DEC 27 1982

The Honorable Lindy Boggs
United States House of Representatives
Washington, D.C. 20515

Dear Congresswoman Boggs:

The newspaper article attached to your letter (dated November 8, 1982) which cites "worst-case" consequences of hypothetical accidents at the Waterford Unit 3 facility does not adequately reflect the reactor siting study performed at Sandia National Laboratories. I would like to respond to the questions posed in your letter and clarify the distorted and incomplete picture of nuclear accident probabilities, consequences, and modeling uncertainties presented in the article. In particular, a discussion follows which addresses:

- the objectives of Sandia's study;
- the misinterpretation of the probability and consequence estimates in Sandia's study as being both applicable to actual operating reactors and including best estimate public emergency response assumptions, especially beyond ten miles of the site;
- the uncertainties associated with accident consequence modeling of "low probability/high consequence" reactor risks; and
- several calculated results for public health risk versus distance away from a reactor to characterize the risk in the New Orleans metropolitan area.

Sandia Study Objectives

The Sandia study is entitled "Technical Guidance for Siting Criteria Development" (NUREG/CR-2239). Its purpose was to develop the technical guidance to support the formulation and comparison of possible siting criteria for nuclear power plants. It includes information on (i) consequences of hypothetical severe accidents; (ii) characteristics of population distributions around current reactor sites; (iii) site availability within the continental United States based on population density, seismicity, topography, water availability and land use restrictions; and (iv) socioeconomic impacts of reactor siting.

The Sandia study is not a new generic analysis of the risk of reactor accidents; it merely assumes the occurrence of severe core melt accidents of different severity and calculates the range of possible consequences at U.S. reactor sites to examine differences among sites. Although the Sandia study provides us with useful analyses of the importance of various siting factors, it does not change our overall perception of reactor risk. On the contrary, the results presented

in this report are consistent with those presented in the Reactor Safety Study (WASH-1400) and later NRC and industry publications. The results in the Sandia study also give us assurance that our present reactor siting criteria are not seriously flawed and that it is reasonable to postpone further consideration of changes in siting criteria until new information on radioactive source terms (i.e., the amounts and types of radioactive materials released outside of the plant in an accident situation) is available next year.

Nonreactor-Specific Nature of Siting Consequence Calculations

The Sandia report carefully states that the results presented in the report do not represent potential accident risks at existing reactor/site combinations. That is, the study did not estimate specific accident sequences of events and source terms for individual power plants. The report examined potential accident consequences for specific site characteristics (e.g., population and meteorology) coupled with a generic plant. It was assumed that a standard plant (of the same size) was operating at 91 existing sites. The intent was to explore site differences using a set of source terms which are essentially independent of particular reactor design considerations and published in NUREG-0773, "The Development of Severe Reactor Accident Source Terms: 1957-1981."

Furthermore, the calculations incorporate a conservative bias in the emergency response assumptions for the extreme cases which leads to a conservative overestimation of the maximum calculated number of deaths or injuries. For example, the siting analysis study assumes that individuals beyond a ten-mile evacuation radius from the facility would not be evacuated or seek more effective sheltering, but would go about their normal activities for 24 hours after the released radioactivity had reached them. Peak estimates of early fatalities and injuries are caused by rainout of radioactivity from the atmospheric plume onto cities located more than ten miles from the reactor.

Risk Extremes and Modeling Uncertainty

The news stories have concentrated on the peak, or maximum calculated values of consequences. The likelihood of occurrence of these most severe consequences is very low. The exact value of this low probability is, of course, quite uncertain. But the fact that it is very low is beyond reasonable dispute, since it is necessary for the joint occurrence of a combination of many low probability events. This report assumes that the annual probability of large scale core melt at a typical plant is 1 chance in 10,000 and that the probability of large scale release resulting from a full scale core melt is 1 chance in 100,000. These assumptions are supported reasonably well by existing risk studies including both predictive studies (probabilistic risk analyses) and analysis of operating experience. The siting study merely assumes these probabilities of core melt and large release and calculates further probabilities based on meteorology and population data. The analyses indicate about 1 chance in 10,000 that weather sequences and wind direction could combine to produce the very unlikely scenarios which led to the maximum calculated consequences. Thus, the staff estimates that these maximum calculated annual

