SECY-97-020

January 27, 1997

FOR: The Commissioners

FROM: Hugh L. Thompson, Jr. /s/
Acting Executive Director for Operations

SUBJECT: RESULTS OF EVALUATION OF EMERGENCY PLANNING FOR EVOLUTIONARY AND ADVANCED REACTORS

PURPOSE:

To inform the Commission of the results of the staff's effort to develop recommendations for technical criteria and methods to use to justify simplification of existing emergency planning (EP) requirements for evolutionary and advanced reactor designs.

SUMMARY:

In response to a Commission request, the staff performed an evaluation to develop technical criteria and methods for EP for evolutionary and advanced reactor designs. The evaluation focused on the evolutionary and passive advanced light water reactor (LWR) designs because of the availability of design and risk assessment data and because applicants were pursuing certification of these designs. The staff determined that the rationale upon which EP for current reactor designs is based, that is, potential consequences from a spectrum of accidents, is appropriate for use as the basis for EP for evolutionary and passive advanced LWR designs and is consistent with the Commission's defense-in-depth safety philosophy. Rigid application of the technical criteria derived from this rationale against the evolutionary and passive advanced LWR designs indicates that no changes to EP requirements are warranted because the potential consequences of severe accidents associated with evolutionary and passive advanced LWRs are similar to those for current reactors. The staff recognizes the industry's significant effort to make evolutionary and passive advanced LWRs safer than current designs. The staff also recognizes that changes to EP requirements may be warranted if the technical criteria for the EP requirements were modified to account for the lower probability of severe accidents or the longer time period between accident initiation and release of radioactive material for most severe accidents associated with evolutionary and passive advanced LWRs. In order to justify these types of changes to the EP basis, the staff believes that several issues, which would require significant expenditure of staff resources, need to be addressed: (1) the probability level, if any, below which accidents will not be considered for EP, (2) the use of increased safety in one level of the defense-in-depth framework to justify reducing requirements in another level, and (3) the acceptance of such changes by Federal, State, and local emergency response agencies. Because industry has not petitioned for changes to EP requirements for evolutionary and passive advanced LWRs, the staff did not dedicate the resources to fully evaluate these issues. The staff remains receptive to industry petitions for changes to EP requirements for evolutionary and passive advanced LWRs but it does not intend to dedicate further staff resources until such a petition is received.

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BACKGROUND:

In SECY 93-092, "Issues Pertaining to the Advanced Reactor (PRISM, MHGTR, and PIUS) and CANDU Designs and Their Relationship to Current Regulatory Requirements," dated April 8, 1993, the staff raised the issue, "Should advanced reactors with passive advanced design safety features be able to reduce emergency planning zones and requirements?" The staff proposed no changes to existing regulations governing EP for advanced reactors at that time; however, it did indicate that regulatory direction would be provided at or before the start of the design certification phase so that EP implications on design could be addressed.

In a staff requirements memorandum (SRM) dated July 30, 1993, the Commission stated that "it is premature to reach a conclusion on emergency planning for advanced reactors....However, the staff should remain open to suggestions to simplify the emergency planning requirements for reactors that are designed with greater safety margins. To that end, the staff should submit to the Commission recommendations for proposed technical criteria and methods to use to justify simplification of existing emergency planning requirements." The Commission further stated that "work on EP should be closely correlated with work on Accident Evaluation and Source Term, in order to avoid unnecessary conservatism. Also, the work on EP for advanced reactors should be coordinated with the approach for evolutionary and passive advanced reactors."

In response to that SRM, the staff stated in a memorandum to the Commission, dated December 22, 1993, that it would be reexamining the technical basis for EP and would be developing recommendations for possible simplification of EP requirements for reactors with greater safety margins.

In a memorandum of February 27, 1995, the staff informed the Commission of the progress of staff efforts to develop recommendations for possible simplification of EP requirements for reactor designs with greater safety margins. In that memorandum, the staff indicated that because design certifications of advanced reactors such as PRISM, MHTGR, and PIUS were not being pursued and because adequate design and risk assessment information for

these advanced reactor designs was not available, the focus and direction of the staff's effort had changed to concentrate on the evolutionary and passive advanced LWR designs[(1)] that are currently being reviewed by the staff.

