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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING APPEAL BOARD

Before Administative Judges
Alan S. Rosenthal, Chairman
Howard A. Wilber

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, ET AL., (Seabrook Station, Units 1 and 2)	Docket Nos. 50-443-OL 50-444-OL (Off-Site Emergency Planning and Safety Issues) January 7, 1988

ATTORNEY GENERAL JAMES M. SHANNON'S MOTION FOR DIRECTED CERTIFICATION OF THE NOVEMBER 16 AND 18, 1987 ATOMIC SAFETY AND LICENSING BOARD RULINGS CONCERNING THE ADMISSIBILITY OF CERTAIN EVIDENCE

INTRODUCTION

On November 16, 1987, the Atomic Safety and Licensing Board ("ASLB") sustained the Applicant's objection raised in the form of a motion *in limine* to the admission of certain pre-filed testimony submitted by the Attorney General of Massachusetts ("Mass AG") as part of its case-in-chief in the ongoing litigation before the ASLB on the adequacy of the emergency plans for the New Hampshire portion of the Seabrook EPZ. This testimony, a copy of which is attached hereto as Exhibit 1, is entitled "Commonwealth of Massachusetts Corrected Testimony of

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Steven C. Sholly on the Technical Basis for the NRC Emergency Planning Rules, Dr. Jan Beyea, on Potential Radiation Dosage Consequences of the Accidents that Form the Basis for the NRC Emergency Planning Rules, Dr. Gordon Thompson on Potential Radiation Release Sequences, and Dr. Jennifer Leaning on the Health Effects of Those Doses." On November 18, 1987, after a proffer of this testimony by the Mass AG, the ASLB refused to admit this testimony into evidence and placed it in the rejected evidence file. Also on November 18, 1987, the ASLB denied the Mass AG's motion to refer this evidentiary ruling to the Appeal Board pursuant to 10 C.F.R. 2.730(f). The Mass AG, pursuant to 10 C.F.R. 2.718(i), now brings this motion for directed certification seeking interlocutory review of these ASLB's rulings.

ARGUMENT

I. THE STANDARDS FOR INTERLOCUTORY REVIEW HAVE BEEN MET IN THIS CASE.

It is well-established that interlocutory review will not lie absent a showing by the petitioner that the challenged ruling threatens an affected party with immediate and serious irreparable harm or otherwise affects the basic structure of the ongoing proceeding in a pervasive or unusual manner Public Service Company of Indiana (Marble Hill Nuclear Generating Station, Units 1 and 2), ALAB-405, 5 NRC 1190, 1192 (1977). It is also clear that this standard is the same for consideration of both ASLB referrals pursuant to 10 C.F.R. 2.730(f) and motions for certification pursuant to 10 C.F.R. 2.718(i). Virginia Electric and Power Company, (North Anna Power Station, Units 1 and 2), ALAB-741, 18 NRC 371, 375 n.6 (1983); Commonwealth Edison Company (Braidwood Nuclear Power Station, Units 1 and 2), ALAB-817, 22 NRC 470, 475 (1985). In this case, the second-prong of the Marble Hill test is met: the ASLB's evidentiary ruling affects the ongoing proceeding in a pervasive and unusual way and, therefore, merits interlocutory review.

Although admittedly arising in the posture of an evidentiary ruling, the underlying issues considered and determined by the ASLB in its ruling on the proffered testimony affect the entire nature of the proceeding. In reaching its decision on the admissibility of the challenged testimony the lower Board invited, heard, considered and ruled on fundamental issues concerning the legal standard it is to apply in deciding whether or not the emergency plan presently being litigated before it meets the test established by Commission regulation. In holding that the proffered testimony is not relevant to any issues before it, the lower Board determined that it is precluded from any consideration of the degree to which the emergency plan at issue actually provides protection to the relevant population. Put another way, the Board has interpreted Commission precedent as precluding it from making any judgment that the proposed plan contains "adequate protective measures" which provide adequate protection to the relevant population. 10 C.F.R. § 50.47(a)(1). Instead, the lower Board has accepted the Applicants' and the NRC Staff's invitation to restrict its function to simply that of reviewing the components of the proposed plan against a generic checklist without facing the fundamental site-specific issue whether the actual level of protection afforded by the proposed plan meets the adequate protection standard.[1]

Not only will this ruling pervasively affect the ongoing litigation concerning the New Hampshire plans, but it will delimit the character of the upcoming litigation on the Massachusetts plan affecting the scope and content of admitted contentions, subsequent discovery and the course of those hearings as well. Moreover, because it is anticipated that a consolidated appeal of the ASLB's decision on emergency

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1/ Petitioner is aware of the extent to which he is presenting his arguments on the merits in consideration of the threshold issue whether the challenged ruling has a "pervasive and unusual" impact on the proceeding. This overlap is not unintentional. If the ASLB has erred in excluding this evidence, it has done so on the basis of its erroneous and limited conception of its function and responsibility in adjudging the adequacy of emergency planning at Seabrook. This erroneous and limited conception of its role affects the entire character of the ongoing proceeding including the ASLB's participation in the evidentiary hearing, its rulings on objections and motions, its treatment of other evidence, and its willingness to permit the parties to explore facts and issues as they emerge. In short, having determined that the proffered testimony is not relevant because of its interpretation of its own function and responsibility, the lower Board has transformed an evaluative process of judging the adequacy of a plan into a ministerial process of assuring that the plan has the requisite number and type of components.

planning for the entire Seabrook EPZ will be a desideratum, the challenged ruling will not be reviewed in the normal course until another entire phase of litigation is begun, conducted and completed.[2/]

Significantly, the lower Board itself viewed its determination of the evidentiary issue as a "watershed issue" in the case.[3/] (Transcript at 5532, Exhibit 2).[4/]

2/ The point here is that in addition to delay and added expense, the "very shape of the ongoing adjudication" is altered by the challenged ruling and the lower Board's rationale for it. Cleveland Electric Illuminating Company (Perry Nuclear Power Plant, Units 1 and 2) ALAB-675, 15 NRC 1105, 1113 (1982) (citing cases for proposition that expanded scope or length of proceeding is not ground for certification absent alteration of character of proceeding).

3/ The lower Board did not refer its ruling. However, the comments made by the Board in response to the motion to refer make clear that the Board did not want to prejudice the Appeal Board either way. In essence, the lower Board took the position that it considered the issue fundamental, that the Appeal Board would have to decide whether to permit interlocutory review of it, and that it did not consider a reference by it to the Appeal Board as affecting that issue because the Appeal Board could always reject the reference and would apply the same standard in any case. For example at 5974 of the Transcript, the Board stated:

> "In this particular case, I don't think it makes much difference how it gets to them. They are people who are fully capable of deciding for themselves, and will decide and have represented and acted in the past as entering into an issue when it needs to be entered into. And I think that the issue we have here transcends whether it gets up to them on a certification by the Board, or a motion for directed certification, or whatever. I think that they will do what they think is appropriate and needs to be done with respect to the issue regardless of how it gets up there."

4/ Attached as Exhibits 2,3 and 4 respectively are the transcripts of the November 6, 1987 oral argument on the motion in limine, the November 16, 1987 oral ruling of the ASLB and the November 18, 1987 oral argument on the motion to refer.

In fact, the Board stated at the outset of its oral ruling on November 16, 1987:

> As we stated at the outset during the oral arguments on this testimony, we recognize that it is a very important item of testimony, and ruling on it is extremely important to the case. We believe that it probably meets the standard set out by the Appeal Board for interlocutory appeals, and that is that it would have the potential to affect the basic structure of the case in a pervasive way. (Exhibit 3 at 5594)

Moreover, during the argument on the Mass AG's motion to refer the Board stated:

> Well, it's an important issue, and it's an issue that goes beyond an evidentiary ruling. It is an evidentiary ruling which is based upon our interpretation of a very important Commission regulation, the very regulation that is being heard there [sic]. (Exhibit 4 at 5973)

In light of these circumstances, this Board should permit interlocutory review.

II. THE PROFFERED TESTIMONY IS RELEVANT TO THE ISSUES BEING LITIGATED AND SHOULD HAVE BEEN ADMITTED.

As noted, in reaching its determination that the testimony at issue is not relevant to this proceeding, the lower Board had to interpret the legal standard it must apply to an emergency plan to determine adequacy under the Commission's regulations. The lower Board rested its interpretation on two overlapping considerations. First, the Board considered itself specifically bound by precedent to exclude evidence[5/] that

5/ It should be noted that the lower Board did not interpret Commission precedent regarding dose consequences as constituting an "exclusionary rule" which bars the admission of otherwise relevant evidence. See Exhibit 3 at 5979. Instead, no doubt reading the specific cases in light of the argument of the Applicant and Staff, the lower Board determined that the proffered testimony was not relevant in the first instance.

included dose consequences, citing the decisions in Southern California Edison Co. (San Onofre Nuclear Generating Station, Units 2 and 3), CLI-83-10, 17 NRC 528, 533 (1983) and Long Island Lighting Company (Shoreham Nuclear Power Station, Unit 1), CLI-86-13, 24 NRC 22, 29-30 (1986), and the November 1987 Statement of Policy by the Commission accompanying the new emergency planning rule amendments. See Exhibit 3 at 5606-5609.

Second, the Board appeared to adopt the arguments of the Applicant and the Staff to the effect that even if no specific holding is an all fours with this case, the weight of precedent supports an interpretation of the adequacy standard that makes evidence of the actual dose consequences of a range of accidents not relevant in an individual adjudication. The Staff in oral argument stated:

> There is simply no standard for this Board to evaluate in terms of the adequacy of dose reductions which would bear upon whether or not the utility is complying with NRC regulations.... [T]hey [Mass AG] would have this Board determine what the appropriate standard is as to whether too many people here are being put to too great a risk. And I submit to you that's not the function of an adjudicatory body. That's the function of rulemaking, and it's within the province of the Commission. If the Commission should decide that they do wish to promulgate a rule as to how many people may be exposed to how great a risk, that's something they would do through the general provisions of rulemaking, through notice and comment. And that type of a rule would apply to all plants, not just to Seabrook. Exhibit 3 at 5577 and 5578.

Similarly, the Applicant in its written Objection in the Form of a Motion _In Limine_ dated October 1, 1987 stated:

> the Testimony here at issue is irrelevant in an NRC proceeding on Emergency Planning. The standard which must be met by an Emergency Plan is that it is designed to achieve reasonable and feasible dose savings given the circumstances of the site in question. Whether these dose savings will be high or low in absolute terms at a particular site in the circumstances of a given accident or class of accidents is irrelevant. Applicants' Objection at page 8.

In short, the lower Board accepted the logic of the interpretation of the emergency planning regulations proffered by the Applicant and the Staff: _because_ 1) no quantitative minimum level of protection in terms of dose consequences is set forth in the regulations or case law; 2) every site will present a different profile of risks in the event of an accident; and 3) emergency planning is introduced for this Applicant not at the siting stage but rather at the operating license stage after the plant is sited _and_ constructed,[6/]

6/ The Applicant has put its view of the matter succinctly in an earlier brief to this Appeal Board: "In reality what Mass AG is attempting to do . . . is to turn the emergency planning regulations into a siting criterion; a test over and above, or in addition to, those set forth in 10 C.F.R. 100. This is not the purpose of the regulation. Its purpose is to provide, to the greatest extent reasonably possible, additional 'defense in depth' beyond that provided in the first instance by the siting criteria. _At some sites the additional protection possibly will be considerable given the geographic, demographic and political . . . characteristics involved; at other sites it will be less or essentially none. This makes the latter no less acceptable._" Brief of Applicants on Appeal From the Memorandum and Order of the Licensing Board issued April 29, 1986 before the Atomic Safety and Licensing Appeal Board, dated May 30, 1986 at page 17 (emphasis supplied).

therefore, the emergency planning regulations can not render an already-sited plant unlicenseable because of the level of risk to the relevant population attached to that plant's operation. As a consequence, evidence of the level of risk, and its mirror image, the level of actual protection afforded by the emergency plan, is not relevant because no level of risk would be too high.7/

The logic of this interpretation, however, is not supported by the clear language of the emergency planning regulations, the history of those regulations, or the prior Commission precedent interpreting those regulations.

A. Evidence Of The Actual Level Of Protection Afforded The Public By The Plan Is Relevant To Any Determination By The ASLB That The Plan Is Adequate.

The testimony at issue has as one of its themes the actual radiation dose consequences that will result from a substantial

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7/ Obviously, this logic assumes the plant has been sited and constructed in accordance with Commission regulations. As such, the Commission, in the abstract perhaps, would not consider the level of risk of operation to be high no matter what the emergency planning posture was. However, the Commission has determined that in adjudicating the adequacy of emergency planning this first line of defense must be assumed to have failed. It is in this context that the adequacy of emergency planning is to be judged. For this reason, the argument of the Applicant and Staff that evidence of the actual level of risk is not relevant because no level of risk would be too high cannot be based on any discounting of the actual risk in light of the probabilities of any accident at Seabrook producing off-site consequences.

portion of the range of accidents within the planning basis established by the NRC.[8/] These dose consequences and their corresponding health effects are modeled for one of the emergency scenarios set forth in the NHRERP (Scenario 1; a summer weekend day with a large beach population).[9/] This evidence is directly probative of the actual level of protection afforded the population at risk by the NHRERP. Any determination or finding by the ASLB that the NHRERP provides "reasonable assurance that adequate protective measures can and will be taken" is predicated on an assessment of "adequacy"

8/ The testimony presents the dose consequences for three distinct source terms. Each of these source terms could be generated by a number of different accident scenarios within the planning basis. Thus, many more than three particular accidents are at issue here. In fact, the testimony represents, in part, the attempt to model the effects of those accidents in the planning basis that unfold relatively quickly. Obviously, the selection principle at work here is that it is this subset of all the accidents in the planning basis that are most relevant for assessing the adequacy of an emergency plan. Slower-paced accidents, although within the planning basis, do not really test the adequacy of a plan because the preferred option--evacuation--might be chosen without any cost in higher dose consequences.

9/ The testimony focuses on the summer period because the large summer population obviously presents the greatest difficulties for effectively employing the available protective measures. Whether the available protective measures are adequate or not is best answered by evaluating the actual level of protection afforded during those periods when the protective measures are more difficult to employ. Measuring the adequacy of anything involves a process of assessing its performance in part at the margin of its capacity.

that perforce must look to the actual level of protection afforded the public.[10/]

In a case lacking empirical or descriptive evidence of the actual level of protection afforded by a plan in a site-specific context, it may be permissible for a licensing board to assess the adequacy of a plan by comparing it to a generic set of criteria and presuming that a plan that meets

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10/ No meaningful distinction should be drawn between "adequate protection" and "adequate protective measures". Cf. Transcript at 5564 (Exhibit 2) and 5603 (Exhibit 3.) First, as noted infra, the 1980 emergency planning regulations were adopted by the Commission pursuant to the public protection framework of the Atomic Energy Act which sets forth the "adequate protection" standard at 42 U.S.C. § 2232(a). Second, 10 C.F.R. 50.47(a)(1) requires that the NRC find that "adequate protective measures can and will be taken" (emphasis supplied). The additional necessary predictive finding that adequate protective measures will be taken indicates a regulatory requirement concerning the actual outcome of a radiological emergency. Thus, not only must the proposed protective measures qua planning measures be "adequate" as viewed against an array of technical criteria (as set forth, for example, in NUREG-0654) but those measures that will be taken in the event of an emergency must be "adequate" in practice. In that regard, "adequacy" has less to do with the degree to which planners have actually tried and more to do with the degree to which they will be seen to have succeeded. Finally, the Commission itself has used "adequate protection" and "adequate protective measures" interchangeable, most recently in its discussion of the amendments to the emergency planning rules. See 52 Fed. Reg. 42078 at 42081 (November 3, 1987) (discussing what is essential for "NRC to determine that there will be adequate protection of the public health and safety").

those criteria does provide an adequate level of protection.11/ Moreover, it may even be that the Applicants are under no obligation to produce the type of empirical site-specific analysis undertaken by the Attorney General's experts. However, as an evidentiary matter, once this type of detailed site-specific evidence is proffered, the existence of an alternative method of assessing the adequacy of a plan provides no legal or logical ground for excluding that evidence.12/ As long as the adequacy of the plan is at issue, as it is here, evidence of the actual level of protection afforded by the plan simply can not be excluded.

Moreover, the fact that this evidence illustrates the actual level of protection, in part, in quantitive terms is no grounds for excluding it. Although the applicable legal

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11/ However, as discussed in detail infra, if dose consequence analysis is not normally required because confidence in placed in the generic planning criteria as a way of assuring "reasonable dose savings", such analysis becomes all the more relevant when an emergency plan by its own terms omits sheltering for a significant portion of the relevant population. Instead of relying on dose consequence studies considered during emergency planning rulemaking to assure that the outcome of a particular adjudication will be "reasonable dose savings", a fact-finder confronted with a plan that lacks one of the critical components included in those generic dose consequence studies should require a site-specific one to determine what impact on dose savings the absence of sheltering will have.

12/ Of course, other evidence, equally admissible, might be proffered to indicate that the "actual level of protection" afforded by the Plan is not as represented in the testimony at issue.

standard against which a plan is to be measured is a qualitative one, quantitative evidence that is <u>relevant</u> to that qualitative standard is admissible.[13/] Further, relevant quantitative evidence <u>is</u> admissable even though no precise quantitative standards <u>per se</u> have been articulated. As long as the quantitative evidence is relevant, it should be admitted.

B. <u>The Testimony Is Relevant To A Determination That The Plan Provides Reasonable Dose Savings</u>

Even the Applicant's own statement of the standard of adequacy to be applied provides a predicate for the admission of this testimony. At page 8 of their Objection, the Applicants stated:

> The standard which must be met by an Emergency Plan is that it is designed to achieve reasonable and feasible dose savings given the circumstances of the site in question.

The actual level of protection afforded by a plan is undeniably relevant to any determination that dose savings achieved by that plan are <u>reasonable</u>.[14/] Put bluntly, dose savings for an individual or a group that do not mitigate the adverse health effects of the dose actually received, because the

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13/ For example, qualitative statutory standards of conduct regarding employment discrimination, <u>Dothard v Rawlinson</u>, 433 U.S. 321, 329 (1977) and trade regulation, <u>Brown Shoe Co. v US</u>, 370 U.S. 294, 321-322 (1961) are enforced in proceedings in which quantitative evidence of a violation of a qualitative standard is routinely admitted.

14/ This is true whether the dose <u>savings</u> are measured by comparing the dose to a particular <u>individual</u> with or without a plan or by comparing dosages to a group of individuals with or without a plan. Either or both methods can result in a determination that the dose <u>savings</u> achieved are reasonable.

dosages are so high, can not constitute "reasonable dose savings".

Thus, the Applicants' contradict their own version of the adequacy standard of reasonable dose savings when they assert:

> Whether these dose savings will be high or low in absolute terms at a particular site in the circumstances of a given accident or class of accidents is irrelevant. Id.

Similarly, the precedent cited by the lower Board as grounds for excluding the proffered testimony actually supports its admission. As noted, the Board relied on the Shoreham and San Onofre cases as well as the Commission's Statement of Policy in support of its November 1987 rulemaking. In the context of distinquishing between planning with State and local governmental cooperation and planning without it, the Commission in Shoreham stated:

> Our emergency planning requirements do not require that an adequate plan achieve a preset minimum radiation dose saving....Rather, they attempt to achieve reasonable and feasible dose reduction under the circumstances; what may be reasonable or feasible for one plant site may not be for another. 24 NRC 22, 30.

This statement does not support expressly or by inference the exclusion of the Mass AG's testimony. The actual dose savings to be achieved by a plan are not evaluated in accordance with a preset minimum standard. Rather, the test of a plan is whether the actual does savings achieved are reasonable and feasible. Obviously, this flexibility is required by the variation between sites; what is reasonable and feasible for one site may be far too little actual dose savings for another site. But this guidance is aimed at comparisons of dose savings between plants. No such comparative evidence is at issue here. Instead, the Mass AG is attempting to prove that no reasonable dose savings are achieved by the NHRERP in light of the circumstances of the Seabrook site. Shoreham provides no support for the exclusion of such evidence.[15/]

The San Onofre discussion is even less apposite to the issue here, as the lower Board recognized. Exhibit 3 at 5606. Its discussion of "prudent risk reduction" (17 NRC at 533), assumes that the risks are reduced by planning, an assumption put in question by the testimony at issue here. The Commission's statement in support of its amended emergency planning regulations is more on point but will not bear the weight the lower Board has placed on it. Again, in the context of a comparison between plans benefiting from governmental participation and those which do not, the Commission indicated that no comparisons of dose savings between such plans is appropriate or required to evaluate the effectiveness of the utility-generated plan. The Commission then stated:

> The final rule makes clear that every emergency plan is to be evaluated for adequacy on its own merits, without reference to the specific dose reductions which might be accomplished under the plan or to the capabilities of any other plan. 52 Fed. Reg. 42078 at 42085.

15/ Abstractly, the difference is between evidence comparing dose savings at one plant with another, and evidence illustrating the actual level of protection at a given site to determine whether the dose savings are "reasonable" enough to support a finding of adequate protection.

This statement should be read in context as an iteration of Commission policy concerning detailed comparisons between plans either at different sites or at the same site with or without governmental cooperation. Interpreted more broadly, this statement conflicts with earlier Commission precedent holding that adequacy is a function of "reasonable and feasible dose savings." It is unclear how a plan could be evaluated on its own merits for adequacy understood as "reasonable and feasible" dose savings "without reference" to the dose savings achieved by that plan.

In sum, there is no Commission precedent for excluding evidence of the actual level of protection afforded by a plan when that evidence involves no comparisons between plants but simply attempts to illustrate the inadequacy of the plan based on its failure to achieve reasonable and feasible dose savings.

C. Generic Rule Does Not Preclude Site Specific Analysis and Evaluation.

The Mass AG contends that the NHRERP is not "adequate" because too many people would be put at too great a risk by operation of the Seabrook plant. The Staff argued before the ASLB that the Mass AG is attempting inappropriately to place the burden of determining adequacy on a licensing board. In the Staff's view, such a determination is the function of generic rulemaking and not adjudication. Exhibit 3 at 5578. However, the Commission has adopted a generic standard that the licensing boards are to apply -- "reasonable assurance of adequate protection." 10 C.F.R. 50.47(a)(1). Thus, the Staff has set the matter on its head: the Commission has already adopted a generic standard of "adequate protection" which every plan and plant must meet in the course of an adjudication.

Conversely, the Staff cannot argue that the NHRERP affords "adequate protection" by virtue simply of its conformance with the Commission's regulations. First, the NHRERP does not include sheltering of the beach population as a planned protective measure. See Exhibit 2 at 5569. As such the NHRERP does not conform with 10 C.F.R. 50.47(b)(10) and the corrollary requirements of NUREG-0654 requiring a "range of protective actions." Therefore, no inferences concerning the efficacy of a plan which did conform to the Commission's generic requirements are relevant to the evaluation of the NHRERP.

Second, even if a plan conforms to a generic set of planning requirements, the Commission has made it clear that a particularized, site-specific determination of adequacy still must be made.

> We doubt whether the Commission could prescribe, by rule, a generic emergency plan suitable for all reactor sites . . . . In any event, the Commission did not try to do that, either in 10 C.F.R. 50.47(b) or in Appendix E to Part 50. Except for the specific 10 mile EPZ, the rule speaks in general terms, such as "adequate" emergency facilities, equipment, methods, systems. § 50.47(8), (9). A Board can only judge "adequacy" with reference to levels of risk, some aspects of which vary from site to site. In addition, licensing boards are

> required to make an overall general finding of "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." § 50.47(a). Such a finding goes beyond a check-list determination whether a plan meets the standards of 10 C.F.R. 50.47(b). Southern California Edison Company (San Onofre Nuclear Generating Station, Units 2 and 3), 14 NRC 681, 698-699 (1981).

In sum, the Staff cannot argue that no standard of adequacy is appropriate in an adjudicatory proceeding without a Commission rule-making announcing that standard because the Commission has adopted a generic planning rule. But the Staff also cannot argue that that generic planning rule preempts site-specific analysis of the actual level of protection in favor of a determination that planning measures conform to a generic checklist because the generic rule adopted by the Commission requires a site-specific determination of adequacy and, in any event, the NHRERP does not even conform to the technical planning requirements.

D. The Proffered Testimony Is Relevant To The Objective Standard Of Adequacy Applicable To Emergency Planning Requirements

The interpretation of the "adequacy" standard offered by the Applicants flies in the face of both the express language of the emergency planning regulations and the context in which they were adopted. These emergency planning rules were adopted by the NRC in part in response to and because of the TMI accident. As the Commission's contemporaneous understanding of these emergency rules and regulations indicates, emergency planning was intended to be a substantive safety-oriented set of requirements that would result in an actual increase in the level of public safety if effectively enforced.

> Before the [TMI] accident it was thought that adequate siting in accordance with existing staff guidance coupled with the defense-in-depth approach to design would be the primary public protection. Emergency planning was conceived as a secondary but additional measure to be exercised in the unlikely event that an accident would happen. The Commission's perspective was severely altered by the unexpected sequence of events that occurred at Three Mile Island. 44 Fed. Reg. 75167, 75169 (December 19, 1979) "Emergency Planning, Proposed Rule" (emphasis supplied).

Moreover, the NRC determined that its adoption and enforcement of these emergency planning regulations was mandated by the Atomic Energy Act:

> The Commission finds that the public can be protected within the framework of the Atomic Energy Act only if additional attention is given to emergency response planning. *Id.* (emphasis supplied).

The basis for this determination that public safety required emergency planning was the NRC's view that:

> potential does exist for significant harm to the public in the event of a severe accident and the events at TMI suggest that plans must be made to account for this potential problem. 45 Fed. Reg. 55413, 55415 (August 19, 1980) "Emergency Planning: Negative Declaration."

In light of the plain meaning of these emergency planning regulations as well as their relevant administrative history, it is clear that the NRC intended to preclude the licensing of nuclear power plants unless and until emergency planning in the relevant areas surrounding those plants was sufficiently adequate to assure public safety. The standard against which the adequacy of proposed protective measures and an emergency plan was to be measured was a meaningful standard that not every power plant would necessarily meet. In short, the NRC linked emergency planning to its fundamental regulatory mandate to assure adequate protection and treated "emergency planning as equivalent to, rather than as secondary to, siting and design in public protection." 44 Fed. Reg. 75167, 75169.

The Applicants' proposed "best efforts in light of the circumstances" standard would shift the regulatory focus from the actual level of protection afforded the public by an emergency plan to the degree of effort expended in, and the site specific limitations of, such a plan. For several reasons, such a shift would be wrong as a matter of law. First, as noted, emergency planning is viewed as equivalent to other primary NRC safety standards. NRC technical specifications and requirements are not judged by a subjective "best efforts in light of the circumstances" standard. Although the standard of adequacy of protective measures and an emergency plan may not be expressed in all respects with the precision of technical specifications, the <u>nature of the standard applied</u> - objective and not subjective -- must be the same for any requirements that the NRC adopts in light of its statutory mandate to assure the adequate protection of the public health and safety. Second, the purposes of the emergency planning rules are frustrated if a plan need not meet any objective standard of adequacy but can simply be a "best efforts" attempt at planning. Adequate emergency planning is a normative and not simply a descriptive enterprise. It is either a meaningful safety-based requirement that a nuclear power plant must meet or it is a mirage.

Because the purpose of the emergency planning regulations is to protect public safety, the standard applied must be an objective one. Consequently, neither the degree of effort or money expended by the Applicants nor the inherent site specific limitations on the efficacy of emergency planning should excuse the Applicant from providing an adequate level of protection for the public.

> Unless the safety findings prescribed by the Atomic Energy Act and the regulations can be made, the reactor does not obtain [an operating] license -- no matter how badly it may be needed. . . . [T]he function of the evaluation is to ascertain whether the ultimate, unconditional standards of the Atomic Energy Act and the regulations have been met; e.g., whether the public health and safety will be adequately protected.
> Maine Yankee Power Company (Maine Yankee Atomic Power Station), ALAB-161, 6 AEC 1003, 1007 (1973); cited in Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-623, 12 NRC 670, 678 (1980) (emphasis supplied).

In light of the objective nature of the standard of adequacy to be employed by this Board, the testimony at issue, which details the actual level of protection afforded the population at risk, is clearly probative and should have been admitted.

E. The Applicant And The Staff Completely Misread The Effect Of The Adoption Of The Emergency Planning Regulations On A Plant Sited Before 1980

1. The Logic of the Position of the Applicant and the Staff.

As noted above, the purported irrelevance of the disputed testimony is, in part, a matter of logic. Emergency planning is a burden placed on this Applicant at the operating license stage, after the plant has been sited and constructed. Therefore, the siting and construction permit decisions are not at issue when the adequacy of emergency planning is addressed. As a consequence, the standard of adequacy for this planning must be adjusted in light of the conditions of the Seabrook site. See Exhibit 2 at 5568. Thus, although intervenors can litigate whether the proposed plan has the requisite parts, the efficacy of the plan as a whole in terms of actual protection -- expressed as reasonable dose savings or in some other manner -- can not fail to meet the standard as conditioned by the Seabrook site. Evidence of that actual level of protection, therefore, is not relevant because whether "dose savings will be high or low in absolute terms" is "irrelevant". See supra at page 8.

2. The Proper Way to Interpret the Language of 10 C.F.R. 50.47(a)(1).

a. Similarity between standard applied before 1980 to LPZ and standard for EPZ.

Before 1980, an Applicant for both a construction permit and an operating license had to submit details of emergency plans for a geographic area identified and defined as the "low population zone" ("LPZ"). 10 C.F.R.§ 100.3.[16/] At the construction permit stage these LPZ emergency plans had to meet the following standard:[17/]

> "Low population zone" means the area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that <u>there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident</u>. 10 C.F.R § 100.3 (b) (emphasis supplied)

16/ This requirement technically still exists. <u>Cf</u>. 10 C.F.R. § 50.34 (a)(1) and 50.34(b)(1) <u>with</u> 10 C.F.R. § 100.3. As a practical matter, however, the requirements for planning for the EPZ encompass the LPZ and make separate plans or evaluations redundant. Both before and after 1980, at the construction permit stage only preliminary plans or a sketch of plans would be required. <u>Cf</u>. 10 C.F.R. Appendix E, ¶ II (1971) <u>with</u> 10 C.F.R. § 50.34(a)(10). Similarly, at the operating license stage both before and after 1980, emergency plans had to be submitted in some detail. <u>Cf</u>. 10 C.F.R. Appendix E, ¶ III (1971) <u>with</u> 10 C.F.R 50.34(b)(6)(v).

17/ This normative definition of the LPZ was (and is) then incorporated into 10 C.F.R § 100.10(b) as a "site evaluation factor". Any application for a construction permit had to include a "preliminary safety analysis report" ("PSAR") which had to pay "special attention" to the site evaluation factors identified in Part 100. 10 C.F.R. § 50.34(a)(1). <u>Cf</u>. 10 C.F.R. Appendix E, ¶ II (1970).

At the operating license stage before 1980, the standard used to judge the adequacy of LPZ emergency planning was set forth in the 1970 version of 10 C.F.R. Appendix E:

> the plans submitted must include a description of the elements ...to an extent sufficient to demonstrate that the plans provide reasonable assurance that appropriate measures can and will be taken in the event of an emergency to protect public health and safety and prevent damage to property.18/ 10 C.F.R. Appendix E, ¶ III (1970) (emphasis supplied)

Thus, the standards of adequacy of LPZ emergency plans before 1980 are virtually identical to the standards contained in 10 C.F.R. § 50.47(a) for the EPZ.

b. Commission case law on similar standardsfor LPZ should inform proper interpretation of EPZ standards.

The fact that the legal standard of adequacy for the LPZ and the EPZ is virtually identical makes the case law developed prior to 1980 in LPZ planning cases relevant to the

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18/ This Appendix E requirement for the contents of the "Final Safety Analysis Report" ("FSAR") is then referenced by 10 C.F.R. § 50.34(b) making an FSAR a requirement for an operating license. This structure has been retained: under current regulations § 50.34(a)(10) requires for a construction permit a PSAR that incorporates by reference the requirements of Appendix E; and § 50.34(b)(6)(v) requires for an operating license a FSAR that also incorporates Appendix E. Just as before 1980, the difference between the construction permit and the operating license stages is the detail in which the emergency plans are presented. Appendix E today expressly incorporates by reference the emergency planning standards described in § 50.47(b). 10 C.F.R. Appendix E, ¶¶ II, IV. As a result, the emergency planning standards set forth in § 50.47(b) must be applied in a preliminary manner to any new construction permit application as well as in a detailed manner to any request for an operating license. 10 C.F.R. § 50.34(a)(10) and Appendix E, ¶¶ II, IV.

consideration of: 1) the nature of the standard as a "site-excluder" standard, i.e. the standard is meant to eliminate sites as not appropriate for plant operation,[19] and, as a corollary, the legitimacy of any argument that finds the actual dose savings -- whether high or low -- irrelevant; and 2) what kind of evidence is admissible during adjudication of the adequacy of emergency plans. Case law before 1980 interpreting the adequacy standard makes it clear that the standard could exclude sites and prevent construction permits and operating licenses from issuing. See, e.g. Long Island Lighting Company, New York State Electric and Gas Corporation (Jamesport Nuclear Power Station, Units 1 and 2) 7 NRC 826, 852-856 (1978); Kansas Gas and Electric Company Kansas City

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19/ As discussed infra, depending on the point at which the standard is applied to a site, emergency planning requirements could exclude sites at which no plant is constructed as well as exclude sites on which plants have been built. The latter could occur, if and only if, a construction permit issued before the 1980 EPZ regulations were adopted and made part of the requirements for a construction permit. As will be developed more fully below, a plant like Seabrook whose construction permit predates the 1980 EPZ planning requirements must still meet those requirements. If those requirements, like their earlier LPZ counterparts, are properly interpreted as "site-excluders", they can play no lesser function simply because the plant is already constructed. Such a result would mean that the contingent fact that Seabrook received its construction permit before 1980 changes the nature of the standard applied to Seabrook at the operating license stage. Thus, a utility seeking to site a plant after 1980 in an area similar to Seabrook would face the EPZ regulations as "site-excluders" and if no preliminary showing of "adequacy" could be made for the emergency plans, no construction permit would issue. Seabrook, however, because it already obtained a construction permit wants to avoid even the possibility of that result by having the nature of the standard changed so that it could not block licensing no matter what showing of "adequacy" is made.

Power and Light Company (Wolf Creek Generating Station, Unit No. 1) 5 NRC 301, 369-370 (1977); Northern States Power Compa y (Minnesota), et al. (Tyrone Energy Park, Unit 1) 5 NRC 1197, 1217 (1977); Metropolitan Edison Company, et al. (Three Mile Island Nuclear Station, Unit No. 2) 8 NRC 9, 14 (1978); and Southern California Edison Company et al. (San Onofre Nuclear Generating Station, Units 2 and 3) 8 AEC 957, 961-964 (1974). In the latter case the Appeal Board stated:

> Inside the low population zone, however, protective measures might be necessary. For this reason, the suitability of the low population zone depends upon the feasibility of protecting persons located there. Specifically, the Commission requires that the total number and density of residents within the low population zone be such that "there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident." 10 C.F.R. 100.3(b). Id. at 961.

Similarly, in Consumers Power Co. (Midland Plant, Units 1 and 2) 5 AEC 214, 218 (1972) the Board in issuing a construction permit stated that essentially the acceptability of a low population zone turned on the ability to evacuate the population.

Thus, the standard used to judge the adequacy of LPZ emergency planning (virtually identical to the standard adopted in 1980 for the EPZ) was interpreted as a "site-excluding" standard.[20/] Moreover, because adequacy was a real standard that plans had to meet, the actual level of protection afforded by those plans was relevant in those proceedings. In fact, it was unquestioned and fairly routine for parties to use dose consequence analyses, indistinquishable from the Mass AG's proffered testimony in this case, to establish whether the actual level of protection for the relevant population was adequate.[21/] Wolf Creek, 5 NRC supra at 370 (dose consequence evidence submitted by Staff); Tyrone Energy Park, 5 NRC supra at 1223-1224 (dose consequence evidence submitted by Applicants); Jamesport, 7 NRC supra at 853 (dose consequence evidence submitted by the Staff); and Three Mile Island, 8 NRC

20/ This result also follows logically from the fact that some showing about emergency planning had to be made before a construction permit could issue. If the planning standard did not exclude sites it would not have been a requirement of a construction permit but only of an operating license. In that case, the adequacy of emergency planning would be viewed in light of the particularities of the already-approved site. As noted, this is the persuasive appeal of the Applicant's position at Seabrook, but its force is illusory because it ignores the law.

21/ An important distinction must be drawn between the level of protection afforded those within the LPZ and the level afforded those within the EPZ. In neither case has the Commission promulgated numerical dose standards. Although 10 C.F.R. 100.11(a)(2) established dose requirements for drawing the boundary of the LPZ, once that boundary is drawn, planning for those within the LPZ must meet qualitative standards discussed above. Whether the same level of actual protection must be established for the entire EPZ as had to be established for the LPZ is an open question which has nothing to do with the present issue. Obvious differences between the accident scenarios assumed, the logistics of evacuating a 10-mile zone compared to a much smaller area and other factors make it likely that adequacy could be found for an EPZ even though its population might receive as a whole higher doses than the population of an LPZ under an LPZ emergency plan found adequate before 1980. The point here is that some EPZ dose level would, however, be too high to meet the "adequacy" standard, because that standard remains a "site-excluder" standard.

supra at 15-16 (dose consequence evidence submitted by Applicants). These cases illustrate that because the planning standard could prevent a site and/or a plant from obtaining a license, the actual level of protection was relevant and dose consequence evidence was admitted to establish it.

c. Applicants Position would Be Clearly Untenable If Seabrook Were to Seek a Construction Permit Today.

In light of the foregoing analysis, it should be clear that the position of the Applicant and Staff on the proper interpretation of the planning standard as applied to Seabrook rests on the unexpressed premise that because Seabrook obtained a construction permit before 1980, the planning standard applied to it at the operating license stage should be a "best-efforts" hortatory standard and not a "site-excluding" mandatory standard. In effect, the Applicant is seeking an exemption from the requirements of 10 C.F.R. § 50.47 at the operating license stage by arguing that the planning standards set forth there can not exclude a site already approved before the 1980 regulations went into effect. The short answer to this is obvious: there is no basis for such an exemption.

In fact, the Applicant has known at least since November 1979, that additional emergency planning requirements would be imposed on it at the operating license stage. Seacoast Anti-Pollution League of New Hampshire v NRC, 690 F.2d 1025, 1029 (D.C. Cir. 1982) (SAPL v.NRC). When confronted with a legal challenge to the Seabrook construction permit in 1980, the Director of Nuclear Reactor Regulation reviewed the then existing emergency plans and found them "feasible". The Director stated:

On the basis of available information,22/

22/ The available information included the Seabrook FSAR as it then existed. Attached as Exhibit 5 hereto, is an August 4, 1980 cover letter from the Applicant to the NRC accompanying the ETE studies submitted as a part of the FSAR. These ETE studies were apparently relied on by the Director for his feasibility determination. In that cover letter, the Applicant states:

> public evacuation plans and their time estimates are not the only nor the most important measure of overall public protection ....This measure [of public protection] comes from the analysis of postulated accident sequences -- analyses which incorporate the mitigating effects of the substantial engineered safety features included in the Seabrook Station design ....
>
> An example using the accident analysis results as a gauge of the evacuation time estimates was described for Seabrook at the construction permit stage of the licensing proceedings. It was demonstrated that the evacuation time estimates for peak area population conditions, when converted to doses corresponding to the results of the conservative case loss of coolant accident analysis, were sufficiently short to prevent any member of the public from exceeding the EPA Protective Action Guides for either whole body on thyroid exposures ....
>
> Because of this we wish to urge caution in the uninterpreted use of the evacuation time estimates themselves. They should be reviewed only together with accident analysis results, which for Seabrook, take into account specific and substantial engineered safety features. This provides a more direct measure of public protection. (Exhibit 5, page 2) (emphasis supplied)

Thus, the feasibility finding was made on the basis of then available information which included the Applicant's dose consequence analyses.

> we conclude that plans can be developed for the Seabrook site that will assure that adequate protective measures can and will be taken in the event of a radiological emergency....
> To put this decision in perspective, it must be emphasized that this decision does not presume to decide the adequacy of emergency preparedness for the Seabrook Station. That issue must be resolved, of course, in the context of the Staff's review of the recently tendered application for operating licenses. Public Service Company of New Hampshire (Seabrook Station, Units 1 & 2) 14 NRC 279, 285 (1981).

Because of this initial finding that the Seabrook site could meet the adequacy standard, the Director refused to revoke the Applicant's construction permit. Before the Court of Appeals for the District of Columbia the Commission represented:

> According to the Commission, if it appears at the operating license review that the infeasibility of EPZ evacuation renders it impossible for PSC to provide the requisite "reasonable assurance", the operating license will not be granted.

SAPL v NRC, supra 690 F.2d at 1030. Thus, it should have been obvious to the Applicant that the planning standard can function as a site-excluder in this case and that its construction permit does not entitle it to an operating license or to a more limited interpretation of the standard all emergency planning must meet.

To accept now the Applicant's and Staff's position on the irrelevance of the actual level of protection afforded by a plan would cast a surreal light on these earlier proceedings. The Applicant was permitted to proceed with construction because a preliminary determination indicated that the Seabrook site could meet the planning standard although the issue of whether it would meet that standard would be deferred.23/ This decision was upheld because the Commission represented to the Court of Appeals that the test of adequacy would have to be met at the operating license stage and because the Applicant and not the public would run the risk that the standard would not be met. Now having constructed the plant at this site, the Applicant and the Staff would have that standard of adequacy interpreted in light of the given limitations of that site. In short, says the Applicant, let us build and fully address the standard of adequacy later and now having built, let that fact fundamentally alter the standard we now must address.

Viewed in this light, it is clear that the Applicant and the Staff both have misread the emergency planning regulations and their impact on the Seabrook operating license

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23/ It should also be noted that the Director's preliminary finding that adequate plans could be developed for Seabrook was made in response to a petition seeking to revoke the construction permit and requesting a hearing. The petition was denied and no hearing held. Thus, no developed adversarial record supports the Director's feasibility finding. Moreover, such a hearing was a matter of right on the feasibility of plans for the LPZ at the construction permit stage before 1980 and on the feasibility of plans for the EPZ at the construction permit stage after 1980. Curiously, the Commission treated Seabrook's construction permit as issued after 1980 for purposes of requiring a feasibility finding for emergency plans for the EPZ but treated it as issued before 1980 for purposes of determining participational rights to a hearing on that finding. At the time a hearing was held on the feasibility of Seabrook emergency plans, the planning area was limited to the LPZ and the beach populations were not included.

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application. Based on this misinterpretation, the lower Board has not admitted evidence clearly relevant to the issues of adequate emergency planning.

F. The Testimony Submitted Is Relevant Because It Buttresses FEMA's Position.

FEMA has indicated in its pre-filed testimony before the ASLB that it considers the NHRERP to be inadequate in certain respects. Both the Applicants and the Intervenors have a right to submit evidence supporting or rebutting this FEMA determination. See Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), ALAB - 864 (May 1, 1987) at 19 - 20. FEMA's determination of inadequacy is based on its evaluation of the actual level of protection afforded the population at risk:

> FEMA has made a qualitative decision about the safety of the population of the Emergency Planning Zone in the first several hours where, under the existing plan, no sheltering option is contemplated for large numbers of people at the beach. Exhibit C to FEMA's pre-filed testimony, page 1.

The evidence proffered by Attorney General Shannon addresses additional technical and empirical basis for FEMA's "qualitative decision" of inadequacy.[24/] In fact, in

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24/ Obviously, FEMA does not share the Applicants' view of the nature of the standard to be applied:

> FEMA does not hold that any level of risk is acceptable just because the dose savings are the best that can be conveniently achieved. Id.

As noted above, the testimony at issue is relevant in a direct and immediate way to the issue of adequacy if that issue involves, as FEMA clearly believes, an assessment of the actual level of protection afforded the population at risk.

a December 1985 Memorandum to other RAC members soliciting their response to the issue of the beach population, Edward Thomas of FEMA wrote:

> Based on the RAC's knowledge of the accepted literature in the fields of accident sequences, source terms, and the health effects of radiation, is the current planning acceptable or nearly acceptable? Letter from Ed Thomas, Exhibit C to FEMA's answers to Interrogatories filed June 4, 1987.

Thus, FEMA's own judgment of the inadequacy of the NHRERP for Seabrook is based on knowledge of accident sequences, source terms and the health effects of radiation, precisely the type of information set forth in the testimony at issue. As support for the FEMA position, then, the testimony proffered by the Attorney General should have been admitted.

CONCLUSION

For all the reasons set forth above, this Board should permit interlocutory review and reverse the orders of the lower Board granting the Applicants' motion _in limine_ and sustaining the Applicants' objection to the admission of the testimony in dispute.

Respectfully submitted,

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Dated: January 7, 1988

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before Administrative Judges:
Ivan W. Smith, Chairman
Gustave A. Linenberger, Jr.
Dr. Jerry Harbour

In the Matter of PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, ET AL. (Seabrook Station, Units 1 and 2)	Docket Nos. 50-443-444-OL (Off-site EP) November 17, 1987

COMMONWEALTH OF MASSACHUSETTS CORRECTED TESTIMONY OF STEVEN C. SHOLLY ON THE TECHNICAL BASIS FOR THE NRC EMERGENCY PLANNING RULES, DR. JAN BEYEA ON POTENTIAL RADIATION DOSAGE CONSEQUENCES OF THE ACCIDENTS THAT FORM THE BASIS FOR THE NRC EMERGENCY PLANNING RULES, DR. GORDON THOMPSON ON POTENTIAL RADIATION RELEASE SEQUENCES, AND DR. JENNIFER LEANING ON THE HEALTH EFFECTS OF THOSE DOSES

I. IDENTIFICATION OF WITNESSES

Q. Please state your names, positions, and business addresses.

A. (Sholly) My name is Steven C. Sholly. I am an Associate Consultant with MHB Technical Associates of San Jose, California.