consequences are about 1 chance in 1 billion years* per reactor. Moreover, there is a known, but unquantified, pessimism in these consequence calculations due to the conservative treatment of radioactive release source terms. Major research programs by NRC and others are investigating just how much lower our release estimates should be. If our research confirms that the assumed radioactive ex-plant source terms should be substantially smaller than those used in WASH-1400 or NUREG/CR-2239, this would have a dramatic effect on predicted consequences. The Sandia study indicates that a factor of 10 reduction in source term magnitude, say, would reduce the peak early fatalities by as much as a factor of 100. Also, it is noted that distances to which consequences might occur depend heavily on source term assumptions.

Individual Risk Estimates for Waterford-3 Site

In order to gain some perspective on the distance relationship of risk to an individual for the largest release scenarios postulated in NUREG/CR-2239, the following estimates are provided in the table below. (Here, risk means the product of the probability of occurrence of an accident and the magnitude of the consequences, given that occurrence.) The annual individual risk of an early fatality, assuming that a catastrophic release occurs once per 100,000 reactor years and no emergency response measures are taken, is about 1×10^{-6} (or one chance in a million) and about 4×10^{-9} (or four chances in a billion), at one and ten miles away from the reactor, respectively. Effective evacuation of the area would lower the risk to a person to about 2×10^{-8} (or two chances out of 100 million at one mile) and less than about 1×10^{-12} (or one chance out of a trillion at ten miles).

INDIVIDUAL RISK OF EARLY FATALITY

Distance (Miles)	No Evacuation (1-day Exposure)	Effective Evacuation (1-hour Exposure)
1	1×10^{-6}	2×10^{-8}
10	4×10^{-9}	1×10^{-12}

These calculations show that individual fatality risk is very small compared to other everyday risks people face. For comparison, the U.S. national average individual risk of accidental death, considering all causes, is about 5×10^{-4} (5 chances in 10,000) per year; and the average individual risk of

*This number is the product of the (1/100,000) probability of a large scale release from a full scale core melt times the (1/10,000) probability of adverse weather sequences and wind direction.

cancer death is 2×10^{-3} (2 chances in 1,000) per year. The individual fatality risk calculated above drops by approximately a factor of 1,000 going from one to ten miles away. The early fatality risk continues to drop sharply beyond ten miles; and, beyond twenty-five miles, it is virtually zero.

The risks to the public resulting from routine emissions of a power plant are currently addressed in the Environmental Impact Assessment process before a plant is licensed to operate. For all plants, the NRC has found that there will be no measurable radiological impact on any member of the public from normal operation of the plant.

In summary, I wish to bring all this information back into perspective for the Waterford Unit 3 power plant facility and the concern expressed in your letter about possible danger to people residing downriver in St. Charles, Jefferson, Orleans, Plaquemines, and St. Bernard Parishes. The risk to people adjacent to the power plant and in more distant areas is best characterized as being extremely small. Thus, the siting analysis research report results for "low probability/ high consequence" events are consistent with previous investigations and should not be cause for alarm by the public.

Sincerely,

(Signed) William J. Dircks

William J. Dircks
Executive Director for Operations

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In summary, I wish to bring all this information back into perspective for the Waterford Unit 3 power plant facility and the concern expressed in your letter about possible danger to people residing downriver in St. Charles, Jefferson, Orleans, Plaquemines, and St. Bernard Parishes. A specific risk analysis of the Waterford plant has not been made; but, if its accident characteristics are similar to typical plants which have been analyzed, it is believed that the risk to people adjacent to the power plant and in more distant areas is best characterized as being extremely small. Moreover, the risk, when actually estimated, is likely to meet the criteria proposed in the safety goal statement released for comment and discussed in NUREG-0990, "Safety Goals for Nuclear Power Plants: A Discussion Paper." Thus, the siting analysis research report results for "low probability/high consequence" events are consistent with previous investigations and should not be cause for alarm by the public.

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