November 20, 2000

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT	)	Docket No. 50-400-LA
COMPANY	)	
(Shearon Harris Nuclear Power Plant)	)	ASLBP No. 99-762-02-LA

SUMMARY OF FACTS, DATA, AND ARGUMENTS ON WHICH APPLICANT PROPOSES TO RELY AT THE SUBPART K ORAL ARGUMENT REGARDING CONTENTION EC-6

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I. INTRODUCTION

Pursuant to the Board's Memorandum and Order (Ruling on Late-Filed Environmental Contentions) dated August 7, 2000,[1] Applicant Carolina Power & Light Company ("CP&L") submits its "Summary of Facts, Data, and Arguments on which Applicant Proposes to Rely at the Subpart K Oral Argument Regarding Contention EC-6" ("Applicant's Summary"). As required by 10 C.F.R. § 2.1113(a), attached as exhibits to Applicant's Summary are supporting facts and data in the form of sworn written affidavits.

1 Carolina Power & Light Co. (Shearon Harris Nuclear Plant), LBP-00-19 NRC ___, slip op. (August 7, 2000) (hereinafter "Order").

This proceeding relates to CP&L's December 23, 1998 application for a license amendment to place spent fuel pools C and D in service at CP&L's Harris Nuclear Plant ("Harris Plant," or "Harris").[2] Harris was originally planned as a four nuclear unit site (Harris Units 1, 2, 3 and 4). In order to accommodate four units, the Harris fuel handling building was designed and constructed with four separate pools capable of storing spent fuel. Spent fuel pools A and B were originally intended to support Harris Units 1 and 4. Spent fuel pools C and D were originally intended to support Harris Units 2 and 3.

Harris Units 3 and 4 were canceled in late 1981. Harris Unit 2 was canceled in late 1983. Spent fuel pools A, B, C and D and the spent fuel pool cooling and cleanup system ("SFPCCS") for spent fuel pools A and B were completed as part of the fuel handling building, are described in the Harris Final Safety Analysis Report ("FSAR"), and are licensed as part of Harris. Construction on the SFPCCS for spent fuel pools C and D was discontinued after Harris Unit 2 was canceled. By that time, all four spent fuel pools had been constructed, concrete had been poured, and the SFPCCS piping was installed, welded in place and embedded in reinforced concrete.

The Final Environmental Statement[3] supported the issuance of the Operating License for Harris Unit 1 alone, as Harris Unit 2 had been cancelled. The FES, however, considered two-unit operation and bounded the environmental impacts for single unit

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2 Shearon Harris Nuclear Power Plant Docket No. 50-400/License No. NPF-63 Request For License Amendment Spent Fuel Storage (Dec. 23, 1998) (hereinafter "License Amendment Application").

3 NUREG-0972, "Final Environmental Statement Related to the Operation of Shearon Harris Nuclear Power Plant, Units 1 and 2" (1983) (hereinafter "FES").

operation. In fact, the maximum number of fuel assemblies contemplated at the time of the FES, for two-unit operation with all four spent fuel pools, exceeds the maximum number of fuel assemblies that will be stored pursuant to the instant License Amendment Application, because of the 1.0 MBTU/hr limit on total heat generation in spent fuel pools C and D.[4]

Harris Unit 1 began commercial operations in 1987. In addition, Harris was licensed to accept spent fuel for storage from CP&L's other nuclear plants, H. B. Robinson Unit 2, and Brunswick Units 1 and 2. Beginning in 1989, spent fuel assemblies from Robinson and Brunswick with cooling time greater than five years have been regularly shipped to Harris and are stored in spent fuel pools A and B.

The December 23, 1998 License Amendment Application and the need to expand spent fuel storage at Harris result from the failure of the U.S. Department of Energy ("DOE") to begin taking delivery of spent fuel in 1998, as required by the contract between DOE and CP&L and by the Nuclear Waste Policy Act of 1982, as amended.

