difficult than at other nuclear power plants. Many but not all of these arguments are generic and apply equally to many or all reactor sites. LILCO has identified some unique advantages of the Shoreham site with respect to emergency planning. The NRC staff does note some atypicalities in the emergency preparedness problems for Shoreham, but on balance, the advantages and disadvantages of the site are of comparable importance: we view the objective, technical problem of developing satisfactory emergency plans for Shoreham to be quite typical and solvable.

C. Suffolk County consultants indicate that sheltering (followed by relocation after plume passage) may be a superior risk reduction strategy to evacuation for some accident scenarios and some distances from the plant. The NRC staff agrees. Sheltering should be offsite emergency response of first resort, at least beyond the first mile or so from the plant. Precautionary evacuation, if any is warranted, should generally be confined to a radius of one to five miles from the plant, depending upon the accident scenario, the projected time to release, and the prevailing weather. NRC sponsored research suggests that continued sheltering is generally the superior risk reduction strategy beyond this range. As much or more emphasis should be placed upon planning for relocation after plume passage as to anticipatory evacuation. Note that rapid relocation (within a few hours of plume passage) can be quite effective in limiting doses. The staff believes that a four hour relocation time is a reasonable estimate. Note also that the logistics of relocation, selectively applied first to "hot spots" of radioactive contamination, differ substantially from anticipatory evacuation. First one must survey and map the contaminated areas. Then, by moving small numbers of people out of the highly contaminated areas short distances to adjacent areas free of contamination the relocation can be accomplished.

D. NRC criteria for developing the approximate size of the plume exposure EPZ is correctly summarized in LILCO's fourth slide. The NRC did employ probabilistic risk assessment as one of the bases for its policy of defining the plume exposure EPZ as roughly a circle of ten mile radius around the plant. The NRC is amenable to moving the boundaries of the EPZ modest distances to follow existing political, geographic or demographic boundaries. On the other hand, the NRC does not endorse, at this time, the use of plant-specific risk assessments to justify a plume exposure EPZ radius appreciably smaller than 10 miles. As mentioned above, it is not necessary to suppose or plan for a precautionary evacuation of everyone within the full 10 mile EPZ, nor should one assume that sheltering followed by relocation from contaminated ground need never be considered beyond 10 miles. The 10 mile zone is intended as a planning base - not a sharply defined threshold area of emergency response.

IV. <u>Objective of the NRC Emergency Preparedness Regulations</u>

The NRC has noted that problems in interpreting the symptoms of an accident in a nuclear power plant, diagnosing the symptoms, developing a prognosis of the future course of events, communicating this information from plant personnel to appropriate officials in the offsite environs, their decision to implement appropriate protective actions for the population in surrounding areas, and communication of this information to the public can be delayed or confused if these steps are nct anticipated and planned in advance. The NRC therefore requires both the owner/operators of nuclear reactors and offsite authorities anticipate and plan what is reasonable and prudent to do in the very remote event of a reactor accident with the potential to threaten public health and safety. The objective of the planning process is to pave the way for the expeditious action appropriate to the circumstances.

The NRC would not license a plant if the radiological risk posed by possible accidents were not very small - even in the absence emergency preparedness. Nevertheless the NRC has chosen to require emergency preparedness as another level of "defense-in-depth", the principle that a variety of independent and diverse levels of protection should bo afforded the public from the hazard of radiation exposure. The NRC believes that reasonable efforts to anticipate and plan for public protective actions in the vicinity of a commercial nuclear plant can substantially reduce, though not eliminate, the already small offsite radiological risk, and is, therefore, a prudent if not essential requirement.

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REMARKS

Attached is the paper for Governor Cuomo's Shoreham Commission that I prepared for Bill Dircks to transmit, for your information.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 4, 1984

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

Dear Mr. Glass:

In the course of the Shoreham proceeding, you have received from LILCO copies of various materials used in the LILCO training program for offsite emergency personnel. These materials include scripts of videotapes, workbook sections, lesson plans, and drill scenarios.

In order to provide expert testimony before the Atomic Safety and Licensing Board, it is important that the FEMA witnesses review the LILCO training materials. I am therefore requesting that FEMA conduct such a review. FEMA's views on the adequacy of the training materials can then be presented in the hearing context in response to the specific training contentions raised by Suffolk County.

Your cooperation in this matter is appreciated.

Sincerely,

David A. Repka

David A. Repka
Counsel for NRC Staff

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