Cambridge, MA 02238
Telephone (617) 491-1850
Telex No. 92-1470

Bolt Beranek and Newman Inc.
18 March 1980

Mr. James Kerr
Federal Emergency Management Administration
1725 I Street, NW
Washington, DC 20472

DOCKET NUMBER
PROPOSED RULE PR-50 (171)
(44 FR 75167)

Subject: Use of Sirens for Public Notification Around Nuclear Power Plants

Dear Mr. Kerr:

As we discussed on the phone last week, interest in sirens has rekindled as a result of the NRC's proposed rule to require public notification in the event of certain emergencies at nuclear power plants. I have read the proposed rule and an associated guidance document (FEMA-REP-1), and written a summary of their contents pertinent to sirens. A copy of this write-up is enclosed, and as you will see I have some misgivings about the way the use of sirens has been handled.

In particular, I am concerned about the lack of any quantitative means to assess the effectiveness of an acoustic notification system, and thus to optimize its performance. You will recall that one of the recommendations of the study we did for you under Contract No. DCPA-01-78-C-0329, was for a computer program for this purpose. Given this new and critical application, perhaps FEMA would wish to reconsider that recommendation.

The work required to develop such a computer program would take about a year, and might consist of the following tasks:

1. Assessment of the forms of topographic, demographic, land-use, and meteorological data available for nuclear power plants; and assessment of the computer capabilities of the lead agencies charged with notification-system design, siting and operation around such plants.

2. Preparation, in conjunction with FEMA, of detailed specifications for the computer program. This will include the preparation of an acceptance test for the program upon delivery.

3. Preparation of the computer program in accordance with the specifications, documentation of the program, and preparation of a training and operating manual.

Acknowledged by card. 5/2/80

DOCKETED
USNRC
APR 3 1980
Office of the Secretary
Docketing & Service
Branch

L-4-1, pt. 50

8005230313

4. Performance of field tests with an installed siren system at a site suitable to FEMA, in order to compare observed results with those predicted by the program.

5. Acceptance-testing and delivery of the program to FEMA with related documentation.

I estimate that the cost of such an effect would be in the range from $250,000 to $350,000.

We note that Section I, G. of FEMA-REP-1 indicates that FEMA "expects to make a significant contribution to assist in the development of State and local plans..." for emergency response and preparedness around nuclear power plants. Perhaps the computer program suggested here could be a part of that contribution. If FEMA agrees, BBN would be pleased to submit for your consideration a formal unsolicited proposal and cost estimate.

I will call you again in early April to determine your interest in this suggestion.

Yours very truly,

BOLT BERANEK AND NEWMAN INC.

David N. Keast

DNK/m

Enclosure

The Use of Sirens and Other Acoustic Means for Prompt Public Notification Near Nuclear Power Plants

D.N. Keast
Bolt Beranek and Newman Inc.
(617) 491-1850

March 1980

BACKGROUND

As a result of the accident at the Three Mile Island nuclear power plant, the Nuclear Regulatory Commission (NRC) has published a proposed rule requiring the preparation of plans and capabilities for coping with emergencies at nuclear power plants (44 FR 75167, 19 December 1979). This new emergency planning requirement is much more extensive than that previously required (10 CFR 50, Appendix E).

In January of 1980, the Federal Emergency Management Administration (FEMA) and NRC published a document entitled "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" (FEMA-REP-1 and NUREG-0654) for interim use and comment. This "Criteria" document and the proposed regulation establish a thorough set of requirements for emergency planning and preparations. Included are requirements for planning the analysis of emergencies at nuclear power plants; for notification of and coordination with Federal, State, and local agencies; for emergency response actions at various licensee and governmental levels; for informing the press; and - in some cases - for rapidly informing the public of the need to take protective actions. It is this facet of the planning requirement: informing the public, that is of interest to us here.

The proposed rules require that the Emergency Response Plans be prepared jointly by the NRC licensee and appropriate State and local officials no later than 1 January 1981. The Plans must then be dry-run, reviewed and approved by FEMA and NRC. Subsequently, they must be exercised periodically.

If a Plan is not approved, or if subsequent exercises of the Plan are not acceptable, then the nuclear reactor may be shut down. The proposed rule contains various alternates regarding the requirements for shut-down and the frequency of exercise tests of the Plan.