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4 The Applicant's License Amendment Application includes the addition of Technical Specification 5.6.3.d to the Harris operating license, which requires that "[t]he heat load from fuel stored in Pools 'C' and 'D' shall not exceed 1.0 MBtu/hr." Lic. Amend. App., Encl. 5 at 5-7a. Pursuant to the 1.0 MBTU/hr Technical Specification limit, Applicant does not currently intend to load any fuel in spent fuel pool D under this license amendment. See Lic. Amend. App., Encl. 1 at 4 (pool D is not scheduled for use until 2016). The total number of assemblies in pools A, B and C combined, even if pool C was loaded to its maximum capacity, is less than the total number of assemblies that was considered in the FES. Compare Lic. Amend. App. Enc. 1 at 1 (Harris originally licensed for up to 7640 assemblies), with id. at 3 (pools A, B and C combined would store 7359 assemblies). See also Lic. Amend. App., Encl. 5 at 5-7, Technical Specification 5.6.3.

CP&L had requested that the license amendment to allow placement of spent fuel in spent fuel pools C and D be issued no later than December 31, 1999. CP&L originally planned to begin loading spent fuel in pool C in 2000. Further delays could adversely impact CP&L's ability to maintain adequate spent fuel storage capacity and, with the loss of full core discharge capability at one or more of CP&L's nuclear plants, could lead to a forced shutdown of the CP&L nuclear units.

Applicant invoked the Subpart K Procedures after the Board admitted Technical Contentions 2 and 3 proffered by intervenor Board of Commissioners of Orange County ("BCOC").[5] On January 21, 2000, the Board heard oral argument on whether to designate either of the two admitted issues for an evidentiary hearing. The Board determined that BCOC had failed to show that there was a genuine and substantial dispute of fact or law that could only be resolved by an evidentiary hearing, and disposed of both contentions in CP&L's favor.[6]

The Board admitted Contention EC-6 for litigation on August 7, 2000. The parties conducted discovery pursuant to the Board's schedule, which required completion of discovery by October 20, 2000.[7]

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5 Licensing Board Memorandum and Order (Ruling on Standing and Contentions), slip op. (July 12, 1999).

6 Licensing Board Memorandum and Order (Ruling on Designation of Issues for an Evidentiary Hearing) slip op. at 88-89 (May 5, 2000).

7 Order at 19. During the discovery period, counsel for Applicant deposed BCOC's sole proffered expert, Dr. Gordon Thompson; BCOC's counsel deposed CP&L's experts Dr. Edwards Burns and Mr. Robert Kunita, CP&L's Manager of Environmental & Radiation Control, Mr. Ed Wills, and NRC Staff experts Dr. Gareth Parry, Robert Palla, and Stephen LaVie. In addition, Applicant provided

Footnote continued on next page

This Applicant's Summary presents the facts, data, and arguments on which Applicant proposes to rely at the oral argument with regard to Contention EC-6.

Part II of Applicant's Summary describes the strict standards for an adjudicatory hearing required by 10 C.F.R. Part 50, Subpart K and the burden of proof that BCOC cannot possibly sustain.

Part III discusses the law applicable to determining whether consideration of the consequences of BCOC's postulated scenario involving a sequence of seven events, which begins with a postulated severe reactor accident with containment failure or bypass and a release of radionuclides (the "postulated scenario"), is required pursuant to the National Environmental Policy Act.

Part IV answers the Board's first question as set forth in the Order, and discusses Applicant's best estimate of the overall probability of the postulated scenario at Harris.

Part V answers the Board's second question and discusses whether any recent developments or new data or models suggest modification of the probability value determined in NUREG-1353 and whether any of the concerns expressed in the Advisory Committee on Reactor Safeguards' ("ACRS") letter dated April 13, 2000, are applicable to the postulated scenario. We also discuss the relevance of NUREG-1353 to the postulated scenario.

Footnote continued from previous page

BCOC's counsel and Dr. Gordon Thompson a guided tour of the Harris Plant and took photographs of plant features requested by BCOC. The parties responded to interrogatories and produced documents in response to requests for relevant documents.