EXHIBIT 1

A. (Beyea) My name is Dr. Jan Beyea, I am the Senior Energy Scientist for the National Audubon Society in New York City.

A. (Leaning) My name is Dr. Jennifer Leaning, I am Chief of Emergency Services for the Harvard Community Health Plan in Boston, Massachusetts, and instructor in medicine at Harvard Medical School.

A. (Thompson) My name is Dr. Gordon Thompson. I am Executive Director of the Institute for Resource and Security Studies in Cambridge, Massachusetts.

Q. Briefly summarize your experience and professional qualifications.

A. (Sholly) I received a B.S. in Education from Shippensburg State College in 1975 with a major in Earth and Space Science and a minor in Environmental Education. I have seven years experience with nuclear power matters. In particular, for four and one-half years I was employed by the Union of Concerned Scientists where I worked on matters related to the development of emergency plans for commercial nuclear power plants and the application of probabilistic risk assessment (PRA) to the analysis of safety issues related to commercial nuclear power plants. I have been a consultant with MHB Technical Associate for two years, during which time I have been involved in a variety of projects related to the safety and economics on nuclear power plants, including the evaluation of severe accident issues for light water nuclear power plants generally, and for the Seabrook Station, Unit 1, specifically.

I have testified as an expert witness in proceedings before the U.S. Nuclear Regulatory Commission (NRC) and other bodies, including the safety hearings on Indian Point Units 2 and 3 (Docket Nos. 50-247-SP and 50-286-SP), the licensing hearings on Catawba Nuclear Station, Units 1 and 2 (Docket Nos. 50-413 and 50-414), and the licensing hearings on the Shoreham Nuclear Power Station, Unit 1 (Docket No. 50-322-OL-3). I have also provided expert testimony before the Sizewell B Public Inquiry in the United Kingdom. I have served as a member of a peer review panel on regulatory applications of PRA (NRC report NUREG-1050), as a member of the Containment Performance Design Objective Workshop (NRC report NUREG/CP-0084), as a member of the Committee on ACRS Effectiveness, and as a panelist at the Severe Accident Policy Implementation External Events Workshop, Annapolis, Maryland (presentation on seismic risk assessment, 1987; forthcoming Lawrence Livermore National Laboratory report). The details of my education, experience, and professional qualifications are included in my resume, which is contained in attachments to this testimony.

(Beyea) I received my doctorate in nuclear physics from Columbia University in 1968. Since then I have served as an Assistant Professor of physics at Holy Cross College in Worcester, MA; as a member for four years of the research staff of the Center for Energy and Environmental Studies at Princeton University; and, as of May 1980, as the Senior Energy Scientist for the National Audubon Society.

While at Princeton University, I worked with Dr. Frank von Hippel to prepare a critical quantitative analysis of attempts to model reactor accident sequences. The lessons learned from this general study of nuclear accidents and the computer codes written to model radioactivity releases were then applied by me to specific problems at the request of governmental and non-governmental bodies around the world. I have written major reports on the safety of specific nuclear facilities for the President's Council on Environmental Quality (TMI reactor), for the New York State Attorney General's Office (Indian Point), for the Swedish Energy Commission (Barsebeck reactor), and the state of Lower Saxony (Gorbleben Waste Disposal Site). I have also examined safety aspects of specific sites for the California Energy and Resources Commission, the Massachusetts Attorney General's Office and the New York City Council.

While at Princeton, I wrote a computer program useful for reactor emergency planning for the New Jersey Department of Environmental Protection. This program, appropriately modified, has been used for some of the calculations presented in this testimony.

After joining the National Audubon Society, I continued to work as an independent consultant on nuclear safety issues. I participated in a study, directed by the Union of Concerned

Scie :ists at the request of the Governor of Pennsylvania, concerning the proposed venting of krypton gas at Three Mile Island. The U.S.C. study, for which I made the radiation dose calculations, was the major reason the Governor gave for approving the venting.

I participated in the international exercise on consequence modelling (Benchmark Study) coordinated by the Organization for Economic Cooperation & Development (O.E.C.D.). Scientists and engineers from fourteen countries around the world calculated radiation doses following hypothetical "benchmark" releases using their own consequence models. Participants from the United States, in addition to myself, included groups from Sandia Laboratories, Lawrence Livermore Laboratory, Batelle Pacific-Northwest, and Pickard, Lowe and Garrick, Inc. I also served as consultant from the environment community to the N.R.C. in connection with their development of "Safety Goals for Nuclear Power Plants."

At the request of the Three Mile Island Public Health Fund, I supervised a major review of radiation doses from the Three Mile Island Accident. This report, "A Review of Dose Assessments at Three Mile Island and Recommendations for Future Research" was released in August of 1984. Subsequently, I organized a workship on TMI Dosimetry, the proceedings of which were published in early 1986.

In 1986, I developed new dose models for the Epidemiology Department of Columbia University. These models are being used to assess whether or not the TMI accident is correlated with excess health effects in the local population. The new computer models account for complex terrain, as well as time varying meteorology (including changes in wind direction). Insights gained from this project have been applied to the Seabrook situation.

In addition to reports written about specific nuclear facilities, an article of mine on resolving conflict at the Indian Point reactor site, an article on emergency planning for reactor accidents, and a joint paper with Frank von Hippel of Princeton University on failure modes of reactor containment systems have appeared in The Bulletin of the Atomic Scientists.

I have also prepared risk studies covering sulfer emissions from coal-burning energy facilities. And I have managed a project that analyzed the side effects of renewable energy sources.

I regularly testify before congressional committees on energy issues and have served on several advisory boards set up by the Congressional Office of Technology Assessment.

I currently participate in a number of ongoing efforts aimed at promoting dialogue between environmental organizations and industry.

I was assisted in the early stages of my studies of Seabrook by Brian Palenik, who has worked with me on other reactor studies in the past. In subsequent answers to questions, I will use the pronoun, "we," to describe our collective efforts. However, all work was carried out either by me or under my direct supervision.

Brian Palenik received his Bachelor of Science in Civil Engineering degree with honors from Princeton University. While an undergraduate at Princeton, Mr. Palenik worked with me on "The Consequences of Hypothetical Major Releases of Radioactivity to the Atmosphere from Three Mile Island"--my report to the President's Council on Environmental Quality.

After graduation, Mr. Palenik joined the staff of National Audubon's Policy Research Department. While there, he and I wrote, "Some Consequences of Catastrophic Accidents at Indian Point and Their Implications for Emergency Planning," as part of our testimony before the Nuclear Regulatory Commission Atomic Safety and Licensing Board, July 1982.

Mr. Palenik is currently a graduate student in the Civil Engineering Department at M.I.T.

A complete resume is included in the attachments to this testimony.

(Thompson) I received a Ph.D in applied mathematics from Oxford University in 1973. Since then I have worked as a consulting scientists on a variety of energy, environment, and international security issues. My experience has included technical analysis and presentation of expert testimony on issues related to the safety of nuclear power facilities.

In 1977, I presented testimony before the Windscale Public Inquiry in Britain, addressing safety aspects of nuclear fuel reprocessing. During 1978 and 1979, I participated in an international scientific review of the proposed Gorleben nuclear fuel center in West Germany, this review being sponsored by the government of Lower Saxony.

Between 1982 and 1984, I coordinated an investigation of safety issues relevant to the proposed nuclear plant at Sizewell, England. This plant will have many similarities to the Seabrook plant. The investigation was sponsored by a group of local governments in Britain, under the aegis of the Town and Country Planning Association. This investigation formed the basis for testimony before the Sizewell Public Inquiry by myself and two other witnesses.

From 1980 to 1985, first as a staff scientist and later as a consultant, I was associated with the Union of Concerned Scientists (UCS), at their head office in Cambridge, MA. On behalf of UCS, I presented testimony in 1983 before a licensing board of the US Nuclear Regulatory Commission (NRC), concerning the merits of a system of filtered venting at the Indian Point nuclear plants. Also, I undertook an extensive review of NRC research on the reactor accident "source term" issue, and was co-author of a major report published by UCS on this subject (Sholly and Thompson, 1986).

Currently, I am one of three principal investigators for an emergency planning study based at Clark University, Worcester, MA. The object of the study is to develop a model emergency plan for the Three Mile Island nuclear plant. Within this effort, my primary responsibilities are to address the characteristics of severe reactor accidents.

My other research interests include: the efficient use of energy; supply of energy from renewable sources; radioactive waste management; the restraint of nuclear weapons proliferation; and nuclear arms control. I have written and made public presentations in each of these areas.

At present, I am Executive Director of the Institute for Resource and Security Studies, Cambridge, MA. This organization is devoted to research and public education on the efficient use of natural resources, protection of the environment, and the furtherance of international peace and security.

A detailed resume is included in the attachments to this testimony.

(Leaning) I received an M.D. from the University of Chicago Pritzker School of Medicine in 1975 and completed a residency in internal medicine and a fellowship in emergency medicine at Massachusetts General Hospital in Boston, Massachusetts. For six years from 1978 through 1984 I practiced emergency medicine as an attending physician at Mount Auburn Hospital, one of the Harvard teaching hospitals. Since 1984 I have served as Chief of Emergency Services for the Harvard Community Health Plan, responsible for the organization and delivery of emergency services to the approximately 300,000 members enrolled in the Plan.

Since 1979 I have actively pursued an interest in disaster medicine, with a particular focus on emergency response to radiation disasters, whether resulting from accidents at nuclear power plants or from explosions of nuclear weapons. In 1980 I participated in a five-day course at Oak Ridge, Tennessee in the management of radiation emergencies. I have lectured extensively on the organization of disaster response, the assessment of radiation injury, and the management of mass casualties. For the last three years I have taught the acute radiation and emergency response sections of the Harvard Medical School course on nuclear war. I am the author of several publications on radiation injury and medical response, including a chapter on the health effects of radiation in a book I co-edited, entitled The Counterfeit Ark. I serve as co-chair of the Governor's Advisory Committee on the Impact of the Nuclear Arms Race on Massachusetts and am a member of the Board of Directors of the Disaster Management Center at the University of Wisconsin. The details of my education, training, and professional experience are contained in my resume, which is included in the attached to this testimony.

II. CONTENTIONS

Q. To what contentions does your testimony refer?

A. (All) Town of Hampton revised contention VIII, SAPL revised contention 16 and NECNP contention RERP-8. These contentions and their bases are set out in full in

Exhibit 2. Our testimony also addresses matters raised in the Federal Emergency Management Agency (FEMA) June 4, 1987 "current" position on these contentions. In addition, our testimony bears on aspects of other contentions in this proceeding.

Q. What is the purpose of your testimony and how does it relate to the specific contentions cited here?

A. (All) These three interrelated contentions and the FEMA position on them all concern the issue of protection from radiological releases of the beach populations in the vicinity of the Seabrook Plant. Our testimony first describes the standard guidance used by the Nuclear Regulatory Commission (NRC) and FEMA for the initiation and duration of radiological releases to be considered in emergency planning. Then, and using postulated accidents at Seabrook consistent with the spectrum of accident scenarios called for in the NRC guidance, the testimon estimates and describes the radiation dosages which could affect the beach populations near the Seabrook Plant site. We then describe the health consequences of those dosages on the beach population.

The testimony as a whole demonstrates that NHRERP Rev. 2 is fundamentally flawed and is of no real or practical use because the beachgoing public in the vicinity of the Seabrook plant will not be adequately protected in the event of an emergency. In particular, this testimony shows that because of the size of the beach population in the immediate vicinity of the plant site, the long evacuation times, and the lack of effective sheltering, many thousands of individuals will die, suffer serious injuries or face the prospect of increased likelihood of cancer if one of any number of the accidents required to be planned for by the NRC occurs. Thus, because of the radiation dosages that would reach the beach population, there is no reasonable assurance that NHRERP Rev 2 can and will be implemented to provide adequate protection to the public in the event of an accident.

III. OVERVIEW

Q. Please summarize your portion of this testimony.

A. (Sholly) My testimony describes the technical basis for the current NRC emergency planning rules. The testimony discusses the use in the NRC reports NUREG/CR-1311, NUREG-0396, and NUREG-0654, of the risk assessment results for the Surry Unit 1 plant (as set forth in the NRC report WASH-1400) to derive dose-distance relationships for a spectrum of accidents, including severe accidents beyond the design basis of light water nuclear power plants. The testimony further describes the nature of that spectrum of accidents, including release characteristics, release frequencies, and uncertainies. Finally, the testimony describes how the risk-based insights from the Surry Unit 1 risk assessment were utilized by the NRC to arrive at the generic emergency planning zone distances and other guidance contained in the rules and in the applicable NRC guidance documents (including NUREG-0654, Rev. 1).

A. (Beyea) The situation around the Seabrook Nuclear Power Plant is unusual in the context of emergency planning for nuclear plants, because large populations make use of nearby beaches in the summertime. In order to determine the extent of protection afforded the summer beach population by current emergency plans, we have modelled the radiation doses to the population that would follow releases of radioactivity from the Seabrook plant. A range of releases has been studied, patterned after the range used in the NRC's report, NUREG-0396.

In NUREG-0396, a set of generic accident sequences (PWR1-PWR9) were defined that apply to pressurized water reactors like the Seabrook plant. These sequences span the entire range of physically-plausible release scenarios, making them useful for assessing, at least on a theoretical basis, the effectiveness of emergency plans. For my testimony, we have chosen accident sequences that are similar to the NRC's generic versions, but which take into account reactor-specific differences at Seabrook.

In order to understand the conditions under which the population would not be protected from "early death" (death within 60 days of the release), doses were modelled for these release categories using a range of weather parameters, plume rise heights, and dose contribution assumptions. The results indicate that the potential consequences of severe accidents increase greatly during the summer months, due to the increased population in the area and the unique conditions of a beach release: Beach-goers caught in the open would not be shielded from radiation, and could be expected, by our calculations, to receive doses as much as five times higher than generally considered in nuclear emergency planning. This means that certain accident releases, not normally projected to cause early fatalities, are projected to do so in the Seabrook case.

As a result, it is necessary to consider a range of accident scenarios, from those with very small releases to those with very large releases.

In addition to the risk of early death, we have considered other potential accident consequences, including delayed cancer incidence. These potential outcomes dominate the risk for accident releases in classes PWR4-PWR9.

The proximity of the reactor to an unshielded summer beach population makes the Seabrook case a special and difficult one for emergency planning. The doses that would be received following a range of releases at the Seabrook site, with emergency plans in effect, are higher than doses that would be received at most other sites in the complete absence of emergency planning.

Our results demonstrate that, with current plans, the immediate safety of the beach population is threatened for a wide range of releases and meteorological conditions. For the accidents studies in our testimony, many thousand of people could receive life-threatening doses.

A. (Thompson) The issues I address are:

(1) The potential for an atmospheric release, similar to that designated as PWR1 in the Reactor Safety Study, to occur from a steam explosion or high-pressure melt ejection event.

(2) The range of variation of two parameters which affect plume rise during a "PWR1-type" release, specifically the location of containment breach and the thermal energy release rate for the plume.

(3) The potential for "PWR1-type" releases to contain greater amounts of certain isotopes, such as those of ruthenium, than other categories of releases.

A. (Leaning) The purpose of my testimony is to discuss what is known about the acute and long-term health consequences that can be expected to befall human beings exposed to ionizing radiation in the range of dose levels that might eventuate from nuclear power plant accidents such as those described in the testimony of Mr. Sholly, Dr. Beyea and Dr. Thompson. I describe the kinds of injuries that would be received by the population in both the short and long term.

IV. SYNOPSIS OF WASH-1400 SURRY ANALYSIS

Q. Please identify and describe the nature of the NRC report WASH-1400.

A. (Sholly) WASH-1400 (N.C. Rasmussen, et al., Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, U.S. Nuclear Regulatory

Commission, WASH-1400, NUREG-75/014, October 1975) represents a probabilistic risk assessment of two nuclear power plants, namely Surry Unit 1 and Peach Bottom Unit 2. The report consists of a Main Report and eleven Appendices. WASH-1400 represents the first comprehensive application of probabilistic risk assessment methods to the analysis of the risks posed by commercial nuclear power plants. That is, WASH-1400 includes system analyses, source term estimates, and accident consequence estimates. In the parlance of the NRC's PRA Procedures Guide, WASH-1400 is a Level 3 PRA of two plants.[1/]

Q. Please briefly describe the Surry Unit 1 nuclear power plant and compare its design with that of Seabrook Station, Unit 1.

A. (Sholly) The Surry Unit 1 nuclear power plant is a three-loop, Westinghouse pressurized water reactor with dry, subatmospheric containment. The Surry Unit 1 plant has a design thermal power level of 2441 megawatts, and entered commercial operation in December 1972. Surry Unit 1 is operated by Virginia Power Corporation under operating license DPR-32, issued on May 25, 1972. Seabrook Station Unit 1 is a four-loop, Westinghouse pressurized water reactor with a large,

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1/ Jack W. Hickman, et al., PRA PROCEDURES GUIDE: A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants, American Nuclear Society and Institute of Electrical and Electronics Engineers, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR 2300, January 1983, pages 2-2 to 2-3.

dry containment. Seabrook has a design thermal power level of 3650 megawatts.

Q. Please summarize the results of the WASH-1400 analysis of the Surry Unit 1 plant.

A. (Sholly) The WASH-1400 report calculated a median core melt frequency for Surry Unit 1 of about 5×10^{-5} per reactor-year (or about 1 in 20,000 per reactor-year).[2/] The NUREG-1150 analysis estimated the core melt frequency for Surry to be 2.6×10^{-5} per reactor year. See, NUREG-1150, draft, page 3-2. The dominant accident sequences for Surry Unit 1 which contributed to this core melt frequency are identified along with their estimated sequence frequencies in Table A, which is attached to this testimony. WASH-1400 also defined nine release categories or source terms which defined the release characteristics and release frequencies for Surry Unit 1. These release categories were designated PWR-1 through PWR-9. Release categories PWR-1 through PWR-7 correspond to

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2/ The Surry core melt frequency estimate in WASH-1400 has been cited as several different values. For instance, the NUREG-1150 report cites a value of 4.6×10^{-5} per reactor year. See M.L. Ernst, et al., Reactor Risk Reference Document, U.S. Nuclear Regulatory Commission, NUREG-1150, Vol. 1, "Main Report", draft for comment, February 1987, page 3-12 (hereinafter "NUREG-1150 draft). A technical report supporting NUREG-1150 cites 4.4×10^{-5} per reactor-year. See, Robert C. Bertucio, et al., Analysis of Core Damage Frequency From Internal Events: Surry Unit 1, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986 page V-68. In fact, as indicated in Attachment 3 to this testimony, if one adds the point estimate frequencies for the WASH-1400 dominant accident sequences, one obtains a core melt frequency of 1.2×10^{-4} per reactor-year.

core melt accidents. Release Categories PWR-8 and PWR-9 are non-core melt accidents, and are roughly equivalent to the design basis accident with (PWR-8) and without (PWR-9) containment spray operation. The Surry release categories are described and their characteristics and estimated frequencies defined in Table B, which is attached to this testimony. Many of the WASH-1400 release categories (especially PWR-1 through PWR-4) could result in significant ground contamination offsite should accidents leading to such releases occur.

V. USE OF WASH-1400 RESULTS IN NUREG-0396

Q. Please identify and describe NUREG-0396.

A. (Sholly) NUREG-0396 (Task Force on Emergency Planning, Planning Basis for the Development of State and Local Emergency Response Plans in Support of Light Water Nuclear Power Plants, U.S. Nuclear Regulatory Commission and U.S. Environmental Protection Agency, NUREG-0396, EPA 520/1-78-016, December, 1987), set a revised planning basis for commercial nuclear power plants. In essence, NUREG-0396 concluded that a spectrum of accidents should be used in developing a planning basis.[3/]

3/ H.E. Collins, B.K. Grimes & F. Galpin, et al., Planning Basis for the Development of State and Local Emergency Response Plans in Support of Light Water Nuclear Power Plants, Task Force on Emergency Planning, U.S. Nuclear Regulatory Commission and U.S. Environmental Protection Agency, NUREG-0396, EPA 520/1-78-016, December 1978, page 24 (hereinafter "NUREG-0396").

NUREG-0396 recommended the establishment of two generic emergency planning zones (EPZs) for nuclear power plants; a plume exposure pathway EPZ about 10 miles in radius and an ingestion exposure pathway EPZ about 50 miles in radius. These EPZs were designated as "the areas for which planning is recommended to assure that prompt and effective actions can be taken to protect the public in the event of an accident."4/ A significant part of the basis for these planning zone distances was derived from accident consequence analyses (specifically dose-distance calculations) using the WASH-1400 release categories and frequencies for Surry Unit 1.

Q. Please describe how the WASH-1400 results for Surry Unit 1 were utilized in NUREG-0396.

A. (Sholly) The Task Force on Emergency Planning, which wrote NUREG-0396, utilized the Surry Unit 1 results from WASH-1400 to perform consequence calculations to "illustrate the likelihood of certain offsite dose levels given a core melt accident."5/ While the Task Force members debated various aspects of the WASH-1400 report and considered its results to have limited use for plant-and site-specific factors, it was judged to provide "the best currently available source of information on the relative likelihood of large accidental

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4/ Id. at 11.

5/ Id. at 6.

releases of radioactivity given a core melt event."6/ WASH-1400 results for Surry were also utilized to provide guidance concerning the timing of radiological releases resulting from core melt accidents, and the radiological characteristics of such releases.7/ The planning basis distance, the time dependent characteristics of potential releases and exposures, and the kinds of radioactive materials that can potentially be released to the environment were identified by the Task Force as the three planning basis elements needed to scope the planning effort.8/ WASH-1400 results for Surry Unit 1 were used to define all three of the planning basis elements in NUREG-0396.

Q. Please describe the rationale used by the Task Force in establishing the size of the EPZs recommended in NUREG-0396.

A. (Sholly) The Task Force on Emergency Planning considered a number of possible rationales, including risk, probability, cost effectiveness, and the accident consequence spectrum. Following a review of these rationales, "The Task Force chose to base the rationale on a full spectrum of accidents and corresponding consequences tempered by probability considerations."9/ The rationale used by

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6/ Id. at 6.

7/ Id. at 18-23.

8/ Id. at 8.

9/ Id. at 15.

the Task Force in establishing the EPZ planning distances is more fully described in Appendix 1 to NUREG-0396.

Q. Please describe the spectrum of accidents considered by the Task Force in NUREG-0396.

A. (Sholly) The Task Force on Emergency Planning considered a complete spectrum of accidents, including those discussed in environmental reports prepared by utilities as part of the operating license review (the so-called Class 1 through Class 8 accidents), accidents postulated for the purpose of evaluating plant design (design basis accidents in the Final Safety Analysis Report), and the spectrum of accidents identified in the WASH-1400 report. The Task Force concluded that the Class 1 through Class 8 accident discussions in environmental reports were too limited in scope and detail to be useful in emergency planning, and instead relied on design basis accidents and the WASH-1400 release categories. 10/

Q. Please describe specifically how the Surry Unit 1 results from WASH-1400 were used by the Task Force.

A. (Sholly) Concurrently with the operation of the Task Force, a report was being prepared for the NRC by Sandia Laboratories (now Sandia National Laboratories) which examined offsite emergency response measures for core melt accidents.

10/ Id. at 1-4.

This report, designated SAND78-0454, was published in June 1978.[11] The Sandia report grouped the WASH-1400 release categories for Surry Unit 1 into "Melt-Through" and "Atmospheric" release groups (based on the location of containment failure identified for the WASH-1400 release categories).

Surry release categories PWR-1 through PWR-5 consist of accidents in which the containment was concluded to fail directly to the atmosphere as a result of structural failure or containment isolation failure. These release categories were grouped into the "Atmospheric Release" class. Surry release categories PWR-6 and PWR-7 consist of accidents in which the containment base was penetrated by core debris. These release categories were grouped into the "Melt-Through Release" class. The likelihood of the "Atmospheric" and "Melt-Through" classes were estimated by summing the probabilities of the contributing WASH-1400 release categories; "Atmospheric" releases were estimated to have a frequency of 1.4×10^{-5} per reactor-year, and "Melt-Through" releases were estimated to have a frequency of 4.6×10^{-5} per reactor-year.[12]

11/ David C. Aldrich, Peter E. McGrath & Norman C. Rasmussen, Examination of Offsite Radiological Protective Measures for Nuclear Reactor Accidents Involving Core Melt, Sandia Laboratories, prepared for the U.S. Nuclear Regulatory Commission, SAND78-0454, June 1978 (hereinafter "SAND78-0454"). This report was reissued as NUREG/CR-1131 in October 1979 following the Three Mile Island accident.

12/ Id. at 43.

The characteristics of these release classes were then used as input to the WASH-1400 accident consequence code, referred to as CRAC (Calculation of Reactor Accident Consequences). The calculations were carried out using meteorological data from one reactor site and an assumed uniform population density of 100 persons per square mile.[13/] The CRAC code calculations implemented for the Sandia study used hourly weather data for one year and 91 accident start times (a four day, thirteen-hour shift was assumed to take place for each start time; this results in each hour of the day being represented in 24 samples and a total of 91 samples are taken from one year's data).[14/] The wind direction is assumed to be held constant during and following the release; other weather changes are modeled as indicated in the data.[15/] A revised model of public evacuation (ultimately implemented in CRAC2, an improved version of the code) was also used.[16/]

The most frequently cited curve in NUREG-0396 which was derived from the Surry Unit 1 risk study results is a curve which plots the probability of whole-body dose versus

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13/ Id. at 36.

14/ According to a recent Brookhaven National Laboratory report, weather data from a typical year for New York City were used in calculations. See, W.T. Pratt & C. Hofmayer, et al., Technical Evaluation of the EPZ Sensitivity Study for Seabrook, Brookhaven National Laboratory, prepared for the U.S. Nuclear Regulatory Commission, March 1987, page 6-2.

15/ Aldrich, et al., supra note 11, at 37-39..

16/ Id. at 59.

distance. (This curve, Figure 1-11 from NUREG-0396, is attached to this testimony as part of Table C). The curves on this figure were not calculated directly by the CRAC code, however. As explained in a recent Brookhaven National Laboratory (BNL) report, these curves were interpolated. BNL used the newer CRAC2 code to recalculate the dose vs. distance curves. The results of these calculations are shown in Table D, which is attached to this testimony (this calculation is only for the 200 rem whole-body curve).

Q. What results from the Sandia study were used in NUREG-0396?

A. (Sholly) NUREG-0396 contains a series of figures which are drawn from the Sandia report. These figures are Figures 1-11 through 1-18. These figures are reproduced as Table C, attached to this testimony.

VI. USE OF WASH-1400 INSIGHTS IN SETTING EPZ DISTANCES

Q. Please describe the insights from NUREG-0396, Figures 1-11 through 1-18, that were drawn by the Task Force on Emergency Planning.

A. (Sholly) The Task Force derived a number of insights from Figures 1-11 through 1-18. These insights were set forth in terms of the U.S. Environmental Protection Agency (EPA) "Protective Action Guide" (PAG) doses. PAGs are expressed in units of radiation dose (rem) which "represents trigger levels or initiation levels, which warrant pre-selected protective actions for the public if the projected (future) dose received by an individual in the absence of a protective action exceeds the PAG."[17/] The EPA PAGs used by the Task Force were those for whole-body exposure and thyroid exposure. These PAGs have a range of 1-5 rem whole-body and 5-25 rem to the thyroid. According to EPA guidance, the lower dose in the PAG range is to be used if "there are no major local constraints in providing protection at that level, especially to sensitive populations." If local constraints make the lower value impractical to use, in no case should the higher value be exceeded in determining the need for protective action.[18/]

Based on the figures, the Task Force concluded that given a core melt accident, there is about a 70% chance of exceeding the whole-body PAG doses at two miles, a 40% chance of exceeding the whole-body PAG doses at ten miles. Similarly, given a core melt accident, there is a near 100% chance of exceeding the 10-rem thyroid PAG dose at one mile, about an 80% chance at ten miles, and about a 40% chance at 25 miles. Based in significant part of these observations, the Task Force recommended that EPZs of 10 miles be established for the plume exposure pathway and 50 miles[19/] for the injection exposure

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17/ Collins, et al., supra note 3, at 3.

18/ Office of Radiation Programs, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, U.S. Environmental Protection Agency, EPA-520/1-75-001, September 1975, Revised June 1980, page 2.5.

19/ Collins, et al., supra note 3, at 1-41 and 1-43.

pathway.[20]

Q. Please describe how NUREG-0396 is related to the NRC's emergency planning regulations.

A. (Sholly) In October 1979, the Commission endorsed a policy of having a "conservative emergency planning policy in addition to the conservatism inherent in the defense-in-depth philosophy" and stated that a 10-mile plume EPZ and a 50-mile injection EPZ should be established around each nuclear power plant.[21] Subsequently, these EPZs were codified in the NRC emergency planning rule when the final rule was adopted in 1980.[22] Indeed, NUREG-0396 is explicitly referenced in the final rule.[23]

NUREG-0654, which provides detailed guidance for the preparation and evaluation of radiological emergency plans for nuclear power plant accidents, also references the NUREG-0396 report. NUREG-0654 states that the 10-mile radius plume EPZ was based primarily on four considerations:[24]

20/ Id. at 1-37, 1-41, and 1-43.

21/ Federal Register 61123, 23 October 1979.

22/ Federal Register 55402, 55406, 55411, 19 August 1980.

23/ 10 CFR Part 50, Appendix E, Section 1, fn 2.

24/ U.S. Nuclear Regulatory Commission and Federal Emergency Management Agency, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG-0654, FEMA-REP-1, Rev. 1, November 1980, page 12.

a. projected doses from the traditional design basis accidents would not exceed Protective Action Guide levels outside the zone;

b. projected doses from most core melt accidents would not exceed Protective Action Guide levels outside the zone;

c. for the worst core melt accidents, immediate life threatening doses would generally not occur outside the zone;

d. detailed planning within 10 miles would provide a substantial base for expansion of response efforts in the event that this proved necessary.

Quite clearly, two of these four considerations (i.e., considerations "b" and "c", above) are derived from the NUREG-0396 evaluation of doses from core melt accidents (which is based on the Surry analysis in WASH-1400). In addition, NUREG-0654 guidance on the timing and duration of releases and radiological characteristics of the releases is also derived from the NUREG-0396 evaluation of core melt accidents (which is based on the Surry analysis in WASH-1400).

VII. CONCLUSION REGARDING THE TECHNICAL BASES FOR EMERGENCY PLANNING.

Q. What is your conclusion concerning the degree to which the NRC's emergency planning requirements are based on the analysis of Surry in WASH-1400?

A. (S'olly) It is evident, based on the above, that the current planning basis in NRC emergency planning regulations for nuclear power plants is substantially based on dose/distances insights derived from the risk assessment of

Surry performed in WASH-1400. Thus, the"spectrum of accidents" which were considered in establishing the EPZ distances in the NRC emergency planning rules explicity included core melt accidents (up to and including those core melt accidents which were predicted to result in early containment failure and a large radiological release to the environment). A site-specific analysis which examines dose-distance relationships based on similar accidents would therefore provide useful information concerning the effectiveness of offsite emergency planning measures for the Seabrook site.

Q. Have you reviewed the release categories utilized by Dr. Jan Beyea in his calculations as set forth in his testimony in this proceeding?

A. (Sholly) Yes.

Q. Are the release categories utilized by Dr. Beyea consistent with the spectrum of releases utilized by the NRC in setting the technical basis for the emergency planning zones?

A. (Sholly) Yes, Dr. Beyea's release categories are very similar to the PWR-1 through PWR-9 release categories utilized in the NUREG-0396 report, which sets forth the technical basis for the NRC's emergency planning zones.

Q. Does this conclude your testimony?

A. (Sholly) Yes.

VIII. RADIATION RELEASES FROM ACCIDENTS WITHIN THE PLANNING SPECTRUM

Q. Dr. Beyea, before presenting the results of your calculations, describe in general terms how radioactive material is released to the environment and dispersed.

A. (Beyea) For a large release of radioactive material to occur following an accident, a "release pathway" from the reactor core to the environment is required. (See testimony of Steven Sholly.) One set of these pathways is generated by failure of the reactor's pressure vessel followed by failure of the containment building surrounding the vessel due to overpressurization. Researchers have outlined some, though not all, possible sequences and conditions for these failures.

Other pathways include releases occurring through a containment penetration system. Massive steam generator failure due to aging steam generator tubes might lead to a large release through the secondary cooling system. A so-called check-valve failure could connect the containment directly to the environment.

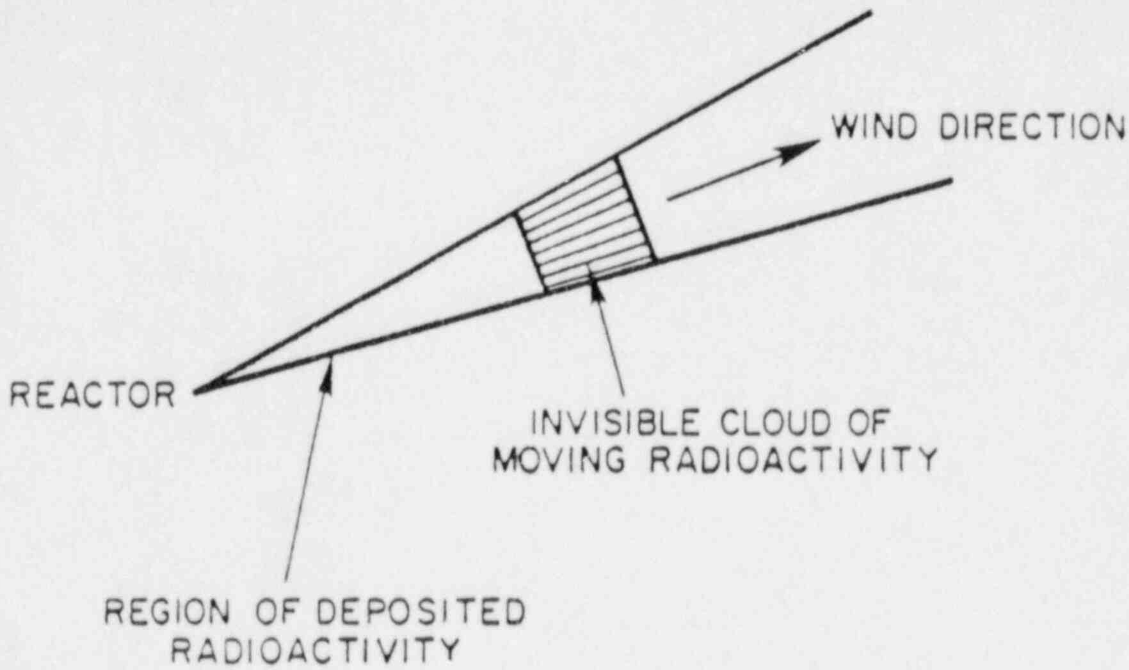
If a large release of radioactive material to the environment occurs, the material will leave the reactor as a "plume" of gases, aerosols and water droplets. Most of the large releases discussed in our testimony are assumed to occur over a period of thirty to sixty minutes; a few are assumed to take longer.

This escaping plume will rise to a height which is dependent on such variables as 1) the amount of heat released in the accident, 2) the weather condition existing at the time, and 3) whether or not the release takes place at the top or bottom of the structure. As will be shown later, there is no satisfactory formula that predicts the magnitude of plume rise.

The plume will be carried by the prevailing wind. Under the action of wind fluctuations and other weather conditions, the plume will spread in both the horizontal and vertical directions, so that the average concentration of radioactive material in the plume will decrease with time as it travels away from the reactor. (See Figure I). After a short time, the expanding edge of the plume will "touch" ground, and the non-gaseous radioactive aerosols will be dispersed along the ground, on vegetation, buildings, cars, people, etc. The rate at which material is removed from the plume, referred to as the deposition rate or "velocity", will also cause the concentration of material in the plume to decrease with time.

For the most energetic release categories, particularly the steam explosion categories which cause rapid rise of gases into the atmosphere, there is the possibility that escaping water vapor may condense to significant amounts of (radioactive) rain.

The plume may disperse radioactive material along the ground for more than a hundred miles if there is no reversal of wind direction. Much of the area where the plume has passed



TOP VIEW OF PLUME

FIGURE I

will be contaminated for decades and "permanent" evacuation of the original population will be required there. In addition, as much as 10 percent of the material will be resuspended by the action of wind and blown about in succeeding weeks.25/ The area of contamination will increase, causing residents who live outside the initial plume path to be exposed to radiation.

Immediately after the release, the plume will be visible, due to the escape of large amounts of cloud-forming water droplets. As the plume travels downwind and as the water droplets evaporate, the plume will most likely disappear from view, making it impossible for anyone without instruments to know where radioactivity is heading.

Q. How does the population receive radiation doses?

A. The population in the area under the plume would receive most radiation doses via three dose pathways.26/ (See Figure II):

1) From external radiation received directly from the radioactive plume itself. (In the

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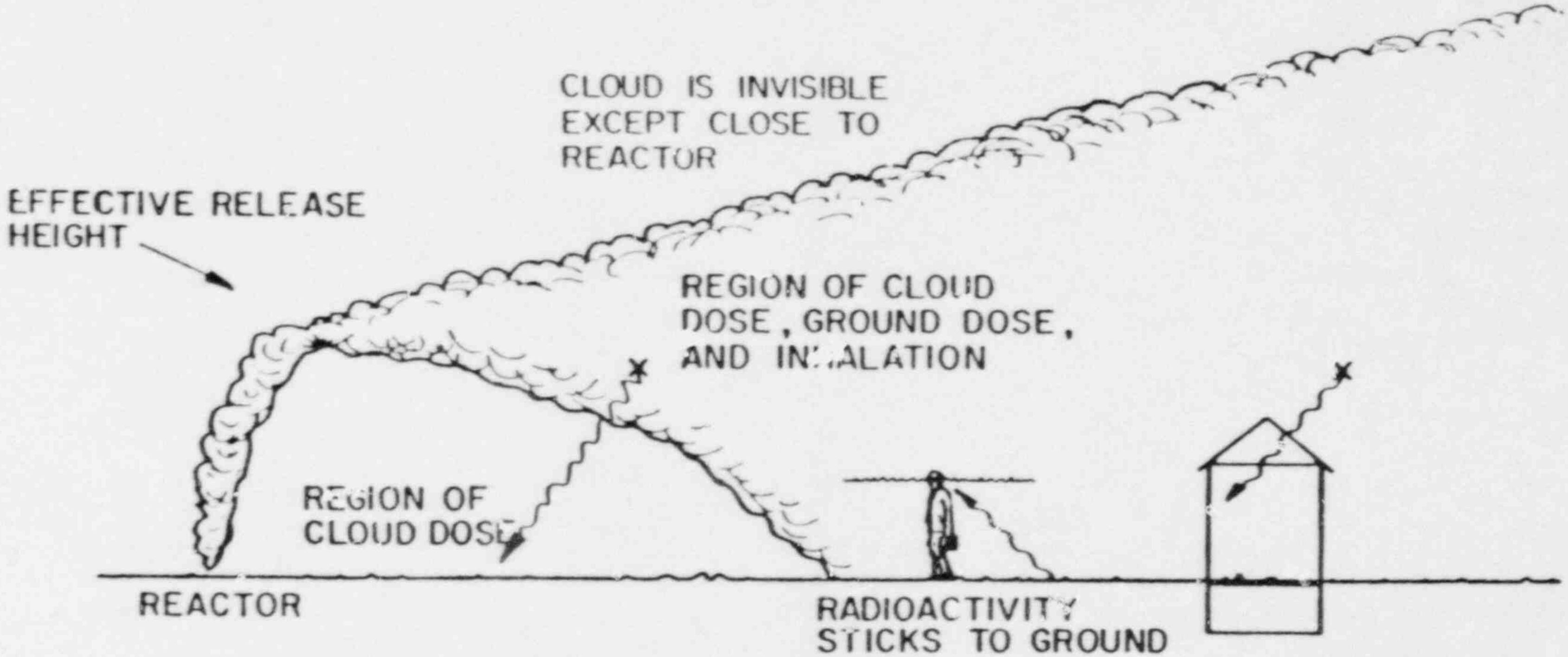
25/ U.S. Nuclear Regulatory Commission, Reactor Safety Study, (Washington, D.C., WASH-1400 or NUREG-75/014, 1975).

The Reactor Safety Study assumed a 50 percent retention rate for radioactivity deposited on vegetation. [See Appendices E and K] Although most of this loss is probably caused by subsequent rain, experimental data indicates that removal begins immediately after deposition. This initial loss must be due to wind action. Ten percent removal by wind seems a reasonable estimate.

26/ See Volume VI of WASH-1400, supra.



SIDE VIEW OF RADIOACTIVE PLUME

FIGURE II

most serious accidents, the main part of the plume is projected to pass by very quickly, within one half to one hour, well before any significant evacuations of beach populations could occur.)

2) From radiation received following inhalation. The inhalation pathway would be the most important contributor to the thyroid dose. It could also be the major contributor to early health effects for accident sequences in which large quantities of ruthenium are released (PWR-1 type releases), i.e. steam explosion or high-pressure melt ejection.

3) From radiation received from material deposited on the ground or other surfaces (cars, skin etc.). It is this "ground dose" which would usually be the most important contributor to early fatalities because it would continue after the plume has passed. Even if evacuation is too slow to prevent inhalation of radiation, evacuation is still needed after the plume passes by to stop the accumulation of "ground dose"; the faster the evacuation, the lower the total "ground dose".

We have concentrated on these three pathways in our testimony, using standard methodology to calculate doses whenever possible. Because generic models do not consider beach situations, it was necessary to make special calculations for contributions to ground dose not normally considered in accident computer codes, but which are of special concern to unshielded beach populations. For instance, beach users caught in the plume would likely receive significant doses from radioactivity deposited on their skin and hair.

Other important dose pathways exist for persons not under the original plume. These include inhalation and ground dose from resuspended and redeposited radioactivity. (As has been stated earlier, as much as 10 percent of the plume's material may be resuspended within a few weeks.)[27/] Also of concern is radiation from contaminated vehicles and personal possessions brought to emergency reception centers. Finally, doses are also possible though ingestion of contaminated food or water.

Q. In what units are doses measured?

A. (Beyea) Doses to organs or to the whole body are measured in "rems," an indication of the amount of biologically-damaging energy absorbed by tissue or bone. The units are useful because a dose in rems can be used to project the likelihood that an exposed person will be injured.

27/ WASH-1400, supra.

Q. What are the dose levels that enter into your calculations?

A. (Beyea) The health consequences of radiation depend upon the magnitude of the dose received. Radiation doses to the whole body on the order of 100 rems or higher --doses that occur relatively close to the plant--may lead to immediate sickness (e.g., nausea) and "early death." At a dose of 125 rems for example, 50 percent of exposed persons would suffer from nausea.28/

Although not fatal by itself, nausea and vomiting should be considered in emergency planning--especially in estimating evacuation times. It is quite conceivable that outbreaks of nausea could precipitate panic in an evacuating population, thereby interfering with an orderly escape.

"Early death," a technical term in the radiological health field, refers to death within sixty days of exposure to a given dose. The threshold for early deaths is between 100 and 200 rems to the whole body, while the probability of early death increases with increasing dose and changes with "supportive" medical treatment29/ standard practice, we have taken 200 rem

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28/ See Volume VI of WASH-1400.

29/ In this proceeding, we do not testify as expert witnesses in the biological effects of radiation. Instead, we have relied on the testimony of Jennifer Leaning and standard references to convert doses to health effects.

"Supportive" treatment is defined in the Reactor Safety Study Appendix VI, as such procedures as reverse isolation, sterilization of all objects in patient's room, use of laminar-air-flow systems, large doses of antibiotics, and transfusions of whole-blood packed cells or platelets.

as a reference standard practice, we have taken 200 rem as a reference dose to indicate the onset of significant probability of early death.

Q. How have you modelled the plume movement and dose pathways?

A. (Beyea) The plume movement and the three major dose pathways[30/] discussed previously have been modelled by us in several computer programs. The programs have been checked against other consequence codes in use around the world.[31/] The original programs have been cited in other reports,[32/]

30/ The major sources of radiation that contribute to early death or delayed cancer are inhaled radioiodine, as well as external radiation (whole-body gamma) from the plume and from contaminated ground. In the case of PWR1 releases, there are situations where inhaled isotopes such as ruthenium can cause pulmonary syndrome, leading to early death.

31/ International Exercise in Consequence Modelling (Benchmark Study), sponsored by the Organization of Economic Cooperation and Development (O.E.C.D.), Nuclear Energy Agency, 38 Boulevard Suchet, 75016 Paris, France.

32/ Jan Beyea, Program BADAC-1, "Short-Term Doses Following a Hypothetical Core Meltdown (with Breach of Containment)" (1978), prepared for the New Jersey Department of Environmental Protection.

Jan Beyea and Frank von Hippel, "Some Long-Term Consequences of Hypothetical Major Releases of Radioactivity to the Atmosphere from Three Mile Island," report to the President's Council on Environmental Quality, Center for Environmental Studies, Princeton University, (1979), Appendix E.

A detailed discussion of the basic dose calculations used in these programs can be found in the Appendices of "A Study of the Consequences of Hypothetical Reactor Accidents at Barseback," Jan Beyea (Stockholm: Swedish Energy Commission, 1978).