PUBLIC NOTIFICATION

Some of the anticipated emergencies for planning purposes (specifically those classed as "site emergencies" and "general emergencies" in NUREG-0610) require immediate public notification and advice on protective actions the public may have to take. This notification would be necessary within the "plume exposure pathway Emergency Planning Zone" (EPZ) - approximately a 10-mile radius around the reactor site. Quoting: "It is expected that the capability will be provided to essentially complete alerting of the public within the plume exposure pathway EPZ within 15 minutes of the notification by the licensee of local and State officials." Operation of a system for public notification would be the responsibility of local or State officials. However, it is the plant operator's responsibility to ensure that means exist for such notification. Estimates of the times required to evacuate various sectors of the EPZ must also be prepared. These times will, of course, be dependent on the time required to notify the public.

Appendix 3 of the "Criteria" document discusses means for providing prompt notification of the public. NOAA weather radios, automatic telephone dialers and aircraft with loudspeakers are mentioned; but the emphasis is on the use of sirens. Material about sirens is extracted from BBN Report 4100 "Outdoor Warning

Systems Guide" published in June 1979 under Contract No. DCPA-01-78-C-0329. Nothing is said about secure power for the prompt notification system.

The Appendix states: "The minimum acceptable design objectives for coverage (e.g. 60 dB signal from sirens) by the notification system are:

Distance	% Notified in 15 Minutes
5 miles	100%
5 to 10 miles	90% ...."

This statement is somewhat confusing, and may in some circumstances be an unjustified assumption. Nevertheless, there is a strong implication that a siren network producing at least 60 dB at all locations in the plume exposure pathway EPZ will be considered acceptable by NRC staff, at least initially.

AREAS OF QUESTION

In addition to the questions noted above about the possible need for secure power; and about the effectiveness of a 60 dB signal to warn 90% to 100% of the public, several other questions are apparent.

60 dB where? We assume that the appendix means out-of-doors. However, at any given time most people are indoors. To achieve 60 dB indoors would typically require 80-85 dB out-of-doors. (This requirement is increasing over time because of the emphasis on building energy conversation.)

To achieve 60 dB inside a motor vehicle would require about 80 dB outside. However, under most circumstances a 60 dB siren sound would be unnoticed in vehicles because of high background levels. 75-80 dB would be required to be noticed (95-100 dB outside).

Costs. To cover a 10-mile radius circle with signals exceeding (on the average) 60 dB out-of-doors would take about 20 sirens and cost up to $300,000, without secure power. Some present proposals are aimed at a 70 dB signal, requiring 100 sirens at a cost of approximately $1.5 million.

To achieve 60 dB indoors, on the average, would require about 650 sirens costing about $10 million. To provide adequate warning sound levels inside most motor vehicles would take about 6,000 sirens and cost about $90 million!

There is the possibility that a 20-siren system would be installed that, through tests, would be found grossly inadequate to warn 90-100% of the population. Costly additions to the system might then be required.

Alternative acoustic notification means. It has been perhaps 15 years since any significant research work has been done on acoustic-warning alternatives to sirens. It is possible that more effective and far-less costly means could be used. One possibility: pyrotechnics. Aerial explosive devices (fired in a distinctive sequence) produce momentary peak overpressures at 100 ft of about 185 dB. This is 60 dB (1,000 times) more intense than the loudest siren. This sound is produced at the best location for propagation through the atmosphere. Low-frequency blast noise travels well through building structures, and its impulsive

signal is quite noticeable. Secure power would be simple to provide and costs would be low. A large body of pertinent data is available from studies of community noise problems around military artillary ranges.

Notification system optimization. Public notification within the plume exposure pathway EPZ presents a unique warning situation with a unique and beneficial attribute: the people to be notified are generally downwind of the origin of the potential hazard. This is the direction in which sould propagation is most favorable, so this fact could be taken into consideration in the layout of any acoustic notification system.

Indeed, at the actual time of an emergency the proposed rule requires that pertinent meteorological data and computational capability be available to predict plume diffusion paths and radiation dose rates. This same capability could be used to optimize sound coverage by steering rotating-horn-type sirens.

Analysis of notification-system effectiveness. The sound level produced by an acoustic notification system will depend upon relatively fixed parameters like terrain, demography and land uses; and upon variable parameters like the time of day and season of the year, wind direction, vertical wind-speed gradient, and vertical temperature gradient (stability class). All of this information is available for regions around nuclear power plants. It could be applied, through a computer model, to assess the effectiveness of an acoustic notification system under various conditions on a statistical basis. No such model is presently available, but if it were it could be used not only to optimize system layout and operation; but also to assess the effectiveness of a given system at the particular time an emergency occurred. Such an assessment method would seem to be a useful tool to have before great reliance is placed upon a siren notification system.