Part VI answers the Board's third question and discusses why no additional environmental impact analysis by the NRC Staff is required under any circumstance.

Part VII states the actions requested of the Board by Applicant at the conclusion of oral argument.

Applicant's Summary is supported by seven sworn statements in the form of affidavits with supporting attachments. We introduce each affidavit and its purpose below.

Exhibit 1 is the Affidavit of Dr. Edward T. Burns ("Burns Affidavit"). Dr. Burns is employed by ERIN Engineering and Research, Inc. ("ERIN") as Vice President and General Manager of BWR Technology. ERIN is the industry leader in risk management and application of risk and reliability analysis techniques to various situations and activities at nuclear power plants. Dr. Burns' affidavit describes the extensive probabilistic analysis and review effort performed by ERIN to determine the best estimate of the overall probability of the postulated scenario. First, Dr. Burns describes his role in preparing a response to the Board's questions, the tasks assigned to ERIN by CP&L, and the team he assembled to perform those tasks. Second, he describes generally the bases of probabilistic risk assessment, the advances in techniques and knowledge since initial applications, and the quality of the existing Harris Individual Plant Examinations ("IPE") and updated Probabilistic Safety Assessment ("PSA"). Third, he discusses the methodology and results, including uncertainty, of the ERIN analyses. Dr. Burns concludes that the postulated scenario has a best estimate overall

annualized probability of occurrence at Harris of less than three in one hundred million. ERIN's comprehensive technical report is Attachment C to Exhibit 1 ("ERIN Report").

Exhibit 2 is the Affidavit of Robert K. Kunita ("Kunita Affidavit"). Mr. Kunita has been employed by CP&L since 1973 and is currently a Principal Engineer, Spent Fuel Management. Mr. Kunita's affidavit evaluates the likelihood of the occurrence of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding in Harris spent fuel pools C and D following a postulated evaporation of water uncovering the spent fuel (i.e., "Step 7" in the postulated scenario). First, he describes the principles of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding. Second, Mr. Kunita discusses the literature survey he conducted to research the likelihood of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding. Third, he describes the application of the information obtained in his literature survey to the specific spent fuel to be stored in Harris spent fuel pools C and D and the analyses he performed to establish that a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding is highly unlikely at Harris. Finally, Mr. Kunita concludes that the old, cold fuel to be stored in Harris spent fuel pools C and D, is highly unlikely to undergo such a self-sustaining exothermic oxidation reaction even if evaporation of the pool water occurs.

Exhibit 3 is the Affidavit of Steven A. Laur, P.E. ("Laur Affidavit"). Mr. Laur is the CP&L Superintendent of the Probabilistic Safety Assessment Unit. The purpose of Mr. Laur's affidavit is to describe the scope of engagement and Harris-specific information that was provided to ERIN for performance of ERIN's analysis of the

postulated scenario. First, Mr. Laur describes the documents, including the Harris PSA and the Harris Individual Plant Examination of External Events ("IPEEE"), that were used to perform the ERIN probabilistic analysis. Second, he discusses the specific steps, including an independent peer review of the Harris PSA, that CP&L took to ensure that the ERIN analysis was consistent with the Harris-specific attributes. Finally, Mr. Laur concludes that the ERIN analysis is of high quality and appropriately uses the Harris updated PSA model, the Harris IPEEE analysis and other Harris-specific information.

Exhibit 4 is the Affidavit of R. Steven Edwards ("Edwards Affidavit"). Mr. Edwards has been employed by CP&L since 1982 and is presently the Supervisor, Spent Fuel Project, responsible for commissioning and placing into service Harris spent fuel pools C and D. The purpose of his affidavit is to set forth the data and calculations on which CP&L relies in establishing the time to heat up the Harris spent fuel pools to boiling, and after boiling has started, the additional time necessary to boil the coolant level down to the top of the spent fuel racks. First, Mr. Edwards summarizes the background of the License Amendment Application and the information submitted in support of the application. Second, he describes the Harris spent fuel pool physical arrangement and associated equipment. Third, Mr. Edwards discusses the heatup calculations and their applicability to the Harris spent fuel pools. Fourth, he discusses the data and assumptions used in calculations. Finally, he describes the results of the time to heat-up and time to boil calculations. Mr. Edwards calculates that the time available to restore makeup water to the spent fuel pools is over a week under worst case assumptions.