DISCUSSION:

In order to gain perspective on potential technical criteria and methods for EP for evolutionary and passive advanced LWR designs and to ascertain whether simplification of the EP requirements may be warranted for these designs, the staff examined the technical basis of EP requirements for current plants and analyzed design-basis and severe-accident data for evolutionary and passive advanced LWRs. The staff's evaluation consists of two parts. Part 1 is a review of the rationale, criteria, and methods that form the basis for EP for currently licensed reactor designs as discussed in NUREG-0396, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants." Part 2 is an evaluation of whether improved safety features of evolutionary and passive advanced LWR designs may warrant changes in the technical criteria or methods used as the basis for the EP regulations and whether application of these criteria for the evolutionary and passive advanced LWRs indicates that changes to EP requirements are warranted. The staff's evaluation is summarized below.

In support of its evaluation, the staff reviewed challenges made to EP regulations for current plants (petitions for rulemaking and requests for a waiver and an exemption), new source-term and severe-accident analyses, and industry submittals concerning EP for advanced reactors. The staff recognizes that an extensive research effort has been conducted to understand accident phenomena, including fission product release and transport. The staff's review of these areas is summarized in an appendix to this paper. The staff is developing a NUREG report documenting the details of the evaluation discussed in this paper.

Part 1: Review of NUREG-0396 Rationale, Criteria, and Methods

NUREG-0396, issued in December 1978, presents the results of a study to develop a technical basis for EP. The study was performed by a task force comprising of U.S. Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA) representatives. NUREG-0396 recommended that the objective of EP should be to produce dose savings for a wide spectrum of accidents that could potentially lead to offsite doses in excess of the EPA protective action guidelines (PAGs). The PAGs represent radiation doses that warrant preselected protective actions for the public if the projected dose received by an individual would exceed the PAGs. The PAGs, in essence,

correspond to a 1-rem total effective dose equivalent and a 5-rem committed dose equivalent to the thyroid. The task force determined that the following three elements needed to be considered in establishing requirements for EP:

1. Review of the Basis for the Size of the Emergency Planning Zone (EPZ)

The most important element to be considered in establishing requirements for EP is the distance from the nuclear power plant over which emergency actions need to be planned. Two areas were identified: (1) a plume exposure pathway EPZ for planning for prompt actions to protect the public and (2) an ingestion pathway zone for planning for actions to prevent radioactive material from entering the food chain. Several rationales were considered for establishing the size of the EPZ. These included risk, probability, cost effectiveness, and accident consequence spectrum. The task force chose to base the rationale on a full spectrum of accidents and corresponding consequences tempered by probability considerations. It was the consensus of the task force that emergency plans could be based upon a generic distance within which predetermined actions would provide a dose saving for any such accidents.

The following criteria were used to determine the generic distance for the plume exposure pathway EPZ:

- The EPZ should encompass those areas in which projected dose from design-basis accidents could exceed the EPA PAGs.
- The EPZ should encompass those areas in which consequences of less severe Class 9 (core melt) accidents could exceed the EPA PAGs.
- The EPZ should be of sufficient size to provide for substantial reduction in early severe health effects in the event of the more severe Class 9 accidents.

Detailed planning within the EPZ was expected to provide a substantial base for expanding response efforts should expansion be necessary for those low probability, high consequence events whose effects extend beyond the EPZ.

To determine the areas in which these criteria were met, the task force evaluated design-basis accident data from licensees' final safety analysis reports and accident sequence and source term data from NRC document WASH-1400, "Reactor Safety Study" (1975). Specifically, the task force calculated (1) the fraction of plants that exceeded PAG doses beyond 10 miles for design-basis accidents, (2) the probability of exceeding various dose thresholds as a function of distance from the reactor, and (3) the benefit of various protective action strategies.

On the bases of these analyses, the task force recommended that emergency plans should be developed for an area within a radius of about 10 miles of the reactor for the plume exposure pathway. Using a similar rationale and considering the expected dispersal and deposition of the radioactive material and the conversion of atmospheric iodine to chemical forms that do not readily enter the ingestion pathway, an area within a radius of about 50 miles of the reactor was selected for the ingestion pathway.