(footnote continued)

while some modifications have been made for this study.33/ It was not necessary for these proceedings to use our most recent set of programs which directly include time-varying weather such as changing wind speed and changing turbulence. In the Seabrook beach case, doses are so high that these smaller probability events do not dominate the risk.

The dose to the population caught directly in the plume for the release categories under consideration has been calculated by these programs as a function of time after release for a range of weather conditions and for a range of model parameters. Ranges of model parameters were used because the appropriate values of parameters are currently uncertain.

The basic modelling used is similar to the approach taken by radiological protection agencies around the world, including the Nuclear Regulatory Commission and the New Hampshire Department of Public Health.34/

(footnote continued)

Brian Palenik and Jan Beyea, "Some Consequences of Catastrophic Accidents at Indian Point and Their Implications for Emergency Planning," direct testimony on behalf of New York State Attorney General, Union of Concerned Scientists (UCS), New York Public Interest Research Group (NYPIRG), New York City Audubon Society, before NRC Atomic Safety and Licensing Board, July, 1982.

33/ For this study, we have used appropriate dose scaling factors, as discussed in detail later, to include dose contributions from material deposited directly on the cars and skin of evacuees.

34/ D.V. Pergola, R.B Harvey, Jr., J.G. Parillo, "SB Metpac, A Computer Software Package Which Evaluates the Consequences of an Off-Site Radioactive Release Written for the Seabrook Station Site at Seabroo , New Hampshire" (Yankee Atomic Electric Company, Framingham, Mass., May 1986).

The only specialized aspects of our calculations involve the following:

1) Radiation shielding: Radiation shielding factors for cars used in the 1975 Reactor Safety Study have been updated to account for changes in car construction that have been made to improve fuel economy in the intervening years.

2) Accounting for dispersion over water. Certain beach sites, like Seabrook, have water between them and the reactor. We have made adjustments for decreased dispersion using standard methodology.[35]

3) Radioactivity deposited on vehicle surfaces: In some of our calculations, we have accounted for radioactivity that would be deposited on cars caught in the plume. This radioactivity could cause a significant dose to riders and should not be ignored.

4) Radioactivity deposited on the skin and clothing of beach-goers: In some of our calculations, we have accounted for radioactivity that would be deposited on beach occupants while standing either on the beach, in parking lots, or outside their cars waiting for traffic to move. Although not generally a major

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35/ In such a case (Seabrook Beach), we have shifted dispersion parameters by one stabililty class. See footnote 39.

effect to be considered at other sites, we have found that the dose from skin contamination is significant at Seabrook because of the large beach population that could be caught outdoors.

Because doses from contaminated skin and vehicles have not to our knowledge been considered in past consequence modelling, our calculations have been presented with and without their inclusion. Their impact is to increase, in comparison to other sites, the number of meteorological conditions during which early death would occur.

Q. In what ways have your calculations taken into account the uncertainties in the current state of consequence modelling?

A. (Beyea)

Plume Rise

The treatment of plume rise due to thermal buoyancy illustrates the current uncertainty that exists in dose calculations due to inadequate knowledge of model parameters. Since calculated doses can be very sensitive to whether or not the edge of the plume has "touched" ground, knowledge of the initial rise of the plume can be critical for projecting doses. Yet, lack of understanding, both experimental and theoretical, about plume rise makes prediction of this parameter difficult.

Figure III shows the enormous range in airborne concentration of radioactivity (and therefore inhalation and ground doses) predicted for the same release of radioactivity by modellers from different countries under one set of weather conditions.[36] Most of this range arises because of different predictions of plume rise. These results from the international exercise in consequence modelling demonstrate that dose predictions from a particular computer code may be highly uncertain within about 20 miles from the reactor if based on one set of model parameters. (Output from the computer codes used to develop our testimony were included in this consequence modelling exercise.)

If a range of weather conditions is examined, the range of doses predicted by different computer codes shows much less of a spread. It is for this reason that we considered a range of weather conditions in this study rather than relying exclusively on predictions using one set of model parameters. The dose ranges used in our testimony fall well within the full range given in Figure III.

At Seabrook, plume rise is a critical issue only for the PWR1-type releases. The other releases are not characterized by sufficient thermal bouyancy to make it an issue.

36/ Figure III has been taken from S. Vogt, CNSI Benchmark Study of Consequence Models, International Comparison of Models Established for the Calculation of Consequences of Accidents in Reactor Risk Studies, Comparison of Results Concerning Problem 1. SINDOC(81) 43.

FIGURE III. RANGE OF AIR CONCENTRATIONS OF RADIOACTIVITY PREDICTED BY DIFFERENT MODELLERS FOR THE SAME RELEASE SCENARIO. (MOST OF THE VARIATION IS DUE TO VARIATION IN THE TREATMENT OF PLUME RISE.)

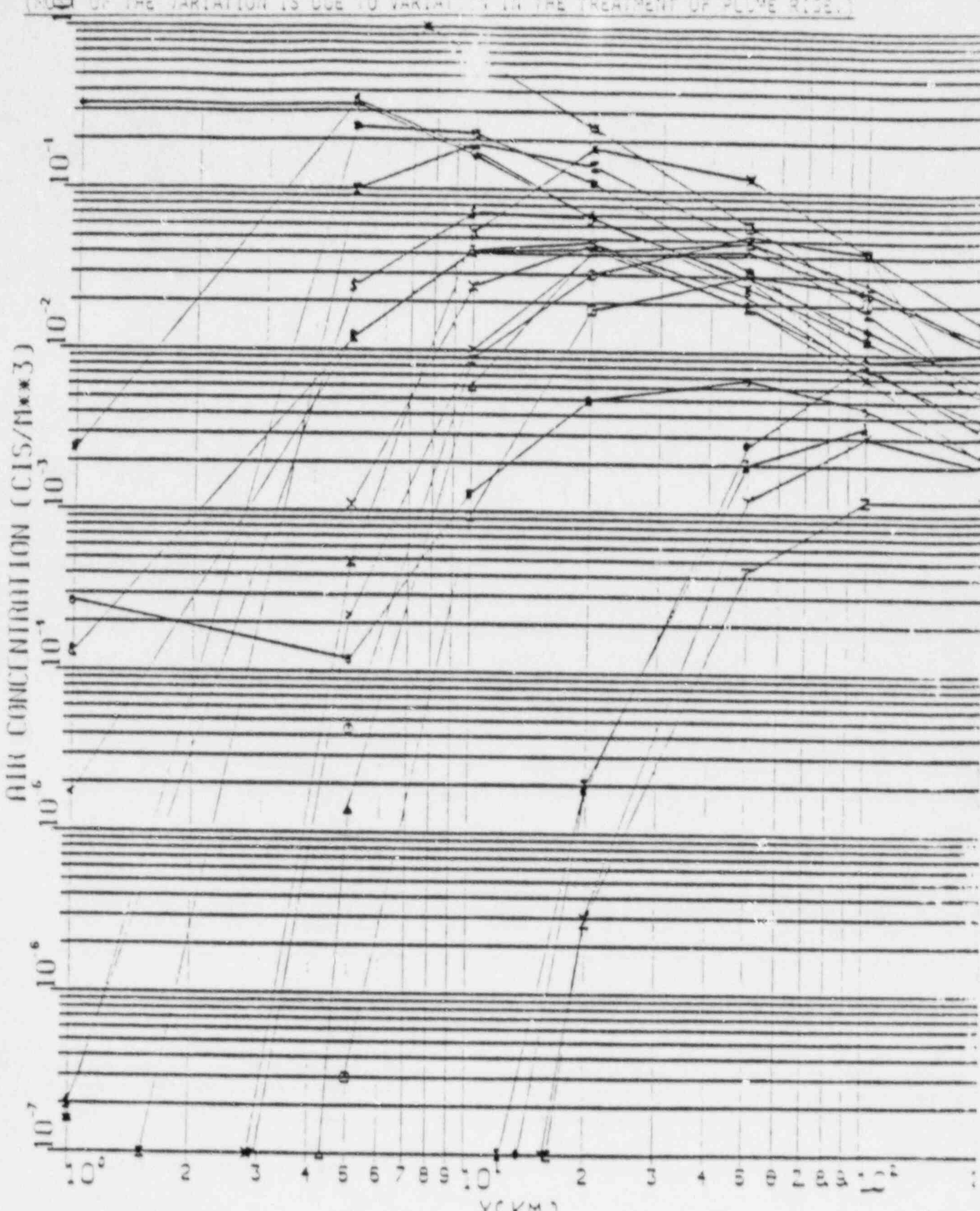

ABB. 21 : BENCHMARK PROBLEM 1

INTEGRATED AIR CONCENTRATION (CIS/M**3)

BMP2 D STABILITY NO RAIN

Deposition Velocity

A range of deposition velocities has not been examined in this testimony. (Deposition velocity governs the rate at which radioactive material deposits on surfaces). Like plume rise, this parameter is also uncertain, but does not have a critical impact on any of our calculations. For simplicity we have used a mid-range value of 1 cm/sec.[37/]

Sea Breezes

Because of the complexity involved in modelling sea breezes, we have treated them qualitatively. To obtain an understanding of the sea breeze phenomenon, it is useful to begin with a simple case, where the inland wind speed is very low. A circulating cell structure would result from daytime heating of the land, extending many miles over both land and water.[38/]

In this example, the wind would blow toward the reactor away from the beach, yet radioactivity would still reach the beach for either low-rising or high-rising plumes, as radioactivity became entrained in the cell and circulated within it. However, in this scenario, because it would take several hours for the radioactivity to reach the beach, it is

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37/ A complete discussion of this parameter can be found in the Barseback Study, supra.

38/ C.S. Keen, "Sea Breezes in the Complex Terrain of the Cape Peninsula," in Third Conference Meteorology of the Coastal Zone (American Meteorological Society, Boston, Mass., January 1984, pp. 129-134).

not possible to say, without detailed study, whether or not the radioactivity would arrive before the beach goers had left.[39/]

In many other sea-breeze cases, the inland wind would be too strong to ignore. The resulting structures can be very complex, either causing plumes to rise above the beach and reduce doses or to slow plumes down, producing higher doses. If the inland wind is very strong, it will eliminate the cell structure entirely or drive it offshore.

In general, turbulence at the beach should increase under sea breeze conditions, leading to the possibility that above-ground plumes will be brought quickly to the ground (fumigated) once the region of excess turbulence has been reached.

The possibility must be considered that a moisture-laden plume could produce its own rain, following rapid mixture with cold, turbulent sea air that would be filled with salt particles capable of nucleating water droplets. Rain would be

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39/ W.A. Lyons, "Lectures on Air Pollution and Environmental Impact Analysis," American Meteorological Society, Boston, Mass., 1975. See also, S.J. Mass and P.R. Harrison, "Dispersion Over Water: A Case Study of a Non-Buoyant Plume in the Santa Barbara Channel, California," in Joint Conference on Applications of Air Pollution Meteorology, Nov. 29-Dec. 2, 1977 (American Meteorological Society, Boston, Mass., pp. 12-15). See also, S. Barr, W.E. Clements, "Diffusion Modeling: Principles of Application," in Atmospheric Science and Power Production, (Report DOE/TIC-27601, Department of Energy, Washington, D.C., 1984, p. 613).

extremely serious for the beach goers, because unusually large amounts of radioactivity would be carried to ground level along with the drops.

In considering the various meteorological combinations that could occur, it is possible to find some conditions that increase doses at the beach and some conditions that decrease doses--sometime during the course of the same day.

In light of this variation, we have assumed that our calculations without sea breeze effects represent a mid-range case.

Q. What are the characteristics of the release types you have considered and why have you chosen to use them?

A. (Beyea) Because the number of possible accident sequences is very large, it would be prohibitive to perform consequence calculations for every possibility. Instead, following standard practice, we have picked surrogate release categories that are intended to span the range of possibilities. As mentioned in the summary, releases have been chosen that generally fall into the release categories used in NUREG-0396, but which take into account site-specific differences. The basic reference documents utilized relating to site-specific accident sequences at the Seabrook Plant are 1) the Licensee's Seabrook Probabalistic Safety Assessment (PSA),40/ and the review of the PSA carried out by analysts

40/ Pickard, Lowe and Garrick, Seabrook Station Probabilistic Safety Assessment, 6 volumes, December, 1983.

at Brookhaven National Laboratories for the NRC.[41]

In our study, we have generally accepted the Brookhaven recommendations, although for completeness we have considered some PSA categories without modification. In such cases, we have included them as part of our generic release categories.

In the release categories used for our testimony, we have picked one specific sequence to define the release magnitude for each category. However, it is important to bear in mind that the probability of the category is not the probability of the specific accident analyzed. The true probability is the sum of the probabilities of all accident sequences, known or unknown, that have similar release magnitudes.

> 1. Category 1 (PWR1-type): <u>Early Containment Failure with Core Oxidation</u>. This category is represented by an "S1" sequence as defined in the Seabrook (PSA). Also included in this category is a high-presure melt ejection sequence.
>
> One of the questions raised by the Brookhaven review of the PSA concerns the assumed rate at which heat would be released during an accident--a variable which governs plume rise. The PSA assumes uniformly high values. In particular, for the S1 case, the PSA assumes such a high release of thermal energy that the plume passes high overhead, causing relatively low doses to the beach population, according to

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41/ M. Khatib-Rahbar, A.K. Agrawal, H. Ludewig, W.T. Pratt, "A Review of the Seabrook Station Probabilistic Safety Assessment: Containment Failure Modes and Radiological Source Term," Brookhaven National Laboratory, Upton, Long Island, prepared for U.S. NRC, draft, September, 1985.

U.S. Nuclear Regulatory Commission, Reactor Safety Study, (Washington, D.C., WASH-1400 or NUREG-75/014, 1975).

conventional consequence models. As indicated by Gordon Thompson (at p. 76 infra) it will not be possible to resolve this discrepancy since a large range of heat rates is possible, depending on the dynamics of the accident. Because the Brookhaven assumption on heat rates represents a mid-range value in the spectrum found by Thompson, we have used it in our calculations of doses from S1 releases, recognizing that the actual doses could be significantly higher or lower.

2. Category 2 (PWR2-type): Severe Containment Bypass. We include in this category an "S6V-total" sequence as defined by analysts at Brookhaven. In this release category, a direct pathway to the atmosphere is opened as a result of containment bypass. 43% of radioiodine, 43% of radiocesium, and 40% of radiotellurium in the core are projected to escape.

In addition to the "interfacing systems accidents" used to define this accident in the PSA, we include in this category thermally-induced steam generator tube failures.

We also specifically analyze the PWR2 release overpressurization scenario utilized in the Reactor Safety Study and NUREG-0396. Note that this rlease category is generally similar to the preceeding rapid bypass category represented by S6V-total.

3. Category 3 (PWR3-type) Slow Containment Bypass. The Seabrook PSA modelled a containment bypass release as a "puff" release in which radioactivity is assumed to escape at different times, for periods of varying duration. We refer to this release category in the Tables with the notation used in the PSA to label the first and most dangerous puff (S6V-1).

Brookhaven, in its review of the PSA assumed radioactivity would be assumed to escape over a period of one hour. For our testimony, we have made consequence calculations using both sets of assumptions. S6V-total in Category 2 represents the Brookhaven approach; S6V-1 in Category 3 represents that taken in the PSA.

4. Category 4: (PWR4-PWR9 -types) The less severe accidents utilized in NUREG-0396 are grouped in this category. Although such accidents can cause doses in excess of protective action guidelines and can increase delayed cancer risks in exposed populations, they are not generally projected to lead to early health affects.

A summary of the characteristics of the first three release categories is given in Table 1.

Q. What special characteristics around Seabrook affect the consequences of a release there?

A. (Beyea) Our investigation of the consequences of releases of radioactivity at Seabrook concentrates on the summer months. The potential consequences, especially with respect to early death from a serious accident at the Seabrook plant, increase greatly during these months due to a large summer population in the area. These summer residents, day visitors, etc. increase the exposed population, and by increasing the evacuation time necessary to clear the area, they increase the potential time exposure. Furthermore, the consequences to a beach area population may be greater than the consequences to an inland population under similar conditions due to a lack of shielding normally provided by buildings. The addition of increased consequences due to material deposited directly on the skin of a beach population must also be considered for the Seabrook plant. Taken together, these factors make summer release scenarios at Seabrook worthy of

TABLE 1

RELEASE PARAMETERS

	PWR1	PWR2		PWR3
	S1 Steam Explosion	S6V-total Containment Bypass	RSS Over-Pressurization	S6V-1 Containment Bypass
Warning Time	0.3	1.0	1.0	1.7
Release Duration (hrs)	0.5	1.0	0.5	1.0
Release Time (hrs)	1.4	2.5	2.5	2.2
Energy Release Rate (million BTU/hr)	520	low*	170	low*
Plume Rise (m)**	200-850	30	80-300	30
Release Fractions				
Noble Gases	.94	.97	0.90	.15
Iodine	.75	.43	0.7	.11
Cesium	.75	.43	0.5	.11
Telurium	.39	.40	0.3	.02
Barium	.093	.048	0.06	.014
Ruthenium	.46	.033	0.02	.0041
Lanthanides	.0028	.0053	0.004	.00041

* Brookhaven suggests a much lower release ratio than does the Seabrook PSA. However, the plume rise is low in both cases.

**Calculations for stability classes A-E. Plume rise varies within an accident because of different wind speeds. Variations for S6V releases are so small that they can be ignored. For an S1 release, the following values apply:

Stability Class	Wind Speed 2 m/sec	4 m/sec	8 m/sec
A-D	850 m	440 m	230 m
E	350	280	230

special consideration, and we have included them in our investigation of the potential consequences of accidents at Seabrook.

Figure IV shows the location of the Seabrook beaches.

It should be noted that for the most severe accident categories considered, as will be discussed below, doses are so far above threshold for overcast conditions, that early deaths are possible at any time of the year. Nevertheless, the number of people who would die would increase greatly during the summer. Furthermore, intermediate accidents--those that would usually not cause early deaths--would be expected to cause early deaths at the beaches. In other words, during the summer, there is a much wider spectrum of accidents that can cause early fatalities.

Q. What are the assumptions behind the evacuation times you have used?

A. (Beyea) At some point during the operation of a reactor, the nuclear facility operator (NFO) may notify the appropriate state and local officials of an "unusual event," an occurrence that may lead to an eventual release of radioactivity. Depending on the seriousness of the event or of following events, a higher emergency level may be reached. The NFO may eventually recommend, in consultation with officials and technical support staff, that an evacuation is necessary of all or part of the surrounding population. The appropriate

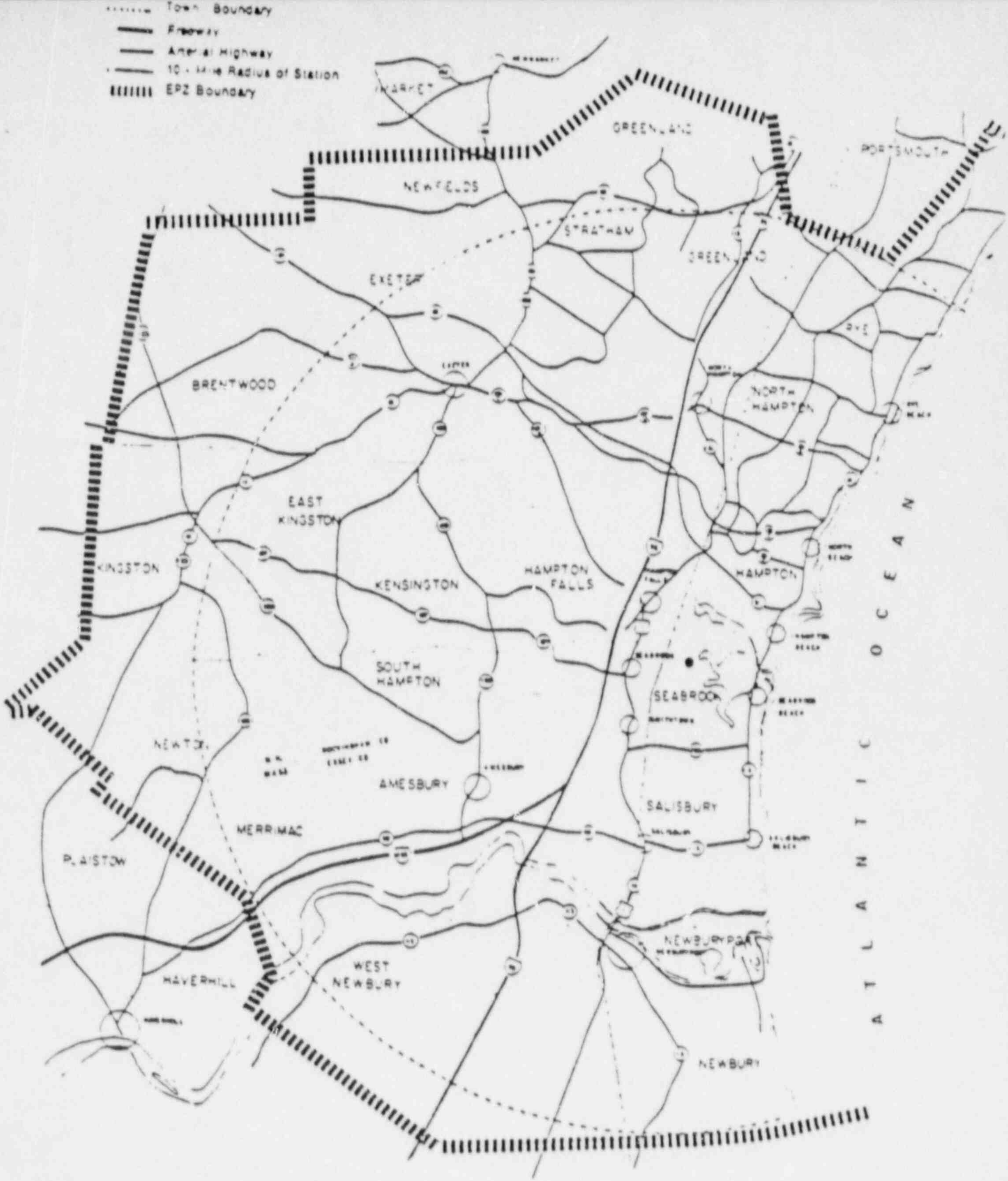

FIGURE IV: SEABROOK AND AREA BEACHES

local officials, who may or may not have received prior warning, are then notified, and the emergency warning system will presumably be activated as soon as possible.

Time elapses between an initial indication to the operator and the moment state and local officials begin notification of the population. CONSAD (a consulting firm to FEMA) estimated this time to take 19-78 minutes during the day and 50 minutes at night. 42/ Their review of historical data shows these kinds of estimates can range from one to many hours for a range of natural disasters and false alerts. Our work here assumes 45 minutes. In addition, some time will be needed to actually notify the population that an evacuation is needed. We take 15 minutes for this time, so that evacuation is assumed to begin one hour (45 plus 15 minutes) after the decision is made to evacuate.

We also assume that the NFO receives an indication of a pending release before the release. This warning time is taken as 18 minutes for a steam explosion, one hour for a rapid containment bypass (S6V-total), one hour for a PWR-2 release, and 1.7 hours for a slow containment bypass (S6V-1). These are the assumptions made by the analysts (Brookhaven, Seabrook PSA, Reactor Safety Study) who devised the release categories

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42/ CONSAD Research Corportion, "An Assessment of Evacuation Time Around the Indian Point Nuclear Power Station," June 20, 1980; revised June 23, 1980, p. 2.7-2.9.

studied. When the one hour delay involved in starting the actual evacuation is accounted for, the results are as follows.

Steam explosion: evacuation starts 42 minutes after radioactivity begins escaping.

PWR-2 and rapid containment bypass (S6V-total): evacuation starts at the same time as radioactivity begins to escape.

Slow containment bypass (S6V-1): Evacuation starts 42 minutes before radioactivity begins to escape.

The evacuation time estimates themselves are based on assumptions about conditions during the evacuation, the state of readiness of an evacuation system, etc. These assumptions vary, leading to differences in evacuation times. The evacuation times for five earlier studies of a Seabrook area evacuation are listed in Table 2. Some of the evacuation times in the table for a two mile radius (and five mile radius) appear to be for a selective evacuation from within that radius. We have used five hours as a representative estimate for beach site evacuation.

Current emergency plans at Seabrook call for notification of beach populations at an earlier stage in an accident than for the general population. However, for PWR1-PWR3 categories, there is doubt as to how much time would actually be gained by this procedural modification. Although we have not taken credit for extra warning time to the beach population, our results can be easily modified to do so. It is only necessary to relabel the evacuation time assigned to our tables. In

TABLE 2

SEABROOK EVACUATION CLEAR TIME ESTIMATES[a)]

SUMMER DAY SCENARIO

RADIUS	DEGREES	HMM[b)]	Vorhees[c)]	Maguire[d)]	NRC[e)]	KLD[f)]
0-2	360	4:50	5:10	[illegible]	----	4:40
0-3	180 East	5:20	----	---	----	----
0-5	360	5:50	5:10-5:40	----	----	6:20
0-10	360	6:05	5:10-6:10	[illegible]0	11:25	6:40

a) Time (Hours:minutes) for the population to clear the indicated area after notification.

b) "Preliminary Evacuation Clear Time Estimates for Areas Near Seabrook Station," HMM Document No. C-80-024A, HMM Associates, Inc., May [illegible] 1980.

c) "Final Report, Estimate of Evacuation Times," Alan M. Vorhees & Associates, July 1980.

d) "Emergency Planning Zone Evacuation Clear Time Estimates," C.E. Maguire, Inc., February 1983.

e) "An Independent Assessment of Evacuation Time Estimates for a Peak Population Scenario in the Emergency Planning Zone of the Seabrook Nuclear Power Station," M.P. Mueller, et al, Pacific Northwest Laboratory. NUREG/CR-2903 PNL-4290.

f) "Evacuation Plan Update, Progress Report No. 3," KLD Associates, [illegible] Broadway, Huntington Station, NY 11746, Januaray 20, 1986, Table 19, Scenario 1A. These calculations refer to the beach population, but assume the entire five mile population is evacuated officially and that 2[illegible] of the population beyond five miles evacuates spontaneously. It is further assumed that beaches are at 80% of capacity and that officials attempt to notify the beach population at the Site Alert stage, 15 minutes <u>before</u> a General Site emergency is called. To make these estimates consistent with the assumptions used in our calculations, 15 minutes should be added to the numbers shown. On the other hand, 15 minutes should be subtracted to avoid double counting the delay associated with notifying beach occupants, which is already included in the KLD time estimates.

other words, if beach populations are assumed to begin evacuating 15-minutes earlier than normal, the equivalent evacuation time in our calculations would be 5 hours minus 15 minutes, not 5 hours.

According to testimony by Thomas Adler in this proceeding, actual evacuation times from the contaminated area would be much, much longer. Some of the persons exposed in an accident will therefore likely receive larger doses than presented in our tables. Our tables, therefore, lead to conservative estimates of the numbers of persons exposed to possible early death.

Q. Is the population around Seabrook subjected to possible "early death" for releases during the summer?

A. (Beyea) We have investigated the conditions under which the nearest beach population, at 2 miles and 4 miles, might be exposed to doses at a threshold level for early death (200 rem) for the release categories discussed previously. According to standard references (see Moeller, et al.)43/ At 200 rem, a few percent of exposed persons would die within a two month period, a few percent of women under 40 would be

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43/ J.S. Evans, D.W. Moeller, D.W. Cooper, "Health Effects Model for Nuclear Power Plant Accident Consequences Analyses," (U.S. Nuclear Regulatory Commission, Washington, D.C., NUREG/CR-4214, 1985) The "LD50" for nausea is given as 1.4 Gy in Table 1.3, page II-29. 1.4 Gy equals about 125 rem.

Biological Effects of Ionizing Radiation, National Academy of Sciences, Washington, D.C., 1980.

permanently sterilized, and a few percent more would develop cataracts. Table 3 illustrates some of our findings for 2 miles. Weather stability class, wind speed, and the time it would take for the beach population to receive a 200 rem dose under those conditions are listed.

We have found these estimates for two sets of assumptions. The first set assumes that all the population is inside cars when the release occurs so that skin and clothes do not get contaminated. Doses are also reduced because of the partial shielding provided by the car from the radioactivity on the ground. The fractional decrease in dose from shielding, here referred to as a "dose scaling factor", is calculated to be .53-.78 for this set of assumptions. The time it takes for a person in a car waiting within the plume to receive a 200 rem dose is then listed in the table. We assume that vehicles remain stalled in traffic within contaminated ground and then move rapidly out of the area once the roads are cleared at the end of five hours. We also assume that a person once evacuated receives no additional dose once outside the plume path.

On the basis of our consideration of a Seabrook-type evacuation, we have decided to also use a second set of assumptions. Some of the population will not have reached their vehicles before plume passage. (Maguire, for example, assumes up to an hour for the beach population to "mobilize"

TABLE 3

EXPOSURE OF 2-MILE BEACH POPULATION[a)]
TO RISK OF EARLY DEATH ON A SUMMER DAY
(SKIN AND CAR DEPOSITION NOT INCLUDED)

		Time in Hours to Reach[b)] 200 R-m			Risk of Early Death?[d)]		
Stab-[c)] ility Class	Wind Speed (m/sec)	PWR1 $\overline{S1}$[e)]	PWR2 S6V-Total	PWR3 S6V-1	$\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	14. -21	18. ->24	>24	50% chance	N	N
A	4	20. ->24	>24	>24	"	N	N
A	8	>24	>24	>24	"	N	N
B	2	>24	5. -7	>24	"	Y	N
B	4	9.5-14	13. -19	>24	"	N	N
B	8	[illegible] -21	>24	>24	"	N	N
C	2	>24	<1	19. -24	"	Y	N
C	4	>24	2.6- 3.7	>24	"	Y	N
C	8	7.7-12	8.3-12	>24	"	N	N
D	2	>24	<1	5. 7.0	25% chance	Y	Y
D	4	>24	<1	12. -17	"	Y	N
D	8	>24	1. - 1.5	>24	"	Y	N

a) The population two miles from the plant, but not directly across the lagoon. Times would be shorter for populations with water between them and the reactor due to reduced dispersions.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. Ground shielding factors are assumed to range from 0.33 to 0.78, depending on the type of automobile. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) If the plume rises high, as at Chernobyl, the population will be protected against early death for this release. Otherwise, the population will be exposed to risk of early death. (Both the thermal release rate and the plume rise equation are uncertain. See text of question 12 for discussion of probabilities in table.)

itself for an evacuation.)[44] Of those that do reach their vehicles before plume passage, some will leave their windows open and some will not enter their cars until traffic starts to move. Thus, some of the population will have radioactive material deposited directly on their skin and hair. We refer to the dose from this material as a "skin deposition" dose. Similarly, we take into account material deposited directly on cars in the plume and the dose resulting from this material (a "car deposition" dose).

For this second set of assumptions, we have estimated that the dose to a person shielded by a car, but exposed to both skin deposition and car deposition doses, would be 1.0 to 1.3 times the dose to an unshielded person exposed to a plane of contaminated ground (see below). The dose scaling factor range is thus 1.0-1.3 Results using this range are shown in Table 4.

A great deal of information is contained in Tables 3, 4 and similar Tables to be presented later. Consider, for example, D-stability conditions. Note that the times shown refer to "clearing" time, that is the time for the last person in the area to be evacuated. But even a 1-hour evacuation time, which might apply to the earliest evacuees, is insufficient to keep

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44/ C.E. Maguire, Inc., "Emergency Planning Zone Evacuation Clear Time Estimates," February 1983.

TABLE 4

EXPOSURE OF 2-MILE BEACH POPULATION[a)] TO RISK OF EARLY DEATH ON A SUMMER DAY
INCLUDES DOSE FROM SKIN & CAR DEPOSITION

Stab-[c)] ility Class	Wind Speed (m/sec)	Time in Hours to Reach[b)] 200 Rem: PWR1 $\overline{SI}$[e)]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d)] $\overline{SI}$[e)]	S6V-tot.	S6V-1
A	2	8.2-11	11-14	>24	50% chance	N	N
A	4	12. -15	>24	>24	"	N	N
A	8	>24	>24	>24	"	N	N
B	2	19. -24	3.1-4	>24	"	Y	N
B	4	5.5-7.3	7.8-10	>24	"	N?	N
B	8	8.4-11	17.4-23	>24	"	N	N
C	2	>24	<1	12. -15	"	Y	N
C	4	>24	1.7-2	>24	"	Y	N
C	8	4.4-5.9	5. -6.5	>24	"	Y	N
D	2	>24	<1	3.5-4.2	25% chance	Y	Y
D	4	>24	<1	7.6-9.6	"	Y	N?
D	8	>24	<1	17.4-22.5	"	Y	N

a) The population two miles from the plant, but not directly across the lagoon. Times would be shorter for populations with water between them and the reactor due to reduced dispersions.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car and directly on the individual. The effective ground shielding factors range from 1.0 to 1.3, depending on the type of automobile. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) If the plume rises high, as at Chernobyl, the population will be protected against early death for this release. Otherwise, the population will be exposed to risk of early death. (Both the thermal release rate and the plume rise equation are uncertain. See text of question 12 for discussion of probabilities in table.)

doses below 200 rem for an S6V-Total release. On the other hand, the first of the evacuees to leave during an S6V-1 release would escape a 200-rem dose.

If the time to reach a 200-rem dose shown in the tables is compared with a 5-hour evacuation time, one arrives at a "yes/no" indication of whether or not the population at 2 miles is exposed to risk of early death. This is noted in the last set of columns in each table.

Some of the entries are marked with a question mark. A question mark indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached early in the evacuation. In such cases, a 5-hour evacuation time calculated from traffic models may be optimistic. Because we were unable to determine a quantatative estimate of the likely delay in evacuation that would result from cases of nausea, we have not been able to do more than indicate uncertainty.

Note that no entries are shown in the Tables for a PWR-2 release. The results turned out to be so similar to, or worse than, the SV6-total release that it was not necessary to include separate entries.

Several caveats about the tables should be kept in mind, especially when exposure of the population is indicated. First of all, risk of early death is much higher for persons very close to the plant where doses reach high levels very rapidly.

Second, we have not looked at slower wind speeds for the various stability classes nor have we examined changing weather conditions. Both of these situations can lead to higher doses. Thus, Tables 3 and 4 do not include the worst possible weather conditions but only the most probable.

A third caveat is that, while D conditions generally represent overcast days, we have not looked at actual precipitation conditions that sometimes catch populations on the beach. The time for a dose to reach 200 rem is greatly decreased in this case (for the same wind speed) due to the increased deposition of radioactive material. Evacuation time is also increased.

On the other hand, overcast conditions in the morning would deter people from coming to the beach. The lower populations would mean reduced clear time estimates. Recall, however, that there is a multi-hour underestimate of clear times in our work for most of the beaches (see Adler). In any case, doses tend to be so high under D-conditions for the S6-V total release that reduced clear times are insufficient to provide protection. The same is true for the S1 release for low thermal release rates and low plumes rise.

Finally, it should be emphasized that the population's exposure may be increased if the shown evacuation times are, for whatever reason, longer than assumed here.

In any case, the results of Tables 3 and 4 can be combined with weather frequency data (Table 15) to show that for the S6V-total release which represents the severe-containment-bypass categories, if the 2-mile beach population is downwind, it will be exposed to risk of early death under meteorological conditions that would be expected to occur about 70-75% of the time.

In contrast, the results in Tables 3 and 4 for the slow-containment-bypass release, S6V-1, indicate that the population at 2 miles is generally not exposed to early death for this release.

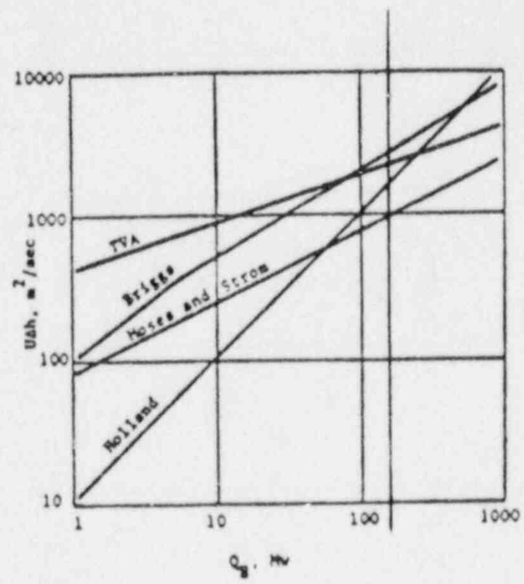
Surprisingly, the S1-steam-explosion release, which represents the largest release of all, in some circumstances might causes fewer problems for the beach population at 2 miles than the PWR-3 type release. The reason for this is that the projected plume rise may be so great, as occurred at Chernobyl, that the plume passes high over the nearby populations. We estimate a 50-percent chance that this will be the case for A, B and C stability conditions and a 75-percent chance during D conditions. Our rationale is that the height to which any radioactive plume rises is uncertain, as was discussed earlier.

Should the true plume rise be a factor of two less than the mid-range value predicted by standard plume rise formulas, which is within the range of uncertainty (see Fig. 5), early

Figure 5

VARIATION IN PLUME RISE

ACCORDING TO SOME WELL-KNOWN FORMULAS



The vertical line at Q_h=150 megawatts corresponds to an $\overline{SI}$ release. At this heat rate, the spread in predictions made by different formula is about a factor of two.

The graph has been taken from G.A. Briggs, "Plume Rise Predictions" in Lectures on Air Pollution and Environmental Impact Analyses, American Meteorological Society, 45 Beacon Street, Boston, Mass. 02108 U.S.A., 1975.

We quote from page 60: "It is no wonder that so many plume rise formulas have been developed. What is particularly distressing is the degree to which they diverge on predicting Δh for a given source and given conditions."

deaths from external gamma exposures become frequent for A, B, and C stability classes. It should also be borne in mind that the PWR-1 releases are projected to include copious amounts of isotopes that can give high lung doses. Thus, 1-day lung dose can contribute to early death when whole body dose is below 200 rem.

When these factors are all included, the combined uncertainty is so broad that it is a toss up (50%) as to whether or not early deaths would occur following an S1 release for A, B, and C stability classes. As for D-stability class, two independent events must conspire to produce early deaths: both the heat rate must be low and a low plume rise formula must be correct. As a result, we estimate that there is a 25% chance that doses will exceed 200 rem to the whole body or the equivalent 1-day lung dose under D-stability class for this release.

It should also be recognized that a real accident may be less severe than the S1-case assumes. Paradoxically, because of lower plume rise, a small breach of containment following a steam explosion could be more severe than a large breach as far as nearby populations are concerned.

Finally, it should be borne in mind that turbulent interaction with the sea breeze and/or condensation of radioactive rain could bring radioactivity down to ground level. An enormous amount of radioactivity would be passing overhead; even a relatively weak meteorological process, one normally not considered in reactor accident dispersion modelling, could couple the upper air with air at ground level, causing high doses.

Note that we have not shown results for release classes PWR4 through PWR9. Athough these releases can cause doses in excess of protective action guides, they rarely lead to doses in excess of 200 rem. Doses for those categories are dominated by noble gases, so that ground deposition can be ignored. As a result, the dose ends after plume passage. Without effective sheltering, the only emergency measure that has any impact on doses for these release classes is pre-plume evacuation.

IX. RADIATION DOSES FROM ACCIDENTS WITHIN THE PLANNING SPECTRUM

Q. How were your dose scaling factors obtained?

A. (Beyea) The basic dose scaling factor, with car and skin deposition ignored, was calculated to have a range of 0.53-0.78, assuming that an evacuee is inside a car in the plume deposition area. This range represents an updating of the 0.4-7 shielding factor range used in the Reactor Safety Study (WASH-1400). Cars are lighter today (and will be more so in the future) compared to the 1975-vehicles analyzed in the Reactor Safety Study. Assuming that vehicles involved in an evacuation will be 30% lighter than 1975 vehicles,[45] the appropriate shielding factor range turns out to be 0.53-0.78[46]

The relative contribution of various doses, including car and skin deposition doses, can be obtained as follows.

Dose per unit time (Relative to dose from a flat, contaminated plane):[47]

A) to person standing on contaminated beach, parking lot, road, etc. 1.0 X Sg[48]

B) Dose inside car from contaminated ground 1.0 X Sc[49]

45/ Due especially to the decrease in the amount of steel used in U.S.-built cars, the material weight of U.S. cars dropped 15% between 1975 and 1981 and is projected to drop another 15% by 1985. (Table 4.3, p. 122, Transportation Energy Data Book, edition 6, G. Kulp, M.C. Holcomb, ORNL-5883 (special), Noyes Data Corporation.)

46/ Shielding varies exponentially with mass per unit area. Thus $(.4)^{.7} = 0.53$; $(.7)^{.7} = 0.78$.

47/ In the absence of detailed calculations, we assume that absorption effects in air can be handled by neglecting all absorption at distances less than 100 meters and by treating absorption beyond 100 meters as total. Thus, we replace the exact problem of a contaminated plane of infinite extent by a finite circular surface of radius 100 meters. Since the integral over the disk turns out to be logarithmic with radial distance, the total dose is insensitive to the cutoff distance chosen. These calculations are conservative since they ignore ground scattering effects which increase relative doses from deposition close to the receptor.

Deposition is assumed to proceed uniformly on any external surface regardless of the surface's orientation. Thus, a square centimeter of ground is assumed to receive the same contamination as a square centimeter of skin.

48/ Shielding factor, Sg = 0.47-0.85. See footnotes 26 and 60.

49/ Shielding factor, Sc = 0.53-0.78. See footnotes 26 and 60.

C) Dose inside car from radioactivity deposited on outside of vehicle — .22 X Sc 50/

D) Dose inside car from radioactivity deposited on inside of vehicle with open windows — .04 -.2 51/

E) Dose from skin conta. nated while outside vehicle — .35 52/

F) Dose from skin contaminated while inside vehicles with open windows — .17 53/

50/ Based on numerical integration over an idealized automobile, deposition is assumed to take place on the underside of the vehicle as well as on the top surface.

51/ This case would occur 1) if windows had been left open, or 2) if evacuees reached their vehicles and opened windows before plume passage were complete.

The low number corresponds to low wind speeds; the high number corresponds to high wind speeds.

52/ An estimate of the relative contribution of skin contamination to the total dose can be obtained by replacing the complex shape of the human body with a set of bounding geometic surfaces:

1) sphere: the dose rate at the center of a sphere contaminated with N curies of radioactivity per square centimeter is 43% of the dose rate 1 meter above a circle of 100 meter radius that has also been contaminated with N curies per unit area.

   Although a cylindrical model would be more accurate, the results will not differ by a large amount, as shown below.

2) right circular cylinder: numerical integration in the case of a cylinder with radius 1/10th of the length indicates that the average centerline dose is approximately 17% greater than the sphere center dose discussed previously. For a cylinder with radius 1/5th of the length, the average centerline dose is slightly less than the sphere case.

The results of these rough calculations suggest that direct contamination of people must make a significant contribution to the total dose. We take the numerical relationship to be 35%, that is, the skin contribution is assumed to be 35% of the dose from contaminated ground.

53/ We take this dose to be half of the value for a person standing in the open, assuming that half of a person's surface area is pressed against a seat and, therefore, not subject to deposition.

The total dose can be obtained by multiplying each of the above dose components by the amount of time spent under each set of conditions. Unfortunately, there are a number of time parameters that must, in principle, be specified to calculate a dose precisely. Rather than make a complex model, we have chosen to simplify the calculations by ignoring a number of effects that should tend to cancel:

1) We ignore the finite duration of the plume, that is, we assume radioactivity is deposited instantaneously. This is equivalent to adding 30 minutes to the evacuation clear time for S6V releases, 15 minutes for the S1 release.
2) We ignore doses from skin and car received after evacuees reach reception centers. This neglected dose should compensate for the above simplification.
3) In cases when skin contamination is assumed to take place, we assume that at least some evacuees remain outside vehicles during the entire time that the plume passes. This appears to be a reasonable assumption, given the fact that traffic will be stalled and it will be uncomfortable inside vehicles that do not have air conditioning.
4) In cases when car deposition is included, we assume that a significant number of evacuees who leave their vehicles to cool off (while waiting for traffic to move) will stand next to, or lean on, a contaminated vehicle.

The net result is that we numerically calculate doses to beachgoers in one of two ways:

> When skin deposition is neglected, we assume that the last group of evacuees remains inside or close to cars, stalled in traffic, while exposed to contaminated ground. Doses do not begin to accumulate until the wind carries the plume to the vehicle. Doses continue to accumulate until the clear time is reached, at which point evacuees are assumed to leave contaminated ground instantaneously and exit their vehicles.
>
> When skin deposition is not neglected, evacuees are assumed to receive the above dose plus the dose from skin contamination that is accumulated up until the clear time.