Exhibit 5 is the Affidavit of Eric A. McCartney ("McCartney Affidavit"). Mr. McCartney is the Supervisor, Licensing/Regulatory Programs, responsible for managing regulatory interfaces for Harris. The purpose of his affidavit is to describe the numerous, diverse sources of water and methods of delivery which exist for establishing makeup to the Harris spent fuel pools. First, Mr. McCartney describes the Harris spent fuel pool physical arrangement, systems configurations, and plant equipment associated with normal and alternate makeup to the spent fuel pools. Second, he discusses the methods available for supplying makeup water to the Harris spent fuel pools and identifies the Harris procedures, controls, conditions, and equipment that establish the viability of each method. Third, Mr. McCartney describes the Technical Support Center ("TSC"), its functions and personnel, and how the Severe Accident Management Guidelines ("SAMGs") are used to assist the operating staff in responding to emergency conditions outside of existing procedures. Finally, he concludes that there are numerous, diverse methods for providing cooling and makeup water to the Harris spent fuel pools following a loss of normal cooling, that Harris operators are trained and capable of performing the actions necessary to initiate one or more of these methods under emergency conditions, and that the necessary tools and equipment are available to perform the required actions.

Exhibit 6 is the Affidavit of Michael J. DeVoe ("DeVoe Affidavit"). Mr. DeVoe is a nuclear engineer, employed by CP&L since 1984. He presently works in the Nuclear Fuel Services Unit of CP&L's Nuclear Fuel Management & Safety Analysis Section. The purpose of his affidavit is to describe the reactor core radioisotope inventory utilized in the dose rate calculations for the postulated scenario. First, Mr. DeVoe describes the

key assumptions and methodology used to develop the reactor core radioisotope inventory used in analyzing the postulated scenario. Second, he describes the CP&L owner's reviews performed on the reactor core radioisotope inventory calculation. Third, Mr. DeVoe describes the information provided to other CP&L personnel for use in performing the dose calculations. Finally, Mr. DeVoe concludes that the use of the calculated reactor core isotope inventory is appropriate for calculating dose rates resulting from the postulated scenario.

Exhibit 7 is the Affidavit of Benjamin W. Morgan, C.H.P. ("Morgan Affidavit"). The purpose of his affidavit is to describe the process he employed in performing the dose rate calculations to enable ERIN to determine the accessibility of Harris buildings and external areas following releases of radionuclides from the postulated scenario. First, Mr. Morgan describes the information he used as input to his calculations. Second, he discusses the methodology and assumptions he used in evaluating the dose rates at various locations resulting from the postulated scenario. Third, Mr. Morgan describes the methodology and assumptions he used to determine potential access restrictions and the information provided to ERIN. Fourth, he discusses the conservatisms in the dose rate calculations. Finally, he concludes that his dose calculations accurately represent a conservative estimate of conditions expected following the postulated scenario based on accepted industry analysis methodologies and Harris-specific information. He also concludes with a high degree of confidence that his dose calculation results demonstrate that certain internal and external areas at Harris are sufficiently accessible within

96 hours of the postulated scenario to allow personnel entrance to mitigate a postulated loss of spent fuel pool cooling and makeup.

Two other exhibits are attached for the convenience of the Board:

Exhibit 8 is the transcript of the sworn deposition of BCOC's designated expert Dr. Gordon Thompson ("Thompson Deposition").

Exhibit 9 is the transcript of the sworn deposition of the NRC Staff's expert on probabilistic risk assessment Dr. Gareth W. Parry ("Parry Deposition").