2. Review of the Time-dependent Characteristics of Potential Releases

The time between the initial recognition that a serious accident is in progress and the beginning of a release of radioactive material is important for developing emergency plans, including developing the means for notifying the public of the need for taking protective actions. The task force determined that, depending on the type of accident, a wide range of time frames for such releases is possible. The Reactor Safety Study (WASH-1400) reported, for example, that major releases may begin in as short a time as one-half hour to as long as 30 hours after an initiating event. The task force concluded that EP requirements should be based on releases that may start as early as 30 minutes following the initiation of an event.

3. Review of the Potential Types of Radioactive Materials Released

In order to specify the characteristics of monitoring instrumentation, develop decision aids to estimate projected doses, and identify critical exposure modes, emergency planners need information on the characteristics of potential radioactive material releases. The NUREG-0396 task force concluded that, since the potential for releases to the environment decreased dramatically when progressing from gaseous materials to volatile solids to non-volatile solids, emergency plans should focus on the release of gaseous materials and volatile solids, such as noble gases and iodine, respectively.

Part 2: Evaluation of Rationale, Criteria, and Methods for EP for Evolutionary and Passive Advanced LWRs

The staff evaluated the evolutionary and passive advanced LWR designs to determine if changes to the rationale, criteria, and methods used to determine the EPZ size requirement and changes to EP requirements, based upon the timing and characteristics of potential radioactive material releases, could be justified.

With respect to the rationale for the size of the EPZ, the NUREG-0396 task force chose to base the size of the EPZ upon a spectrum of consequences from accidents, tempered by probability considerations. This rationale was chosen over others (i.e., risk, probability, and cost/benefit) because consequences could be used to help identify desirable planning elements and establish bounds on the planning effort. The reason for not choosing risk, probability, and cost/benefit was, in part, due to the difficulty in defining the appropriate levels of risk, probability, and cost/benefit to be used as EP criteria. The task force stated on page I-2 of NUREG-0396 that "Emergency planning is not based upon quantified probabilities of incidents or accidents....but on public perceptions of the problem and what could be done to protect health and safety. In essence, it is a matter of prudence rather than necessity."

Evolutionary and passive advanced LWRs have lower calculated probabilities of accidents than current plant designs. However, severe accidents are still possible, although very unlikely. Use of the consequence rationale is closely related to the "defense-in-depth" safety philosophy which provides multiple layers of defense so that if one layer of defense fails, another is available to protect the public. In its Safety Goal Policy Statement, 51 FR 30028, August 21, 1986, the Commission stated that: "A defense-in-depth approach has been mandated in order to prevent accidents from happening and to mitigate their consequences. Siting in less populated areas is emphasized. *Furthermore, emergency response capabilities are mandated to provide additional defense-in-depth protection to the surrounding populations*." (emphasis added) The staff believes that the current rationale for the size of the EPZ, i.e., potential consequences from a spectrum of accidents, tempered by probability considerations, should be maintained for evolutionary and passive advanced LWRs.

With respect to the three criteria (and associated methods) used by the NUREG-0396 task force for determining the size of the EPZ, the staff evaluated evolutionary and passive advanced LWR design basis-accident data and severe-accident data to determine whether modification of these criteria was justified and whether application of these criteria to the evolutionary and passive advanced LWRs indicated that the changes to EP requirements were warranted. Each of these criteria is examined below.

Criterion 1: The EPZ should encompass those areas where the projected dose from design-basis accidents could exceed the EPA PAGs.

The NUREG-0396 task force indicated that emergency planning should address design-basis accidents. The staff considered whether some aspect of evolutionary and passive advanced LWRs designs warranted modification of this criterion. This criterion, in essence, defines the extent of emergency planning for one class of the spectrum of accidents, i.e., design-basis accidents. The extent of planning should be such that protective actions could be taken in case there is a possibility of exceeding a PAG dose level if a design-basis accident occurred. No aspects of evolutionary and passive advanced LWRs would suggest that this criterion for establishing the EPZ size should be modified for evolutionary and passive advanced LWRs.