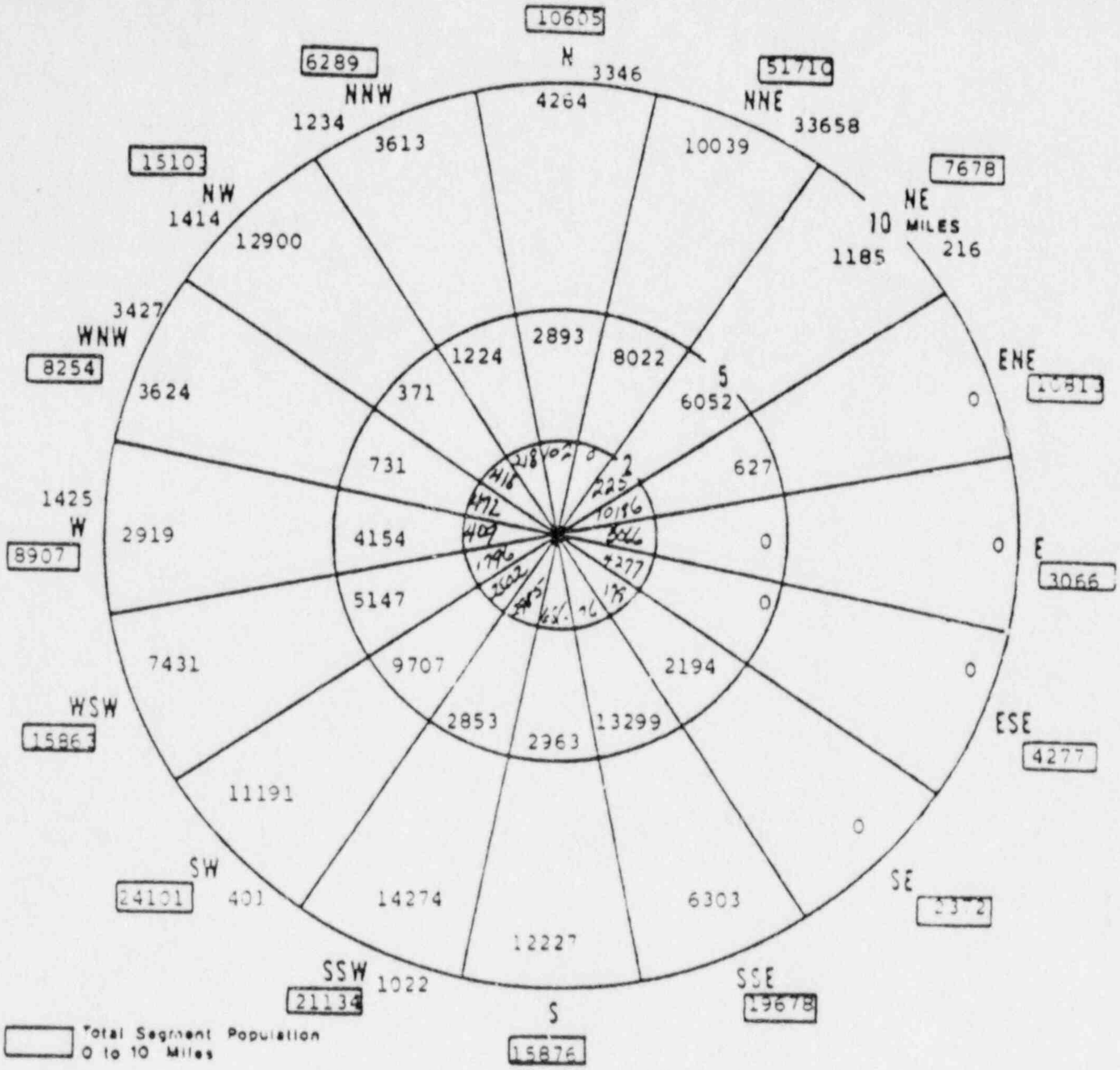
These assumptions lead to an effective dose shielding factor range of 1.0-1.3, when skin contamination is included, and a range of 0.65-0.95 when it is not.

In our judgment, the net effect of these simplifications is to underestimate the high end of the dose spectrum.

Tables 10, 17, and 18 (to be presented later) were calculated for winter populations, which are initially indoors. In these cases we have assumed cloud and inhalation sheltering factors of around 0.75. We have also assumed, for simplicity, a building shielding factor range that is identical to the automobile case (0.53-0.78).

Q. How many people are located near the plant?

A. (Beyea) The size of the beach area population around Seabrook is uncertain. One estimate of this population has been made by Public Service of New Hampshire and is found in Figure 6. Although its accuracy is uncertain, this estimate



POPULATION TOTALS			
RING, MILES	RING POPULATION	TOTAL MILES	CUMULATIVE POPULATION
0-2	27896	0-2	27896
2-5	60237	0-5	88133
5-10	89961	0-10	178094
10-B	47632	0-B	225726

Figure 6 Scenarios 3 and 4: Summer Weekday Population

does indicate that a substantial number of people are located within two miles of the plant. Estimates by other witnesses in this proceeding are much higher.

The number of persons who would be located within a plume obviously varies not only with wind direction but also with stability class and distance from the plant. At two miles the plume could be viewed as being between a 29-wedge (A stability class) and a 13-wedge (D stability class)[54/] compared to the 22.5 population wedges in the table.

Q. How large are doses likely to be and how do they compare with doses that would be received at other sites?

A. (Beyea) In order to gain a better appreciation of the higher risk faced by the beach population (higher than that faced by residents at comparable distances at other sites for comparable releases), we present a series of Tables that show radiation doses likely to be received under various scenarios. Table 8 shows the highest-risk case, which applies to the Seabrook beach population that is separated from the reactor by a lagoon. (Because plumes disperse less over water, the plume is more concentrated by the time it reaches the population than had it traveled over land.)

The doses shown apply to a person assumed to leave the contaminated area after 5 hours. The doses are truly enormous for the S6V-Total release. (Note that a 500-rem dose has a

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54/ Wedges are assumed to have plume widths of 3 times the horizontal dispersion coefficient.

TA[illegible]

DOSES RECEIVED ON A SUMMER DAY BY HIGHEST-RISK POPULATION ON SEABROOK BEACH[a]
(SKIN & CAR DEPOSITION DOSE INCLUDED)

Stab-[c] ility Class	Wind Speed (m/sec)	Dose 5 Hrs After Evacuation starts[b] (In Rem) PWR1 $\overline{S1}$[e]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d] $\overline{S1}$[e]	S6V-tot.	S6V-1
A	2	63-74	230-270	<50	N	Y	N
A	4	160-190	120-150	<50	N?	N?	N
A	8	120-140	65-7[illegible]	<50	N?	N	N
B	2	<50	580-[illegible]	85-98	N	Y	N
B	4	<50	320-380	48-55	N	Y	N
B	8	180-220	[illegible]70-2[illegible]	<50	Y	Y	N
C	2	<50	1600-1900	230-270	N	Y	Y
C	4	"	900-1100	130-150	N	Y	N
C	8	"	490-590	70-83	N	Y	N
D	2	"	2700-3200	379-448	N	Y	Y
D	4	"	1600-1900	222-264	N	Y	Y
D	8	"	840-1000	120-143	N	Y	N?

a) The population at 2 mi. with bay water between reactor and beach.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car and directly on the individual. The effective ground shielding factors range from 1.0 to 1.3, depending on the type of automobile. See Question 13 for further details.
c) Pasquill stability class. Dispersion parameters were shifted by one stability class to account for reduced dispersion over water. [See W.A. Lyons, "Turbulent Diffusion and Pollutant Transport in Shoreline Environments", in Lectures on Air Pollution and Environmental Impact Analyses. American Meteorological Society, 45 Beacon Street, Boston, MA 02108, (1985). Pages 141, 142, and especially Figure 25 on Page 149.]
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) Assuming mid-range plume rise.

mortality rate greater than 70%.) As discussed below, doses exceed the threshold for meteorological conditions that hold 93% of the time.

The doses for an S6V-1 release are smaller than for S6V-Total, but still exceed threshold for meteorological conditions that hold about 33% of the time. Doses shown for the high-rising S1 release have been calculated using a standard plume rise formula, so they almost always remain below threshold. (However, as mentioned earlier, the occurrence of a low-rising plume is expected frequently. For this reason, we continue to list probability values under the yes/no columns in Table 8 that indicate whether or not there is a risk of early death.)

Not all of the 2-mile beach population is separated from the reactor by water. Table 9 shows the results for populations separated by land. The doses are still extraordinarily high for the S6V-Total release, but are significantly less serious for an S6V-1 release. It is of interest to compare these results with doses that would be accumulated at the median reactor site around the United States. The results are shown in Table 10. We have taken 1.5 hours for the evacuation clear time within 2 miles, based on an NRC estimate of the median time.55/

55/ T. Urbanik II, "An Analysis of Evacuation Time Estimates Around 52 Nuclear Power Plants," Nuclear Regulatory Commission, Washington, NUREG/CR-1856 (1981), Vol. I, Table 10, p. 21.

TABLE 9

DOSES RECEIVED ON A SUMMER DAY BY 2-MILE BEACH POPULATION[a)]
(SKIN & CAR DEPOSITION DOSE INCLUDED)

Stab-[c)] ility Class	Wind Speed (m/sec)	Dose 5 Hrs After Evacuation starts[b)] (In Rem) PWR1 $\overline{S1}$[e)]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d)] $\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	122-143	95-110	<50	N	N	N
A	4	92-109	50-59	<50	N	N	N
A	8	53-62	<50	<50	N	N	N
B	2	63-74	230-270	<50	N	Y	N
B	4	160-190	120-150	<50	N?	N?	N
B	8	120-140	65-76	<50	N	N	N
C	2	<50	580-680	85-98	N	Y	N
C	4	<50	320-380	48-55	N	Y	N
C	8	180-220	170-200	<50	Y	Y	N
D	2	<50	1600-1900	230-270	N	Y	Y
D	4	<50	900-1100	130-150	N	Y	N
D	8	<50	490-590	70-83	N	Y	N

a) The population two miles from the plant, but not directly across the lagoon.

b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car and directly on the individual. The effective ground shielding factors range from 1.0 to 1.3, depending on the type of automobile. See Question 13 for further details.

c) Pasquill stability class.

d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.

e) Assuming mid-range plume rise.

TABLE 10

DOSES RECEIVED BY 2-MILE POPULATION[a)]
AT A MEDIAN REACTOR SITE IN THE UNITED STATES
(CAR DEPOSITION DOSE INCLUDED)

Stab-[c)] ility Class	Wind Speed (m/sec)	Dose 1.5 Hrs After Evacuation Starts[b)] (In Rem) PWR1 $\overline{S1}$[e)]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d)] $\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	53-60	<50	<50	N	N	N
A	4	<50	<50	<50	N	N	N
A	8	<50	<50	<	N	N	N
B	2	<50	95-110		N	N	N
B	4	71-82	52-58	<50	N	N	N
B	8	52-61	<50	<50	N	N	N
C	2	<50	220-250	50	N	Y	N
C	4	<50	130-140	<50	N	N?	N
C	8	78-91	67-76	<50	N	N	N
D	2	<50	540-610	77-87	N	Y	N
D	4	"	330-370	<50	N	Y	N
D	8	"	170-200	<50	N	Y	N

a) The population two miles from the plant.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by buildings and their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car, but they are not assumed to have had their skin contaminated. The effective ground shielding factors range from 0.65 to 0.95, depending on the type of automobile. Cloud and inhalation shielding factors are taken to be 0.75. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) Assuming a mid-range plume rise.

Table 10 shows that doses, even for S6V-Total, get very high only for two meteorological conditions (D-stability, wind speeds 2 and 4 meters/second). Doses for the other releases never rise above early-death threshold. In general, doses at these other sites are less than one-fifth the doses for the highest-risk Seabrook beach case.

Q. Are the beach populations beyond two miles exposed to risk of early death during a summer day?

A. (Beyea) Yes, certainly for an S6V-Total release. Tables 11 and 12 show the calculated results for beach populations at 4 miles and an evacuation time of 5 hours. Note that the beach population is not protected for a low-rising S1 release either.

Additional insight into how far from the reactor threshold doses are likely to occur for an S6V-Total release can be gained from examining Table 13. It shows early death radii for D-stability class and a five-hour evacuation time. This means that an individual remaining in the plume at a radius given in the last column of the table for five hours under the given weather conditions will receive at least a 200-rem dose. These are the individuals who have not been able to evacuate earlier due to traffic congestion, etc. It should be noted, however, that individuals at this radius who have evacuated earlier may still receive a 200-rem dose due to the continuing dose contribution from material deposited on their skin and car. Similarly, individuals beyond the early death radius for a

TABLE 11

DOSES RECEIVED ON A SUMMER DAY BY 4-MILE BEACH POPULATION[a)]
(SKIN AND CAR DEPOSITION DOSES INCLUDED)

Stab-[c)] ility Class	Wind Speed (m/sec)	Dose 5 Hrs After Evacuation Starts[b)] (In Rem) PWR1	PWR2	PWR3	Risk of Early Death?[d)]		
		$\overline{S1}$[e)]	S6V-total	S6V-1	$\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	61-71	48-55	<50	N	N	N
A	4	<50	<50	<50	N	N	N
A	8	<50	<50	<50	N	N	N
B	2	82-96	59-69	<50	N	N	N
B	4	64-75	<50	<50	N	N	N
B	8	<50	<50	<50	N	N	N
C	2	<50	160-190	<50	N	N?	N
C	4	98-120	[illegible]-110	<50	N	N	N
C	8	93-110	52-61	<50	N	N	N
D	2	<50	540-640	77-89	N	Y	N
D	4	<50	340-410	50-58	N	Y	N
D	8	<50	190-230	<50	N	Y	N

a) The population 4 miles from the plant.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car and directly on the individual. The effective ground shielding factors range from 1.0 to 1.3, depending on the type of automobile. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) Assuming a mid-range plume rise.

TABLE 12

EXPOSURE OF 4-MILE BEACH POPULATION[a)] TO RISK OF EARLY DEATH ON A SUMMER DAY
(SKIN & CAR DEPOSITION DOSES INCLUDED)

Stab-[c)] ility Class	Wind Speed (m/sec)	Time in hours to Reach[b)] 200 Rem: PWR1 $\overline{S1}$[e)]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d)]: $\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	19-24	23. ->24	>24	N	N	N
A	4	>24	>24	>24	N	N	N
A	8	>24	>24	>24	N	N	N
B	2	13-17	18. - 23	>24	N	N	N
B	4	18-24	>24	>24	N	N	N
B	8	>24	>24	>24	N	N	N
C	2	>24	5.4- 6.7	12-15	N	Y	N
C	4	11-14	10.5-13.5	23->24	N	N	N
C	8	12-15	21.6->24	>24	N	N	N
D	2	>24	<1	3.5-4.2	N	Y	Y
D	4	>24	1.7- 2	6.8-8.6	N	Y	N?
D	8	>24	4- 5.2	14-18	N	Y	N

a) The population 4 miles from the plant.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car and directly on the individual. The effective ground shielding factors range from 1.0 to 1.3, depending on the type of automobile. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) Assuming a mid-range plume rise.

given set of conditions are not necessarily protected from a 200-rem dose, because we have not accounted for the doses they might receive outside the plume from skin and car deposition material.

As noted previously, if evacuation times for the beaches beyond 2 miles are longer than 5 hours, as is documented by Adler, the consequences of these releases for a given set of conditions will be more serious. The early death radii will be larger and many more people will be exposed.

Q. How would a summer evening scenario affect your results?

A. (Beyea) There is evidence that there would still be a substantial population on or near the beaches on summer evenings. Although evacuation times might be reduced due to a smaller evacuating population, it is not clear that this reduction would be enough to ensure that no early deaths occurred in the population--especially since night-time plumes are more concentrated and therefore are more dangerous. In order to investigate the consequences of a summer evening scenario, we have obtained an estimate from our model of the doses at 2 miles which would be received for typical evening weather scenarios assuming a clear time of 1.5 hours. We have assumed, in contrast to the summer scenario, that the population is wearing more clothes and could remove them after exposure to reduce the skin deposition dose. While it is very uncertain how much this would reduce the skin deposition dose, we have also assumed for simplicity that removing clothes would eliminate it, including the contribution from contaminated hair. We have still assumed a dose component from material deposited on cars. (The dose scaling factor range for this scenario becomes .65-.95.)

The results of our model are shown in Table 13a. The time to reach 200 rem is usually one hour or less for the S6V-total release, which means that any reduction of evacuation times during the evening is not going to protect the population for this release category.

Q. How frequently do the various weather conditions occur?

A. (Beyea) The frequencies of the Pasquill stability classes, as reported in the SB 1&2, ER-OLS,[56/] are given in Table 14. The frequencies of the A,B, and C stability classes increase during the summer months, with C the most frequent of the three. D and E are the dominant stability classes. Although not indicated in the Table (which is based on 24 hour data), C and D stability classes would probably dominate during daytime hours because the E, F, and G stability classes tend to occur primarily in the evening or early morning hours.

The consequences during C, D, and E classes are all serious in terms of early death. Consequences would also be serious

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56/ Public Service of New Hampshire, "Seabrook Station - Units 1 & 2, Environmental Report, Operating License Stage," Figure 2.1-19.

TABLE 13

EARLY DEATH RADII FOR A 5-HOUR EVACUATION TIME

ON A SUMMER DAY

S6V-TOTAL RELEASE

STABILITY CLASS	WIND SPEED (m/sec)	EARLY DEATH RADIUS (miles)[a]
B	2	2-3
B	4	1-2
B	8	1-2
C	2	3-4
C	4	2-3
C	8	1-2
D	2	7-8
D	4	6-7
D	8	4-5

a) An individual in the plume at this radius under the given conditions will receive, assuming a five-hour clear time, at least a 200 rem dose. Individuals at this radius who have evacuated earlier may still receive at least a 200 rem dose due to the continuing dose contribution from material deposited on their skin and car. Individuals at farther distances may still receive 200 rem doses due to skin and car deposition doses after leaving the plume.

A dose scaling factor range of 1.0-1.3 is assumed. This is equivalent to assuming 1) that some individuals are caught in the open during plume passage, 2) that the last to evacuate are stuck in traffic and spend the full five hours in contaminated ground, and 3) that all doses cease after five hours. See Question 13 for further details.

TABLE 13a

DOSES RECEIVED ON A SUMMER EVENING BY TWO-MILE BEACH POPULATION[a]
(CAR DEPOSITION DOSE INCLUDED, NOT SKIN DOSE)

		Dose 3 Hrs After Evacuation starts[b] (In Rem)			Risk of Early Death?[d]		
Stab-[c] ility Class	Wind Speed (m/sec)	PWR1 $\overline{S1}$[e]	PWR2 S6V-total	PWR3 S6V-1	$\overline{S1}$[e]	S6V-tot.	S6V-1
D	2	<50	820-970	120-140	N	Y	N
D	4	"	480-560	72-81	N	Y	N
D	8	"	260-310	<50	N	Y	N
E	2	"	1300-1600	200-220	N	Y	Y
E	4	"	790-950	120-130	N	Y	N
E	8	"	430-520	64-73	N	Y	N

a) The population 2 miles from the plant, not directly across the lagoon. Doses would be higher should the plume be blowing over the lagoon.

b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car. No skin dose is included on the assumption that a)clothes keep radioactivity from reaching skin; and b)that clothes are discarded once evacuees enter their cars. The effective ground shielding factors range from 0.65 to 0.95, depending on the type of automobile. See Question 13 for further details.

c) Pasquill stability class.

d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.

e) Assuming a mid-range plume rise.

TABLE 14

FREQUENCY OF PASQUILL STABILITY CLASSES AT SEABROOK(a)
(Values in % of Time)

Month	A	B	C	D	E	F	G
Apr 1979	1.27	2.11	3.80	49.65	29.40	7.88	5.91
May	1.20	2.86	4.82	52.86	26.51	5.27	6.48
Jun	2.92	6.69	12.26	39.83	25.49	6.13	6.69
Jul	4.90	6.94	11.56	29.12	28.84	12.65	5.99
Aug	2.91	4.71	9.97	43.07	26.59	7.34	5.40
Sep	1.25	7.64	11.81	30.69	27.36	10.83	10.42
Oct	0.81	2.96	5.79	39.30	34.05	10.09	7.00
Nov	0.00	0.56	4.76	43.92	34.83	9.27	6.57
Dec	0.00	0.41	2.70	47.03	41.35	5.81	2.70
Jan 1980	0.13	1.88	6.59	51.88	30.38	5.78	3.36
Feb	0.44	2.03	5.37	50.36	34.69	5.66	1.45
Mar	10.68	1.64	5.34	43.15	24.66	6.03	8.49
Yearly	2.22	3.37	7.08	43.31	30.38	7.76	5.87

a) Period of Record: April 1979 - March 1980. Stability class calculated using 43'-209' delta temperature. Source: SB 1&2, ER-OLS, Table 2.3-24.

TABLE 15

JOINT FREQUENCY DISTRIBUTI OF WIND SPEED, AND

STABILITY CLASS FOR SEABROOK[a] (209-FOOT LEVEL)[b]

APRIL '79 - MARCH '80

Stability Class	Wind Speed (mph)	Wind Speed (m/sec)	% Within Class
A	<4	<1.8	1.04
	4-7	1.8-3.1	8.85
	8-12	3.6-5.3	31.77
	>12	>5.3	58.33
B	<4	<1.8	1.03
	4-8	1.8-3.1	10.65
	8-12	3.6-5.3	42.[illegible]7
	>12	>5.3	4[illegible].[illegible]5
C	<4	<1.8	2.29
	4-7	1.8-3.1	17.5[illegible]
	8-12	3.6-5.3	36.5[illegible]
	>12	>5.3	43.[illegible]
D	<4	<1.8	3.34
	4-7	1.8-3.1	17.92
	8-12	3.6-5.3	36.70
	<12	>5.3	42.03
E	<4	<1.8	1.57
	4-7	1.8-3.1	16.78
	8-12	3.6-5.3	44.32
	>12	>5.3	34.33

a) Source: SB 1&2, ER-OLS, Table 2.3-27.

b) Frequency distribution would vary with measurement level and season.

for F and G conditions though we have not considered them. Our results are not based on an infrequently occurring weather scenario.

The distribution of wind speeds within the stability classes is given in Table 15.[57/] Note that these distributions are not disaggregated by season, and the summer distribution might be different.

Although the frequency data given in Tables 14 and 15 are not precisely applicable to earlier tables, it is possible to use the information to make a rough assessment of the probability that the population would not be protected from early death should a severe release occur with the wind blowing toward a beach. For instance, it was indicated in Table 9 that for an S6V-total release, the 2-mile beach population on a summer day was not protected from early death under C and D conditions. These meteorological conditions are likely to occur 75% of the time during summer days.[58/] The probability is even higher for the highest-risk Seabrook beach population -- around 93%.

Q. What about the S6V-1 release?

57/ New Hampshire Emergency Response Plan, Rev. 2., Vol. 6, p. 10-52.

58/ This assumes that C and D stability classes occur with a 75% probability on a summer day (E, F, and G do not occur during the day and about one half of the D percentages in Table 14 occur at night.)

A. In this case, a similar analysis suggests that doses exceeding threshold would occur about one-third of the time for the highest-risk population at Seabrook beach, if it were downwind.59/

Q. How many people would be contaminated during a summer release?

A. (Beyea) It must be recognized that, based on Tables 6, 9, and 11, thousands of people might be exposed to life-threatening doses should a release occur on a summer day.

In order to put some bounds on the health consequences to a beach area population, we have done a simple calculation of the number of people who might be contaminated due to a release at Seabrook. An unknown fraction of this number would receive doses at or above 200 rem. The others might suffer a range of consequences, from nausea within a few hours to cancer many years in the future.

The lower bound to this limit is zero; that is, with enough warning time, it is possible that no one will be contaminated. The maximum number of persons contaminated within ten miles

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59/ The S6V-1 column in Table 8 indicates that the early death threshold would occur for 1) D stability class and wind speeds of 2 and 4 m/sec, and 2) C stability class and wind speeds around 2 m/sec.

According to Table 15, the D wind speeds would occur 60% of the time, while the C wind speeds would occur 18% of the time. The net result, based on the data for summer months in Table 14, is a 28% chance of early death threshold under D conditions and a 5% chance under C conditions.

during an accident on a summer weekday is listed in Table 16, for a low estimate of weekday population taken from New Hampshire Seabrook Plan. (See testimony of other experts in this proceeding for an explanation of why the actual population may be considerably higher.) The table shows a range of between 10,000 and 23,000 people who may be exposed.

The table assumes no one within ten miles will have had sufficient time to evacuate before passage of the plume. The purpose of the table is basically to show the size of the population that may be of immediate concern--those persons within ten miles who will know they may have been exposed, later will presumably learn that they have been exposed, and who will wonder what the potential consequences will be.

The maximum number is so large that it is questionable whether medical facilities will be adequate to treat those seeking treatment. (See the Testimony of Jennifer Leaning).

Q. Is the population exposed to "early death" during other times of the year?

A. (Beyea) Yes. We prepared Tables 17 and 18 in a manner similar to those for a summer day beach scenario and found that the population is not always protected from "early death" (200 rem) at two and four miles for the rapid bypass sequence, S6-V total, although the population is protected for other sequences considered.

For those tables we examined evacuees who would take about three hours to evaculate as shown in Table 19. During plume

TABLE 16

VARIATION IN POPULATION EXPOSED IN SSE SECTOR WITHIN 10 MILES ON A SUMMER WEEKDAY

STABILITY CLASS	PLUME ANGLE[a] AT 5 MILES (degrees)	MAXIMUM EXPOSED POPULATION[b]
A	26	23,000
B	20	18,000
C	15	13,000
D	11	10,000

a) Assumes a plume angle of three times the horizontal dispersion coefficient.

b) Calculated as the population in the SSE sector (20,000) according to figure 6 multiplied by the ratio of plume angle to 22.5 degrees. Minimum population could be zero if the wind were blowing towards the ocean and there were sufficient warning time of a release.

TABLE 17

DOSES RECEIVED AT 2 MILES ON AN OFF-SEASON WEEKDAY[a]
(CAR DEPOSITION DOSE INCLUDED)

Stab-[c)] ility Class	Wind Speed (m/sec)	Dose 3 Hrs After Evacuation starts[b)] (In Rem) PWR1 $\overline{S1}$[e)]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d)] $\overline{S1}$[e)]	S6V-tot.	S6V-1
A	2	62-73	48-55	<50	N	N	N
A	4	47-56	<50	"	N	N	N
A	8	<50		"	N	N	N
B	2	"	110-140	"	N	N	N
B	4	83-94	62-72	"	N	N	N
B	8	60-73	<50	"	N	N	N
C	2	<50	270-320	"	N	Y	N
C	4	<50	150-180	"	N	N?	N
C	8	93-110	81-94	"	N	N	N
D	2	<50	690-840	97-120	N	Y	N
D	4	<50	410-490	59-68	N	Y	N
D	8	<50	220-270	<50	N	Y	N

a) The resident population two miles from the plant.
b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by buildings and their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car. The effective ground shielding factors range from 0.65 to 0.95, depending on the type of automobile. Cloud and inhalation shielding factors are taken to be 0.75. See Question 13 for further details.
c) Pasquill stability class.
d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.
e) Assumes mid-range plume rise.

passage, residents were assumed to be inside buildings with cloud and inhalation shielding factors of 0.75. We assumed a ground-dose scaling factor of 0.65-0.95, implying that the evacuees were in cars within the plume, and that the cars had radioactive material deposited on them. No skin deposition dose was assumed.

Although Table 17 shows several "unprotected" cases for the rapid bypass sequences at two miles, it should be noted that the actual doses above threshold would be considerably higher in the summer time. Doses to the highest-risk beach population would be about four times as high as those projected for an off-season accident. (At four miles the corresponding ratio would be two to one.) As a result of these higher doses, the total number of injuries would be greater in the summer even if the exposed populations were the same.

Furthermore, because the population during the off-season scenarios is smaller than for summer scenarios, fewer people would receive radiation doses during off-season scenarios. Therefore, there would be less of a chance that medical facilities would be overwhelmed, and more of a chance that most of those exposed to doses about 200 rem would receive the "supportive" medical treatment that would be needed to raise the early death threshold above 200 rem. This would be particularly important for the 4-mile case shown in Table 18.

Q. What difficulties are associated with reducing the health consequences of a large release at Seabrook?

TABLE 18

DOSES RECEIVED AT 4 MILES ON AN OFF-SEASON WEEKDAY[a]
(CAR DEPOSITION DOSE INCLUDED)

Stab-[c] ility Class	Wind Speed (m/sec)	Dose 3 Hrs After Evacuation Starts[b] (In Rem) PWR1 $\overline{S1}$[e]	PWR2 S6V-total	PWR3 S6V-1	Risk of Early Death?[d] $\overline{S1}$[e]	S6V-tot.	S6V-1
A	2	<50	<50	<50	N	N	N
A	4	"	"	"	N	N	N
A	8	"	"	"	N	N	N
B	2	"	"	"	N	N	N
B	4	"	"	"	N	N	N
B	8	"	"	"	N	N	N
C	2	"	78-92	"	N	N	N
C	4	50-58	47-55	"	N	N	N
C	8	47-56	<50	"	N	N	N
D	2	<50	240-290	"	N	Y	N
D	4	"	160-190	"	N	N?	[illegible]
D	8	"	93-100	"	N	N	N

a) The resident population four miles from the plant.

b) Persons caught in the plume are assumed to be partially shielded from contaminated ground by buildings and their vehicles. They are assumed to receive a dose component from radioactive material deposited on the car. The effective ground shielding factors range from 0.65 to 0.95, depending on the type of automobile. Cloud and inhalation shielding factors are taken to be 0.75. See Question 13 for further details.

c) Pasquill stability class.

d) "Y" indicates exposure to a 200-rem dose or higher. An evacuation time of 5 hours is assumed. A question mark by an entry indicates that even though doses do not reach the 200-rem early death threshold, the 100-rem threshold for nausea has been reached. In such cases, the assumed 5-hour evacuation time may be suspect.

e) Assumes mid-range plume rise.

TABLE 19

SEABROOK EVACUATION CLEAR TIME ESTIMATES[a)]

OFF-SEASON WEEKDAY SCENARIO

RADIUS	DEGREES	HMM[b)]	Vorhees[c)]	Maguire[d)]	NRC[e)]
0-2	360	3:10	-	-	-
0-5	360	3:10	-	-	-
0-10	360	4:30	3:40	3:00	6:[illegible]

a) Time (Hours:minutes) for the population to clear the indicated area after notification.

b) "Preliminary Evacuation Clear Time Estimates for Areas Near Seabrook Station," HMM Document No. C-80-024A, HMM Associates, Inc., May 20, 1980.

c) "Final Report, Estimate of Evacuation Times," Alan M. Vorhees & Associates, July 1980.

d) "Emergency Planning Zone Evacuation Clear Time Estimates," C.E. Maguire, Inc., February 1983.

e) Letter to Mitzie Solberg, Emergency Preparedness Development Branch, U.S. N.R.C. from A.E. Desrosiers, Health Physics Technology Section, Battelle, Pacific Northwest Laboratories, August 20, 1982.

A. (Beyea) Limited options exist for reducing the severity of accidents at Seabrook.

None of the extraordinary emergency measures that we, or other nuclear analysts have been able to devise are likely to eliminate or effectively reduce the serious radiation doses that would result from a range of releases at Seabrook.

(A) Possibility of reducing skin and car deposition dose.

Our work here has shown that skin and car deposition doses could make important contributions to the total dose to an individual, but no consideration has been given to reducing these doses in emergency planning. We have considered whether or not extraordinary emergency measures could be taken to protect against them. For instance, evacuees could be instructed to leave the evacuation vehicle as soon as possible, to shower (skin and hair) as soon as possible, and perhaps to remove hair with scissors. Automated car spraying devices could be installed near important beach exit points in an attempt to remove some of the material from cars as soon as possible, thus reducing doses to the occupants. The effectiveness of various methods for removing radioactive aerosols from skin, hair, and cars must be investigated, however, before credit can be taken for them. The logistics of washing every car in the beach area would be formidable and would likely add to evacuation times. (Removal of aerosols is complicated by the fact that radioactive aerosols attach themselves too strongly to clean surfaces to be removed easily. On the other hand, the fraction depositing on dirty or oily surfaces could be removed at the same time as dirt and oil were removed.)

All these measures, if they worked, could be helpful in reducing the number of delayed cancers that would show up in later years. However, their implementation would not change the significance of our tables with respect to early health effects. This is because post-evacuation doses are not even considered in our calculations and because not all cars could be decontaminated. Also, populations are not protected, even when car deposition doses are excluded.

B) Possibility of relying on shelters.

In principle, one way to reduce the chances of early death occurring in the beach population would be to provide shielding by means of sheltering, especially from ground dose, while people wait for roads to clear. However, shelters would only be useful if they are suitably massive, which seems doubtful in this case.[60/] Serious questions exist as to whether they

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60/ Z.G. Burson and A.E. Profio, "Structure Shielding from Cloud and Fallout Gamma Ray Sources for Assessing the Consequences of Reactor Accidents," EG & G, Inc., Los Vegas, Nev., EGG-1183-1670.

would actually be used by a majority of the population. As is indicated by the testimony of other experts in this proceeding, sheltering is not a realistic option for the beach populations.

The possibility of having beach occupants shield themselves by immersing themselves in ocean water has been rejected by us because of the low temperature of the water. On the other hand, it would be physically possible for exposed persons to partially shield themselves from ground dose by covering themselves with sand prior to evacuation. However, the notion that people will wait away from their cars buried in the sand or immersed in the water while traffic congestion clears seems grotesquely unrealistic.

C) Possibility of evacuating on foot or by bike.

The beach population might be instructed to walk out of the area. If the release has occurred, has blown towards the beaches, and has been confined to a relatively narrow area, this might be the best strategy to reduce doses from a theoretical nuclear physics perspective. In this way, no one would wait within the plume area accumulating doses from the radioactive material on the ground or on cars. Our calculations show that a person walking out in certain circumstances would have received, about five hours after the release, between a 30 to 40% lower dose than a person who has remained in a car within the plume while trying to evacuate.[61] However, this type of forced march strategy flounders when faced with normal human behavior.

Providing bicycles for beachgoers might be a strategy since it would offer the hope of relatively rapid escape. Nevertheless, it is not clear what percentage of beachgoers would utilize the bikes and what the traffic impact would be. In fact, access to bikes might increase the disorderliness of the evaculation. For example, consider those beachgoers who opted for driving (with or without official permisssion), only to return for bicycles after being stuck in traffic for an hour or so. Their abandoned automobiles could well block traffic for those remaining. Certainly no credit could be given in emergency planning for reliance on bicycles without a full-scale test of the process. Yet, a convincing test would be impossible. How could a test reliably simulate the stress and fear that would be generated in a real accident?

61/ We calculated the dose to an individual on the beach who waits for about one and a half hours after the release (dose scaling factor of 1.35), who then leaves the plume, but accumulates doses from skin deposition (dose scaling factor .35). We also calculated the dose to an individual in a car within the plume, accumulating doses from the plume on skin and car deposition material (dose scaling factor of 1.0-1.3). By comparing the doses for about five hours after the release, we found a 30-40 percent lower dose for those individuals walking out.

D) Possibility of pre-distributing potassium iodide.

The value of pre-distributing potassium iodide near nuclear power plants has been discussed by us previously. However, pre-distribution will not work for a transient beach population, unless the authorities are willing to hand out tablets every day to everyone who visits the beaches. Also, potassium iodide would be of limited usefulness for the high-dose scenarios that would develop at Seabrook beaches.

Q. What about the probability of the releases discussed in your testimony?

A. (Beyea) PWR1-PWR9 releases are established by NUREG-0396 as the spectrum of releases that must be considered in emergency planning for nuclear power plants. The NRC took the probability and credibility of these accidents classes into account in developing NUREG-0396. Every emergency plan, therefore, must address the entire range of these releases, and should also examine the site-specific equivalent of these generic releases.

Q. What is your overall assessment of the doses that might be delivered at Seabrook?

A. (Beyea) The summer Seabrook situation is the worst case I have ever examined in connection with emergency planning or hypothetical reactor accidents. The doses that would be received following a range of releases at the Seabrook site, even with the proposed emergency plans in effect, are higher than doses that would be received at most other sites in the complete absence of emergency planning.

Q. Dr. Beyea, does that complete your testimony?

A. (Beyea) Yes, it does.

X. PWR-1 RELEASES AT SEABROOK

Q. Dr. Thompson, what is the basis for your statements in your testimony?

A. (Thompson) As mentioned earlier, I have co-authored a review (Sholly and Thompson, 1986) of various "source term" issues. This review was current through mid-1985. I used that review and the documents cited within it as a basis for my statements. In addition, I have studied a variety of more recent documents, which collectively form the remaining basis for my statements. These more recent documents include the draft NRC report NUREG-1150 (NRC, 1987a) and the documents generated as a result of a January 1987 technical meeting sponsored by the NRC (Kouts, 1987; NRC 1987b). (See attached references.)

Q. Please describe the potential for a "PWR1-type" release.

A. (Thompson) The Reactor Safety Study (NRC, 1975) described the PWR1 release category as being "characterized by a core meltdown followed by a steam explosion on contact of molten fuel with the residual water in the reactor vessel." More recent work has identified the potential for a similar release through a different mechanism--high-pressure melt ejection. In this case, molten core material is expelled from the reactor vessel under pressure of steam and gases within the vessel.

Q. Where might the containment breach occur during an accident sequence leading to a "PWR 1-type" release?

A. (Thompson) For either steam explosion or high-pressure melt ejection sequences, the location of the breach cannot be predicted. The breach might occur anywhere from the base of the containment wall to the containment dome. In addition, a co-existing bypass pathway could lead to some release through buildings adjacent to the main containment building.

Q. Please describe the range of thermal energy release rates which could be experienced during a "PWR 1-type" release.

A. (Thompson) This range is illustrated by Figure 7, which is drawn from the Seabrook Station Probabilistic Safety Assessment (PLG, 1983). For present purposes, release category S1 is relevant. The table shows that the estimated energy release rate for this release category could vary from 21,000 million BTU per hour to 60 million BTU per hour, according to the size of the containment leak area. Present knowledge of containment failure modes is

TABLE 11.6-4. ENERGY RELEASE RATES FOR RELEASE CATEGORIES $\overline{S1}$, $\overline{S3}$, $\overline{S3V}$, AND $\overline{S4V}$

Release Category	Energy Released (10^8 Btu)	Energy Release Rate (10^9 Btu/hr)				
		Blowdown Duration				
		10 Seconds	1 Minutes	10 Minutes	30 Minutes	1 Hour
$\overline{S1}$	0.58	21	3.5	0.35	0.12	0.06
$\overline{S3}$	1.26	25	7.6	0.76	0.25	0.13
$\overline{S3V}$	2.0	70	12	1.2	0.4	0.2
$\overline{S4V}$	1.6	57	9.6	0.96	0.32	0.16
Leak Area (ft^2)		250	25	2.5	1	0.5
Equivalent Diameter (feet)		18	6	1.8	1.1	0.8

Figure 7
Source: PLG, 1983

such that the energy release rate cannot be predicted within this range, and perhaps within a wider range.

Q. Please describe the potential for "PWR 1-type" releases to be relatively enriched in certain radioactive isotopes?

A. (Thompson) In Appendix VI of the Reactor Safety Study (NRC, 1975), release category PWR1 is shown as having a relatively large release fraction for the ruthenium group of radioactive isotopes--40% for this release category as opposed to 2% for release category PWR 2. Such an enhanced release is predicted to occur because of the physical and chemical behavior of a steam explosion event. More recent studies have shown that a high-pressur melt ejection event could also lead to enchanced release of certain isotopes including those of ruthenium, molybdenium and tellurium.

Q. Mr. Thompson, does this complete your testimony?

A. (Thompson) Yes, it does.

XI. HEALTH EFFECTS FROM RADIATION DOSES FROM ACCIDENTS WITHIN THE PLANNING SPECTRUM

Q. How does radiation cause injury?

A. (Leaning) The radiation emitted from a nuclear power plant accident is called ionizing radiation because it contains energy sufficient to remove one or more electrons from an atom and thus change its electric charge. This process of ionization creates an ion which is chemically reactive and can damage living tissue. The extent of the damage depends upon the intensity of the energy delivered and the radiation sensitivity of the target cell. In general, those cells that divide most rapidly or are metabolically most active are the most radiosensitive. Bone marrow, lymph tissue, and gastrointestinal epithelium are among the tissues most susceptible to radiation injury.

At the lower range of energy intensity and cell sensitivity, radiation may affect a cell by reducing its functional capacities or by altering its genetic material and thus possibly inducing malignant changes in later cell lines. At higher ranges, radiation may destroy the cell's capacity to replicate. At still higher ranges, radiation may result in the death of that particular cell or organ.[62/]

Q. What radiation exposure levels are considered safe?

A. (Leaning) Residents in the United States currently receive radiation from a variety of background and man-made sources, resulting in an annual exposure of approximately 0.05 to 0.3 rads. Much controversy is attached to what effects low levels of radiation may exert in inducing cancer and genetic defects among exposed populations. It is prudent to begin from the perspective that any level of radiation may carry some risk. The question is the magnitude of this risk and its relationship to other risks individuals or societies may incur.

62/ Committee on the Biological Effects of Ionizing Radiation (BEIR III), The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980, National Academy Press, Washington, D.C., 1098, pp. 11-35.

The National Council on Radiation Protection and Measurements (NCRP) has established guidelines that define the permissible limits for additional radiation exposure (over and above current background levels). A member of the general public may receive an additional 0.5 rems (for these purposes, 1 rad equals 1 rem) per year; and a worker in a peace-time industry may receive an additional 5 rems per year.[63/]

Q. What is known about the health consequences of exposure to high levels of radiation?

A. (Leaning) There is also much uncertainty in the scientific and medical community about the health consequences of exposing human populations to radiation at higher dose levels. The principal reason for this uncertainty is that our data on human response at these higher ranges is very meagre. Our main source for data comes from the populations of Hiroshima and Nagasaki, each exposed in 1945 to an airburst of a nuclear bomb and each still part of an ongoing thorough epidemiological study. Three other populations also exposed to radiation at relatively high levels and also undergoing prospective investigation are the approximately 5,000 radium dial painters of the 1920's; the 253 residents of the Rongelap and Utrik Atolls in the Marshall Islands, exposed to fallout

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63/ 10 C.F.R. Part 20, § 1959.

from the 15 megaton BRAVO thermonuclear test in 1954; a Utah population exposed at school age to fallout from above-ground tests conducted in the years 1951 to 1958; and the 135,000 people downwind from Chernobyl, exposed in 1986 to plume and fallout effects from the world's most serious nuclear power accident known to have occurred to date. Other data results from occupational exposures (uranium miners), from industrial accidents, and from the experience of patients involved in medical therapeutic protocols.

The circumstances surrounding the radiation exposures of the majority of people in these populations precluded comprehensive, accurate, and detailed data collection during the initial events that created the exposure and during the first few days thereafter. In retrospective analysis it has usually been impossible to define with any precision the following key variables: the nature and intensity of the radiation received, the duration of exposure, and the relative individual susceptibility to a given dose received.

Within the limits of the data available, a few central general points about health consequences of radiation exposure have been identified and substantiated. Four main factors are involved: radiation quality, radiation dose, radiation dose rate, and the age of the exposed population.

Radiation quality

Linear energy transfer (LET) is the term used to describe radiation quality and refers to the density with which radiation ionizes matter per unit distance traveled. Alpha radiation, with high LET, ionizes more densely per unit distance traveled than does gamma or beta radiation. This quality is frequently specified in terms of its different biological effects on different tissues. The relative biological effectiveness, or RBE, of a given kind of radiation is directly related to its LET. The higher the LET, the greater the RBE. Alpha radiation has an RBE of 10 to 20, beta and gamma of 1.

These differences translate into the difference between a rad dose and a dose expressed in rems. A rad, (or radiation absorbed dose) reflects only the amount of radiation absorbed by tissue. A rem, (or roentgen equivalent man), expresses the biological impact of that dose on human tissues. For a given rad dose of radiation whose RBE is 1, as with gamma radiation, a rad equals a rem. For a given rad dose of radiation whose RBE is 10, as with alpha radiation, a rad equals 10 rems.

In situations where it is difficult to estimate the various components of the radiation released, it is the convention to assign an RBE of 1 to the radiation dose, according to which rads are equal to rems. Such a convention underestimates the actual biological effects of the dose received.