II. BCOC CANNOT SUSTAIN ITS BURDEN TO DEMONSTRATE THAT AN ADJUDICATORY HEARING MUST BE HELD TO RESOLVE CONTENTION EC-6

A. Contention EC-6 and the Questions Posed by the Board.

BCOC Contention EC-6, "Environmental Impact Statement Required," reads:

> In the Environmental Assessment ("EA") for CP&L's December 23, 1998, license amendment application, the NRC Staff concludes that the proposed expansion of spent fuel storage capacity at the Shearon Harris nuclear power plant will not have a significant effect on the quality of the human environment. Environmental Assessment and Finding of No Significant Impact Related to Expanding the Spent Fuel Pool Stage Capacity at the Shearon Harris Nuclear Power Plant (TAC No. MA4432) at 10 (December 15, 2000). Therefore, the Staff has decided not to prepare an Environmental Impact Statement ("EIS") for the proposed license amendment. The Staff's decision not to prepare an EIS violates the National Environmental Policy Act ("NEPA") and NRC's implementing regulations, because the Finding of No Significant Impact ("FONSI") is erroneous and arbitrary and capricious. In fact, the proposed expansion of spent fuel pool storage capacity at Harris would create accident risks that are significantly in excess of the risks identified in the EA, and significantly in excess of accident risks previously evaluated by the NRC Staff in the EIS for the Harris

> operating license. These accident risks would significantly affect the quality of the human environment, and therefore must be addressed in an EIS.
>
> There are two respects in which the proposed license amendment would significantly increase the risk of an accident at Harris:
>
> (1) CP&L proposes several substantial changes in the physical characteristics and mode of operation of the Harris plant. The effects of these changes on the accident risk posed by the Harris plant have not been accounted for in the Staff's EA. The changes would significantly increase, above present levels, the probability and consequences of potential accidents at the Harris plant.
>
> (2) During the period since the publication in 1979 of NUREG-0575, the NRC's Generic Environmental Impact Statement ("GEIS") on spent fuel storage, new information has become available regarding the risks of storing spent fuel in pools. This information shows that the proposed license amendment would significantly increase the probability and consequences of potential accidents at the Harris plant, above the levels indicated in the GEIS, the 1983 EIS for the Harris operating license, and the EA. The new information is not addressed in the EA or the 1983 EIS for the Harris operating license.
>
> Accordingly, the Staff must prepare an EIS that fully considers the environmental impacts of the proposed license amendment, including its effects on the probability and consequences of accidents at the Harris plant. As required by NEPA and Commission policy, the EIS should also examine the costs and benefits of the proposed action in comparison to various alternatives, including Severe Accident Mitigation Design Alternatives ("SAMDAs")and the alternative of dry storage.[8]

To support its contention, BCOC postulated the following seven-step chain of events ("postulated scenario"):

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[8] Order at 10-11 (internal footnote omitted).

(1) a degraded core accident;

(2) containment failure or bypass;

(3) loss of all spent fuel cooling and makeup systems;

(4) extreme radiation doses precluding personnel access;

(5) inability to restart any pool cooling or makeup systems due to extreme radiation doses;

(6) loss of most or all pool water through evaporation; and

(7) initiation of an exothermic oxidation reaction in pools C and D.[9]

In order to assess the significance of materials submitted in support of their positions, the Board asked the parties to address the following points:

1. What is the submitting party's best estimate of the overall probability of the sequence set forth in the chain of seven events in the CP&L and BCOC's filings, set forth on page 13 supra? The estimates should utilize plant-specific data where available and should utilize the best available generic data where generic data is relied upon.

2. The parties should take careful note of any recent developments in the estimation of the probabilities of the individual events in the sequence at issue. In particular, have new data or models suggested any modification of the estimate of 2×10^{-6} per year set forth in the executive summary of NUREG-1353, Regulatory Analysis for the Resolution of Generic Issue 82, Beyond Design Basis Accidents in Spent Fuel Pools (1989)? Further, do any of the concerns expressed in the ACRS's April 13, 2000 letter suggest that the probabilities of individual elements of the sequence are greater than those previously analyzed (e.g., is the chance of occurrence of sequence element seven, an exothermic reaction, greater than assumed in the decade-old NUREG-1353)?