The NUREG-0396 task force evaluated the decrease in the radiation dose from design-basis accidents as a function of distance from the plant to determine the distance at which the EPA PAGs were exceeded. The staff performed a similar analysis using a limited set of design-basis accident data from the evolutionary and passive advanced LWR safety analysis reports. The results were similar to results obtained for most current plants, that is, the EPA PAGs dose levels were not exceeded beyond 10 miles. Specifically, the results indicated that the PAGs would not be exceeded beyond about 2 miles. Rigid application of this one criterion would indicate that, for the limited study performed by the staff, the EPZ size could be reduced for evolutionary and passive advanced LWRs. However, as discussed below, the other two criterion for the EPZ size indicate that the EPZ size should not be reduced.

Criterion 2: The EPZ should encompass those areas where consequences of less-severe Class 9 (core-melt) accidents could exceed EPA PAGs.

The NUREG-0396 task force indicated that the EPZ should encompass those areas in which consequences of less-severe accidents could exceed EPA PAGs. Again, in essence, this criterion defines the extent of emergency planning for one class of the spectrum of accidents, i.e., less-severe core-melt accidents. The extent of planning should be such that protective actions could be taken in case there is a possibility of exceeding a PAG dose level if a less-severe core-melt accident occurred. No aspects of evolutionary and passive advanced LWRs would suggest that this criterion for establishing the EPZ size should be modified for evolutionary and passive advanced LWRs.

The NUREG-0396 task force analyzed the probability of exceeding a whole-body dose of 1 rem as a function of distance from the reactor for less-severe core-melt accidents, i.e., those that resulted in a basemat melt-through release rather than an atmospheric release. The staff contracted with Brookhaven National Laboratory to perform a similar analysis of the consequences of less-severe core-melt accidents using evolutionary and passive advanced LWR severe-accident data. The results of this analysis were similar to results reported in NUREG-0396, that is, the probability of exceeding a 1-rem whole body dose substantially decreased at about 10 miles from the reactor. Therefore, rigid application of this criterion would not indicate that a change to the EPZ size is warranted. However, if some accident sequences were not applied against this criterion, because of the low probability of their

occurrence or because of the existence of design features to prevent their occurrence or mitigate their consequences, then reductions in the EPZ size might be possible. In order to justify these types of changes to the EP basis, the staff believes that several issues, which would require significant expenditure of staff resources, need to be addressed: (1) the probability level, if any, below which accidents will not be considered for EP, (2) the use of increased safety in one level of the defense-in-depth framework to justify reducing requirements in another level, and (3) the acceptance of such changes by Federal, State and local emergency response agencies. Because industry has not petitioned for changes to EP requirements for evolutionary and passive advanced LWRs, the staff did not dedicate the resources to fully evaluate these issues.

Criterion 3: The EPZ should be of sufficient size to provide for substantial reduction in early severe health effects in the event of the more severe Class 9 accidents.

The NUREG-0396 task force indicated that the EPZ should be of sufficient size to provide for substantial reduction in early severe health effects in the event of the more-severe Class 9 accidents. Again, in essence, this criterion defines the extent of emergency planning for one class of the spectrum of accidents, i.e., the more-severe core-melt accidents. In this case, the extent of planning should be such that protective actions could be taken where there is a possibility of severe health effects if a more-severe core-melt accident occurred. No aspects of evolutionary and passive advanced LWRs would suggest that this criterion for establishing the EPZ size should be modified for evolutionary and passive advanced LWRs.

The NUREG-0396 task force used data from all the core-melt accidents evaluated in WASH-1400 to evaluate this criterion. The evaluation showed that, given the occurrence of a severe accident, the probability of exceeding doses at which early health effects may occur (200 rem) significantly decreased at about 10 miles. The staff contracted with Brookhaven National Laboratory to perform a similar analysis of the consequences of more-severe core-melt accident using evolutionary and passive advanced LWR severe-accident data. The results of this analysis were similar to results reported in NUREG-0396, that is, the probability of exceeding a 200-rem whole-body dose substantially decreases at about 10 miles from the reactor. However, as discussed for less-severe core-melt accidents, if some accident sequences were not applied against this criterion, because of the low probability of their occurrence or because of the existence of design features to prevent their occurrence, then changes to the EPZ size might be possible.