Radiation dose

The existing data on radiation exposure indicates that most people who receive radiation doses below 200 rems will survive, in the short-term, and that most people exposed to radiation doses in excess of 500 rems will die. Much controversy surrounds the issue of where to assign with more precision the threshold for what is termed the LD50/60, or the lethal dose for 50 percent of the people exposed, followed for 60 days from time of exposure. (Deaths occurring after that period are assumed to result from other causes.) One estimate for the LD50/60, arising from study of people exposed in industrial accidents and in medical protocols, established the range of 360 to 450 rads, depending on whether the dose is measured directly at the organ target level (the midline dose) or at the body surface.[64/] In the WASH-1400 report, the LD50/60 was estimated to be 340 rads, given minimal support to victims, and 510 rads, if supportive treatment were extended. (Supportive treatment is described as including "barrier nursing, copious antibiotics, and transfusions of whole blood, packed cells, or platelets.")[65/] Figure 8, from

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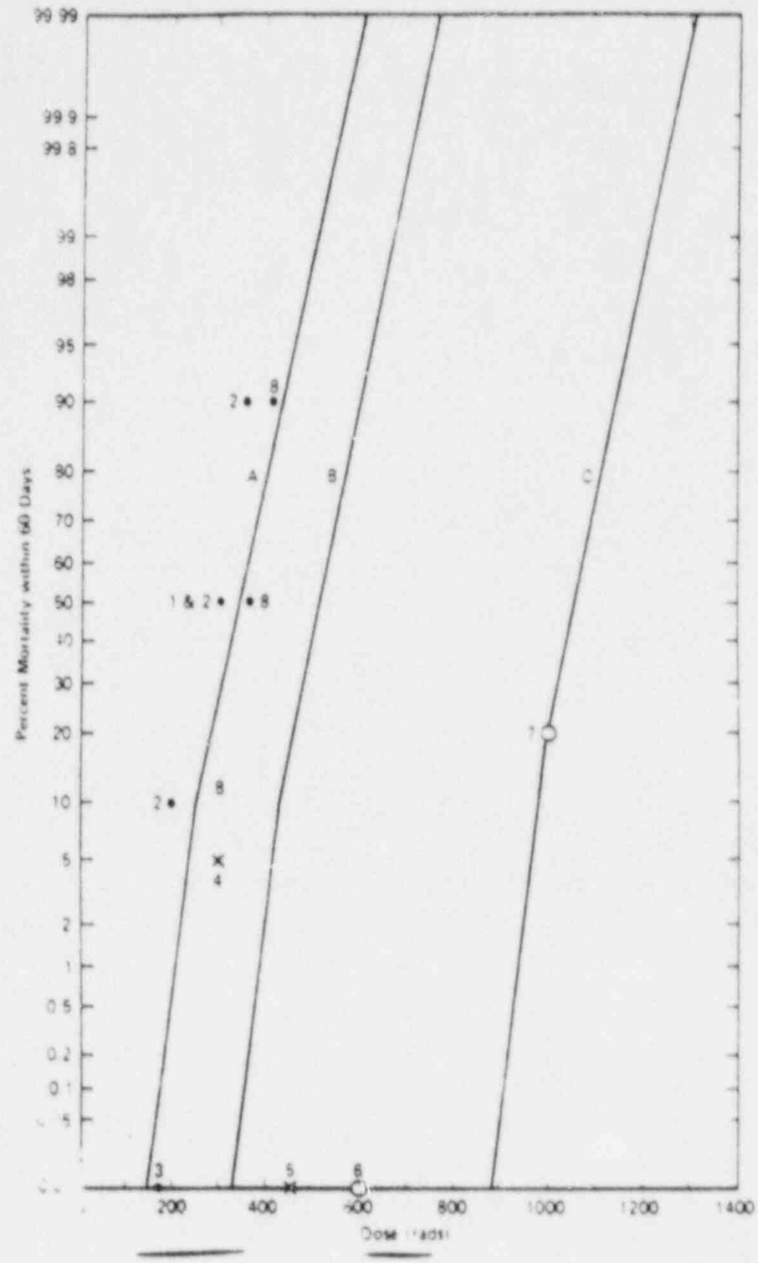
64/ Clarence C. Lushbaugh, "Human Radiation Tolerance," in Space Radiation Biology and Related Topics, Cornelius A. Tobias and Paul Todd, eds., Academic Press, New York, 1974, pp. 494-499.

65/ United States Nuclear Regulatory Commission, Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, WASH-1400 (NUREG 75/014), Washington, D.C., 1975, Appendix VI, 9-3.

FIGURE 8

Estimated Dose-Response Curves for LD50/60



Estimated dose-response curves for 50% mortality in 60 days with minimal treatment (curve A), supportive treatment (curve B), and heroic treatment (curve C). Origin if data points: 1, NCRP Report 42 (converted to rads using factor given in NCRP Report 42); 2, Langhorn (1957. Table 12, estimate for "normal man?") 3, Marshall Islanders (protracted exposure); 4, radiation therapy series, 22 patients (Rider and Hasse ba k, 1968); 5, clinical group III accident patients (Thor and Wald, 1959, with newer cases added); 6, Pittsburgh accelerator accident patient (E.D. Thomas, 1971; Wal , 1975); 7, 37 leukemia patients (E.D. Thomas, 197 ; 8, "best estimate" of the Biomedical and Environmental Assessment Group at the Brookhaven National Laboratory.

Source: WASH-1400, Appendix VI, 9-4.

the WASH-1400 study, illustrates the various dose-response curves as derived from a range of exposure experiences analyzed in arriving at this overall summary estimate.

Another authoritative review of the existing database has stated that the LD50/60 for humans is approximately 250 rems, measured as a midline dose.[66/] See Figure 9. A recent re-analysis of the Hiroshima data has prompted the suggestion that for populations in war or major disasters (who may already be debilitated and for whom medical support would be minimal) the LD50/60 may lie within the range of 150 to 250 rems.[67/] To the extent that the dosimetry estimates from Chernobyl are reliable, experience from that accident indicates that all people exposed to levels of 200 rads or less survived, and that death occurred to the majority of people exposed to levels of 600 rads or more, despite the advanced technical support they received.[68/]

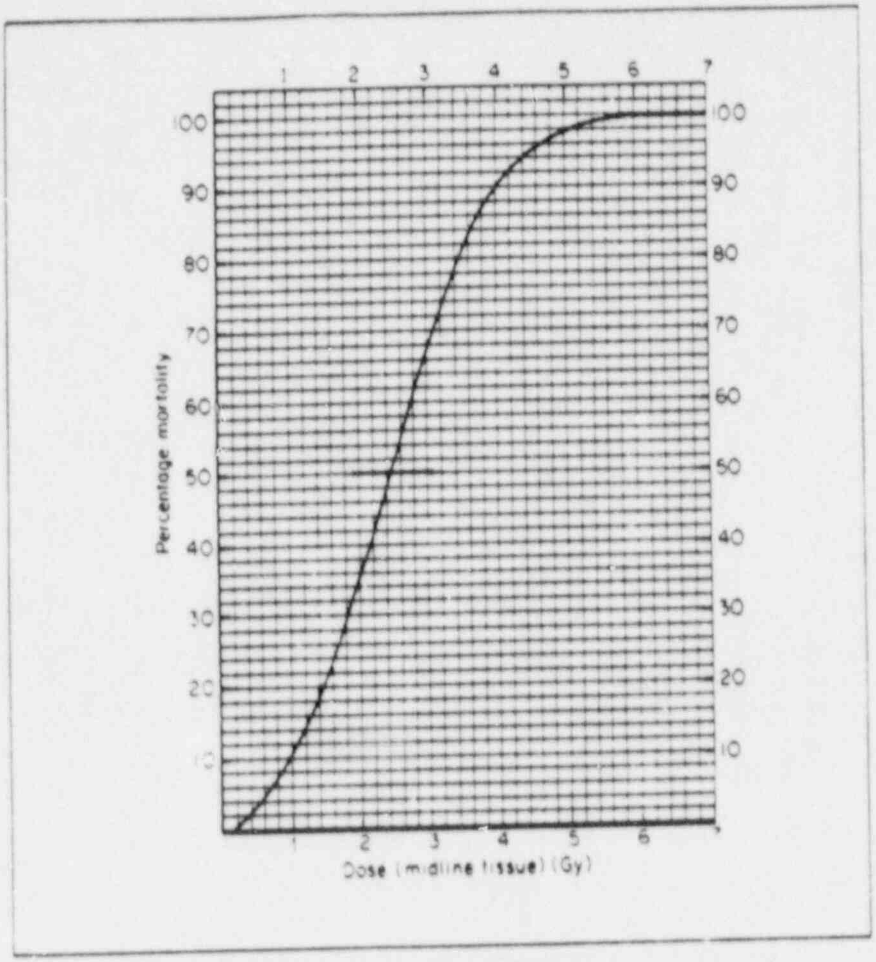
66/ Joseph Rotblat, Nuclear Radiation in Warfare, Stockholm International Peace Research Institute, Oelgeschlager, Gunn & Hain, Inc., Cambridge, Mass., 1981, pp. 34-35.

67/ Joseph Rotblat, "Acute Radiation Mortality in a Nuclear War," The Medical Implications of Nuclear War, Fredric Solomon and Robert Q. Marston, eds., Institute of Medicine, National Academy of Sciences, National Academy Press, Washington, D.C., 1986, pp. 233-250.

68/ Roger E. Linnemann, "Soviet Medical Response to the Chernobyl Nuclear Accident," Journal of the American Medical Association 258 (1987): 637-43.

FIGURE 9

Probability of Death from Acute Effects



Source: Rotblat, 1981, 35.

Dose rate

The literature suggests that a given dose of radiation will inflict more severe immediate damage if given all at once, in a single dose, than if fractionated and given in multiple, smaller doses over time. The dose fractionation effect pertains only to the acute effects of radiation, however. For long-term effects like cancer induction, it may be in fact that dose fractionation enchances development of malignant cell transformation.[69/]

Fractionating a given dose reduces prompt effects because it is thought that all biological systems have inate mechanisms which can serve to repair cellular damage and compensate to some extent for the initial radiation injury received. Estimates vary as to the rate at which biological repair can be predicted to occur. Very large doses of radiation will overwhelm any biological repair mechanisms. Below lethal thresholds, different species, different individuals within a species, and different tissues within each individual all have different rates of repair.

Age of exposed population

Children in all stages of development--those in utero, infants, and toddlers--are known to be particularly

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69/ John B. Little, "Cellular Effects of Ionizing Radiation," New England Journal of Medicine 278 (1968): 308-15, 369-76.

Arthur C. Upton, "The Biological Effects of Low-Level Ionizing Radiation, Scientific American 246 (1982): 41-9.

sensitive to the acute effects of radiation and to the induction of long-term sequelae. It has also been suggested that the elderly are also more susceptible to acute radiation. The data are too limited, however, to allow a quantitative adjustment of the LD50/60 for people at either end of the age spectrum.[70/]

Q. How does radiation injure people?

A. (Leaning) There are three main ways in which radiation can injure people: whole body irradiation, external contamination, and internal contamination. Depending on the type and severity of exposure, people can experience a range of acute, intermediate, and long-term effects. Early radioactive fallout from a nuclear power plant accident primarily exposes people to risk from whole body irradiation and external contamination. Internal contamination becomes a hazard if air containing radioactive particles is inhaled or if food or water containing radioactive particles is ingested.

Q. Describe whole-body radiation and its treatment.

70/ H. Aceto, et al., "Mammalian Radiobiology and Space Flight," in Tobias and Todd, eds., p. 374.

National Council on Radiation Protection and Measurements (NCRP), Radiological Factors Affecting Decision-Making in a Nuclear Attack, NCRP Report No. 421, Washington, D.C., November 15, 1974, p. 42

Rotblatt, 1981, p. 53.

A. (Leaning) Acute effects of whole body irradiation occur when the whole body, or most of it, is subjected to external radiation doses in excess of 20 rads.71/ The time of onset and the severity of this initial or prodromal stage of radiation exposure indicates the intensity of dose received and helps predict whether or not the course will progress to one of the three recognized acute radiation syndromes. The sympton of mildest exposure within this prodromal complex is anorexia, occurring within minutes to hours of exposure. With larger doses of radiation, nausea, vomiting, and diarrhea may occur. Fatigue is also considered one of the

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71/ Lushbaugh, 1974, pp. 485-486. For discussion of whole body irradiation, see:

Ibid., pp. 476-488.

G.A. Andrews, "The Medical Management of Accidental Total-Body Irradiation," in The Medical Basis for Radiation Accident Preparedness, K.F. Hubner and S.A. Fry, eds., Elsevier/North-Holland, New York, 1980, pp. 297-3210.

H. Fanger and C.C. Lushbaugh, "Radiation Death from Cardiovascular Shock Following Criticality Accident," Archives of Pathology 83 (1967): 446-60.

Stuart C. Finch, "Acute Radiation Syndrome," Journal of the American Medical Association 258 (1987): 664-667.

Robert Peter Gale, "Immediate Medical Consequences of Nuclear Accidents," Journal of the American Medical Association 259 (1987): 625-628.

J.S. Karas and J.B. Stanbury, "Fatal Radiation from an Accidental Nuclear Excursion," New England Journal of Medicine (1959): 421-47.

G.E. Thomas, Jr., and N. Wald, "The Diagnosis and Management of Accidental Radiation Injury," Journal of Occupational Medicine (1959): 421-47.

symptoms in this complex. Since individuals vary widely in response to a given radiation dose, the symptom complex is best described in terms of statistical probability. Table 20 shows the percentage of people who will experience one or more of the prodromal symptoms at a given level of radiation exposure.

If exposed to radiation in the lower range of these dose levels, an individual would experience these prodromal symptoms for several days and would then recover. The symptoms of people exposed to doses in the higher range would, after a latency period of relative well-being that might last for days or weeks, then progress to one of the three acute radiation syndromes described below. The clinical manifestations of these syndromes overlap. In general, larger doses of radiation will result in more rapid onset of more severe symptoms.

a) Hematopoetic syndrome

Hematologic abnormalities predominate at doses between 200 and 600 rads. The hematologic picture yields important information on prognosis and therapy. Lymphocytes in the peripheral blood plummet almost immediately. Changes in other white blood cells, in platelets, and in capacity to make new red blood cells will also be seen. From a hematological standpoint, the peak risk of death from

TABLE 20

Radiation Doses Producing Symptoms of Exposure Prodrome

(in rads)

	Percentage of Exposed Population		
Symptom	*10%*	*50%*	*90%*
Anorexia	40	100	240
Nausea	50	170	320
Vomiting	60	210	380
Diarrhea	90	240	390

Source: W.N. Langham, ed., Radiobiological Factors in Manned Space Flight, National Academy of Sciences, Washington, D.C., 1967, 248; cited in Rotblat, 1981, 33.

infection and hemorrhage occurs about three weeks from time of exposure, when the worst declines in platelets and white blood cells converge. Depending upon dose received, individual susceptibilities, and extent of intensive care, recovery may or may not proceed from that point on.

b) Gastrointestinal (GI) syndrome

Within a few days to a few weeks of exposures to 700 rads and above, loss of GI mucosa and bone marrow depression contribute to a clinical picture marked by sudden onset of nausea, vomiting, and bloody diarrhea. These symptoms can progress to intense fluid loss, electrolyte imbalances, and severe hemorrhage from all mucosal surfaces. Death ensues from infection or hemorrhage.

c) Neutrovascular syndrome

Neutrovascular symptoms arise from exposure to over 2,000 rads and occur within the first hour to first two days. Victims initially experience confusion, drowsiness, and weakness. Delirium and convulsions then ensue, followed within a matter of hours to days by death from cerebral edema (brain swelling).

Treatment of whole-body irradiation

a) Triage. Since the treatment of people exposed to whole-body irradiation depends upon the dose of radiation received, the first task involves efforts to estimate exposure. In disaster settings, where large numbers of people may have been exposed, the task becomes one of triage, or sorting people into exposure categories on the basis of their presenting symptoms. Since many people in these circumstances will be agitated and anxious, it may be difficult in the first few hours to sort out psychological factors from those induced by radiation. However, although nausea, vomiting, and diarrhea are normal physiological responses to stress of any kind, the time from exposure to onset of vomiting appears to be still the most reliable indication of severity of dose received. Redness of the conjunctiva and skin erythema may appear within several hours to days of exposure, but these findings have variable thresholds and, from the perspective of early triage, are less useful as indicators of exposure levels. Epilation of any significance usually arises from exposures to over 200 rads, but because its occurrence lags until two to three weeks from time of exposure it also cannot be relied upon to guide initial triage efforts.

Specific laboratory studies and careful questioning of exposed individuals are the techniques yielding the most useful information. Both of these interventions can be invoked if the number of people exposed are relatively few and time permits. Determining the precise location of the individual at key points in time and the exact timing of onset of symptoms will help define the dose received.

Results of a baseline complete blood count and chromosomal analysis, if resources are available to permit these tests, will also serve to define the exposure level. Based on this information, treatment protocols can be instituted.

b) Treatment. An individual exposed to 500 to 1000 rads and who received intensive care therapy might recover, although he or she would require a protracted convalescence of two to six months. Intensive care in this context would need to include reverse isolation techniques, matched allogeneic bone marrow transplant, fluid resuscitation, antibiotics, white cell, red cell, and platelet transfusions--performed in a setting with skilled hematology, oncology and burn unit capabilities. The medical interventions needed in this setting fall into the category termed "heroic" by the WASH-1400 report and characterize the response given to the Soviet victims of the Chernobyl accident. Soviet physicians have testified that the effort to care for the 200 most exposed victims of the Chernobyl disaster stressed their entire national health care system to the limits of its capacity.72/ Teaching hospitals in the greater Boston area could probably each absorb approximately 5 to 10 such patients, with a total treatment potential of about 50 to 100 victims.

72/ H. Jack Geiger, "The Accident at Chernobyl and the Medical Response," Journal of the American Medical Association 256 (1987): 609-12.

People exposed to doses of 1,000 rads or more would present with extensive GI hemorrhage in the first four days after the event and would have little chance of survival, even if treated most aggressively and appropriately.

With exposure under 500 rads, intravenous fluid and electrolyte therapy with parenteral antibiotics might support patients through the initial stages of fluid loss and, if bone marrow depression were not too severe, chances of recovery would be good.

A suggested protocol for treatment of an individual exposed to a potentially lethal radiation dose is found on Table 21.

Q. Describe external contamination and its treatment.

A. (Leaning) External contamination. When radioactive material emitted from either a nuclear power plant accident or as fallout after the explosion of nuclear weapon is deposited on the skin or clothing, external contamination is said to have taken place.73/

73/ For discussion of external contamination, see:

International Atomic Energy Agency (IAEA), Manual on Early Medical Treatment of Possible Radiation Injury, Safety Series No. 47, IAEA, Vienna, 1978, pp. 33-36, 60-62.

R.V. Leonard and R.C. Ricks, "Emergency Department Radiation Accident Protocol," Annals of Emergency Medicine 9 (1980): 462-70.

National Council on Radiation Protection and Measurements (NCNP), Management of Persons Accidentally Contaminated with Radionuclides, NCRP Report No. 65, NCRP, Washington, D.C., 1980, pp. 113-119.

G.A. Poda, "Decontamination and Decorporation: The Clinical Experience," in Hubner and Fry, eds., pp. 327-332.

TABLE 21

Treatment Protocol for Potentially Lethal Radiation Exposure

Immediately after diagnosis of exposure to 100 rad or more:

Avoid hospitalizing patient except in sterile environment facility. Look for preexisting infections and obtain cultures of suspicious areas—consider especially carious teeth, gingivae, skin, and vagina. Culture a clean-caught urine specimen. Culture stool specimen for identification of all organisms; run appropriate sensitivity tests for *Staph. aureus* and Gram-negative rods. Treat any infection that is discovered. Start oral nystatin to reduce *Candida* organisms. Do HLA typing of patient's family, especially siblings, to select HLA-matched leukocyte and platelet donors for later need.

If granulocyte count falls to less than 1500/mm³:

Start oral antibiotics—vancomycin 500 mg liquid P.O. q. 4 hr, gentamycin 200 mg liquid P.O. q. 4 hr, nystatin 1×10^6 units liquid P.O. q. 4 hr, 4×10^6 units as tablets P.O. q. 4 hr. Isolate patient in laminar flow room or life island. Daily antiseptic bath and shampoo with chlorhexidine gluconate. Trim finger and toenails carefully and scrub area daily. For female patients, daily Betadine douche and insert one nystatin vaginal tablet b.i.d. Culture nares, oropharynx, urine, stool, and skin of groins and axillae twice weekly. Culture blood if fever over 101 degrees F.

If granulocyte count falls to less than 750/mm³:

In the presence of fever (101°F) or other signs of infection give antibiotics while waiting results of new cultures (especially blood cultures). The regimen suggested is ticarcillin 5 gm q. 6 hr I.V., gentamycin 1.25 mgm/kg q. 6 hr I.V. For severe infection not responding within 24 hrs, give supplemental white cells, and if platelet count is low give platelets from preselected matched donors. When cultures are reported, modify antibiotic regime appropriately. Watch for toxicity from antibiotics, and reduce medications as soon as practicable.

When granulocyte count rises to over 1000/mm³ and is clearly improving:

Discontinue isolation and antiseptic baths, antibiotics; continue nystatin for 3 additional days.

Source: Andrews, in Hubner and Fry, eds., 307.

The health risk of such contamination varies with the kind of contaminating particle and the duration of exposure.

If the contaminating particles emit gamma radiation, then skin and organs in the path of the gamma radiation will be exposed to a given dose. If the individual is effectively covered in gamma-emitting particles, the health consequences to that person are the same as if the person had been exposed to a whole body radiation dose. That person should also be considered a danger to others, in that until decontaminated he constitutes a source of radioactivity. If the person is contaminated with beta particles, the radiation is delivered over a very small distance (measured in millimeters) with relatively high intensity. Beta burns are local radiation skin burns created by exposure of skin to beta particles. These burns can inflict extensive damage to local tissues, and, if the dose is sufficiently severe, could produce elements of the whole body radiation syndrome. Alpha particles exert effects over even smaller distances than beta particles (measured in micrometers) but at much higher levels of intensity. Alpha radiation is most damaging to humans when ingested or inhaled internally.

The time consumed and number of personnel required to decontaminate a large number of people exposed to external contamination can be envisioned by considering the medical protocol currently recommended for the external decontamination of one person. See Table 22.

Q. Describe internal contamination and its treatment.

A. (Leaning)

Internal contamination. Whenever radioactive material is inhaled or ingested, internal contamination occurs.[74/] Inhalation of aerosolized radioactive particles, consumption of particles dusting food or water, and absorption of particles through mucus membranes or wound surfaces may all contribute to the internal body burden of radioactivity. If a large-scale release of radioactivity has taken place, food chain contamination, incorporating radioactivity in concentrated forms into the food supply, creates an additional and more long-term source of internal contamination. This form of contamination adds to whatever radiation dose an individual may have received from whole body irradiation or from external contamination with radioactive particles.

The amount of radiation a person received from inhalation or ingestion of radioactive particles depends on complex interactions between the physical and chemical properties of

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74/ For discussion of internal contamination, see:

IAEA, pp. 39-42.

NCRP, Report No. 65, pp. 20-29.

G.L. Voelz, "Current Approaches to the Management of Internally Contaminated Persons," in Hubner and Fry, eds., pp. 315-316.

TABLE 22

Protocol for External Decontamination

1. *Decor   nation site requirements*
   - Separate entrance and isolated air and water systems;
   - Drainage sluicing table;
   - Personnel dressed in water-repellent disposable total garb, including masks and gloves;
   - Labels for radioactive areas;
   - Beta and gamma Geiger counters, hand-held, battery-operated (alpha very difficult to get and maintain).
2. *Procedure on site*
   - Remove victim from contaminated a-ea;
   - Remove all clothing;
   - Cotton swab sarr ples of nares, ear canals, and mouth to test dose level at lab;
   - Rinse out mouth and nose with water;
   - Survey with Geiger counter;
   - Wash with soap and water—especially orifices and hair;
   - Survey with Geiger counter again;
   - Repeat wash if necessary and shave all body hair areas if necessary;
   - Avoid abrading skin—enhances absorption;
   - Use occlusive dressings (to be removed every six to twelve hours) for persistent contamination (sweating will flush out much of the contamination from superficial horny skin layers).

Source: IAEA No. 47, 33-42; NCRP No. 65, 113-118.

the radioactive isotope and the biological system that metabolizes it. Alpha emitters, which deliver intense ionization in very focal areas, are, in general, most hazardous. The chief health consequences are expressed over years, as induction of malignancy in local affected sites. A more acute toxic effect on the lung has been observed with high-dose inhalation injury, especially when combined with some component of external contamination and whole body irradiation. In this setting, over a several-month period, a patient can experience progressive hemorrhagic pulmonary edema (blood and fluid in the lungs) and die from hypoxia (low level of tissue oxygen) and infection.[75/]

To assess the amount of radiation a person has absorbed internally requires a battery of tests and a series of calculations over time that often challenge the technical capacities of hospitals even when only one or two patients are involved in the treatment protocols. In disaster settings, where many people may be at risk for internal contamination, the assessment task may prove insurmountable.[76/]

Treatment. Treatment of internal contamination must be delivered as soon as possible. Procedures or antidotes that are experimental and cumbersome to employ in individual

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75/ Rotblat, 1981, p. 38.

76/ IAEA, pp. 4-32.
NCRP, Report No. 65, pp. 125-158.

cases, such as chelation, are not recommended on a population scale. The administration of potassium iodide is the only antidote currently recommended for widespread use. If taken as prescribed, potassium iodide will protect populations from one of the major contributors to radioactive releases from nuclear power plants--radioactive iodine. Unless blocked, this radioactive iodine is selectively concentrated by the thyroid gland and can inflict high local doses in a short time frame. Administering potassium iodide saturates the iodine receptors in the thyroid gland and inhibits uptake of the radioactive forms. If administered within one hour of exposure, more than 85 percent of the radioactive dose will be blocked. The recommended dose is 100 milligrams of potassium iodide taken orally within two hours and then daily for 10 days. At this dose, administered to populations, some side effects may be observed. Levels of thyroid stimulating hormone (TSH) may rise slightly, transient and clinically insignificant hypothyroidism may be induced in people with borderline thyroid function, and a percentage of the population may develop a skin reaction.77/

77/ David V. Becker, "Reactor Accidents: Public Health Strategies and their Medical Implications," Journal of the American Medical Association 258 (1987): 649-654.

Luther J. Carter, "National Protection from Iodine-131 Urged," Science 206 (1979): 201-206.

Frank von Hippel, "Available Thyroid Protection," Science 204 (1979): 1032.

Q. What are the long-term health consequences of radiation exposure?

A. (Leaning) Exposure to radiation exerts two principal long-term effects among those who survive the acute effects: induction of cancer and promotion of genetic defects. Both of these consequences appear after a significant latent period. At issue is the dose-response curve, or the relationship between the amount of radiation to which a population is exposed and the subsequent numbers of malignancies or genetic defects that will later develop. Most of the data on long-term effects derives from populations exposed in the range of 100 rads or more. Since the human data is incomplete at lower levels of exposure, attempts to extrapolate back to effects at lower doses must rely on theoretical concepts of threshold doses and calculated dose-response curves. The scientific argument about this question is explored in detail in the 1980 report of the National Academy of Sciences, submitted by the Biological Committee on the Effects of Ionizing Radiation. The BEIR III report examined the literature on long-term effects with a particular focus on an attempt to define a threshold radiation dose above which long-term consequences could be predicted with some certainty. Both the concept of a threshold dose and the shape of the dose-response curve on either side of this threshold remain active questions in the literature.[78]

78/ BEIR III, pp. 21-23.

Cancer. In studies of populations exposed to relatively high-dose radiation (the survivors of Hiroshima and Nagasaki, Marshall Islanders, uranium miners, and others), the carcinogenic effect of radiation--its capacity to induce cancers--has been repeatedly demonstrated. Only certain cancers are increased in incidence by radiation exposure and the time of their peak occurrence varies by cell type. Follow-up on Hiroshima and Nagasaki survivors reveals that they have experienced increased incidence of leukemia, cancer of the breast, lung, stomach, and thyroid, and are probably at risk for an increased incidence of multiple myeloma and cancer of the colon and urinary tract. In the case of leukemia, which in the years of peak incidence occurred at a rate 10 times that in the non-exposed population, a dose-response curve can be drawn. That curve is now in dispute since the gamma and neutron dosimetry data for Hiroshima have been revised.[79/]

79/ Stuart C. Finch, "The Study of Atomic Bomb Survivors in Japan," American Journal of Medicine 66 (1979): 900.

Hiro Kato and William J. Schull, "Studies of the Mortality of A-Bomb Survivors: 7: Mortality, 1950-1978: Part 1. Cancer Mortality," Radiation Research 90 (1982): 395-432.

Eliot Marshall, "New A-Bomb Studies Alter Radiation Estimates," Science 212 (1981): 900-903.

Warren K. Sinclair and Patricia Failla, "Dosimetry of the Atomic Bomb Survivors: A Symposium," Radiation Research 88 (1981): 437-447.

The International Commission on Radiological Protection (ICRP) has published standard estimates of cancer risks, based on extrapolations from a broad range of data, employing a linear dose-response curve. Although the linear hypothesis is controversial, the ICRP estimates presented in Table 23 serve as gross indicators of risk.

According to the ICRP formula, the total risk of death from all cancers for both sexes comes to 12.5×10^{-3} per 100 rems, meaning that if 10,000 people were exposed to 100 rems, 125 would subsequently die of cancer who would otherwise not incur this disease. The number of non-lethal cancers induced by this radiation exposure might be double this figure.

Genetic effects. Ionizing radiation can damage chromosomes, containing many genes, or alter the structure of just one gene. Genetic or chromosomal alterations in germ cells may be transmitted to the offspring of the exposed person. These defects may take several generations to reveal themselves in populations.

Since it is assumed that radiation-induced gentic defects will be similar to the significant spontaneous mutations that currently occur at the rate of 10 percent of all live births, scientists employ the concept of doubling dose, or the radiation dose required to double the normal background incidence of significance mutation from all causes. The doubling dose concept assumes that the dose response curve is linear.

TABLE 23

Risk Factors for Cancer Deaths

Cancer Type[a]	*Death Rate per 100 Rems*
Leukemia	2.0×10^{-3}
Breast cancer	2.5×10^{-3}
Lung cancer	2.0×10^{-3}
Bone cancer	0.5×10^{-3}
Thyroid	0.5×10^{-3}
Other (stomach, colon, liver, salivary glands)	5.0×10^{-3}
Total	12.5×10^{-3}

a. No allowance made for age or sex of person exposed; since breast cancer occurs almost exclusively in females, the risk for them is double what is given here as an average for both sexes.

Source: ICRP No. 26, cited in Rotblat, 1981, 47.

The doubling dose in humans has been estimated to range between 50 and 250 rads.[80/] Translating this range to population effects, the BEIR III Committee has suggested that exposing a population to 1 rem will induce in the first generation thereafter 5-65 significant genetic mutations per million live births.[81/]

Q. Could you describe the task facing an emergency physician asked to respond and provide triage and treatment to people possibly exposed to a release of radioactivity from Seabrook?

A. (Leaning) The response to this question can be approached by defining the problem, describing the resources available, outlining the established procedure to be followed, and evaluating the potential results.

The problem:

It is assumed that the release of radioactivity has been significant, resulting in the likelihood that many of the people on the beach have received a potentially lethal dose.

Notification of the disaster has occurred, and the evacuation of the beach population is in progress. The time frame for this discussion is within the first four to eight hours from the time of the accident.

80/ BEIR III, p. 84.

81/ Ibid., p. 85.

At one of the local community hospitals within a 10 mile radius of the Seabrook plant, one might anticipate the arrival of at least 100 patients per hour, experiencing a range of symptoms from anxiety to intense vomiting.

The Resources:

(a) Physical Plant

The appropriate treatment of radiation victims requires space, equipment, ventilation, and waste disposal systems that are separate from the general treatment area and from the external environment. In most hospitals that have paid attention to the risk of radiation accidents and have organized a response system, the physical plant is usually arranged for multi-purpose use, so that in the actual event of a radiation emergency, necessary modifications in routine space must be made at very short notice.82/

82/ For discussion on necessary resources and recommended procedures, see:

J. Geiger, op cit.
Harold A. Goldstein, "Radiation Accidents and Injuries," Emergency Medicine, September 15, 194-215.
R.E. Linnemann, op. cit.
Fred A. Mettler, "Emergency Management of Radiation Accidents," Journal of the American College of Emergency Physicians," 7:8 (1978); 302-305.
Oak Ridge Associated Universities, Radiation Accident Management: Syllabus, Oak Ridge Associated Universities, Oak Ridge, Tennessee, N vember, 1980.
LL. Richter, et al., "A Systems Approach to the Management of Radiation Accidents," Annals of Emergency Medicine, 9:6 (1980): 303-309.
Frances Shepherd, "Treatment for Patients with Radioactive Contamination," Dimensions in Health Service, June (1990): 19-20.

(b) Personnel

The local disaster plan would be activated. For a community hospital responding to a radiation alert, at most 20-30 physicians and nurses could be expected to assemble.

(c) Coordination

In this context, the organization and coordination of personnel is more crucial than the actual numbers deployed. This priority always prevails, regardless of the kind of disaster under discussion; in the case of radiation accident, the various procedures that need to be performed are discrete, serial, often counter-intuitive, and carry an element of fear. Consequently, even in small-scale radiation disasters, a higher premium is placed on leadership, training, and appropriate task assignment than what might otherwise be needed in a disaster response employing procedures tht physicians and nurse are more accustomed to perform in the course of their regular work. And, as with any disaster, even seasoned responders can find their efforts overwhelmed if the numbers of people in need outstrip the physical and human resources available.

Procedure

A) Standard Procedure:

Standard procedure for evaluating and treating one patient with possible exposure to external contamination and the potential for internal contamination has been outlined in preceding sections.

The process of assessing for life-threatening injury, taking patient history, screening for radiation contamination, and implementing decontamination procedures would take two experienced people approximately 15 to 30 minutes for each patient.

The task of triage requires estimating radiation received. This estimate would be based on patient history, on evidence of prodromal symptoms (anorexia, nausea, vomiting, fatigue), and on results of Geiger counter survey for external contamination. Such an estimate will often be hard to arrive at with any certainty or precision. In making this triage decision, a protocol will have to be in place or arrived at soon into the event as to where and how to send patients who are deemed at risk for lethal exposures. The destination should be a hospital environment equipped for the management of severely exposed individuals. In the example described here, preparations should be made to transport the patient by ambulance to teaching hospitals in the Greater Boston area.

B) General triage guidelines:

- Send to tertiary hospital anyone with presumed exposures of 200 rems or more;

- Send to community hospital all patients with exposures estimated to be between 50 and 200 rems, where, pending results of blood samples, admission will provide surveillance for further symptom development;

- Send home, with information allowing for immediate re-call, any patient whose exposure is judged to be 50 rems or less.

Procedure for Mass Casualty Response

Available space, equipment and personnel, even in the most advanced and prepared radiation sites, would be stressed to capacity after receiving 100 patients an hour. An orderly, comprehensive response would be disrupted. The area around and outside the hosptal emergency room would be crowded with patients. Crowd supervision would be a matter of great priority. If not handled well (and crowd management requires sufficient numbers of trained people) the situation could degenerate to hysteria and mass panic. The management of large numbers of children would especially complicate matters.

One of two different consequences could result. The personnel on site could think clearly and de-escalate their response protocols to a minimum level of intervention aimed at identifying the mostly severely exposed and delaying until later the assessment and treatment of those less seriously exposed.

The key problem with this decision process in the context of radiation injury is the degree of uncertainty that is inexorably attached to the assessment of individual cases--a degree of uncertainty, given our medical knowledge, that is greater than the uncertainty with which a skilled physician approaches someone with a traumatic chest injury. The stress of this process lead to a deterioration in medical judgment over time.

If the on-site personnel become confused and anxious, they might resort to a serial treatment pattern (taking care of each patient as he or she arrives). Serial intervention results in a situation where many potentially seriously ill patients queue up, unevaluated, and untreated. Ultimate morbidity and mortality of victims would, in this mode, be increased.

Summary

The short-term response to a significant radiation accident at Seabrook, involving exposures of over 200 rems to a population in excess of 500 people, could be expected to overwhelm a methodical standard approach to the assessment and decontamination of radiation victims. Instead, an accelerated and truncated treatment process would develop, and, in the best case, those most seriously exposed would be identified, decontaminated, and sent to more definitive treatment sites with little delay. In the worst case, medical organization would crumble, resulting in delay in treating those who should be treated at once. A greater incidence of morbidity and mortality could be expected.

Q. In conclusion could you describe what might be the reactions of the beach population during the first few minutes to one hour after exposure to a potentially lethal radiation release?

A. (Leaning) Radiation is invisible and leaves no smell or taste. The first signs of the release would be the onset of nausea and vomiting in that section of the population whose sensitivity to radiation was highest and who were in the path of the release of radioactivity. This population would include a preponderance of children and whatever elderly adults were present on the beach. Initially, other family members, friends, and bystanders would not pay particular attention to isolated instances of nausea or vomiting occurring up and down the beach area. However, this kind of news, recounting untoward and unexpected symptoms, travels very rapidly. Within minutes of onset of symptoms in a few people, word of a strange epidemic would spread throughout the several miles of populated beach region.

At that point, regardless of official communications and advice, mass turmoil could be expected. Any exodus would be complicated by the fact that an increasing number of people would begin to fall ill. This expanding number would include parents and drivers of vehicles. The nausea that afflicts people is intense and sudden, often persisitng for several hours. This nausea will reduce energy levels, impair clarity of thought, and contribute to emotional instability. These adverse effects would be felt more by that segment of the population that immediately becomes nauseated and soon after exposure begins to vomit. The vomiting of the radiation prodrome syndrome can come on suddenly, and may continue relentlessly for several hours. Again, people with this condition may well be unable to manage, with any dispatch or efficiency, the task of assembling family and belongings, getting to vehicles, and negotiating the journey out of the affected area.

In the scenarios described in the testimony of Professor Beyea, on any given summer day there might be as many as 10,000 to 23,000 people who could be exposed. According to statistical probablity, based on study of previous population experience, even at levels of radiation below 100 rems one could predict that approximately 30% of the population would begin to feel loss of appetite and general decline in wellbeing, another 10% would become nauseated, and 10% would begin to vomit. A few people might experience abrupt onset of diarrhea, with or without other symptoms.

Translated into numbers, within minutes of exposure to a radioactive release, 1,000 people or more on the beach would become acutely nauseated, and another 1,000 people would begin active vomiting. It should be noted that these percentages were derived for an adult population. Higher percentages for illness in each category should be employed for populations containing many children. Evacuation procedures in this setting would take longer and involve more complexities than the evacuation of people who are not ill.

Q. Does this complete your testimony?

A. (Leaning) Yes. It does.

TABLE A TO TESTIMONY OF STEVEN C. SHOLLY

SURRY DOMINANT ACCIDENT SEQUENCES, WASH-1400

The WASH-1400 analysis of Surry Unit 1 identified twelve accident sequences which dominated the estimated median core melt frequency of 5×10^{-5} per reactor-year. 1/ These twelve accident sequences, their designations, and their estimated frequencies are described below. 2/

Sequence TMLB' -- This sequence is a station blackout sequence (a loss of offsite power followed by the failure of onsite AC power and the failure to recover AC power within about three hours). WASH-1400 estimated the frequency of sequence TMLB' at 3×10^{-6} per reactor-year. 3/ 4/

1/ It will be noted that if the frequencies of these twelve sequences are summed the resultant core melt frequency is 1.24×10^{-4} per reactor-year. WASH-1400 obtained the 5×10^{-5} per reactor-year by a Monte Carlo sampling technique, the particulars of which are not especially clear. The latter value has been cited widely, and is therefore used here for reference purposes.

2/ Recently, a new risk assessment for Surry Unit 1 was performed for the draft NRC report NUREG-1150, *Reactor Risk Reference Document*. The full results of the new Surry 1 PRA are documented in Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events: Surry Unit 1*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986. This study estimated the mean frequency of core melt at 2.6×10^{-5} per reactor-year from "internal events" accidents (i.e., not including "external events" such as earthquakes, floods, fires, etc.). *Id.*, page I-4. WASH-1400 sequences TKQ, TKMQ, and S_2C were found not to lead to core melt. Other WASH-1400 sequences for Surry were identified as among the dominant core melt sequences in the new study, along with several newly-identified accident sequences. A table from NUREG/CR-4550 which summarizes the results of the newer study is provided as an addendum to Exhibit 3 for comparison purposes.

3/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 82.

4/ The NUREG-1150 analysis of Surry identified four separate station blackout sequences. These four sequences have an aggregate core melt frequency estimated at 9.5×10^{-6} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia

Sequence TML -- This sequence is a transient either resulting from or followed by a loss of main feedwater, with a failure of auxiliary feedwater. WASH-1400 estimated the frequency of sequence TML at 6×10^{-6} per reactor-year. 5/ 6/

Sequence V -- The V sequence represents an "intersystem LOCA" resulting from the failure of the low pressure injection system check valves. This results in the rupture of the low pressure injection system piping outside of the containment; the radiological release from this core melt accident also bypasses the containment. WASH-1400 estimated the frequency of sequence V at 4×10^{-6} per reactor-year. 7/ 8/

Sequence S2C -- Sequence S_2C represents a small LOCA in which the containment spray injection system fails. This results in a lack of containment heat removal. The containment fails due to steam overpressure, following which the emergency core cooling systems fail due to insufficient net positive suction head (NPSH) and/or damage due to containment depressurization. This results in core melt *after*

National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 and V-6.

5/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 82.

6/ The NUREG-1150 analysis estimated the frequency of this type of accident sequence at 1.1×10^{-6} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, page V-5.

7/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 81.

8/ Science Applications International Corporation has re-estimated the V sequence frequency at 5×10^{-7} per reactor-year. See, R.L. Ritzman, et al., *Surry Source Term and Consequence Analysis*, Science Applications International Corporation, prepared for the Electric Power Research Institute, EPRI Report No. NP-4096, Final Report, June 1985, page 2-8. The NUREG-1150 analysis estimated the frequency of the V sequence at 9.0×10^{-7} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. N[illegible] Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, page V-[illegible] containment failure. WASH-1400 estimated the frequency of sequence S_2C at 2×10^{-6} per reactor-year. 9/ 10/

Sequence S2D - Sequence S_2D represents a small LOCA in which the emergency coolant injection system fails. WASH-1400 estimated the frequency of sequence S_2D at 9×10^{-5} per reactor-year. 11/

Sequence S2H - Sequence S_2H represents a small LOCA in which the emergency coolant recirculation system fails. WASH-1400 estimated the frequency of sequence S_2H at 6×10^{-6} per reactor-year. 12/

9/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 99.

10/ Both Science Applications International Corporation and the NUREG-1150 analyses conclude that this is a non-core melt sequence. See, R.L. Ritzman, et al., *Surry Source Term and Consequence Analysis*, Science Applications International Corporation, prepared for the Electric Power Research Institute, EPRI Report No. NP-4096, Final Report, June 1985, page 2-10; and Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, page V-70. The NUREG-1150 analysis identified similar sequences with medium and large LOCAs, loss of offsite power transients, and loss of feedwater transients as initiating events. These sequences were estimated to have an aggregate frequency of about 1.1×10^{-7} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-69 to V-71. The large reduction in frequency arises from analyses which suggest that containment failure results in ECCS failure only 2% of the time, rather than 100% of the time as assumed in WASH-1400.

11/ The NUREG-1150 analysis estimated the frequency of this sequence at 7.1×10^{-7} per reactor-year. The analysis also estimated a similar sequence (resulting from reactor coolant pump seal LOCAs, which were not considered in WASH-1400) at 2.6×10^{-6} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

12/ The NUREG-1150 analysis estimated the frequency of this sequence at 1.2×10^{-6} per reactor-year (sequences S_2H_1 and S_2H_2). See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

Sequence S1D -- Sequence S_1D represents a medium LOCA in which the emergency coolant injection system fails. WASH-1400 estimated the frequency of sequence S_1D at 3×10^{-6} per reactor-year. 13/ 14/

Sequence S1H -- Sequence S_1H represents a medium LOCA in which the emergency coolant recirculation system fails. WASH-1400 estimated the frequency of sequence S_1H at 3×10^{-6} per reactor-year. 15/ 16/

Sequence AD -- Sequence AD represents a large LOCA in which the emergency coolant injection system fails. WASH-1400 estimated the frequency of sequence AD at 2 $\times 10^{-6}$ per reactor-year. 17/ 18/

13/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 80.

14/ The NUREG-1150 analysis estimated the frequency of this sequence at 7.1×10^{-7} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

15/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 80.

16/ The NUREG-1150 analysis estimated the frequency of this sequence at 7.7×10^{-7} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

17/ N.C. Rasmussen, et al., *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 80.

18/ The NUREG-1150 analysis estimated the frequency of this sequence at 3.9×10^{-7} per reactor-year. See, Robert C. Bertucio, et al., *Analysis of Core Damage Frequency From Internal Events*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

<u>Sequence AH</u> -- Sequence AH represents a large LOCA in which the emergency coolant recirculation system fails. WASH-1400 estimated the frequency of sequence AH at 1 x 10^{-6} per reactor-year. <u>19</u>/ <u>20</u>/

<u>Sequence TKQ</u> -- Sequence TKQ represents a transient followed by failure of the reactor protection system and a failure of at least one pressurizer safety/relief valve to reclose. WASH-1400 estimate the frequency of sequence TKQ at 3 x 10^{-6} per reactor-year. <u>21</u>/ <u>22</u>/

<u>Sequence TKMQ</u> -- Sequence TKQ represents a loss of feedwater transient followed by failure of the reactor protection system and failure of at least one pressurizer safety/relief valve to reclose. WASH-1400 estimated the frequency of sequence TKMQ at 1 x 10^{-6} per reactor-year. <u>23</u>/ <u>24</u>/

<u>19</u>/ N.C. Rasmussen, et al., *<u>Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants</u>*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 80.

<u>20</u>/ The NUREG-1150 analysis estimated the frequency of this sequence at 3.9 x 10^{-7} per reactor-year. <u>See</u>, Robert C. Bertucio, et al., *<u>Analysis of Core Damage Frequency From Internal Events</u>*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, pages V-5 to V-6.

<u>21</u>/ N.C. Rasmussen, et al., *<u>Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants</u>*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 99.

<u>22</u>/ The NUREG-1150 analysis estimated the frequency of a similar sequence ($TKRD_4$) at 1.1 x 10^{-6} per reactor-year. <u>See</u>, Robert C. Bertucio, et al., *<u>Analysis of Core Damage Frequency From Internal Events</u>*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, page V-69.

<u>23</u>/ N.C. Rasmussen, et al., *<u>Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants</u>*, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "*Main Report*," page 99.

<u>24</u>/ The NUREG-1150 analysis estimated the frequency of a similar sequence (TKRZ) at 4.8 x 10^{-7} per reactor-year. <u>See</u>, Robert C. Bertucio, et al., *<u>Analysis of Core Damage Frequency From Internal Events</u>*, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-4550, SAND86-2084, Vol. 3, November 1986, page V-69.