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9 Id. at 13.

3. Assuming the Board should decide that the probability involved is of sufficient moment so as not to permit the postulated accident sequence to be classified as "remote and speculative," what would the overall scope of the environmental impact analysis the staff would be required to prepare (i.e., limited to the impacts of that accident sequence or a full blown EIS regarding the amended request)?[10]

B. Congress Created Special Procedures For Spent Fuel Storage Expansion License Amendments.

In the Nuclear Waste Policy Act of 1982,[11] Congress recognized that it would be many years before a permanent repository was ready to accept spent nuclear fuel. The Act provided special expedited licensing procedures designed "to encourage utilities to expand storage capacity at reactor sites."[12] The new procedures require written submissions and sworn testimony on any contentions, along with oral argument on the issues.[13] Following the oral argument, the Licensing Board must determine whether any of the contentions merits an adjudicatory hearing:

> (b) ADJUDICATORY HEARING. (1) At the conclusion of any oral argument . . . , the Commission shall designate any disputed question of *fact*, together with any remaining questions of law, for resolution in an adjudicatory hearing only if it determines that —
>
> > (A) there is a genuine and substantial dispute of *fact* which can only be resolved with sufficient accuracy by the introduction of evidence in an adjudicatory hearing; and

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10 Id. at 17.

11 42 U.S.C. § 10101 et seq. (2000).

12 H.R. Rep. No. 97-785, at 39 (1982).

13 42 U.S.C. § 10154(a) (2000).

> (B) the decision of the Commission is likely to depend in whole or in part on the resolution of such dispute.[14]

Congress reasoned that by "scoping" the issues in this manner, the time and expense of adjudicatory hearings could be avoided unless the *factual* issues were truly significant and capable of accurate resolution only through full-blown adjudicatory proceedings.[15] It was recognized that the standards for an adjudicatory hearing were "extremely narrow."[16] Nevertheless, the narrow standards were judged necessary for a "streamlined regulatory process" that would "insure predictable and timely measures necessary to keep America's nuclear power plants in full operation without any threat of reduced operations or shutdown because of a failure by the Federal Government to provide for interim spent fuel management."[17]

C. The Purpose of Subpart K is to Expedite Resolution of Spent Fuel Licensing Issues.

The Nuclear Regulatory Commission implemented the Act's new procedures via a 1985 rulemaking that added Subpart K to the Commission's regulations.[18]

The regulations track the statutory language. Thus, an issue may be designated for an adjudicatory hearing *only* if (1) there is a genuine and substantial dispute of fact; *and* (2) the dispute can be resolved with sufficient accuracy *only* through introduction of

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14 Id. § 10154(b) (emphasis added).

15 H.R. Rep. No. 97-785, at 39, 82.

16 128 Cong. Rec. S15,644 (daily ed. Dec. 20, 1982) (statement of Sen. Mitchell).

17 128 Cong. Rec. S4155 (daily ed. Apr. 28, 1982) (statement of Sen. McClure).

18 50 Fed. Reg. 41,662 (1985).

evidence at an adjudicatory hearing; *and* (3) the Commission's ultimate decision is likely to depend in whole or in part on the resolution of the dispute.[19] Any issues not meeting this test are to be disposed of by the Licensing Board promptly after the oral argument.[20]

Promptness, or the lack thereof, is an issue of significant weight in light of the two-year length of these proceedings and the associated burdens already placed upon Applicant. The Commission in adopting Subpart K acknowledged that the purpose of NWPA section 134 "is *to encourage and expedite the licensing of onsite spent fuel expansions and transshipments*."[21] Further, the Commission reiterated "its long-standing commitment to the expeditious completion of adjudicatory proceedings" only a few months before Applicant submitted the License Amendment Application at the focus of this proceeding.[22] An expedited resolution of this proceeding is required by the Commission's rules and policy.