With regard to the timing of the release, the time differential between recognition of a severe accident and a release of radioactive material for current plants was reported to be as early as 30 minutes in NUREG-0396. The time between recognition of a severe accident and the start of the release affects the time available to take action to protect the public and, therefore, affects the need for the capability to promptly notify the public of the emergency. Currently, licensees are required to notify offsite officials within 15 minutes of declaring an emergency and offsite officials need to have the capability to notify the public within about 15 minutes of receiving notification from the licensee.

A review of evolutionary and passive advanced LWR severe-accident data indicates that radioactive material could be released as early as about 1-1/2 hours after a severe accident is recognized. The 1-hour difference between the time differentials calculated for current plants and for evolutionary and passive advanced LWRs is not large and would not appear to justify changing the requirement for prompt notification of offsite officials and the general public. However, as discussed for the EPZ size, if some accident sequences with predicted early releases of radioactive material were not applied against this criterion, due to the low probability of their occurrence or because of the existence of design features to prevent their occurrence, then perhaps the requirement for prompt public notification capability could be changed. Again, the staff did not fully evaluate the effect that this change may have on size of the EPZ, nor did the staff evaluate the technical and policy issues, including public acceptance, associated with this potential change in the EP basis.

With regard to the composition of the release, the mixture of radionuclides for evolutionary and passive advanced LWRs is essentially the same as that on which current EP requirements are based and, therefore, no changes are needed to aspects of EP such as specifications for monitoring equipment, dose projection models, and exposure modes.

As discussed in the Background section of this paper, the staff focused its evaluation on the evolutionary and passive advanced LWR designs. Advanced reactor designs, such as the modular high temperature gas cooled reactor, were not evaluated. However, the same process used for evaluating EP for the evolutionary and advanced LWRs, as described in this paper, would be appropriate for evaluating EP for the more-advanced reactor designs. Changes to EP requirements may be warranted for advanced reactor designs for which the consequences from potential accidents are reduced or the timing or composition of potential releases are different from that for current reactor designs.

At the November 7, 1996, Advisory Committee on Reactor Safeguards (ACRS) meeting, the Nuclear Energy Institute stated that it is evaluating the potential consequences of severe accidents for evolutionary and passive advanced LWR designs and may petition the NRC for changes to EP requirements following completion of its study. The staff intends to remain receptive to industry petitions for changes to EP requirements.

CONCLUSION:

The staff concludes that the rationale upon which EP for current reactor designs is based, that is, potential consequences from a spectrum of accidents, is appropriate for use as the basis for EP for evolutionary and passive advanced LWR designs and is consistent with the Commission's defense-in-depth safety philosophy.

Rigid application of the technical criteria derived from this rationale against the evolutionary and passive advanced LWR designs indicates that no changes to EP requirements are warranted because the potential consequences of severe accidents associated with evolutionary and passive advanced LWRs are similar to that for current reactors. The staff recognizes that the industry has made a significant effort to make the evolutionary and passive advanced LWRs safer than current designs, and that changes to EP requirements may be warranted if the technical criteria for EP requirements were modified to account for the lower probability of severe accidents or the longer time period between accident initiation and release of radioactive material for most severe accidents associated with evolutionary and passive advanced LWRs.

In order to justify these types of changes to the EP basis, the staff believes that several issues, which would require significant expenditure of staff

resources, need to be addressed: (1) the probability level, if any, below which accidents will not be considered for EP, (2) the use of increased safety in one level of the defense-in-depth framework to justify reducing requirements in another level, and (3) the acceptance of such changes by the Federal, State and local agencies responsible for emergency planning.

Because industry has not petitioned for changes to EP requirements for evolutionary and passive advanced LWRs, the staff did not dedicate the resources to fully evaluate these issues. The staff remains receptive to industry petitions for changes to EP requirements for evolutionary and passive advanced LWRs, but does not intend to dedicate further staff resources until such a petition is received.