ADDENDUM TO TABLE A

DOMINANT SURRY UNIT 1 ACCIDENT SEQUENCES, NUREG/CR-4550, VOL. 3

Table V.1-1

Surry Dominant Accident Sequences

Sequence	Frequency*	Plant Damage State
$T_1(SL)-D_1CF_1$	6.6E-6	SNNN
S_3D_1	2.6E-6	TYYB
$T_{L3}Q-H_1$	1.9E-6	SYYB
$T_{LH}Q-H_1$	1.6E-6	SYYB
$T_1L(LT)D_1CF_1$	1.3E-6	TNNN
$T_1L(ST)D_1CF_1$	1.3E-6	TNNN
T_1LP	1.1E-6	TYYB
$TKRD_1$	1.1E-6	TYYB
EVENT-V	9.0E-7	EVENT-V
S_2H_1	8.9E-7	SYYB
$T_{L3}Q-H_2$	8.1E-7	SYYB
S_1H_1	7.7E-7	AYYB
S_1D_1	7.1E-7	AYYB
S_2D_1	7.1E-7	SYYB
$T_{LH}Q-H_2$	6.3E-7	SYYB
TKRC	4.5E-7	SYYB
AD_5	3.9E-7	AYYB
AH_1	3.9E-7	AYYB
S_2H_2	3.3E-7	SYYB
$T_1Q-D_1CF_1$	3.0E-7	SNNN
$S_1F_1F_2$	7.0E-8	AYYB

* Point estimate based on propagation of mean values.

Table V.1-1 (Continued)
Surry Dominant Accident Sequences

Sequence	Frequency*	Plant Damage State
$S_2H_1F_1F_2$	3.0E-6	SYNI
$S_1H_1F_1F_2$	3.0E-6	AYNI
AF_1F_2	3.5E-6	AYNB
$AH_1F_1F_2$	2.5E-6	AYNI
$S_1D_6D_1C$	2.7E-9	ANNN
AD_6D_1C	1.4E-9	ANNN
$T_1LF_1F_2$	1.1E-9	TYNI
CORE DAMAGE TOTAL	2.5E-5	

* Point estimate based on propagation of mean values.

TABLE B TO TESTIMONY OF STEVEN C. SHOLLY

SURRY RELEASE CATEGORIES, WASH-1400

This exhibit provides a description of the WASH-1400 release categories for Surry Unit 1, as well as a table which gives the release characteristics (frequency, release magnitudes, etc.). Information for this Exhibit is taken from WASH-1400. 1/

1/ The release category frequencies and characteristics are taken from N.C. Rasmussen, et al., Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, "Main Report," page 97; the descriptions of the release categories are taken from N.C. Rasmussen, et al., Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, U.S. Nuclear Regulatory Commission, WASH-1400, NUREG-75/014, October 1975, Appendix VI, "Calculation of Reactor Accident Consequences," pages 2-1 to 2-3.

TABLE VI 2-1 SUMMARY OF ACCIDENTS INVOLVING CORE

[illegible]

2.2 ACCIDENT DESCRIPTIONS

To help the reader understand the postulated containment releases, this section presents brief descriptions of the various physical processes that define each release category. For more detailed information on the release categories and the techniques employed to compute the radioactive releases to the atmosphere, the reader is referred to Appendices I, VII, and VIII. The dominant event tree sequences in each release category are discussed in detail in section 4.6 of Appendix V.

PWR 1

This release category can be characterized by a core meltdown followed by a steam explosion on contact of molten fuel with the residual water in the reactor vessel. The containment spray and heat removal systems are also assumed to have failed and, therefore, the containment could be at a pressure above ambient at the time of the steam explosion. It is assumed that the steam explosion would rupture the upper portion of the reactor vessel and breach the containment barrier, with the result that a substantial amount of radioactivity might be released from the containment in a puff over a period of about 10 minutes. Due to the sweeping action of gases generated during containment-vessel meltthrough, the release of radioactive materials would continue at a relatively low rate thereafter. The total release would contain approximately 70% of the iodines and 40% of the alkali metals present in the core at the time of release. Because the containment would contain hot pressurized gases at the time of failure, a relatively high release rate of sensible energy from the containment could be associated with this category. This category also includes certain potential accident sequences that would involve the occurrence of core melting and a steam explosion after containment rupture due to overpressure. In these sequences, the rate of energy release would be lower, although still relatively high.

PWR 2

This category is associated with the failure of core-cooling systems and core melting concurrent with the failure of containment spray and heat-removal systems. Failure of the containment barrier would occur through overpressure, causing a substantial fraction of the containment atmosphere to be released in a puff over a period of about 30 minutes. Due to the sweeping action of gases generated during containment vessel meltthrough, the release of radioactive material would continue at a relatively low rate thereafter. The total release would contain approximately 70% of the iodines and 50% of the alkali metals present in the core at the time of release. As in PWR release category 1, the high temperature and pressure within containment at the time of containment failure would result in a relatively high release rate of sensible energy from the containment.

PWR 3

This category involves an overpressure failure of the containment due to failure of containment heat removal. Containment failure would occur prior to the commencement of core melting. Core melting then would cause radioactive materials to be released through a ruptured containment barrier. Approximately 20% of the iodines and 20% of the alkali metals present in the core at the time of release would be released to the atmosphere. Most of the release would occur over a period of about 1.5 hours. The release of radioactive material from containment would be caused by the sweeping action of gases generated by the reaction of the molten fuel with concrete. Since these gases would be initially heated by contact with the melt, the rate of sensible energy release to the atmosphere would be moderately high.

PWR 4

This category involves failure of the core-cooling system and the containment spray injection system after a loss-of-coolant accident, together with a concurrent failure of the containment system to properly isolate. This would result in the release of 9% of the iodines and 4% of the alkali metals present in the core at the time of release. Most of the release would occur continuously over a period of 2 to 3 hours. Because the containment recirculation spray and heat-removal systems would operate to remove heat from the containment atmosphere during core melting, a relatively low rate of release of sensible energy would be associated with this category.

———

PWR 5

This category involves failure of the core cooling systems and is similar to PWR release category 4, except that the containment spray injection system would operate to further reduce the quantity of airborne radioactive material and to initially suppress containment temperature and pressure. The containment barrier would have a large leakage rate due to a concurrent failure of the containment system to properly isolate, and most of the radioactive material would be released continuously over a period of several hours. Approximately 3% of the iodines and 0.9% of the alkali metals present in the core would be released. Because of the operation of the containment heat-removal systems, the energy release rate would be low.

PWR 6

This category involves a core meltdown due to failure in the core cooling systems. The containment sprays would not operate, but the containment barrier would retain its integrity until the molten core proceeded to melt through the concrete containment base mat. The radioactive materials would be released into the ground, with some leakage to the atmosphere occurring upward through the ground. Direct leakage to the atmosphere would also occur at a low rate prior to containment-vessel meltthrough. Most of the release would occur continuously over a period of about 10 hours. The release would include approximately 0.08% of the iodines and alkali metals present in the core at the time of release. Because leakage from containment to the atmosphere would be low and gases escaping through the ground would be cooled by contact with the soil, the energy release rate would be very low.

PWR 7

This category is similar to PWR release category 6, except that containment sprays would operate to reduce the containment temperature and pressure as well as the amount of airborne radioactivity. The release would involve 0.002% of the iodines and 0.001% of the alkali metals present in the core at the time of release. Most of the release would occur over a period of 10 hours. As in PWR release category 6, the energy release rate would be very low.

PWR 8

This category approximates a PWR design basis accident (large pipe break), except that the containment would fail to isolate properly on demand. The other engineered safeguards are assumed to function properly. The core would not melt. The release would involve approximately 0.01% of the iodines and 0.05% of the alkali metals. Most of the release would occur in the 0.5-hour period during which containment pressure would be above ambient. Because containment sprays would operate and core melting would not occur, the energy release rate would also be low.

PWR 9

This category approximates a PWR design basis accident (large pipe break), in which only the activity initially contained within the gap between the fuel pellet and cladding would be released into the containment. The core would not melt. It is assumed that the minimum required engineered safeguards would function satisfactorily to remove heat from the core and containment. The release would occur over the 0.5-hour period during which the containment pressure would be above ambient. Approximately 0.00001% of the iodines and 0.000006% of the alkali metals would be released. As in PWR release category 8, the energy release rate would be very low.

BWR 1

~~This release category is representative of a core meltdown followed by a steam explosion in the reactor vessel. The latter would cause the release of a substantial quantity of radioactive material to the atmosphere. The total release would contain approximately 40% of the iodines and alkali metals present in the core at the time of containment failure. Most of the release would occur over a 2-hour period. Because of the energy generated in the steam explosion, this category would be characterized by a relatively high rate of energy release to the atmosphere. This category also includes certain sequences that involve overpressure failure of the containment prior to the occurrence of core melting and a steam explosion. In these sequences, the rate of energy release would somewhat smaller than for those discussed above, although it would still be relatively high.~~

TABLE C TO TESTIMONY OF STEVEN C. SHOLLY

FIGURES I-11 TO I-18, NUREG-0396

This exhibit consists of reproduced pages from NUREG-0396 containing Figures I-11 through I-16. These figures are reproduced on the following six pages.

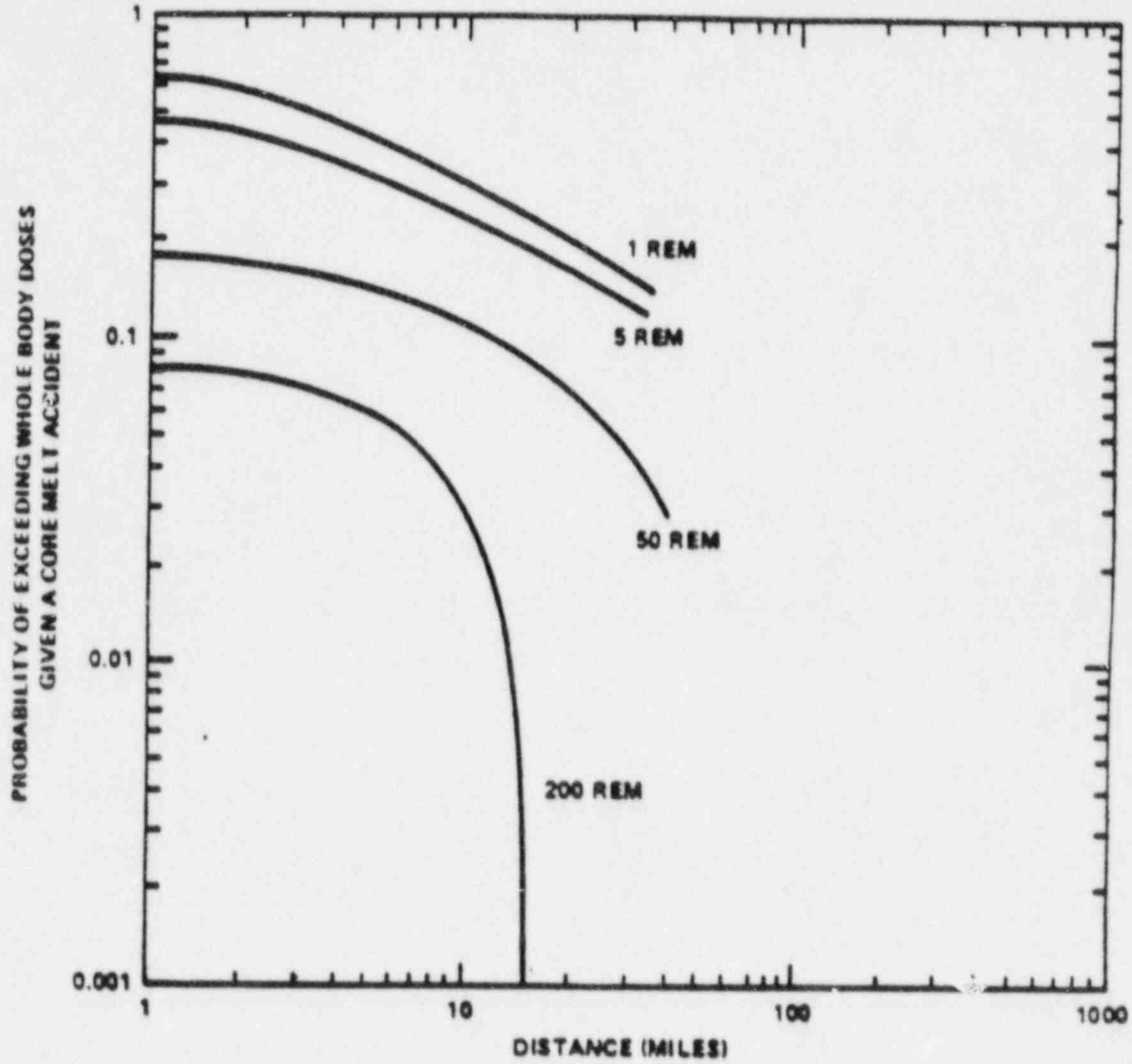

Figure I-11. Conditional Probability of Exceeding Whole Body Dose Versus Distance. Probabilities are Conditional on a Core Melt Accident (5×10^{-5}).

Whole body dose calculated includes: external dose to the whole body due to the passing cloud, exposure to radionuclides on ground, and the dose to the whole body from inhaled radionuclides.

Dose calculations assumed no protective actions taken, and straight line plume trajectory.

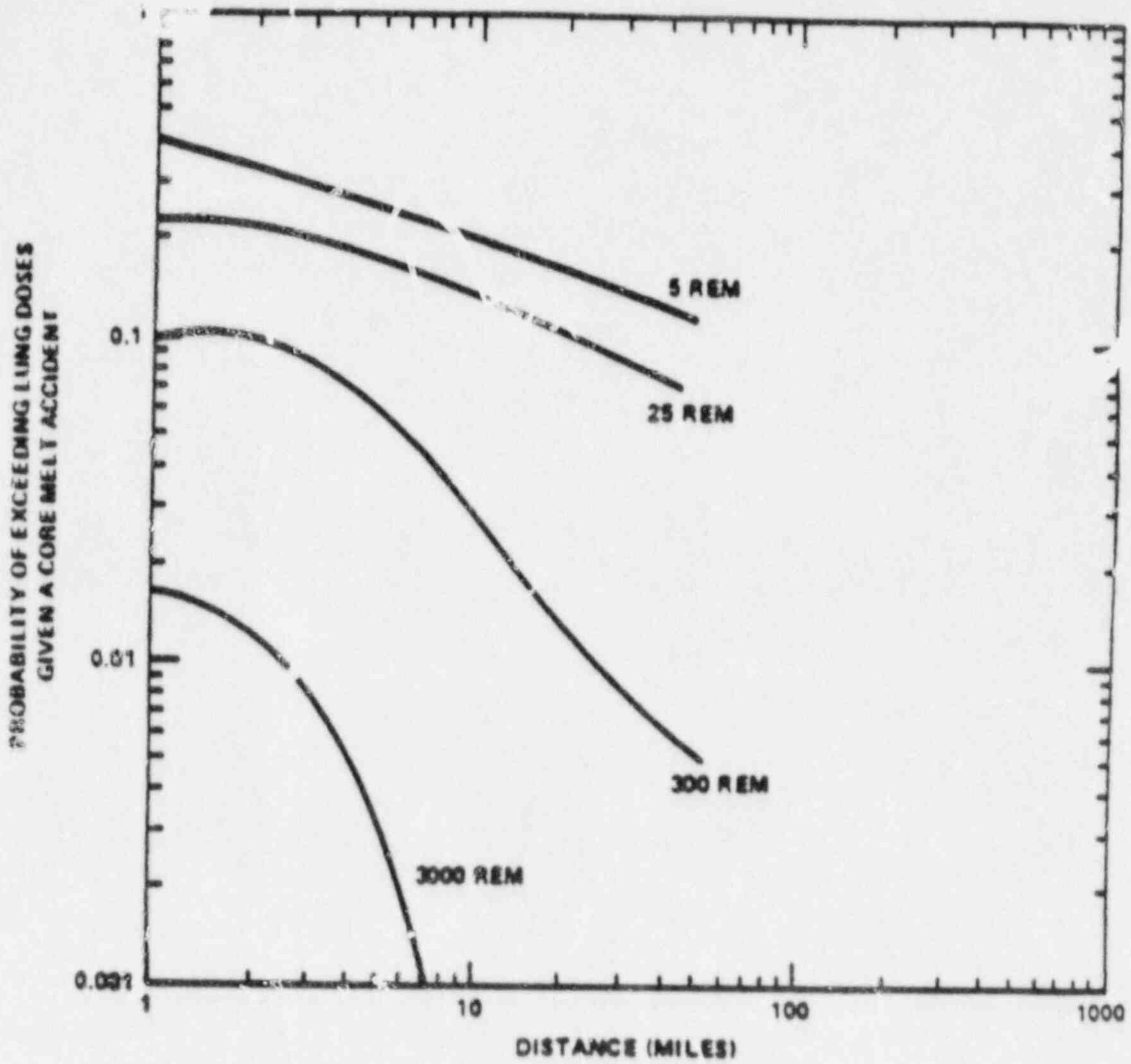

Figure I-12. Conditional Probability of Exceeding Lung Doses Versus Distance. Probabilities are Conditional on a Core Melt Accident (5×10^{-5}).

Lung dose calculated includes: external dose to the lung due to the passing cloud, exposure to radionuclides on ground, and the dose to the lung from inhaled radionuclides within 1 year.

Dose calculations assumed no protective actions taken, and straight line trajectory.

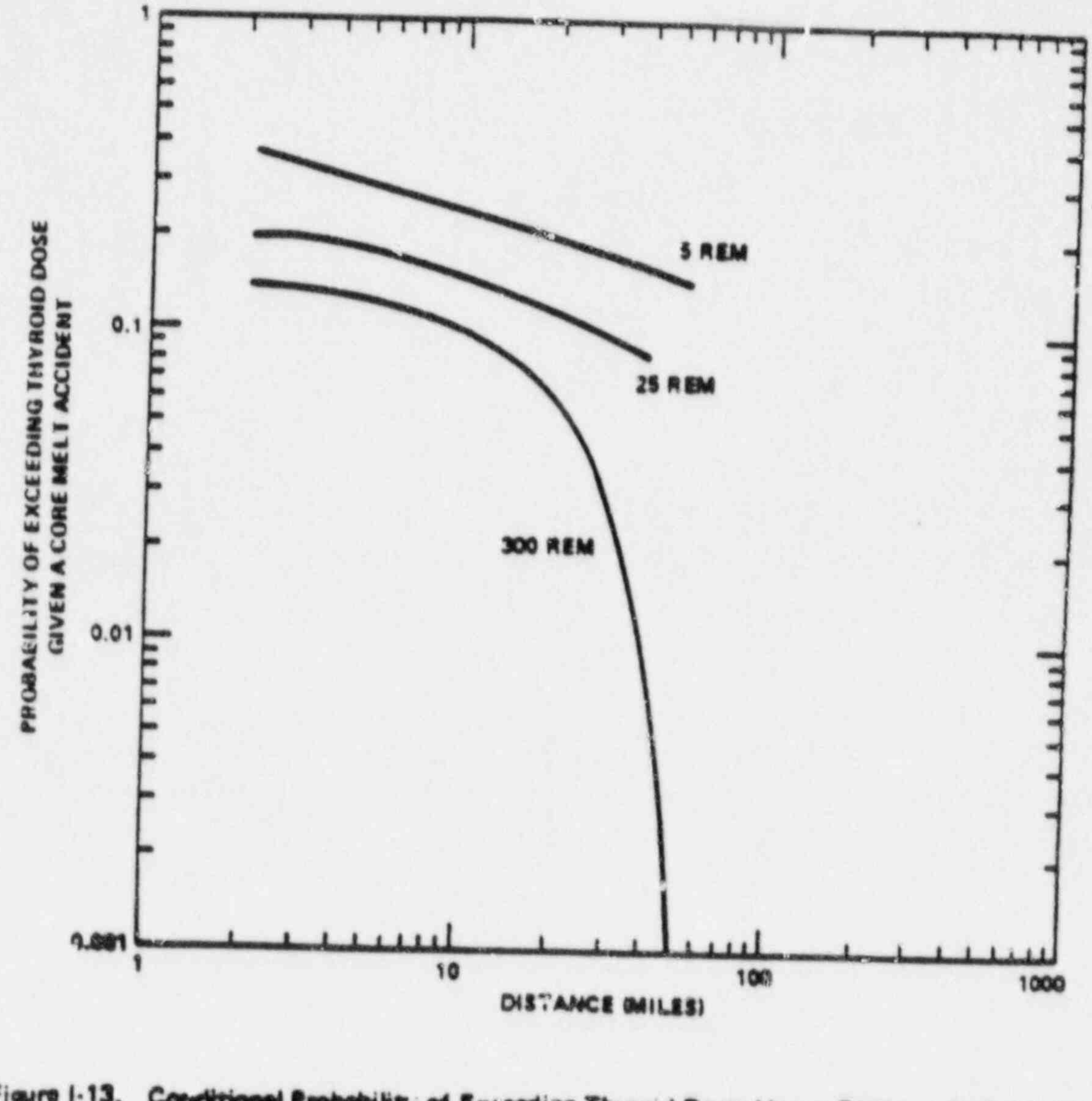

Figure I-13. Conditional Probability of Exceeding Thyroid Doses Versus Distance. Probabilities are Conditional on a Core Melt Accident (5×10^{-5}).

Thyroid dose calculated includes: external dose to the thyroid due to the passing cloud, exposure to radionuclides on ground, and the dose to the thyroid from inhaled radionuclides.

Dose calculations assumed no protective actions taken, and straight line trajectory.

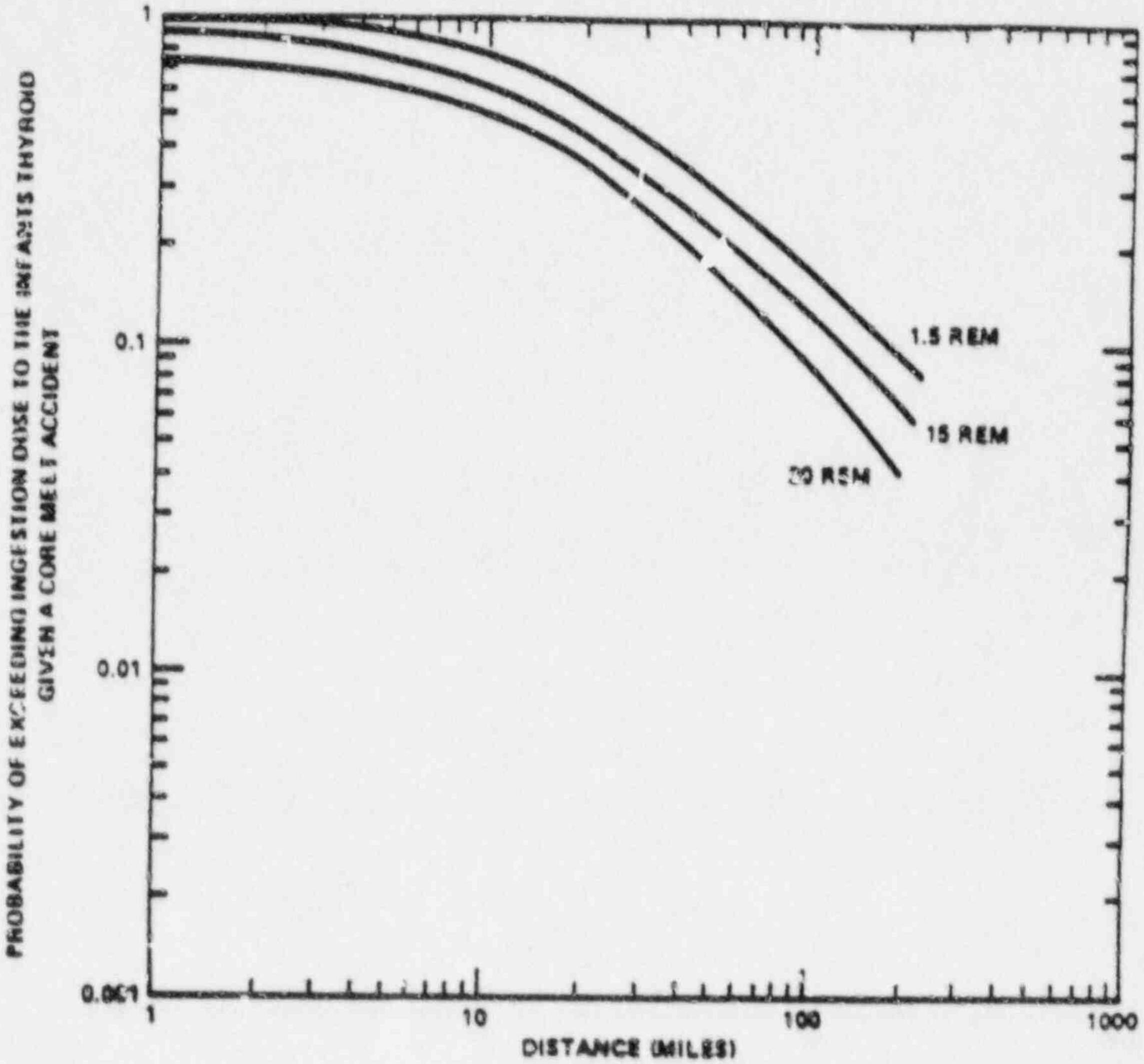

Figure I-14. Conditional Probability of Exceeding Thyroid Dose to an Infant Versus Distance. Probabilities are Conditional on a Core Melt Accident (5×10^{-5}).

Thyroid dose calculated is due solely to radionuclide ingestion through the milk consumption pathway.

Dose calculations assumed no protective actions taken, and straight line trajectory.

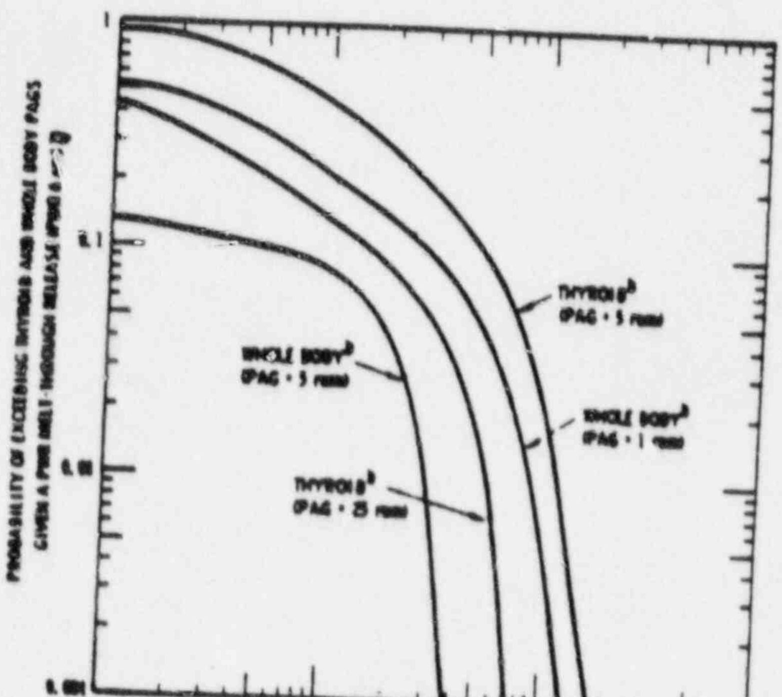

Figure 5-18. Conditional Probability of Exceeding Thyroid and Whole Body Protective Action Guides (PAGs) Versus Distance for an Individual Located Outdoors.[a] Probabilities are Conditional on a PWR "Melt-Through" Release (PWR 6 and 7).

[a]Shielding factor for airborne radionuclides = 1.0. Shielding factor for radionuclides deposited on ground = 0.7. 1-day exposure to radionuclides on ground.

[b]Whole body (marrow) dose equivalent includes external dose to the whole body (marrow) due to the passing cloud and 1-day exposure to radionuclides on ground, and the dose to the whole body (marrow) from inhaled radionuclides within 1 year.

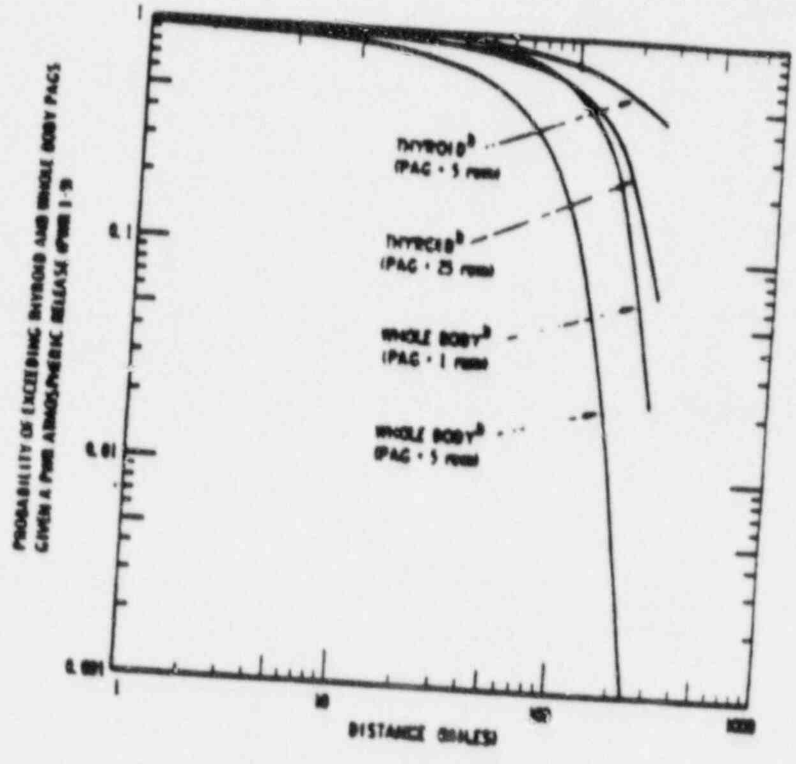

Figure I-10. Conditional Probability of Exceeding Thyroid and Whole Body Protective Action Guides (PAGs) Versus Distance for an Individual Located Outdoors.[a] Probabilities are Conditional on a PWR "Atmospheric" Release (Ref I-5).

[a]Shielding factor for airborne radionuclides = 1.0. Shielding factor for radionuclides deposited on ground = 0.7. 1-day exposure to radionuclides on ground.

[b]Whole body [illegible]: external dose to the whole body [illegible] due to the passing cloud and 1-day exposure to radionuclides on ground, and the dose to the whole body [illegible] from inhaled radionuclides within 1 year.

TABLE D TO TESTIMONY OF STEVEN C. SHOLLY

FIGURE 6.1 FROM MARCH 1987 BNL REPORT

This Exhibit consists of Figure 6.1 from W.T. Pratt & C. Hofmayer, et al., *Technical Evaluation of the EPZ Sensitivity Study for Seabrook*, Brookhaven National Laboratory, prepared for the U.S. Nuclear Regulatory Commission, March 1987, page 6-19. This figure can be compared with Figure I-11 from NUREG-0396 (see, Exhibit 5 attached to this testimony).

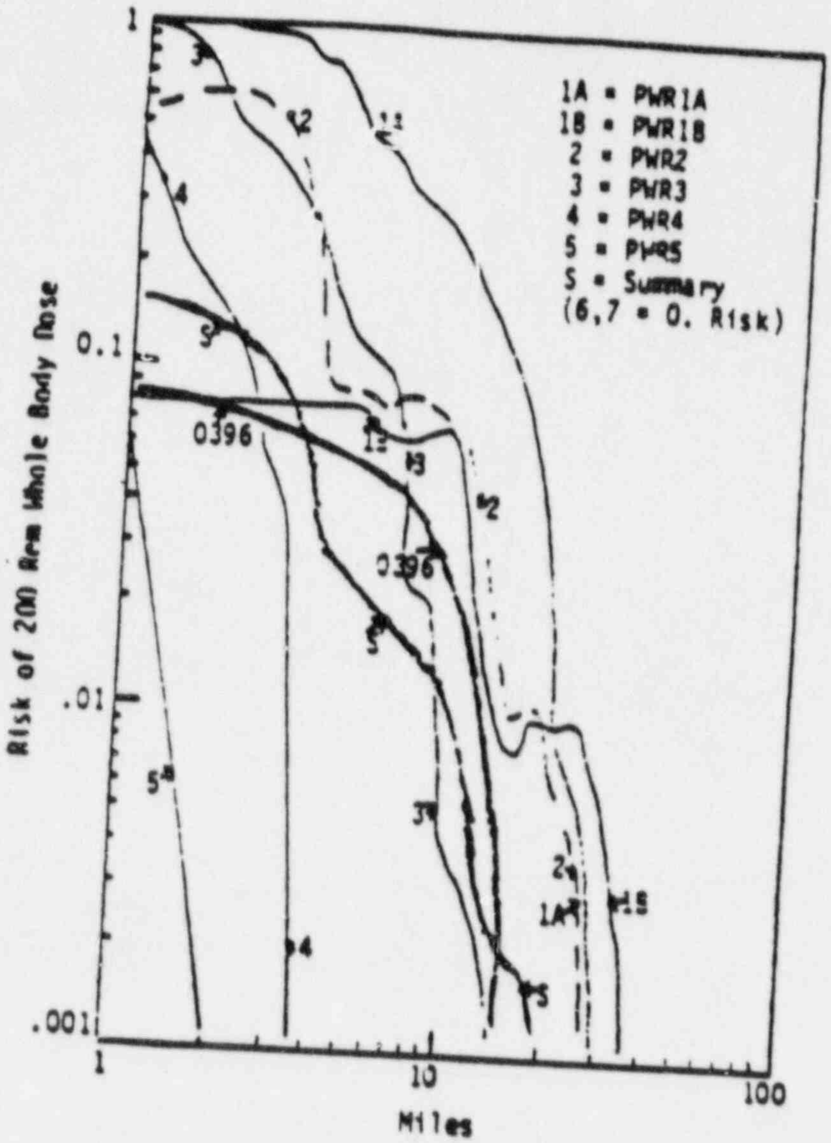

Figure 6.1 Components of NUREG-0396 curve as computed by BNL using CRAC2. The summary curve is normalized to $6x10^{-5}$ core melt probability. The result differs from NUREG-0396.

REFERENCES TO TESTIMONY OF GORDON THOMPSON

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B. John Garrick (Study Director) et al., Seabrook Station Probabilistic Safety Assessment, Pickard, Lowe and Garrick Inc., prepared for Public Service Company of New Hampshire and Yankee Atomic Electric Company, 6 volumes, December 1983.

(Sholly and Thompson, 1986)

Steven Sholly and Gordon Thompson, The Source Term Debate: A Report by the Union of Concerned Scientists, Union of Concerned Scientists, January 1986.

UNITED STATES NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:		DOCKET NO:
EVIDENTIARY HEARING	)	50-443-OL
	)	50-444-OL
PUBLIC SERVICE COMPANY OF	)	OFFSITE EMERGENCY
	)	PLANNING
NEW HAMPSHIRE, et al.	)	
	)	
(SEABROOK STATION, UNITS 1 AND 2	)	

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DATE: November 6, 1987

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EXHIBIT 2

MR. BROCK: I'd agree with that, Your Honor. Hampton.

MR. DIGNAN: Your Honor, I don't want to be heard as such. I would like an opportunity, if I feel it necessary, to reply to the oral argument which we hear today from the Attorney General.

JUDGE SMITH: All right.

Okay, Mr. Turk, please.

MR. TURK: Thank you, Your Honor.

JUDGE SMITH: Oh, let me just point out a minute. I'm sorry, -- yes.

MR. TRAFICONTE: My name is John Traficonte, Your Honor.

JUDGE SMITH: Oh, yes, I'm familiar with your notice of appearance.

MR. TRAFICONTE: Yes.

JUDGE SMITH: About how long do you think that your remarks will take, if you can give us an estimate.

MR. TRAFICONTE: Well, I will try to be as concise I can be, but 10 - 15 minutes.

JUDGE SMITH: Oh, that's fine. We have at least that time.

The Board realizes that this is a very important issue, a watershed issue here, and we want to hear absolutely fully everything that has to be said even if we have to provide additional time.

All right, Mr. Turk.

MR. TURK: Thank you, Your Honor. I'll try to be very brief as well.

The Board may recall that sometime ago I indicated in our telephone conference call, I believe back in September, that the Staff was considering a motion to strike the Sholly - Beyea testimony. The Applicant has done it already.

I have reviewed the Applicants' paper, and I concur in it fully. So my comments today will be rather brief.

I do want to lay in a bit of history, and I would like to take an opportunity to respond briefly to some things I saw in the Massachusetts Attorney General's opposition to the Applicants' motion.

First, back in early 1986, the Massachusetts Attorney General proffered a contention, the only contention that they have proffered in the off-site emergency planning phase of this proceeding. That contention essentially asserted that the provisions in the New Hampshire plan with respect to beach populations were inadequate, and the premise underlying this was that there could be significant doses incurred by the beach populations in the event of an emergency.

The Massachusetts Attorney General indicated that they were in the process of developing a study to support the contention. And the study which they -- excuse me. The persons involved in that study were stated in the contention t be inclusive of Mr. Beyea. Trying to find the exact page reference. I don't have it in front of me, and I won't belabo: the point.

It's our perception that what has been proffered as evidence to be admitted in this proceeding now is really what the Massachusetts Attorney General had in mind all along back when the proffered their original contention which has already been rejected by the Board.

Our position, in response to that initial contention proffered by the Mass. AG, was that consideration of dose consequences is inappropriate in an emergency planning proceeding. That's not the purpose of the Commission's rules and that's not something that we should be getting into in this proceeding.

Now, we did state in our response to that contention, however, that to the extent the contention sought to assert that there were inadequate provisions for sheltering contained in the New Hampshire plan, that was something that we felt was fair for litigation within the context of this proceeding.

Now the Massachusetts Attorney General rejected that suggestion and said, no, it's all or nothing. This is our contention. This is what we stand on, and the contention was rejected.

Now the reasons why it's inappropriate to consider dose levels in emergency planning proceedings are pretty much well laid out within the Applicants' motion. And if I can simply summarize very briefly, perhaps in one sentence, and this will probably be an overstatement, it's the function of the emergency planning regulations to assure that there are plans in place to help deal with the consequences of an accident should one occur.

We don't get into probabilities at this phase. We simply make the assumption that an accident can happen, and if an accident happens, we need to have plans in place within the areas outside of the plant to help the evacuation or other protective actions which may be recommended for the population And that's what we have been doing through these many weeks of hearings until now, and that's what we will continue to do until this phase of the hearing is completed.

There is no minimum acceptable dose for emergency planning purposes. To the extent that the Massachusetts Attorney General's testimony here seeks to assert that some level of dose reduction has been provided, or is not being provided, that's simply irrelevant for purposes of emergency planning.

In their response to the Applicants' motion, the Massachusetts Attorney General's office says that, in fact, dose consequences have been considered in certain NRC proceedings, and he cites two. One is the Jamesport proceeding in which a decision was rendered in 1978. The other is the Clinch Breeder Reactor proceeding in which I note Judge Linenberger was involved, because I also was a part of the proceeding. Those two cases are simply inapposite.

The Jamesport decision came out prior to the adoption of these emergency planning rules at a time when the emergency planning occupied a totally different place within the Commission's regulations. At that time, as the Jamesport decision itself discusses, the consideration was whether design basis accidents would have certain consequences which had to be ameliorated. It's in that context that the doses at Jamesport were considered in that decision.

The Clinch River case, similarly, is not applicable. The Clinch River was a -- was not a light water reactor but rather, was a breeder reactor cooled by liquid sodium. NUREG-0654, and indeed the regulations for emergency planning make it clear that these relate to light water reactors. Clinch River presented something entirely new for the Commission to consider. It presented a reactor concept which had not been considered in the course of adopting the Commission's regulations.

For that reason, various new considerations were given to that reactor which are not given in normal light water reactor proceedings. For instance, in that proceeding we had extensive testimony on the consequences of core disruptive accidents. Those are accidents which are beyond the design basis and, in essence, I guess to over simplify again, those are core melt-type situations.

Similarly in that proceeding, the Board had a concern as to whether the protective action guidelines of the EPA which apply to light water reactors similarly should be applied to a breeder reactor, which is not a light water reactor. And it's in that context that we got into somewhat of a limited, but still a discussion of what the dose consequences would be and what emergency planning would require for the breeder reactor.

Those cases are not applicable. The main body of law of the Commission, as cited in the Applicants' motion with respect to the San Onofre decision, as cited in -- and as reiterated most recently when the Commission adopted its final rule last week with respect to jurisdictions where governments do not participate in emergency planning, that law states that it is inappropriate for the dose reductions to be taken into account in considering emergency planning of any particular governmental regime.

And on that basis, the staff supports the Applicants' motion to strike the testimony.

JUDGE SMITH: Mr. Traficonte.

MR. TRAFICONTE: Thank you, Your Honor.

Initially the Commonwealth wants to express its appreciation for the opportunity to have oral argument on the

Applicants' motion to strike the Beyea - Sholly testimony. We appreciate the additional time and we understand, obviously, that it does burden the proceeding, but we agree with the Panel that that this is an extremely important issue, and one worth hearing.

I personally feel in a rather awkward position. I've never argued in a situation before where I have been so convinced that I was right with a certain degree of certainty, having the same degree of certainty that the Panel believes quite the contrary. And I would like to as briefly and as concisely as I can lay out what I believe the Intervenors collectively see as the immediate clear and direct relevance of the testimony that's been proffered. And then to proceed to a discussion of the precedent, as Mr. Turk has mentioned, to distinguish that precedent and to show why in the circumstances of this particular case the kind of evidence that's at issue here should not be stricken.

In fact, it would be -- we believe it would be error not to take this evidence into consideration in judging the adequacy of the New Hampshire plan.

EndT69

T70

To begin on relevance, we like to characterize this evidence essentially as an effort to display or illustrate the actual level of protection afforded the summer beach population by the plan. This illustration takes the form of radiological dose consequence information, in part. Obviously, it also contains health consequence discussion.

But, in essence, we believe it is illustrative of th actual level of protection afforded the summer beach populatio in the event of a range of accidents afforded that population by the plan. Expressed that way, I believe the Intervenors collectively have a hard time seeing how that cannot be relevant. To a layman, it's quite clear if a layman were reading a newspaper or in a discussion about what's at issue here, he would no doubt come away from that discussion understanding that this Panel is burdened with the task of judging the adequacy of this plan. Does it provide reasonable assurance that there will be adequate protective measures afforded the population at risk.

If that lay person then found out that an empirical piece of evidence that was illustrative of the actual level of protection afforded was not going to be considered, was not going to be admitted because it was determined that that kind of evidence, the actual level of protection afforded the relevant population was not relevant to the determination by this Panel as to whether that level of protection was adequate or not, I think that person would be puzzled as I am.

As I said at the outset, I am fairly certain that on the issue of relevance alone, which if the Panel would review the Applicants' motion, it's certainly on the basis of relevance that the objection has been stated; that on the basis of relevance alone if the issue is what is the level -- is there -- strike that -- is there an adequate level of protection.

On that issue evidence of the actual level of protection afforded is directly, clearly, immediately relevant. I go as far as to say that something must be blocking, either something in the way of an exclusionary rule, which I would like to come back to in a few minutes, or something else is blocking it, that obvious perceptions that this is relevant testimony. I think it would be considered relevant by most people.

That in the general way should be more narrowly put, I believe, in the circumstances of the Seabrook case, because whatever the rule is or is not generally at the operating license stage adequacy of emergency planning is tested. In this particular circumstance where the plan has no planned sheltering provision, that essentially the applicant is prepared to run on the basis of -- to go forward and run on the basis of evacuation alone, I think that clearly sets your task, the judgment of the adequacy apart from the normal, if there is such a thing, the normal test of adequacy of some other plan.

You are to judge the adequacy of the plan essentially with no planned sheltering in it. On that basis, setting aside

JUDGE SMITH: Would you repeat that?

MR. TRAFICONTE: Certainly.

JUDGE SMITH: I just wandered there for a minute, and I thought I was following you, and it didn't come out that way.

MR. TRAFICONTE: Certainly. I am distinguishing the Seabrook plan, and the task in front of you from the general context of judging the adequacy of emergency planning, and the key distinction is that in this case you are to judge the adequacy of the plan in the absence of a planned sheltering component in the plan.

I think that distinguishes what the task is. The issue of adequacy is not as simple as it otherwise would be. In part, because the regulations clearly anticipate that a plan will have a range of protective measures, and that the Panel, the public, the NRC can take some confidence that there is -- take confidence in the fact that there is this range.

Here there is no planned range of protective measures. There is simply one -- evacuation. In those circumstances, our evidence -- and again, our effort to display or illustrate the actual level of protection afforded should be admitted. You should consider what the result is in terms of radiological dose consequences. You should consider what the result is on the affected population at risk of the absence of one of the major set of protective measures, which is exactly what we have in this case. Sheltering has become quite clear, at least as of now, it's not a planned protective measure.

On that point, and I'll be very brief, I think on that point at least this evidence is completely in harmony wit Hampton Contention 8. Hampton Contention 8 being the contention, in fact, that in the absence of a sheltering measure there can be no finding of adequate protection. And s our testimony would -- our testimony would support that proposition that in the absence of a sheltering measure, planned sheltering, the actual radiological dose consequences are severe enough that the Board is going to be unable to find adequacy.

Along the same line, I would say that our testimony is relevant here because FEMA in its prefiled testimony has made exactly the same point. It essentially has distinguished this case from other cases. Finding that in the absence of a sheltering or a realistic sheltering alternative, there is not adequate protection.

We, obviously are in -- we are attempting to supply, if you will, the technical basis for that judgment that in the absence of sheltering there is no adequacy.

Now let me proceed. I think I have said certainly enough on relevance as an essential matter, as a preliminary matter. We obviously think the testimony is relevant.

However, it is also clear, it's clear both from case precedent cited by the Applicant in its motion. It's clear from a careful reading of the Commission's rulemaking issue this week. It's also clear that you are not obligated to make specific dose saving findings. That it is not necessary for the purpose of your task to make findings in the record that this is going to be the number of people injured in the event of Accident X, or this is going to be the amount of dose savings achieved in the event of Accident Y.

It's very clear that that is not your task, nor does the Massachusetts Attorney General believe it is your task.

JUDGE SMITH: Well, did you before?

MR. TRAFICONTE: I don't believe that anytime we have taken the position in the pleadings that I have reviewed, or otherwise, that we felt it was a part of the job, a part of your task to take specific findings of the level of dose savings. Never felt that way, and I don't think the testimony is structured is on that basis.

There is a far -- there is large difference, and it is a far cry from the need, or the absence of the need to make specific findings of dose consequence to the position that evidence of the actual level of protection expressed in dose consequence terms in not relevant. That, quite frankly, is apples and oranges.

JUDGE SMITH: Okay, this --

MR. TRAFICONTE: That's the heart of the matter.

JUDGE SMITH: Right there you are.

MR. TRAFICONTE: I believe it is. And I think if I can analogize it to a court sitting in judgment on the competency of an individual, for example, comes up every day -- probate courts and other kinds of cases. If a panel or a court is required to find competence as a general legal matter, it may well hear evidence of the objective results of testing, for example, presented by a psychologist. It may hear evidence of a similar kind that is quantitative, objective.

That evidence which would be admissible is admissible because it's relevant to the ultimate fact -- is the person competent. It is not necessary for the court in those circumstances to find, yes, the person scored a certain numerical amount in the Minnesota test. That wouldn't be a necessary finding. It wouldn't be your burden to do that. But the evidence of what the person scored on that test would certainly be relevant as part of the picture as to whether or not the person was competent.

I think we are in absolutely analogous, if anything is absolutely analogous, I think we are in an analogous situation. I think the task before you is the determination that the plan is adequate. And we all know, and we don't need to clutter the record with a dispute as to what is adequate. It's clearly something that's site-specific. It's not defined for a good reason. The Commission has not indicated what that is in numbers.

You cannot conclude from that that to hear about numbers or to take evidence expressed in numbers of the actual level of protection afforded by a plan, that somehow that exercise is illegitimate, or that that evidence is inadmissible, because it is the position of the Applicant that that kind of evidence cannot be admitted, and that's different from a determination that this Panel must find that the level of protection expressed in an objective mathematical way reaches a certain level.

JUDGE SMITH: Do you want me to ask you questions as you proceed or --

MR. TRAFICONTE: Certainly, certainly.

JUDGE SMITH: -- wait until you get done?

Well, all right, take that point, take your point, and then carry it through to the next step. Let's assume that we -- under your argument we accepted testimony as at least relevant for the reasons you said. Now comes that we have received it, it's cross-examined and it survives pretty much.

What are you going to do with your proposed findings? Where do we go with it? How do we plug it in to the rest of the evidence and to our conclusions of law and proposed findings. Where does it take us?

MR. TRAFICONTE: Not to precommit ourselves to how we would actually reference it in a finding of fact --

JUDGE SMITH: Well, but that's a test you are going to have to meet.

MR. TRAFICONTE: Certainly.

JUDGE SMITH: That's really what the test is.

MR. TRAFICONTE: Sure, let me be directly responsive to that.

I believe that the testimony other than this radiological dose consequence testimony the Intervenors have put forward is designed, and this is no secret, to illustrate and to prove that the plan is not adequate. And again it's no secret that if we believe it's inadequate, we believe it is inadequate because too many people are put at too great a level of risk. That's the point. That's why there is opposition to the plant. It's also a major reason why we are here. We believe that too many people are put too great a level of risk.

If you press us as to what constitutes too many people, and what constitutes too much risk, we're going to, unfortunately, kick it right back at you. We view that as your obligation to determine what is too many people and what is too great a risk. But we believe that if reasonable assurance of adequate protection means anything, if it means anything, if there is a standard there at all, obviously there is because we are all here testing it, there has to be a line that could be drawn. Too many people --

JUDGE SMITH: A quantitative line, a quantitative level of adequacy.

MR. TRAFICONTE: Judge Smith, whether we express it as a quantitative line or a qualitative line, as FEMA obviously has done, chosen to express it as a qualitative line, whether it's quantitative or qualitative, it's a line. It's a point, and here obviously we take great exception with the thrust of Mr. Dignan's motion which essentially, in my view, reduces to the point that there really is no line. That once the plant is sited here, it's passed the siting requirements, we will put a plan in effect, but the level of protection is not any longer going to hold up the licensing, or the actual level afforded the population will not hold up the licensing.

We obviously disagree with that. We think that the Commission has set a standard of adequate protection. It's a finding that comes before a license, can't get one without it. And we think, again going back to the quantitative/qualitative distinction, we think any kind of evidence is relevant. Qualitative evidence, the traffic management plan is not adequate, I-DYNEV is not the best that it could be, the ETEs are artificially low, and quantitative evidence. In the absence of sheltering, and again I want to reinforce that point, in the absence of sheltering, this is going to be the consequence of an entire range of accidents -- serious radiological injury to a significant number of people.

Of course, we believe those are too many people at risk, and we believe that level of risk is too high. But, again, not to be particularly vicious about that, but that's your problem, to determine whether it is too many people, and it is too great a risk. But we believe that the evidence of that risk is clearly admissible to your task of trying to establish that line.

I don't want to take up too much time. Obviously, I have gone over the 15 minutes.

JUDGE SMITH: Take your time.

MR. TRAFICONTE: Let me make some final points in the way of just clearing the ground, although from the Panel's comments, I understand perhaps you have a very clear view of what the issue is.

We are not presenting this --

JUDGE SMITH: I want you to take all the time that you feel is necessary. We will provide for it. This is an issue where the Board wants as much help as we can possible get. I mean, it's awfully important as you recognize.

MR. TRAFICONTE: All right, thank you, Your Honor.

Just some quick ground-clearing points. As I just indicated, I believe the Panel has the question quite clearly in view, but I just want to eliminate these issues, because they are not serious issues although they do appear in the Applicants' motion.

Our evidence is not evidence that would lead us to litigate a worst-care scenario. It is not evidence that is structured or based on a single accident. It's quite clear from the Sholly portion of the testimony that we have attempted to model the radiological effects of a whole range of accidents within the planning basis. And our papers on this point I think speak to it.

JUDGE SMITH: You mean the Beyea portion?

MR. TRAFICONTE: The Beyea portion.

JUDGE SMITH: Yeah.

MR. TRAFICONTE: Sorry.

Furthermore, along the same line, my comments should be clear if our papers are not that it is not our position that the issue here is zero risk. That has never been our position. And after rereading the pleadings that predate my work on the case, I have to insist on the record that that is Mr. Dignan's red herring. I don't believe the Massachusetts AG's office has ever represented that zero risk is the name of the game. Quite frankly, it doesn't make any sense.

The third point, and this is in the way of clarifying my earlier points, we are not offering this testimony in support of the proposition that any particular level of protection that we can identify in the record and give it a numerical expression, we're not offering our testimony for the proposition that any particular level of protection is necessary.

Instead, we are offering our testimony as evidence that this plan doesn't provide adequate protection. And it doesn't provide that level of adequace -- it doesn't reach the level of adequacy because of the number of people at risk and the severity of that risk. It's not -- this is really a gloss on the point that we don't represent zero risk. Not only do we not represent zero risk as the standard, we are not identifying in our testimony what level of risk is acceptable. Again, we don't see that as our task, thankfully. We see that again as the Panel's task. We are only representing that the level of risk that this plan imposes on the population is too high, and therefore doesn't reach the level, the statutory and regulatory level of adequate protection.

Final point, and I'm prepared to go into some detail on this one. I think it's an important point. I apologize to the Panel for not having cited further case which I am prepared to cite and will cite in the record this morning. Further cases indicating that the NRC and the licensing boards at the operating license stage have taken dose consequence evidence into consideration in a very analogous circumstance.

So, in part, I want to respond to Mr. Turk's point that our two cases that we have cited, the Clinch River case and the Jamesport case are distinguishable.

I would like as an initial matter just to read into the record these cites. The first is at 5 NRC 1197. It's the Tyrone Energy Park construction permit case of 1977. The relevant -- in fact, Judge Smith, you were chairman of that board as well. The relevant portion of the opinion concerning dose consequence evidence is set forth on Pages 1223 and 1224.

JUDGE SMITH: Mr. Traficonte, would you concede at that time, however, that the board was addressing the siting standards?

MR. TRAFICONTE: Yes. If you would allow me to simply -- there are only two other cases.

JUDGE SMITH: I'm sorry.

MR. TRAFICONTE: And, obviously, I'm going to make an effort to show how they are analogous.

JUDGE SMITH: All right.

MR. TRAFICONTE: We don't contend they are controlling, but I want to present to the Panel the argument that they are, in fact, very analogous although obviously involved at a different stage in the proceeding.

The second case I would like to cite this morning is at 8 NRC 9, and it is an Appeal Board discussion, and the discussion of dose consequence evidence is set forth on Pages 15 and 16, and that is a Three Mile Island, Unit 2 operating license proceeding.

And the final case is the Wolf Creek case at 5 NRC 301, and the discussion of radiological dose consequence evidence is set forth at Pages 369 and 370. That is a licensing board decision, and again involving construction permit.

And, please, let's be clear with one another. We don't believe these are directly analogous. Strike that. We don't believe these are directly controlling cases. We believe they are analogous.

These cases involved the siting requirement which is still good law, still a regulatory requirement. In the event that someone had it into his mind to attempt to license a nuclear reactor today, they would have to meet this standard. I want to be brief on this point, but I want the Board to understand why we think these cases are analogous.

Under the siting requirements, there are clear, objective dose requirements for the determination of the LPZ boundary, the distance away from the plant of that boundary, and the relationship between that LPZ boundary and the exclusion area as well as the relationship between the LPZ boundary and the nearest population center.

These regulations are -- they are not the easiest thing to read, but they are set forth in Part 100 of the regulations.

However, not only must an applicant both at the construction -- and I'm now talking before, obviously, the emergency planning regulations were adopted. During the 1970s, not only was an applicant required to meet those expressed objective dose calculations for purposes of drawing the boundary of the LPZ, but licensing boards had another issue that it had to determine. It had to determine both at the construction permit stage, as well as the operating license stage, that there were adequate emergency plans in existence. At the construction stage they had to be -- they didn't have to be overly detailed. They had to be presented in some detail, but at the operating license stage there had to be a determination as there in the Tyrone Energy Park case. There had to be a determination by the licensing board that the area within the LPZ could be adequately -- strike that. That the evacuation plan for the area inside the LPZ provided a level of adequate protection.

JUDGE SMITH: Well, wasn't that indeed the case right here in this proceeding, too? I mean, --

MR. TRAFICONTE: It seems that the standard -- we believe that the standard is in fact the same.

JUDGE SMITH: No, I mean wasn't that an issue and --

MR. TRAFICONTE: Yes, the same issue had to be crossed. That's correct, Your Honor.

JUDGE SMITH: Here, at Seabrook.

MR. TRAFICONTE: No question, no question.

And, again, because this is an important point, nor are we now attempting to litigate with our [illegible]ence the siting decision. We are not trying to argue that t[illegible] siting decision that was made in this case -- I might want to retract that slightly. We might believe that that siting decision was wrong in a more global sense. We're not here arguing that the siting decision that was made under the then prevailing regulations was wrong. That's not our point.

It is legally analogous, because in every case boards face the problem of what is the adequacy of the evacuation plans proffered by the applicant for the area inside the LPZ. Some cases that involved thousands of people. One of the cases I cited involves 15 to 18 thousand people.

Boards had to determine, is the level of protection afforded by the plan adequate. Same issue in an analogous stage of licensing.

What did those boards do? They took evidence of the radiological dose consequences that was often proffered by the board -- strike that -- by the staff, and offered proffered by the applicant, and sometimes proffered by the applicant at the insistence of the staff.

JUDGE SMITH: But aren't the radiological dose consequences an essential part of the Part 100 regulation? And they are required --

MR. TRAFICONTE: They are not. And here is the crux of the matter, and I think perhaps the reason why our argument that there is analogous case law out there has not resonated in a way that I think it should.

There is a difference between the objective dose requirement that's set forth in those regulations for the boundary of the LPZ, and I can pi k up the regulation if I need there. There is clearly objective standards set forth.

If the Panel would review these cases that I have mentioned, it is equally clear that that standard, that dose standard which set the boundary of the LPZ was not going to be the standard applied to the determination of the adequacy of the protection afforded the population within the LPZ. There is two completely different issues.

JUDGE SMITH: All right.

MR. TRAFICONTE: On the issue of what standard to apply to the people within the LPZ, the cases I have cited are quite clear that it's not -- it's simply, to be blunt, that the standard for which you draw the boundary is way too high. That can't function as the test for adequacy of the plan for the people within the LPZ. They didn't express it in an objective, there was no objective standard. The cases are clear on that point, too. Panels struggled with that question -- what was an adequate evacuation plan.

But our point is this. In struggling with the question as to what was an adequate level of protection for the population within the LPZ, and again that standard was expressed in the same language that we are now litigating, those licensing boards took radiological dose consequence evidence offered often by the staff of the NRC, and offered by the applicant at the behest of the staff on one occasion, and spontaneously in another.

Now it's quite clear to me why the applicant in those cases was offering that evidence. Because the plan, the dose consequence study revealed that evacuation of the relevant population was adequate. The people would get out in time. The consequences would not be great.

The Applicant in our case today here in Seabrook is not about to offer that evidence. And again, that's not surprising. But to go to the point of arguing that that kind of evidence is not admissible is simply to ignore the record of licensing proceedings at the siting stage, and we think by analogy, to the operating license stage after the adoption of the emergency planning regulation.

In conclusion, I just want to say this. I believe the Board should be very circumspect on this point as its willingness to hear extended argument for which I apologize. It's quite clear it's willing to be circumspect and careful.

One of the concerns we have goes back to my initial point about the appearance here of the proceeding, and what the issue that this Board has to address involves. We believe that this Board should not allow itself to be put into the situation of having found or not found that the plan at issue provides an adequate level of protection, but at the same having stricken from the record and refused to admit evidence of what the actual level of protection is. We think that's an untenable situation. We don't think it's necessary. We don't think it's -- we believe no case controls that determination. We don't believe that you have to find that.

But more importantly, we believe that to find that would be a serious error both of law, in light of the existing precedent and you task, as well as a serious error in terms of the acceptance by the public of the determination that you are attempting to make.

Thank you very much for the time. I appreciate that.

If the panel would like I could present the three cases. I don't know if you have access to them.

JUDGE SMITH: No, no, that's fine. We won't take time now for that, because we are generally familiar with them. We will go -- we will read them.

I will listen to you further if you wish to comment specifically --

MR. TRAFICONTE: If the Panel would like to address specific questions, that would be fine. I have nothing further except to respond to questions.

JUDGE SMITH: Of course, you recognize the Panel will be guided by -- a very large extent by what we think that the Commission had to say on this issue in the Shoreham decision which they reiterated in the new emergency planning rule, and also the -- well, to a lesser extent in San Onofre when they were talking about contaminated injured persons and treatment for them.

And if you -- we are going to read those. Those are important. If you want to talk about them, well, I know you must know that we know that they are important cases.

MR. TRAFICONTE: Of course, I do.

JUDGE SMITH: Yeah.

MR. TRAFICONTE: If the panel would indulge me, let me comment on those cases, as well as comment again on the proposed -- not the proposed -- the new rule as adopted this week, and the language used in that discussion.

I believe there is a difference between requiring an applicant to produce the kind of evidence, or the kind of testimony that we have proffered for purposes of passing a Commission-enunciated standard, or test of adequacy.

It is quite clear that is not where we stand as a matter of regulatory law. The applicant need not do what the Mass. AG's office has done. It need not go out and hire somebody to do what we have done.

It is equally clear the Commission hasn't announced, and here is the standard against which that objective evidence is to be measured. You must have no fewer than these people at no greater than this risk. That's also equally clear that's not been required.

And I think the San Onofre case as well as the discussion by the Commission this week makes it quite clear that that's not been a requirement of an applicant. But what has been the requirement -- so we think that those cases are, as far as they go, obviously quite -- we don't disagree with them as far as they go, but how far will they go?

It seems to me the Applicant wants to take them to the point that this Board will rule irrelevant the proffer of evidence, or the evidence proffered by an Intervenor as to the actual level of protection afforded by a plan. That, to me, is apples and oranges not to -- sir.

JUDGE SMITH: No, I wasn't -- I thought you had concluded. I was sort of agreeing with you there that you have identified the issue and I -- go ahead, I'm sorry.

MR. TRAFICONTE: Well, it's a question of perspective. I don't disagree the Applicant is not under the burden of doing this. He's not.

JUDGE SMITH: Yes, but you're talking about --

MR. TRAFICONTE: That's a different issue.

JUDGE SMITH: -- ordinary relevancy.

MR. TRAFICONTE: Ordinary relevance, absolutely.

JUDGE SMITH: And if I were to summarize your point, would this be fair, in that you can't really give a good look at what is a reasonable effort toward dose savings unless you know in advance what those dose consequences are expected to be.

MR. TRAFICONTE: I don't believe that you can give a reasonable look.

Furthermore, I don't know of any exclusionary rule.

JUDGE SMITH: Well, right.

MR. TRAFICONTE: In fact, that's what we are dealing with.

JUDGE SMITH: There is a point of evidence, we could go down that direction, but again, we always have to come back and to what are we going to do with the evidence in which -- in the event it's received. And in your view, the relevance is that we cannot make -- and this isn't your only point, and I don't exactly -- you can disagree with me. You don't even have to agree with me, but this is the way I come away from your argument.

That we cannot make an informed judgment as to the effectiveness, or the reasonablaness of the New Hampshire radiological plan with respect to reasonable dose savings, dose avoidance, unless we have a better idea of what the dose consequences are expected to be.

MR. TRAFICONTE: I would agree, and state it, if I may, another way, which is I don't believe that it would make sense, regulatory sense and legal sense for you to make a finding, affirmatively make a finding that the plan is adequate, it adequately protects the population at risk, after you have stricken evidence of what the actual level of protection is. That's another way of putting it.

JUDGE SMITH: All right, that's exactly it. That is -- you have identified the very issue that is going to be driving this case.

MR. TRAFICONTE: We don't believe the Commission has ruled -- we don't believe you are bound by any precedent, let me put it that way.

JUDGE SMITH: Okay. All right, we will find that out, and right now is when you can just exactly talk to what the Commission has said on it, and we point you in particular to what they said in Shoreham, not only the points cited by Mr. Dignan in his brief, but to back up. This member of the Board wasn't involved in emergency planning for quite a few years. And when I come back to it in this case, I had a very, very difficult time trying to understand just what is the philosophy, and what is expected, and where are we going.

And I heard all the arguments about, well, you don't have to have any particular dose savings achieved by evacuation plans, or in sheltering, nor in any of the other protective actions which might be taken. Nevertheless, we are required to find whether a plan is adequate.

So is that a third standard, you know? And apparently the Commission has spoken to that in Shoreham.

MR. TRAFICONTE: Well, to the extent that Shoreham deals with a situation in which the state is not a participant.

JUDGE SMITH: Okay, right.

MR. TRAFICONTE: I think that would be grounds to distinguish the treatment of that kind of evidence in Shoreham, although, Your Honor, --

JUDGE SMITH: I want to --

MR. TRAFICONTE: -- I don't think there is a holding in Shoreham, and correct me if I'm wrong, but I know of no holding by a board or a higher authority that the kind of evidence proffered here is not admissible evidence.

JUDGE SMITH: Right, but I just want to point you right -- I understand that.

MR. TRAFICONTE: Yeah.

JUDGE SMITH: But I want to point to you the language that the Board will be focusing on. I mean, and so that you know, you know, just what we think is important in Shoreham. And it begins on the -- the citation as given throughout this hearing, and it is very well known to everybody, it's 24 NRC 22 is the case, and the discussion begins on page 29. And the Commission says at the bottom of that page, "The root question becomes whether the Long Island LILCO plan can provide for 'adequate protective measures' in the event of a radiological emergency."

Then it goes on to say, "This root question," on Page 30. "This root question cannot be answered without some discussion of what is meant by 'adequate protective measures.'" And the rest of it, it was cited in Mr. Dignan's brief and is well known. But there, it seems to me, the Commission has taken that very phrase and provided what they regard a meaning. I just want you to know that that is the Supreme Court of the NRC speaking here as far as law is concerned. That is very, very important law to us, and we are focusing on that.

MR. TRAFICONTE: To belabor this, because I think at this point it would be belaboring it, but I think given your indication of the significance of this language, let me respond to the portion of it. I don't have the entire opinion in front of me, but I have Mr. Dignan's brief, and I think it picks up from quoting that same opinion right after the point that you stopped reading.

JUDGE SMITH: Right after that.

MR. TRAFICONTE: Yes. 24 NRC 22 at 30. The portion in the motion of the Applicant reads, "Our emergency planning requirements do not require that an adequate plan achieve a preset minimum radiation dose saving."

No dispute. We don't have a dispute with that. We believe it does not preset a minimum dose saving. We believe the standard, however, does require a finding of adequate protection. And another way that's been often expressed is that there be reasonable dose saving. There is an affirmative requirement here.

This is a negative way of stating something. There is also an affirmative way of stating the same point. There is no preset objective standard. That's not the same as saying that evidence of what the level of protection is simply not relevant. That's the baby with the bathwater.

JUDGE SMITH: Right.

MR. TRAFICONTE: Thank you.

JUDGE SMITH: Mr. Dignan.

MR. DIGNAN: Yes, Your Honor. I will be brief. I wish to address only what I consider to be new points that were brought out in this oral argument.

Perhaps the difference between our reading of the regulations and the Commonwealth's was best illustrated with the learned counsel's opening remarks. He talked about adequate level of protection. And the regulation doesn't say that. The regulation phrase is "adequate protective measures". And when you go into the Commission authorities that we have cited, I think the Commission has made patently clear what the standard is.

And I think Mr. Flynn articulated it well when he indicated to you the full thrust of the FEMA position. And that is that what the Board is to judge is have all the efforts, and I'm going to go a little -- just let me use the superlatives. Has every effort been made by the Applicant to minimize the dose savings that -- excuse me -- to maximize the dose savings in any given event. It may well be that the event, as the Commission as indicated, could be totally catastrophic and you still have a great deal of potential injury. But has the Applicant put a plan together that whatever the event may be, this will do the best job that the human beings can do, even though it may mean that all they can do is save a certain number of people, or save a certain amount of dose rather than all of it.

And there is the difference. The Commonwealth -- every time I have heard them argue this position in any forum keep reading that regulation as saying "adequate level of protection", and it doesn't say it.

The only other point I wish to make is this business of arguing that dose savings -- excuse me -- evidence of doses came in before. Conceded. It comes in in every single construction permit case. And if a plant came for one, it would come in again. It comes in because of the siting regulations which still require that design basis accidents be analyzed to set the low population zone, the population center distance and the exclusion area.

The manual, I believe, I reach back, TID-1484 is still the bible on that. Every application has had it. Whether it gets discussed in the hearing or not is whether or not somebody has made a contention as to whether one of the zones or the population distance, center distance has been properly set.

The only reason that that ever got mixed up at all with emergency planning was this, and I ask the Board to think back a little history. At the time Seabrook was in the construction permit stage two cases came out of the New England area to the Appeal Board. One was the Seabrook case on appeal from the initial decision granting the construction permit. Another one that came out was the New England Power reactors that were then slated to go into Charleston, Rhode Island. In that case, a contention had been let in that would have allowed evidence of this nature. In the Seabrook case, the licensing board had ruled as a matter of law that emergency planning, if you will, stop at the low population zone boundary insofar as what they call dynamic -- what we call dynamic protection is concerned. That is to say, evacuation or shelter.

The issue came up to a Joint Appeal Board. It was argued before five Appeal Board members, and they ruled in that case, that joint case, that there was an unbroken line of authority going back to the beginning -- to the AEC times that the siting criteria insofar as they mentioned in 100.3 that the low population zone had to be an area were effective measures could be taken.

It had made it clear that dynamic protection, such as evacuation or sheltering, and demonstration of its stop at the low population zone boundary, and that was the old rule. And it became -- the only reason that dose evidence ever got talked about in that context was it came up through those cases in which that ruling was made.

And in those days, one of the -- and still you can under the siting criteria, you can pull the LPZ in, or the restricted area in, or the population center distance in by the use of engineering safeguards. And that was historically the way it was done. And, indeed, one could make an argument that it was an extremely rational regulation from the point of view of public protection, because if one believes, and some do, and this is a philosophical argument which is relevant here, but if one believes that the better way to protect is with hardware than the vicissitudes of evacuation, the utility was encouraged to put more engineered safeguards in the plants, and thus shrink the zone in which it had to demonstrate an ability to evacuate or shelter.

And, indeed, Seabrook in particular, I remind the Board, was designed as a so-called double containment reactor for precisely that purpose. That second containment had the effect of pulling the LPZ in very tight. The final setting of it was I think at -- I may be wrong, but I think it was at 1.25 or 1.15, I don't remember.

So that's just --

JUDGE SMITH: You take no credit for that fact, however, in the emergency planning regulations.

MR. DIGNAN: We cannot -- we cannot under the new regulation. And that is -- all I am getting at is when the Commission after TMI changed the regulation, the question of doses went right out the window, because what they said is you had to plan for this 10-mile area. But they never said in addition to that, that you get into doses. They say, we're going to assume there is big doses out there in one of these events. What you have got to demonstrate to us is you have done everything, and everything is too strong a word maybe, but you have done essentially everything human beings can do to minimize what's going to follow from that kind of an event, and that's why the word "spectrum of accidents" is in the planning document. And I submit that's what the regulation mean.

And the standard that any plan is judged against is just that. And if a given site results in a given accident producing more injury than another given site results in with the same accident, that is of no moment, and that has been painted absolutely clear in the recent issuance of the rule where they -- in discussing what standard the utility plans would be judged against, the Commission made it clear we're not going to judge one plant against another. And again in so stating, they are saying we're not going to judge one site against another.

The siting regulations are a separate item now. They no longer deal with the question of emergency planning. And with that fell the relevance of any dose evidence of the nature that the Commonwealth is trying to offer.

That completes my argument.

MR. TRAFICONTE: Could I briefly respond?

JUDGE SMITH: Yes, Just a moment.

MR. TRAFICONTE: I'm sorry.

JUDGE SMITH: I want to ask Mr. Dignan a question.

This argument about the relevance seems to have come up in the context, and under the assumption that there is no sheltering as a part of the plan. And I'm not real familiar with the history of that issue. Although my colleagues have brought me up to date on it, I'm just not familiar.

But if it were your position that sheltering simply is not needed, would you agree that their testimony was relevant?

MR. DIGNAN: No, I would not.

JUDGE SMITH: It would seem to me that it would be relevant.

MR. DIGNAN: No, I think not, Your Honor. I think, I think if the position was -- if I could trace that out, and call you back to the argument we had concerning the FEMA testimony, and I thought your colloquy with Mr. Flynn was quite revealing. If the --

JUDGE SMITH: What I'm saying is -- what I'm saying is let's say that -- I'm not suggesting that there is any quantitative standard that has to be achieved by sheltering.

But if you were to take the position that apparently was tosse around the RAC or something that, you know, in this area we just don't have to bother with sheltering. Evacuation times are fast and low probabilities and everything like that.

Would you then agree that there -- you would not even --

MR. DIGNAN: No, no, Your Honor, because the evidenc that would become relevant at that point is the evidence -- that portion of the Commonwealth's evidence to which we have raised no objection, the sheltering -- the so-called shelterin evidence, other than Sholly.

What becomes relevant as Mr. Flynn indicated at that point is this. If it were the Applicants' position that under no circumstances would sheltering be a chosen protective measure, and the plan has stated that it's a doubtful one on a summer day on the beach. But on the other hand, in certain accidents it still could be the choice there.

But if the Applicants' position and that of the State were that sheltering is never an alternative at Seabrook and we are not going to plan for it, the relevant evidence would then be for somebody to come in and say, now, look, you have got this building, this building, this building and this building that should be used, and you people should have a procedure to use that, because there may be an accident where that would maximize the dose savings. And you are ignoring that, you are ignoring sheltering means that your plan does not contain adequate --

JUDGE SMITH: Yes.

MR. DIGNAN: -- protective measures. That is a much different piece of evidence than the Sholly panel --

JUDGE SMITH: I would agree with that but --

MR. DIGNAN: And that's why I say even if that were the position of the Applicant.

JUDGE SMITH: But my hypothetical was, and you have disabused it, but my hypothetical was, hey, it's true we've got a lot of neat sheltering buildings there, but we are just simply not going to bother because they are not needed. And then that would be a different, entirely different matter. But that's not your position, so that's just a --

MR. DIGNAN: That is not my position, but I could see the thrust of your -- but I guess even then if the hypothetical is would you still object to the evidence, the answer is yes, because I think the evidence that would meet that would be evidence that says, come on, you can do it and it would help. That's the kind of evidence that's relevant under these regulations. Not evidence that says on accident one you've got this kind of death and destruction.

JUDGE SMITH: Sir, that would be your choice of the evidence that would be used to meet it. But, okay, that's fine.

MR. DIGNAN: Well, I think that's the only thing that would be relevant to meet it, Your Honor. I am not just choosing. My point simply is that as I read the Commission decisions and put them together with the words of the regulation, the fact of the matter is it is not relevant to get into what is in fact going to or not going to happen in certain accidents. You can "what if" any nuclear power plant to death.

JUDGE SMITH: Right.

MR. DIGNAN: And had the Commission allowed that, then this would be relevant.

JUDGE SMITH: I understand.

MR. DIGNAN: But the Commission does not.

JUDGE SMITH: I postulated a position that I guess you have not taken.

MR. DIGNAN: That's correct.

JUDGE SMITH: And so there is no use pursuing it,

EndT71 because it doesn't throw any light.

T72 Mr. Flynn.

MR. FLYNN: May I be heard for just one moment?

As you know, FEMA has not taken a position on this motion, and I certainly don't want to jump into the middle of this debate. But I am just a bit uncomfortable having Mr. Dignan act as spokesman for FEMA.

I just want to point out that the colloquy to which he referred appears on Pages 5153 and 5154 of the transcript from November 4, and we will stand by what we said, but we don't want it enlarged either.

JUDGE SMITH: Now Mr. Traficonte.

MR. TRAFICONTE: I'm going to be very brief.

MR. TURK: Could I --

MR. TRAFICONTE: Oh, I'm sorry.

MR. TURK: -- just for sake of orderliness.

JUDGE SMITH: All right.

MR. TURK: I will want to respond to Mr. Traficonte's oral presentation somewhat. But I leave it to you to tell me whether I may at all, and whether this is the time or after he speaks.

JUDGE SMITH: Well, let him complete his arguments. Then you can respond all at once.

MR. TURK: Thank you.

MR. TRAFICONTE: Thank you, Your Honor.

Just very quickly on several points Mr. Dignan has made. I'll return the compliment, learned counsel for the Applicant. However, learned counsel for the Applicant, in citing those siting cases, is simply not correct. And I'll leave it to the Panel's reading of those cases to determine that the radiological dose evidence that I make reference to, those relevant pages in the transcript, are not evidence for purposes of drawing the LPZ boundary. Far from it.

That was evidence submitted on the sole issue as to whether the evacuation plans for the LPZ were or were not adequate, and that judgment was made by taking evidence of the radiological dose consequences. And if the panel would -- and when it reviews those cases that distinction will become quite clear, I'm sure.

Second point, and again I would add this in thinking it through, I think this is another ground for distinguishing our case from the Shoreham case. Not only do we not have an absent state here, at least on the New Hampshire side of the border. But in addition, we have, and I'm really reinforcing my point, we have no range of protective measures in the plan. We have a reliance on evacuation essentially alone. So that I think that's a ground for distinguishing the Shoreham discussion on what you must do or what you must not do from our present case.

Finally, I want to be fair, but I think to state this argument is to refute it, Mr. Dignan's crabbed reading of this standard. I don't believe there is much dispute about that. If Your Honors want to make a finding in this case and say, well, we don't have to find adequate protection. We only have to find adequate protective measures. And that's a big difference.

If we have to find adequate protection, well, then we would actually have to make sure the public is safe. But if all we have to find adequate protective measures, well, that's a completely different fish that we have to fry.

I think to say that really is to refute it. I don't believe that's a -- that's not a meaningful distinction in the regulation. I don't believe the case law supports that proposition.

That's really all I have.

JUDGE SMITH: Mr. Turk.

MR. TURK: Thank you, Your Honor. I'll try not to bring us too much further out in time. I do want to respond to a few comments made by Mr. Traficonte.

First, he has an argument that the doses that could result in a severe accident are relevant, and it's relevant for you to consider them.

Well, the question of relevance always has to be governed by the question relevant to what. And under the Federal Rules of Evidence, Rule 401, the definition of relevant evidence reads. "Relevant evidence means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence."

The question in this proceeding is has the utility, through its proffering of the New Hampshire RERP, complied with NRC regulations. The only way that the Beyea - Sholly testimony would be admissible as relevant is if it tends to make it more probable or less probable that Commission regulations are being complied with.

Now, then the question is again, what do the regulations require. And I think the most clear statement in this regard came out just last week when the Commission promulgated its final rule dealing with situations where state and local governments are not participating in the planning process. And earlier when I distributed this rule on Monday, I indicated I would be citing Page 27, and I'd like to turn to that.

The Commission in this statement of consideration reexamined its decision in Shoreham, CLI 86-13. And in the bottom paragraph on Page 27 of the statement of consideration, in discussing that decision it -- it discusses the potential reading of its Shoreham decision as saying that the NRC must estimate radiological dose reductions which would be achieved by the utility plan, and then compare them to the dose reductions which might be achieved under a governmental plan.

And then further, that reading would say that you could only have issuance of an operating license if the dose reductions are generally comparable. Now that's the background, and I would like to read the following language from the Commission's statement.

"Such an interpretation would be contrary to NRC practice under which emergency plans are evaluated for adequacy without reference to numerical dose reductions which might be accomplished, and without comparing them to other emergency plans, real or hypothetical. The final rule makes it clear that every," and let me underline that word, "every emergency plan is to be evaluated for adequacy on its own merits without reference to the specific dose reductions which might be accomplished under the plan or to the capabilities of any other plan."

Well, it goes on but for my purposes I don't think the -- well, let me complete the paragraph. "It further makes clear that a finding of adequacy for any plan is to be considered generally comparable to a finding of adequacy for any other plan."

Now the Commission was very clear in this statement as well as in prior case law. There is simply no standard for this Board to evaluate in terms of the adequacy of dose reductions which would bear upon whether or not the utility is complying with NRC regulations.

The emergency planning rules take knowledge of the fact that a severe accident can happen, and that there can be severe dose consequences. And for that purpose this overlayer of protection, this need for planning in the areas outside of the plant was developed. So that if you do have a severe accident with potentially severe consequences, the public can be protected rather than simply letting them stay in place, or letting chaos and confusion reign in the absence of planning.

Now if Massachusetts' testimony should come in as dose consequences, it's quite likely that the Applicants and the Staff would feel a need to bring in similar testimony, and we may be litigating the consequences of enumerable accidents. Aside from the fact that it's irrelevant and it's not contemplated --

JUDGE SMITH: If we were to find that it's relevant, we would do that, provide for that.

MR. TURK: I understand that, but my point is not only is it not relevant to the decision you must make, but it's going to lead to the introduction of lots more irrelevant testimony, none of which is going to get us anywhere because it's not what the emergency planning regulations require.

Now the Massachusetts Attorney General's office also made the point that they would have this Board determine what the appropriate standard is as to whether too many people here are being put to too great a risk. And I submit to you that's not the function of an adjudicatory body. That's the function of rulemaking, and it's within the province of the Commission. If the Commission should decide that they do wish to promulgate a rule as to how many people may be exposed to how great a risk, that's something they would do through the general provisions of rulemaking, through notice and comment. And that type of a rule would apply to all plants, not just to Seabrook.

the Massachusetts Attorney General's suggestion would invite this Board to make a rule in this case which is not applicable to any other plant operating in the country.

JUDGE SMITH: Mr. Traficonte, I sense that you would like to respond.

MR. TURK: Well, if I may --

JUDGE SMITH: I'm sorry, I thought you were --

MR. TURK: -- two very brief points.

I have not reviewed the cases cited today by Mr. Traficonte, but it's obvious to me that these cases go back in time. It's my impression, certainly for Tyrone and Wolf Creek, that they precede the emergency planning rules of 1980. And I would hazard a guess that the TMI case he cited similarly predated the current emergency planning rules. They simply are not applicable.

Now, finally, I believe I heard a statement in his presentation that went to the effect that Shoreham did not involve a situation where dose testimony was being considered by the Commission when it issued 86-13. And if I'm wrong, I stand corrected and leave it at that.

But I would point out if that is what I heard that there was an attempt in Shoreham to proffer testimony as to doses, and it was testimony not by Beyea and Sholly, but by Radford and others.

JUDGE SMITH: But would it be sufficient to say that that's not what the Commission was talking about in their discussion that was being cited?

MR. TURK: They certainly did not have this -- that testimony which I have just referred to in front of them. But the point I was going to make is that that kind of testimony was excluded in Shoreham as well. It's an unpublished decision. It may not be proper for you to rely upon it so I --

JUDGE SMITH: You mean by the Licensing Board there?

MR. TURK: Yes.

JUDGE SMITH: Oh, okay.

MR. TURK: That, for reference, is a decision dated January 11, 1984 in the Shoreham emergency planning proceeding OL-3.

JUDGE SMITH: January 11, '84.

MR. TURK: 1984.

JUDGE SMITH: It's unpublished?

MR. TURK: I believe it's unpublished.

JUDGE SMITH: Does it have an LBP number on the top?

MR. TURK: No.

JUDGE SMITH: Okay, it's -- we probably -- we [illegible]'t rely on it.

Mr. Traficonte.

MR. TRAFICONTE: Yes, just really a one-sentence response.

In a strange way, I don't disagree with even perhaps the syntax of Mr. Turk's point that we're here asking the Panel to make a determination that is applicable to this reactor and this reactor alone. That's not verbatim, but that's fairly close.

That's true. We're asking the panel to apply the adequate protection standard to this one reactor in this instance by at least accepting evidence of what the actual level of protection afforded is.

We don't think that's incorrect. We think that is what the standard requires that you do.

JUDGE SMITH: Okay.

MR. TRAFICONTE: Thank you.

JUDGE SMITH: Sure.

Well, Mr. Traficonte, as you recognized at the outset that you began with a situation where you were totally convinced that you are right, and you are facing what you thought was held a contrary view.

We had planned to rule following the arguments. We are not going to. We will go back and read the transcript and listen to the debate again, and approach the issue as fresh as we possibly can, with an open mind as we possibly can. In the meantime, however, regardless of how it comes out I want to commend you in particular for bringing the issue to us in a responsible, well-reasoned way. I can't imagine how it could have been presented any more effectively or forcefully, and you have done the Board a substantial service in your argument, and we appreciate it.

MR. TRAFICONTE: Thank you, Your Honor.

JUDGE SMITH: Anything further today?

All right, we are adjourned.

(Whereupon, at 1:00 p.m., the hearing was recessed, to resume at 1:00 p.m., Monday, November 16, 1987.)

EndT-67MB

M-353 A G.

UNITED STATES
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF: DOCKET NO:

PUBLIC SERVICE COMPANY OF	)	50-443-OL
NEW HAMPSHIRE, et al	)	50-444-OL
	)	OFFSITE
(SEABROOK STATION, UNITS 1 AND 2	)	EMERGENCY PLANNING

EVIDENTIARY HEARING

LOCATION: CONCORD, NEW HAMPSHIRE PAGES: 5583 through 5722

DATE: November 16, 1987

Heritage Reporting Corporation

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1220 L Street, N.W.
Washington, D.C. 20005
(202) 628-4888

EXHIBIT 3

MR. DIGNAN: I'm just trying to organize some things before we get started.

JUDGE SMITH: Okay. Well, why don't we do that then. We will rule on the --

MR. DIGNAN: Thank you.

JUDGE SMITH: Sorry, Panel.

As we stated at the outset during the oral arguments on this testimony, we recognize that it is a very important item of testimony, and ruling on it is extremely important to the case. We believe that it probably meets the standard set out by the Appeal Board for interlocutory appeals, and that is that it would have the potential to affect the basic structure of the case in a pervasive way.

I had hoped to have an opportunity to prepare our answer -- our ruling on it in writing last week. I just didn't get to it, and rather than wait yet another two weeks. We thought it would be helpful if we ruled on it now. Moreover, if it is possible, we might even answer questions on the ruling, because we want you to have the most complete record on it that is possible.

We will begin with a rather brief characterization of the testimony as it is offered, and it's not intended to be a summary of it; more or less just an identification of it for the purpose of putting our ruling in the context.

We begin with Mr. Sholly who described the technical basis for the emergency planning rules. We felt that it was a rather straight forward review of NUREG-0396 and NUREG-0654, and went all the way back to WASH-1400, which is the reactor safety study.

He concludes that, Mr. Sholly concludes that the emergency planning rule setting the EPZ distances considered a spectrum of accidents, including early containment failure with a large radiologic release to the environment. According to Mr. Sholly, a site-specific analysis which examines dose/distance relationships based on similar accidents would therefore provide useful information concerning the effectiveness of off-site emergency planning, and we will return to the dose/distance relationships in the context of the argument made by Mr. Traficonte later on.

We didn't have much quarrel at all with Mr. Sholly's testimony, or his conclusion that the emergency planning rule does assume accidents involving severe fuel degradation or core melt that would result in significant inventories of fission products in the containment and the need for immediate action because of the potential for containment leakage. And that's language that I paraphrased from the statement of considerations in the emergency planning rule.

That is taken from the 15-minute notification assumption, and that 15-minute notification requirement is based upon the very assumption that the -- the very conclusion

Mr. Sholly makes.

Mr. Sholly then hands the ball off to Dr. Beyea who describes the dispersion characteristics of the spectrum of accidents, including the severe, fast-developing accident. He describes how dose may be received by the public and the level of the doses, and he also describes in a general way the health consequences of the doses taken into account, the special characteristics of the summer population at the beach in New Hampshire oceanside.

He postulates evacuation and sheltering scenarios and discusses the use of potassium iodide. And he finally concludes that the doses that would be received at Seabrook following a range of releases, even with the proposed emergency plans in effect, are higher than those that would be received at most other sites even in the absence of emergency planning. It is the worst case he has ever examined, that Dr. Beyea has ever examined in connection with emergency planning or hypothetical nuclear accidents.

Dr. Thompson picks up and describes a potential for an atmospheric release, parameters affecting plume rise and the potential for greater amounts of certain isotopes and for other categories of releases, and these are all references, as we understand it, to the PWR-1 type of releases. Again, taken from WASH-1400 of the reactor safety study.

And finally, Dr. Leaning testifies concerning the health consequences which would be expected from dose levels that might be received from an accident such as described by Mr. Sholly and Drs. Beyea and Thompson. And she is apparently using a PWR-1 type of release scenario from WASH-1400 as her predicate.

Again, that is simply to identify the testimony. I am not trying to summarize it at all.

We have looked carefully again at the Massachusetts Attorney General's written and oral arguments. We characterize roughly four or five basic arguments, depending upon how you count them. Massachusetts Attorney General states that the Sholly panel testimony is relevant because the actual radiation dose consequences and the corresponding health effects are probative of the actual level of protection afforded by the New Hampshire Radiological Emergency Plan, and that the actual level of protection afforded to the public is an assessment that must be made before the Baord can made a finding that the plan provides reasonable assurance that adequate measures can and will be taken in the event of a nuclear emergency.

Applicants state that -- I mean, Massachusetts Attorney General states that, in their view of relevancy, is not a matter that the Applicants would be required to come forward with. The Applicants would not be required to make the analysis that they are making, nor need the Board base its decision upon such an analysis.

But as an evidentiary consideration the proffered testimony is relevant even though a generic alternative method of assessing adequate protective measures exists as we understand that argument.

Another argument is that the testimony is relevant to a determination that there will in fact be reasonable dose savings, and that in this cases expected doses are so high that the dose savings for sheltering or evacuation would not mitigate them.

Another argument, and this is what I regard as the conclusionary argument, testimony would be relevant to the objective standard of whether adequate protective measures can and will be taken. I mean its relevance goes directly to the central standard that Massachusetts AG sees in the regulation.

In short, the Attorney General argues that there must be an objective standard equivalent to the standards used in siting in a design. That is, a three-fold type of protection that the public is entitled to. Each of them apparently, as I understand the argument, having equal footing: Design of the plant, the siting of the plant and the emergency plans.

Subarguments along that line, and conclusions are that the best possible plan may not be adequate. A fact that a plant needs siting regulations does not imply adequacy in emergency planning. And even if adequacy cannot be expressed in precise terms, the test must be objective and not subjective.

The Attorney General also argues that the testimony is relevant to FEMA's testimony, or at least FEMA's testimony before it was argued. I don't know if that is still the case.

And then finally, you argue that the testimony is relevant to the Applicants' own sheltering testimony. We will just go directly to that.

Even in the portion of the Applicants' testimony that refers to that argument, it is clear that they were talking about the implementation of protective measures, and not, in our view, protection objectives.

Mr. Traficonte, as we stated at the conclusion of his remarks a week ago Friday, did an excellent job in focusing on actually what the issue is and what the Attorney General's position is. And after having read the transcript of his arguments, we believe that that commendation to him was deserved.

Focusing, to begin with on areas in which Mr. Traficonte was quite helpful, are the things that he pointed out are not the position of the Massachusetts Attorney General, and this helps quite a bit, because it takes some of the chaff away from it and leaves the main argument quite highlighted and easy to identify.

Massachusetts Attorney General does not argue that the Baord is obligated to make specific dose savings findings.

We need not find that a specific number of people will be injured in a given accident, but that would be a relevant consideration in any event, but we need not find it.