COORDINATION:

The ACRS was briefed on November 7, 1996, regarding the overall approach, methodology, and conclusions in this paper.

The Office of the General Counsel has no legal objection to this paper.

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APPENDIX

Reviews Supporting the Staff's Evaluation of EP for Evolutionary and Passive Advanced LWRs

Review of Challenges to EP Regulations

As part of its evaluation of the EP basis, the staff reviewed challenges to the EPZ size requirement in the EP regulations in order to gain further insight on the regulatory basis for EP and to ensure consistency with the rationale offered in previous NRC decisions when considering any potential changes for EP for evolutionary and passive advanced LWRs.

Three petitions for rulemaking were received which requested, among other things, an expansion of the EPZ radius or a determination of the EPZ size on a site-specific basis. The Commission denied those petitions citing, as part of its rationale, the Commission's decision on EP for the Shorehem Nuclear Power Station (CLI-87-12, 26 NRC 383) which quoted the following excerpt from NUREG-0396: "Emergency response plans should be useful for responding to any accident that would produce offsite doses in excess of the PAGs...it was the consensus of the task force that emergency plans could be based upon a generic distance out to which predetermined actions would provide dose savings for any such accidents. Beyond this generic distance it was concluded that actions could be taken on an ad hoc basis using the same considerations that went into the initial action determinations." Furthermore, the Commission stated that "a reading of the Report [NUREG-0396] indicates clearly that the margins of safety provided by the recommended 10 mile radius were not calculated in any precise fashion, but were qualitatively found adequate as a matter of judgment."

Two licensees have petitioned the Commission to allow for a reduction in the size of the EPZ. In 1985, the licensee for Calvert Cliffs requested exemptions and license amendments to allow for reduction in the 10-mile EPZ to 2 miles and, in 1986, applicants for the Seabrook nuclear power plant requested a waiver to allow for reduction in the 10-mile EPZ to 1 mile. The technical argument supporting these requests was that a site-specific analysis of design-basis and severe-accident risks showed a decrease in these risks relative to the risks considered in NUREG-0396. In regard to the Calvert Cliffs exemption request, the NRC staff concluded that it could not consider the request because the NRC was still studying severe-accident issues (April 11, 1988, letter from S. Varga (NRC) to J. Tiernan (BG&E)). In regard to the Seabrook petition, the Atomic Safety and Licensing Board concluded that "there are a number of areas wherein it appears the Applicants had not presented full and complete results sufficient to inspire confidence that their motion deserves further consideration at this time" (ASLBP 82-471-02-02).

The insights gained from review of these challenges to the EPZ size requirement are (1) the objective of EP is to provide for dose savings for accidents with releases which could exceed PAG levels, (2) a generic plume exposure pathway EPZ size of about 10 miles has been qualitatively found adequate, and (3) industry-sponsored studies contend that a reduction in the EPZ size is warranted based upon site-specific risk analysis.

Review of New Source Term and Severe Accident Data

Two reports summarize the NRC's improved understanding of design-basis and severe-accident risk at nuclear power plants: (1) NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," updates the risk estimates from WASH-1400 using improved probabilistic risk assessment (PRA) techniques and better understanding of severe-accident phenomena and (2) NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," updates the postulated fission product source term released into containment used to determine offsite and control room doses for design-basis accidents to assure that such doses are within the guidelines of 10 CFR Part 100 and in conformance with General Design Criterion 19 of Appendix A to 10 CFR Part 50; it also provides useful insights for accidents progressing beyond design-basis accidents.

NUREG-1150 provides information on the type, consequences, and probability of severe accidents as well as information on the effect of various public protective measures, e.g., evacuation of the population around the plant. NUREG-1150 shows that the risk from currently licensed plants falls within the range of, or is less than, the risk calculated in WASH-1400. In addition, the NUREG-1150 study indicates that there is a large degree of uncertainty in the results.