The Massachusetts Attorney General does not intend to litigate a worst case scenario, or even any one single accident. Mr. Traficonte said that the Attorney General does not take a position that the risk must be zero, or it does not propose that any particular level of protection is necessary.

States also that there is no legal precedent that in itself mandates the Board to accept the Attorney General's precedent. And when we pointed out the Shoreham case to us which we thought would have a big influence over our decision, Mr. Traficonte pointed out that the Shoreham case can be distinguished because of the difference in the parties and the fact that the state is not a participant there.

What Mr. Traficonte does say, however, is that beginning from the very fundamental base in simple layman's language, the actual level of protection afforded is clearly relevant to the language of the regulation "adequate protective measures". He argues that there is no exclusionary rule, nor do we find one if we understand the meaning of what he meant by exclusionary rule. We must judge the adequacy of the plan with no planned sheltering.

Therefore, the New Hampshire plan must be compared with a plan which includes sheltering in that there also must be -- because there must be a range of protective measures.

He argues further that the adequacy of the plan is site-specific, and even though it is undefined. In fact, because a plan must be site-specific, as we understand the argument, that is why it is not defined.

The overall position is that there are too many people at too great a risk, but if queried on how you quantify that or qualify it, Mr. Traficonte would "kick it right back to the Board" as it being our responsibility to determine what are too many people and too much risk.

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(Continued on next page.)

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JUDGE SMITH: (Continued) He states quite clearly and eloquently, that there must be a line, whether it is qualitative, or quantitative, it cannot be a best effort, but it is the Board's task, and not the Attorney General's task to draw that line.

I am sure that I don't characterize your argument as you would have, Mr. Traficonte, but that is the way that we understood it to be.

The Staff's position is that generally it supports the Applicant's arguments in writing the written response on why dose levels and emergency planning, why dose level considerations are inappropriate, and Mr. Turk argued that we don't go into probabilities. We simply assume that accidents can happen.

Testimony must be examined in the light of the general test for relevancy and that is, is it more or less probable alluding to the Federal Rules of Evidence, is it more or less probable that the Commission's regulations are complied with and in that respect, Mr. Turk directs us to the San Onofre case, the Shoreham case, and the statement of considerations of the new regulations on emergency planning.

Mr. Dignan referred us back to his written brief, but elaborated somewhat. And he stated that the test before us, is that one must simply maximize dose savings, whatever the doses might be.

That is the test that we would look at, has that been done. He distinguishes present emergency planning regulations from the old one, in that presently, you do your best for 10 miles. He points out that part 100 is still in effect, and there and only under part 100 considerations, are specific dose avoidances required.

Part 100 is satisfied therefore, whatever event may happen, even a catastrophic -- I mean the emergency planning rules are satisfied, if part 100 is satisfied, in that the emergency planning rules anticipate that whatever event may be, even if it is a catastrophic event -- and those are his words -- the standard is simply the best job that humans can do.

Even though, that all that can be done would be to save a certain number of doses or a certain number of people, that is the test in an emergency planning rule.

We have not followed the parties into what appears to be somewhat of a debate as to what is the difference between adequate level of protection, compared to the regulatory phrase, adequate protective measures?

We think that if you just focused on those phrases themselves, if nothing else, you could go either way. The fact is that the regulatory phrase, standing alone, does not give a lot of guidance to the Board or the parties. And this is why we spend so much time at it, and that is why we are spending so much time on it today.

Now, Mr. Traficonte also asked us to go back and review some cases, that were admittedly, as far as he was concerned, were heard when part 100 was a consideration, but he asked us to look at them for a different purpose, for a different value.

And that is, even though they were part 100 standards, licensing boards did look at the adequacy of emergency planning. And the quantitative, or the -- as we understand his argument -- licensing boards did look at a quantitative dose/distance considerations and did have a quantitative standard of dose avoidance in those cases.

And we went back and looked at them and I think that is pretty clear. The Tyrone case, in particular, refers to the adequacy of evacuation plans with respect to dose/distance considerations and that was our finding.

But Mr. Dignan cited us to, in his oral arguments, cited us to what we believe to be the controlling case, as far as what was meant by the Wolf Creek case, and the Tyrone case, cited by Mr. Traficonte.

In the Tyrone case, in fact, the Board alluded to the two cases referred to by Mr. Dignan and those are the New England Power Company et al, and Public Service Company of New Hampshire, ALAB-390, decided in 1977.

The Tyrone Board noted in its decision that that case had recently been decided and it controlled our reasoning on what considerations we would give to the adequacy of evacuation plans, in that case.

And there, it was clear, that the Appeal Board, stated that these considerations, the dose avoidance considerations, in evacuation plans related to the low-population zone, and only the low-population zone.

The scheme that was in effect then and there now, as far as I know, was that persons residing in the low-population zones were entitled to have the same type of protection under emergency planning, evacuation, whatever it might be, as those immediately on the border of the low-population zone, if they took no action.

Now, that was a collateral finding, because the real issue there was, how is this accomplished? You can do it either by expanding or contracting the low-population zone, depending upon the population in it, and the feasibility of evacuation or whatever.

But it was clear, that the only reason that the boards, in the cases cited by Mr. Traficonte, talked about dose/distance considerations and dose consequences, is that it was a part of the consideration as to whether part 100 standards are met.

Now, if Mr. Traficonte, if you meant something else, we just cou... not find it. And I read the cases very carefully and I read your arguments and your urging us to read those cases, but it is just not there. We just could not find another point, which may be more elusive, but we could just not find it.

Therefore, we are back to where we came from but I think with a little bit more insight into emergency planning as a consequence of the arguments of the parties.

And our decision is, our determination on this issue is controlled by, beginning with the San Onofre decision, at 17 NRC 528, decided in 1983, as a Commission decision, CLI-8310 and discussion on page 533.

Where, in the context of planning for contaminated injured persons, which is a much narrower context, the Commission stated that the emphasis is on quote, emphasis "prudent risk reduction measures."

The regulation does not require dedication of resources to handle every possible accident that can be imagined.

The concept of the regulation is that there should be core planning, with sufficient planning flexibility to develop a reasonable ad hoc response to those very serious low-probability accidents which could affect the general public.

But San Onofre still does not pick up the key phrases. That has been argued here, the key phrase setting the standard for emergency planning, but Shoreham certainly does and this is the language that I quoted to Mr. Traficonte, during his argument, from Shoreham, which is CLI-8613, reported in 24 NRC 22, in 1986, and discussion beginning on page 29.

The Commission begins, "The root question becomes whether the Long Island Lighting Company plan can provide for 'adequate protective measures' in the event of a radiological emergency." And as far as we can determine that is the only time that the Commission either by rule, or otherwise, sets out to define that exact phrase.

And to repeat the quote that we made, during the oral arguments, the Commission goes on to state, "This root question cannot be answered without some discussion of what is meant by 'adequate protective measures.'"

"Our emergency planning regulations are an important of the regulatory framework for protecting the public health and safety but they differ in character from most of our siting and engineering safety requirements which are directed at achieving or maintaining a minimum level of public safety protection."

And they cite, for example, 10 CFR Part 100.11, "Our emergency planning requirements, do not require that an adequate plan achieve a pre-set minimum radiation dose savings, or a minimum evacuation time for the plume exposure pathway emergency planning zone, in the event of a serious accident."

"Rather they attempt to achieve reasonable and feasible dose reductions under the circumstances. What may be reasonable or feasible for one plant, may not be for another. And in the past, what was reasonable and feasible in a given case, depended upon the cooperative planning efforts of the utility and the state and local governments."

And then they go on to the case presented at Shoreham. As Mr. Turk points out, the Commission went back to the Shoreham reasoning in the statement of considerations in the final version of the ~~new~~ Emergency Planning Rule, it says, "The final rule makes clear that every emergency plan has to be evaluated for adequacy on its own merits, without reference to the specific dose reductions which might be accomplished under the plan, or to the capabilities of any other plan."

That is the law and the statement of the Commission's policy which we are bound to follow.

Despite the sincere efforts of the Massachusetts Attorney General to distinguish their testimony from the Commission's guidance, in Shoreham and the planning rule, emergency planning rule the testimony in one way or the other does propose specific, perhaps not in a narrow spectrum, but specific assumptions of doses, dose consequences, health effects, and the entire array that the Commission stated is not a part of consideration.

That is our ruling.

For that reason, then, the objections to the testimony of Mr. Sholly, Jan Beyea, Dr. Gordon Thompson and Dr. Jennifer Leaning is sustained. And the testimony will not be received.

Do you have any questions?

MR. TRAFICONTE: If I may, I would just like to clarify for the record, Judge Smith, I don't have very much to disagree with, except perhaps your decision.

But your recitation of the arguments that we made, just so that the record is clear, if I just might, for one minute respond to the characterization of the case law, under part 100, as you have just discussed it.

I appreciate that you went back and read the cases, and I am puzzled that you did not find what I said that you would find. And that concerns me, because I see it there. I don't want to reargue it, obviously you have decided the issue after much time and energy.

But just again, for the record, it is my understanding of those cases, including the Tyrone Case, that the issue at hand, once the boundary of the LPZ was drawn, in accordance with the rem dosage set forth in part 100, for which, of course, you would need dose/distance evidence to establish, after that boundary was drawn, the next issue on the agenda was, is the evacuation, is the emergency plan, for the people who live within that boundary, does it provide adequate protection, actually adequate protective measures, I think was the phrase.

JUDGE SMITH: But adequate as measured by the standards of part 100.

MR. TRAFICONTE: That is clearly the dispute as between us, right now, and here is how I read those cases.

And I can refer you to the Tyrone case, I don't think that I have it with me, today, but we could get into that, if you need to.

JUDGE SMITH: We have it.

MR. TRAFICONTE: The standard, the one standard for drawing the boundary is high. That is to say that it is an injurious standard, and the assumption is, that a person does not move; he stays put. An accident, a fairly severe accident occurs, and you draw the boundary using that rem dosage that is put forth in 100.

When you shift to measuring the adequacy of the evacuation plan, I do not believe that that same rem dosage is then used as the measurement of the adequacy of the evacuation plan.

JUDGE SMITH: When you shift it to outside the LPZ?

MR. TRAFICONTE: No, inside the LPZ.

JUDGE SMITH: Inside the LPZ.

JUDGE SMITH: Yes, okay, I think that you have sharpened the distinction.

MR. TRAFICONTE: Okay, then I think that it is where

I really thought that we did disagree. I was not citing those cases, and I hope that I was not unclear on this, I was not citing those cases for the proposition that that standard, however it was measured back then, is applicable, directly to an area outside the LPZ.

Mr. Dignan is absolutely right —

JUDGE SMITH: I did not read it that way either.

MR. TRAFICONTE: Okay.

JUDGE SMITH: I did not read it that way. I thought that you were telling us, look at the cases you cited, and we should see in there, wherever the evacuation is being considered, we should see in there, an objective, quantitative standard of protection, or objective, or a line that has to be drawn.

MR. TRAFICONTE: No, —

JUDGE SMITH: Well —

MR. TRAFICONTE: To that extent those cases did not go that far.

My point was that what those Boards took in evidence, of adequate protection, was objective dose/distance evidence. That was, it was legally analogous to our present circumstance.

JUDGE SMITH: They did do that.

MR. TRAFICONTE: They did do that, yes.

JUDGE SMITH: Yes, so that we saw that.

MR. TRAFICONTE: So then it is your position that ultimately, as a result of Shoreham and further discussion by the NRC, after TMI and emergency planning rules in the 5047 section, that evidence that at an earlier point, during a siting proceeding would have been admitted, is now no longer relevant.

JUDGE SMITH: No, if we were having a siting decision today, if those contentions and those issues were still alive, within the LPZ and I am sticking my neck out here --

MR. TRAFICONTE: Yes, I think you might be.

JUDGE SMITH: -- because I am not comparing any differences which there may be between part 100 today, and requirements in part 100 then.

So, I could very well be wrong, but nevertheless, if we were talking about the LPZ, the Seabrook LPZ, as a siting consideration today, we would have to look at it, and I don't know what the litigation was then.

But you know, I don't know if it was -- there would be no evacuation necessary in the LPZ, or whatever it was, or the containment was such that none is required, I don't know. But whatever it is, part 100 still exists today. I only looked at part 100 as it existed at the time of your argument.

MR. TRAFICONTE: Just to sum up that point and that is really the only comment I have at present, but it --

JUDGE SMITH: Of course, excuse me, one other thing, of course, the case that I cited was the very case that we are talking about here today, you know, the Seabrook case, that is the case that Mr. Dignan has pointed us to and the Tyrone case rested on was the actual Seabrook case.

MR. TRAFICONTE: And again, for the record, the LPZ was drawn in by the Appeal Board in the Seabrook case to 1.25 miles, eliminating the need for evacuation planning for the area inside the LPZ.

Correct me, if I am wrong, Mr. Dignan, 1.25 miles is what the opinion said.

MR. DIGNAN: The Appeal Board did not draw in the LPZ; the LPZ was always exactly that 1.25 that was put forth by the Applicants, on the basis of the calculations made. And as I indicated in the argument before the Board, a week ago, the very tight LPZ was enabled to be accomplished because of the feature of the two containments around these reactors.

What the Appeal Board drew in and this may be what Mr. Traficonte has recollection of, is the population center distance. The population center distance for Seabrook as originally proposed, I believe, was the city of Portsmouth.

And the Appeal Board said that the population center distance should be assumed to be the beach, because in the summer, there would be a large concentration of population.

It was not the LPZ that the Appeal Board ruled.

(Continued on the next page.)

T-?SMB

JUDGE SMITH: Well, we did not analyze, we did not go back, we looked at the Seabrook case, and the Appeal Board case there, solely for what was intended and what was required of Licensing Boards and parties in the construction stage, as far as evacuations were concerned, and emergency planning was concerned, and they made it clear they were talking there, about the low-population zone, and nothing was required outside, and they were meeting low — and which I don't think that you disagree with.

MR. TRAFICONTE: We don't.

Essentially, I think that if, at a certain period in the history of a licensing of nuclear power, they were citing regulations that included a requirement that evacuation plans be generated for any area, any identified area.

And, if during that period in the history of regulation, evidence of the actual level of protection, afforded for those people inside that area, was admitted, then at a later stage as we are now, post-TMI, when there is a more expansive emergency planning regulation, the same kind of evidence should be admissible now, as was then.

That is the thrust here, Your Honor.

JUDGE SMITH: We understood your argument and we just did not agree with it, and furthermore, let's address this basic problem that you have.

And that is, you certainly realize that it is not the prerogative of the licensing boards to approve or disapprove or commend, or anything else, Commission's regulations.

Ours is simply to look at them and execute them as accurately as we know how, for the benefit, of not only the Applicant for a license, but for the benefit of those who oppose a license. Because if we vary in our rulings, our own concept of the way that the regulations should be, then your rights are trampled on as much as anybody else's, because you will never know why you lost and if you lost, and your right of appeal would evaporate.

If we merged our own view of what the regulations should be, into our findings of facts, and you did not prevail, your right of review, your right of appeal to the courts would be lost.

And we are, in this particular case, especially, we are trying to define and recognize precisely what the Commission wants us to do and make a record based upon it, because we know that it is very, very important to the parties, and you must have a record for review.

MR. TRAFICONTE: I certainly appreciate the view that the Board has of its position, in light of the Board's understanding of what the existing precedent is. It is not my view, nor is it the Mass AG's view of that precedent, but we have gone now, over that bridge, more than once.

JUDGE SMITH: Yes, you have and it has not been excessive. We have spent a lot of time at it, and we have allowed reargument and but it is very important and that is our ruling.

And we are prepared to proceed now, with the rest of the case.

Mr. Dignan?

MR. DIGNAN: Your Honor, I believe that the Board has sworn the new witnesses who have not appeared before. Just to introduce each of the new witnesses to the Board formally: they are Gordon Derman, president of Avis Air Map Company; Edward B. Lieberman of KLD Associates; and Dennis S. Mileti, professor of sociology, and director of Hazards Assessment Laboratory at the Colorado State University.

And I would begin, Mr. Lieberman, with you, if you would take the microphone, sir?

DIRECT EXAMINATION

BY MR. DIGNAN:

Q Mr. Lieberman, I direct your attention to an 11-page document, entitled, Professional Qualifications, Edward B. Lieberman, vice president KLD Associates.

And I ask you if that document sets forth your professional background and qualifications, sir?

A (Lieberman) Yes, it does, with the proviso, that my current title is now president of KLD.

Q You are now president of KLD as opposed to vice

Mass A.G.

UNITED STATES
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF: DOCKET NO:

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, et al (SEABROOK STATION, UNITS 1 AND 2)	50-443-OL 50-444-OL OFF-SITE EMERGENCY PLANNING

EVIDENTIARY HEARING

LOCATION: CONCORD, NEW HAMPSHIRE PAGES: 5948 through 6175

DATE: November 18, 1987

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P R O C E E D I N G S

JUDGE SMITH: Good morning.

Except for Mr. Traficonte's business, is there any other preliminary matters?

(No response.)

JUDGE SMITH: All right, Mr. Traficonte?

MR. TRAFICONTE: Thank you, Your Honor.

First, I appreciate the opportunity to take you up the offer to ask you questions, which is, I think, what you said yesterday, having looked at the transcript.

I am not going to ask you any questions, and I am not really going to discuss the argument again, obviously. What I would like to do this morning is move orally that you refer the ruling that you made to the Commission, pursuant to 10 CFR 2.730(f).

And I would like to turn to that provision --

JUDGE SMITH: What is that section number?

MR. TRAFICONTE: That is 2.730(f).

JUDGE SMITH: I might say, Mr. Traficonte, I am at a disadvantage here. My one observer suggested whatever ruling have been involved in should be reviewed, so I am a novice at it. No survivors.

MR. TRAFICONTE: Well, it is the practice of law, Your Honor.

In that provision F, interlocutory appeals to the

Commission, it is quite clear and I want to go into some detai on this point, that no interlocutory appeal may be taken to th Commission from a ruling of the presiding officer. Where the paragraph refers to the Commission, other rules make clear tha that would include the Appeal Board.

I read this, that we have no right to an interlocutory appeal. When in the judgment of a presiding officer, a prompt decision is necessary to prevent detriment t the public interest, or unusual delay or expense, the presidin officer may refer the ruling promptly to the Commission.

Just for the record, it turns out, after looking at the case law, that the Appeal Board in those circumstances, would not necessarily have to accept the reference. They woul not have to accept the reference.

JUDGE SMITH: Frequently, they have not accepted references.

MR. TRAFICONTE: If I might, before asking you these specific questions, that I obviously am going to come to, I want to discuss one case, if I might and I am going to make some extensive references to it, so I would like to provide the Board and the parties with copies of the case.

It is a case involving a referral by a licensing board of a decision and the conditions prompting that referral. It is the San Onofre case, LBP-81-36 at 14 NRC 691.

And if I might, I would just like to provide a context for this licensing board decision. As I understand th history of that case, at the operating license stage, the board, sua sponte, wanted to examine the impact on the adequac of emergency planning, of a severe earthquake. An earthquake that was at the level of seismic safety or seismic shutdown safety or beyond.

In order to investigate the impact of such an earthquake on evacuation planning, the board, in this order, directed the parties to submit a certain kind of evidence. In fact, part of the evidence concerned the impact on the transportation system, of an earthquake, and moreover, the board asked the parties to produce radiological dose consequence evidence.

They then referred, before that work was done, and before that ever became a litigated issue, they referred the predicate, which is, did the board have sua sponte authority tc reach the situation of an earthquake of that severity which would cause an accident, while simultaneously causing damage tc the evacuation system?

And the board, at the behest of the applicant in that case, referred that determination, after deciding that it did have that authority, it referred that issue to the Commission.

Three months after this opinion I presented to you, the Commission, in a one-page order, said that that issue, the impact of an earthquake on evacuation planning was not to be considered in an individual licensing proceeding, but was to be handled at the generic level.

JUDGE SMITH: Did — I recall generally the referral and the issue. I don't recall the sequence of events. Did the Commission, in that case, act in recognition of the licensing board's referral to the Appeal Board?

MR. TRAFICONTE: The order of events, as I understand it, is that there was a referral by the licensing board, in the first instance, to the Appeal Board. At the same time, as is the practice that the papers were sent on to the Commission.

JUDGE SMITH: Yes.

MR. TRAFICONTE: The Commission reached down and sua sponte took it from the Appeal Board. So that there is really only one higher authority.

I am going to go into some detail on this, but before I do, I want to reiterate that the decision by the Commission, on this whole issue, involved the sua sponte authority to reach the issue of simultaneous earthquake or an earthquake of that severity that would cause damage to the evacuation system. That is the only issue addressed by the Commission in its treatment of the referral.

In that —

MR. BACHMANN: Judge Smith, may I interrupt on behalf of the Staff?

JUDGE SMITH: Yes, you may.

MR. BACHMANN: I feel that an oral argument on a request for directed certification, which cites specific NRC cases, etc., is out of place at this time in the hearing.

The other parties have had no time to respond. The way that I understand it, a request for directed certification generally is considered in writing, with an opportunity for the parties to fully brief and respond to it.

We will not, in essence, be able to see, essentially the entire argument, until tomorrow, when the transcripts come out. I suggest that such a request should be made in writing, with an opportunity for the parties to respond in a truncated time frame, perhaps.

But I do not believe that it is, comports with due process and fair play to go to an extensive oral argument out of nowhere, where none of the other parties have had an opportunity to understand, brief, check these cases, or anything else, in that respect.

MR. DIGNAN: Your Honor, I must say that I respectfully disagree with the Staff. It was my understanding that what Mr. Traficonte was bringing to you, was not a motion for directed certification, which is a case law remedy which is directed to the Appeal Board, itself. But rather, he is seeking to have you refer the ruling.

Wasn't that correct, Mr. Traficonte?

MR. TRAFICONTE: Yes, yes.

The decision has been made. We are not here to argu a motion for reconsideration.

MR. DIGNAN: And that being the case, I confess, personally, that while I want to be heard on it, I have always viewed the reference by the licensing board, to be a matter, essentially, to the discretion of the licensing board. The licensing board has to decide for itself, as to whether or not it wants to refer the ruling.

I would like to be heard on the question of whether you should refer. But at least, from the Applicants' point of view, I don't care if we see this in writing and have a long opportunity to brief it.

Now, I don't mean to cut off the Staff's view, if they feel they do, but I did not understand Mr. Traficonte to be arguing a motion for directed certification here.

MR. TRAFICONTE: I'm, Your Honor.

I don't see these as alternatives, frankly. We don't have any objection to making a written submission, we just wanted to get it on th record, as early as we can, because we obviously, as we think the Board does, believe this entire issue is extremely important and will impact on the nature of the proceedings.

MR. DIGNAN: I do have a problem with procedure, in one respect, however, Mr. Chairman.

Normally, what is referred, and that is what is bein asked, is a ruling. There is, as yet, as I understand it, no ruling.

And the reason that there is no ruling, is the forma offer of the evidence, and exclusion of it has not yet taken place. I understand the Board has made clear in a motion in limine, how it is planning to rule, and has indeed, invited th thing.

And, so, I think asking you to defer, "your ruling", is premature, until the offer has been made, the exclusion has taken place, and the proper thing has been marked and in the rejected exhibit file.

MR. TRAFICONTE: I think that is technically correct and I was going to do that first thing, but did not have a cop ready to hand. I am prepared to do that now.

(The Board confers.)

JUDGE SMITH: I see that that is no problem. Go ahead, offer it, and we will get that problem resolved.

MR. TRAFICONTE: All right, Your Honors, I would li to offer into evidence, —

JUDGE SMITH: If you had a foreboding before that you—

MR. TRAFICONTE: This time it is a certainty, an absolute certainty what is going to happen.

That is right.

I would like to offer into evidence, a document th is loosely bound, unfortunately at this point, entitled, Commonwealth of Massachusetts Corrected Testimony of Stephen C Sholly, on the Technical Basis for the NRC Emergency Planning Rules; Dr. Jan Beyea, on Potential Radiation Dosage Consequences of the Accidents That Form the Basis for the NRC Emergency Planning Rules; and Dr. Gordon Thompson, on Potentia Radiation Release Sequences; and Dr. Jennifer Leaning on the Health Effects of Those Doses.

Just from reading it, I will tell you that it will not be on the New York Times best seller list, in the near future, since the title takes that long to read.

In addition, and I am not trying to pull any unfair surprise here, what we are offering, has an errata sheet on it and the corrections incorporated, as just a technical point.

I would like to offer this material and testimony anc ask that it be admitted and bound into the record, in this proceeding, at this time.

JUDGE SMITH: I propose that it is just as easy to mark it as an Exhibit.

MR. TRAFICONTE: That is fine.

JUDGE SMITH: Since it will not be cross-examined upon or further examined upon, it will needlessly occupy transcript space.

If you have no objection, you can offer it any way that you want to, but if you have no objection, I propose that you offer it as Massachusetts Attorney General Exhibit Number 5, the testimony and the attachment and the errata sheet, as a single exhibit.

MR. TRAFICONTE: That is fine, we will offer it in that form.

(The documents referred to, were marked for identification as Massachusetts Attorney General Exhibit Number 5.)

JUDGE SMITH: Hearing no objections --

MR. DIGNAN: The objection is made to the offer into evidence.

JUDGE SMITH: All right, and for the reasons that we set out in our discussion, on the Applicants' motion in limine objecting to the testimony, the Exhibit is not received, and i will be in the rejected evidence file.

(The document marked for identification as Massachusetts Attorney General Exhibit Number 5 was rejected.)

JUDGE SMITH: Now, as to Mr. Bachmann's concern, we are sensitive to your problem but there are practicalities involved. If we were to take your advice, and do it in writing, it would defer the ruling for perhaps, maybe a month, maybe six weeks, by the time that the rules were followed, and there was an opportunity to get back to their offices, and responses to it, and everything, it would put it off until, th issue would by, for that reason alone, become moot almost.

We don't believe that the considerations that we are likely to have here this morning are so complex that you may be prejudiced by it, and if, after the argument, you are, well, then, you can identify what your problem is, and we will look at it.

MR. BACHMANN: Judge Smith, let me just respond briefly. My concern was that this, Mr. Traficonte, was making a 10 CFR 2.730(f) motion for directed certification —

JUDGE SMITH: — yes.

MR. BACHMANN: — which the other parties would then have to respond to, immediately. As I read from just my notes here, in the Perry case, ALAB-736, that is the only vehicle, i.e., a motion for directed certification, to rectify a ruling by the licensing board, other than a motion for reconsideration.

And were we dealing with merely a motion for reconsideration, I would have no problem with it. I think that if we are looking for a directed certification motion, that there would be no problem in doing it in writing, for instance if we had a truncated time frame, up until the time that the record in this case is closed.

And if the licensing board felt strongly enough tha it should be directed to the appeal board for a ruling, then that is within the province and the jurisdiction of the licensing board.

What I was objecting to, basically, is a 2.730(f) motion done orally, case material cited, and the other partie are expected to respond on an ad hoc basis, without having an opportunity, really to brief the Board on that. That was my only concern.

JUDGE SMITH: Well, our ruling will remain the same If you, after the argument, if you feel that you have been unfairly prejudiced or surprised by the novelty of the arguments, raise it again, but as I stated, it would be virtually moot, if we waited for the regular process to unfolc

MR. TRAFICONTE: If I might proceed, Your Honor?

Referring back to the San Onofre case, which I provided to the Board and the parties, in light of the contex that I described, if the Board would refer to page 695, of th opinion, in the paragraph numbered 3, there is the following language:

Radiation dose estimates: assuming that the evidenc will show some substantial delay in evacuation, and degraded capability to take shelter, the Board asks the parties to provide an envelope of radiation dose estimates that will result, both in terms of magnitude and numbers of persons affected. The assumed radiation releases should be those postulated in the PWR-2 accident in Wash 1400.

I am summarizing it slightly.

In addition, the Board asked the parties for their gross estimates of the acute and chronic radiation effects, including the fatalities that may occur as a result of such exposures.

And one last reference, if the Board would turn to Page 699, strike that, 698.

The Board continues in this order on referral discussing the Applicants' and the Staff's response to its willingness to investigate the impact of an emergency.

And in that discussion, on Page 698, discusses the Staff's argument, specifically addressed to the reasons why th Board should not hear that kind of evidence. It is in the highlighted section, entitled, Site Specific Accident Analyses

The Staff argues that, and this should be placed in quotes, "an adequate planning basis is assured by conformance with the Commission's regulations and site specific analyses are not required for the extremely large releases already generically considered in establishing the regulations."

Skipping the next two sentences, the next paragraph begins, But many aspects of emergency plans, particularly evacuation routes, are by their very nature, site specific. We doubt whether the Commission could prescribe by rule, a generic emergency plan, suitable for all reactor sites, as the Staff's argument seems to suggest.

In any event, the Commission did not try to do that either in 10 CFR 5047(b) or in Appendix E, to Part 50. Except for the specific 10-mile EPZ, the rule speaks in general terms, such as adequate emergency facilities, equipment methods systems. I am omitting a cite.

And a Board can only judge adequacy with reference to levels of risk, some aspects of which vary from site to site. In addition, licensing boards are required to make an overall general finding of reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency, again, omitting a cite.

Such a finding goes beyond a checklist determination whether a plan meets the standards of 10 CFR 5047(b).

In that context, in which the Board believed, that an earthquake could impact on the range of protective measures, so as to reduce them below the level that the emergency rule and the rulemaking anticipated, in that context, this Board was prepared to take evidence, obviously by description, very close to the evidence that we have proffered and this Board has rejected.

This issue, the evidence issue, did not get reached review, absent, and I quote, that the ruling would have to affect "the basic structure of the proceeding in a pervasive or unusual manner."

And I think that is a very difficult --

MR. DIGNAN: Now, I do object, because now counsel is arguing a directed certification standard, and that is not the same standard as referral.

(Continued on the next page.)

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It turns out that my brother was exactly right, because this is really a motion directed to the wrong tribunal because the directed certification motion goes to the Appeal Board.

MR. TRAFICONTE: Well, in fact, Mr. Dignan, if I might just respond to that. The case law makes it clear that the actual standard is the same. The Appeal Board on a motion for certification will ask itself in the first instance, is th test for referral met. And I can cite the case for that proposition. So I don't think that's a serious issue.

The issue is, is the omission or the striking of thi evidence going to have pervasive or unusual impact on this proceeding. And what I'm telling the Board and trying to be forthright about is that it is quite clear in the law that generally when evidence is stricken that would not meet that test.

And what we're indicating in reference to the San Onofre case is that the issue here is not just a simple issue of should evidence go in, or shouldn't it go in. There are much larger background issues about the nature of the proceeding, the nature of the standard to be applied, and your role as a licensing board at this stage in this proceeding. That's the point of the San Onofre reference, that seen narrowly, construed narrowly on the narrow issue of whether th striking of evidence is otherwise going to get interlocutory review, it is not. I don't think that should come as any surprise.

And I think that would be a tremendous waste of resources. It would impact directly on the Board's, I think, on the Board's view of the case. I frankly think we would al want to have this issue resolved at the earliest possible tim

JUDGE SMITH: I'm sure Mr. Dignan agrees.

I would wonder just where you feel your interests better lie.

MR. DIGNAN: My view always is, assuming this is a 2.730(f) motion, which is I think the only motion this Board can entertain, if it's a 2.718(i) motion for directed certification, it belongs up in the Appeal Board. That's a case law created remedy, and its standards are pretty clear, and they are more difficult to meet, if you will, in some respects than the referral by the Licensing Board itself.

Having said that, I have indicated to the Board my belief that the law is fairly clear that in the first instanc at least, it's a matter of virtually unlimited discretion to the Licensing Board as to whether to refer one of its rulings As has been indicated, the Appeal Board may refuse the referral. but the Licensing Board in the last analysis has discretion to do so.

The question is whether that discretion should be exercised in this case. It is my view that it should not he, and I would like to comment as to why.

The reason is that the standards set in the regulation is unusual delay or expense. The only party that can suffer unusual delay or expense as a result of this ruling is the Applicant, because if the ruling be in error and later be overturned, it is the Applicant that is going to have to deal with the fact that a favorable decision to it went down, if it be a favorable decision. If, of course, the decision of this Board be unfavorable, there is no injury to anybody because that moots the question of whether this ruling was correct in terms of appeal.

Now, having first stated that, I would point out to the Board that my brother Traficonte is certainly correct that in the first instance 2.718(i) motions are decided on the basis of would a referral have been appropriate. And for that reason certain of the 2.718(i) cases become relevant to this discussion.

In any time when an Appeal Board has turned down a 2.718(i) motion, one can say that that is authority for the question that it may well have not met the first standard, which is the easier standard of referral. And I would point out to the Board -- incidently, the case that says that the 2.718(i) motion would be decided in the first instance by seeing whether it would at least meet the minimum of a referral is the seminal case which created the remedy, and that is

Public Service Company of New Hampshire eabrook Station, Units 1 and 2, ALAB-271 appearing at 1 NRC 478, and the jump cite is 483, decided in 1975. That theory was also repeated in Toledo Edison Company, Davis-Besse Nuclear Power Station, ALAB-300,
2 NRC 752; the jump cite being 759, decided in 1975.

Keeping that principle in mind, Your Honor, there is a plethora of cases, I submit, which have indicated that directed certification will not be granted absent exceptional circumstances on questions of what evidence or how evidence should be admitted.

In particular, I will cite to you the cases of Metropolitan Edison Company, Three Mile Island Nuclear Station, Unit 1, ALAB-791, 20 NRC 1579, with a jump to 1583, decided in 1984; Davis-Besse again, this time ALAB-314, 3 NRC 98; the Long Island Lighting Company case, Jamesport Nuclear Power Station, Units 1 and 2, ALAB-353, 4 NRC 381; Power Authority of the State of New York, Green County Nuclear Power Plant, ALAB-439, 6 NRC 640.

Now there is a reason for that, and the reason is because when you get up to the higher standard of directed certification, you talk about the question of the standard my brother was arguing to you and that I objected to. And that is a standard of a pervasive effect on the proceeding, and the other standard is whether or not it's something that cannot be reviewed at all if it is not reviewed now. An evidentiary ruling is a classic ruling that can have review at the end of the termination of a proceeding.

So if we just stick with the standard that is appropriate for this Board, and stay with the kind of a motion that can be made to this Board, 2.730(f), it seems to me the unusual delay of expense problem lies wholly in my client's ball park, not in his. And in any event, if the complaint of the Commonwealth is they may litigate the whole case and then find out they should have won on appeal, that is never considered, at least in the context of when you're talking about stays or injunctions to be usual delay or expenses, the cost of litigation. That's what we are all here for.

I respectfully submit that the discretion should not be exercised. I have considerable question as to whether the Appeal Board would allow this referral. That, obviously, should not be your main consideration. You have made a ruling on a basis of at least what I submit to you is a true, solid Commission precedence. I think the ruling is unassailable, an I think the ruling is one of law and on evidence. It is not the type of ruling that is normally referred up as a matter of discretion, I submit.

MR. TRAFICONTE: May I just respond briefly to the grounds for why we think you should refer it?

We obviously think that undue delay and expenses involved, we think that undue expense and delay affects more than just the Applicant. But, frankly, we don't believe that' the primary consideration. We believe, just as in San Onofre, that the more fundamental issues of legal and policy nature ar at issue here as to what the standard for evaluating a plan is in the absence of a full range of protective measures, and wha kind of evidence of that standard is admissible.

And I think the Board was quite clearly aware of those issues that are, if you will, surrounding what is basically an evidence issue. I'm not trying to say it is not a issue here of the admissibility of evidence. But behind that issue is a more substantial issue which I believe is appropriate for referral, just as in the San Onofre case. And I think the Board itself has referred to this issue is a watershed issue in the case.

JUDGE SMITH: Well, it's an important issue, and it' an issue that goes beyond an evidentiary ruling. It is an evidentiary ruling which is based upon our interpretation of a very important Commission regulation, the very regulation that is being heard there.

So for that reason, I mean, on that account you made a persuasive argument that it is a very important consideration.

Now, we haven't heard from Mr. Bachmann on this, and he didn't want to have to be heard. But I'll hear from him, but I just wanted to express some thought on this for the guidance of the parties.

I think that this issue, the interpretation of this regulation occupies much of the attention of the Commissioners themselves, and I would be very much surprised if it doesn't occupy a great deal of the attention of the Appeal Board sitting in this case who know that they are going to have to review our decision.

In this particular case, I don't think it makes much difference how it gets to them. They are people who are fully capable of deciding for themselves, and will decide and have represented and acted in the past as entering into an issue when it needs to be entered into. And I think that the issue we have here transcends whether it gets up to them on a certification by the Board, or a motion for directed certification, or whatever. I think that they will do what they think is appropriate and needs to be done with respect to the issue regardless of how it gets up there.

Although your arguments are classic, traditional, an in the traditional sense virtually unassailable, as you have listed them, those are the reasons, and it may be in some sens that the standard for Board referral is somewhat less than a motion for directed certification. And in this particular instance, because of the importance of the interpretation of the regulation, I just don't think that the Appeal Board would care how it gets up there.

MR. TRAFICONTE: So that you will refer it then.

JUDGE SMITH: Well, I don't know. Mr. Dignan is also correct that we should not be in the business of putting ourselves in the Appeal Board's place in trying to predict how they are going to act or give guidance to the parties based upon a prediction how they are going to act.

But on the other hand, the very fact that there is a provision for referral by the Licensing Board does invite us to wonder whether it's a rational thing to do to begin with. So don't know, you can take either part of the argument. Let's hear the rest of the arguments and we will take it under advisement.

We have already, in my view, given you everything that you could seek to proceed on your own. I don't know what else it could be.

MR. TRAFICONTE: I don't disagree with that. I have reviewed the transcript and I don't disagree with that. And I think that was the Board's intent. However --

JUDGE SMITH: And I think we have added to it this morning when we say, you know, this is more than just a routine evidentiary ruling. This is a evidentiary ruling predicated upon an interpretation of a very, very important Commission regulation, a regulation that pervades this hearing. And I really don't think it matters, but let's hear the rest of the arguments and maybe we will be persuaded one way or the other.

MR. TRAFICONTE: Well, I would be done at this point with one question. I will reduce my -

JUDGE SMITH: Well, I'm also interested, however, in the arguments is what are the practicalities, what are the practicalities. How is the public interest and the interest o the parties better served? Is it better served by getting it up to the Appeal Board forthwith, or is it better served by letting the case unfold to its logical conclusion, and let the take it up in due course?

I think we have a right to look at the broader aspects of it as well as the specific regulations and see what is likely to be the better course of action in the public interest, and in overall fairness to the parties, and that's probably how we're going to look at it anyway.

MR. TRAFICONTE: Well, just on the public interest, think one of the elements of the public interest, as I mentioned in my argument of 10 days ago, is the perception by the public of what the proceeding is about, and directly relevant to that is what kind of evidence is going to be reviewed. So I think there is a public interest in having thi issue addressed sooner rather than later.

But if I might, just as I understand -

JUDGE SMITH: Well, I'm interested on this point. Why don't you mouse trap them? You know, if you are so confident in your position, why don't you just relax and let the case go to a decision, and then sometime next summer you prevail, and there you are. I mean, what is your view of how the interests of your client are better served, and the interest of — how does that happen?

MR. TRAFICONTE: Well, to be forthright about it, I believe we have an interest in the best proceeding first time around. I mean, maybe that's naive, but the Mass. AG's office is not here attempting to turn this into delay just for delay sake. You know, maybe there is a presumption that that's what we are doing, but we're not. We want the hearing to be adequate. We want the evidence in. We want the Board to make the decision in accordance with what we believe the law entails, and we're not here with trumps up our sleeves assumin that we can wait you out, and we'll come back and we'll get yo reversed and we'll do this again in another year. As pleasant as this is, I don't think any of us want to go through this again next year. We'll already be doing something else next year in Massachusetts.

But that seems obvious to me that we have an interes in the integrity of the proceeding —

JUDGE SMITH: All right.

MR. TRAFICONTE: — which is real.

If I might, I just really do want to pose one question to you. You clearly don't have to answer it at all. You certainly don't have to answer it at all. You don't have to answer it on the record this morning, but it is for the purpose if the Board does decide not to refer, it's obviously for the purpose of a record that we could then use before an Appeal Board on a motion for certification. I'm not trying to pull anything.

The only question I have is, I would like to put it this way. Is the evidence we have proffered relevant, but otherwise excluded by this Board because of prior precedent, or is the evidence not relevant in the proceeding based on the prior precedent as the Board interprets it? And again, I just want that in the record.

The Board obviously has not issued a written opinion, nor is that particular issue addressed in its comments of yesterday.

MR. DIGNAN: If we're going to get into the business of questioning the Board rulings —

MR. TRAFICONTE: I have to ask questions.

MR. DIGNAN: — can I ask to leave a third box at least, none of the above?

JUDGE SMITH: Not to worry, Mr. Dignan. The subtleties in those two different questions escaped me, and we couldn't rule even if we were so inclined.

Generally speaking, however, let me state that we d not want to revisit the motion and the reasons for the decision. I don't even have the notes here anymore, they are long gone, and we made our ruling in the context of fresh arguments at the time, and I think we have gone very far in explaining our ruling, and we had invited at the time question and clarifications in an almost unprecedented degree.

So I couldn't answer your question right now even if I were so inclined, and I'm not really all that eager to answe it anyway, and we would have to study the transcript, so don't count on an answer.

I will point out in the transcript, however, we did not find an exclusionary rule. We acknowledged the argument that was made by Mr. Turk of the NRC Staff, and agreed that as an appropriate test that is the evidence more or less likely t be probative of whether the Commission's regulations are complied with or not, and we accepted that in our ruling. But I just can't sort out the differences in your questions all that well.

MR. TRAFICONTE: Well, that's clarified actually. That was not clear to me in rereading the transcript, so that' clarifying.

So the Board will take the motion for referral under advisement?

JUDGE SMITH: Yes, but quickly, as quickly as we can

PSNH PUBLIC SERVICE
Company of New Hampshire

SEABROOK STATION
Engineering Office:
20 Turnpike Road
Westborough, MA 01581

August 4, 1980

SBN-129
T.F. B.18.5.4

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

Reference: a) Construction Permits CPRR-135 (Docket No. 50-443) and CPPR-136 (Docket No. 50-444)

b) USNRC Letter to Licensees of Plants Under Construction, dated July 2, 1980

Gentlemen:

Submission of Evacuation Time Estimates

In preparation of the Seabrook Station FSAR and in answer to the request contained in Reference b), preliminary evacuation analyses have been performed for various areas surrounding the site. The results of these analyses are hereby submitted and described.

These estimates as well as many matters of emergency planning arrangements for Seabrook Station are preliminary at this time because the detailed considerations to be made and elements to be included in overall plans for the site and surrounding area are not available at this stage of station construction. An element such as the evacuation analysis methodology identified herein is one of the items that will be used for the specification of detailed traffic management and evacuation control measures which are to be established by state and local emergency preparedness personnel.

Because Seabrook emergency plan arrangements are at this preliminary stage and because the ultimate NRC and FEMA requirements for operator, state, and local emergency plan contents are not finally established, information on elements such as public notification methods, evacuation confirmation plans, and details about special institution evacuation considerations cannot be specified now. As these plans do develop through the remainder of the Seabrook Station construction period, these elements will be developed to address the final emergency preparedness requirements.

EXHIBIT 5

We express concern over the review and use of evacuation analyses and their results for the Seabrook Station site. This concern stems from the fact that public evacuation plans and their time estimates are not the only nor the most important measure of overall public protection from potential accident conditions at Seabrook Station. This measure comes from the analysis of postulated accident sequences - analyses which incorporate the mitigating effects of the substantial engineered safety features included in the Seabrook Station design. These features certainly include the complete secondary containment with a filtered vent for accident conditions. The results of these accident analyses, when used to gauge items such as evacuation time estimates, offer a more proper measure of public protection than do a review of the evacuation time estimates alone.

An example using the accident analysis results as a gauge of the evacuation time estimates was described for Seabrook at the construction permit stage of the licensing proceedings. It was demonstrated that the evacuation time estimates for peak area population conditions, when converted to doses corresponding to the results of the conservative case loss of coolant accident analysis, were sufficiently short to prevent any member of the public from exceeding the EPA Protective Action Guides for either whole body or thyroid exposures. Accident analyses now underway in preparation of the FSAR indicate the results of this type of comparison - evacuation times to radiation doses - will be even more favorable than they were at the CP stage.

Because of this we wish to urge caution in the uninterpreted use of the evacuation time estimates themselves. They should be reviewed only together with accident analysis results, which for Seabrook, take into account specific and substantial engineered safety features. This provides a more direct measure of public protection.

With this expression of concern and caution about the use of the evacuation time estimates, we present the results our analyses have produced to date in the enclosed report. This report and the application of the methodology it describes have recently been discussed with state and local emergency preparedness officials and will be considered in their efforts to develop detailed emergency planning arrangements for the Seabrook Station area.

We trust the supplied information is adequate. Should any further information be required, please contact us.

Sincerely,

Arthur M. Shepard

Arthur M. Shepard
Project Manager

JAM/111
Enclosure
cc: B.B. Beckley
J.H. Herrin
W. Sturgeon
G. Thomas
W.A. Harvey

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, ET AL. (Seabrook Station, Units 1 and 2)	)	Docket No.(s) 50-443/444-OL

CERTIFICATE OF SERVICE

I, John Traficonte, hereby certify that on January 8, 1988, I made service of the within Attorney General James M. Shannon's Motion For Directed Certification of the November 16 and 18, 1987 Atomic Safety and Licensing Board Rulings Concerning The Admissibility of Certain Evidence, by mailing copies thereof, postage prepaid, by first class mail to, and on January 7, 1988 by Federal Express to those individuals as indicated by *:

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