NUREG-1465 provides information on the source term (i.e., type and quantity) of radioactive material released into containment during design-basis events and shows that the source term currently endorsed by the NRC for calculating the release from a design-basis accident is conservative. The

NUREG-1465 source term has been used by the staff for design certification reviews of evolutionary and passive advanced LWRs to calculate the consequences from design-basis accidents in which there is a substantial meltdown of the core with the containment leaking at its design leakage rate. One of the criteria used for determining the EPZ size was that "the EPZ should encompass those areas where the projected dose from design basis accidents could exceed the Environmental Protection Agency (EPA) Protective Actions Guidelines (PAGs)." The staff believes that use of the new source term will likely result in a reduction in the distance within which doses are calculated to exceed PAG levels from design-basis accidents. Therefore, if the size of the EPZ were based solely on this criterion, a reduction in the size of the EPZ may be warranted. However, the size of the EPZ was based upon consideration of a spectrum of accidents, including severe accidents of the type analyzed in WASH-1400 and NUREG-1150, which indicate that a 10-mile EPZ is appropriate.

Review of Industry Submittals

The Electric Power Resource Institute (EPRI), Nuclear Energy Institute (NEI), and an applicant for design certification of an evolutionary reactor design, have submitted documents that provide technical bases supporting a reduction in EP requirements for evolutionary and passive advanced LWRs. An overview of these submittals and the staff's evaluation of them follows:

EPRI Utility Requirements Document -- Section 2.6 of the EPRI Utility Requirements Document discusses the criteria and methodology for evolutionary and passive advanced LWR EP. The following criteria were proposed:

- Containment performance criteria: Plant design characteristics and features shall be provided to preclude damage sequences which could bypass containment and to withstand core damage sequence loads.
- Site boundary dose criteria: Dose at 0.5 mile from the reactor from a physically based source term shall not exceed 1 rem for approximately 24 hours.
- Supplemental PRA evaluation: Sequences resulting in greater than a 1 rem dose over 24 hours at the site boundary shall have a core-damage frequency of $< 10^{-5}$ and a cumulative frequency of $< 10^{-6}$.

The following methodology was proposed:

- Containment performance methodology: Demonstrate that the pressure and temperature loads associated with core-damage sequences are no more limiting than the peak loss-of-coolant accident plus hydrogen loads.
- Site boundary dose methodology: Demonstrate that the site boundary dose criterion is met utilizing a physically based source term (similar to that described in NUREG-1465) released into an intact containment.
- Supplemental PRA: Perform PRA in accordance with assumptions provided in the Utility Requirements Document.

There was no discussion regarding how these criteria and methodologies could be used to establish the size of an EPZ or the types of accidents for which EP should be established. Rather, these criteria seem to be directed at establishing a level of safety for which no (or a reduced level of) offsite EP would be necessary.

ABB/CE System 80+ Design Basis Accident PAG Dose Calculation -- The safety analysis report submitted for design certification of the System 80+ contained a calculation of the dose at the site boundary from a loss-of-coolant accident which progressed beyond the design basis to where an ex-vessel release of core material to the containment occurred. This calculation utilized the draft NUREG-1465 source term and showed that the dose at the site boundary was below the PAG levels. This calculation is consistent with that specified in the EPRI Utility Requirements Document for meeting the site boundary dose criterion.

NEI Response and Awareness Areas -- In a public meeting held on January 24, 1995, and at an Advisory Committee for Reactor Safeguards (ACRS) meeting held on November 7, 1996, NEI briefed the staff on its concept of EP for evolutionary and passive advanced LWRs. In the NEI concept, the current EPZ would be replaced with a "response area" and an "awareness area." The response area is "that area close to the plant within which a serious reactor accident could possibly cause radiological consequences of sufficient concern that there should be provisions for prompt notification and response." The size of the response area would be based on the distance at which a 1-rem dose would not be exceeded for approximately 1 day or longer following a "maximum credible accident." Planning elements within the response area would be similar to that required in existing EP. The awareness area is that area within which the radiological effects following a serious accident would be small and would take place over a longer period.

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1. Evolutionary designs include the Asea-Brown-Boveri/Combustion Engineering (ABB/CE) System 80+ and the General Electric (GE) Advanced Boiling Water Reactor. Passive designs include the Westinghouse AP600 and the GE Simplified Boiling Water Reactor.