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19 10 C.F.R. § 2.1115(b) (1997) (emphasis added).

20 Id. § 2.1115(a)(2). The proposed rule would have required the Licensing Board to "decide" all issues not designated for an adjudicatory hearing. 48 Fed. Reg. 54,499, 54,505 (1983). The Edison Electric Institute and a group of interested utilities submitted comments challenging the proposed language requiring the Board to "decide" all issues, when in fact "dismiss" may be the more appropriate way to resolve certain issues. The NRC accommodated this comment in the final rule by using the term "dispose," which can include both "decide" and "dismiss."

21 50 Fed. Reg. at 41,665 (emphasis added).

22 "Policy on Conduct of Adjudicatory Proceedings; Policy Statement," 48 NRC 18, 24 (1998).

D. Adjudicatory Hearings are Reserved for Genuine and Substantial Disputes of Material Facts That Cannot Be Resolved Without a Hearing.

In adopting the Subpart K regulations, the Commission made it clear that the threshold for an adjudicatory hearing is strict:

> The Commission continues to believe that the statutory criteria are sufficient. As the Commission pointed out in connection with the proposed rules, the statutory criteria are *quite strict* and are designed to ensure that the hearing is focused exclusively on *real issues*. They are similar to the standards under the Commission's existing rule for determining whether summary disposition is warranted. *They go further, however, in requiring a finding that adjudication is necessary to resolution of the dispute and in placing the burden of demonstrating the existence of a genuine and substantial dispute of material fact on the party requesting adjudication.*[23]

The Board reminded the parties of BCOC's burden of demonstrating the existence of a genuine and substantial dispute of material fact in the Order directing the Subpart K proceeding.[24] Accordingly, as with its earlier, rejected contentions, BCOC again bears the burden of demonstrating that it is entitled to an adjudicatory hearing.

The Subpart K rules must be strictly applied to limit such hearings to real issues that can be decided only through formal adjudicatory procedures. First, there must be a dispute of fact. Pure questions of law obviously do not require an adjudicatory hearing

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23 Id. at 41,667 (emphasis added).

24 Licensing Board Memorandum and Order (Subpart K Oral Argument Procedures), slip op. at 2 (Jan. 13, 2000).

and can be resolved by the Board on the briefs.[25] The only exceptions might be legal issues so interrelated with factual issues designated for a full hearing that they cannot be decided independent of the factual determination. Legal issues standing alone can never justify an adjudicatory hearing.

Second, the factual dispute must be genuine and substantial. If the dispute is genuine but peripheral or of secondary importance, then no hearing is warranted and the Board can resolve the issue on the basis of the sworn testimony and written submissions filed by the parties.

Third, even if the factual dispute is genuine and substantial, a hearing is still not warranted unless it is the type of dispute that can be accurately resolved only with traditional adjudicatory procedures, such as oral testimony from live witnesses subject to cross-examination. This might be the case, for example, if the issue turned primarily on the credibility of a particular witness. Most factual disputes, however, depend on technical or scientific issues that can be accurately decided on written submissions. Such issues are typically decided on the basis of plant records, scientific reports and other written materials that the Board itself can evaluate, drawing upon its own technical expertise. In this sense, the Subpart K rules go beyond the usual summary disposition procedures, as the Commission pointed out. Under the usual summary disposition

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25 See 10 C.F.R. § 2.714(e) (1997) ("If the Commission or the presiding officer determines that any of the admitted contentions constitute pure issues of law, those contentions must be decided on the basis of briefs or oral argument according to a schedule determined by the Commission or presiding officer.").

procedures, any genuine issue of material fact requires a hearing.[26] Under Subpart K, by contrast, Licensing Boards must dispose of genuine factual issues without a hearing, if they are able to do so with sufficient accuracy.

Fourth, the resolution of the factual issue must be *central* to the ultimate decision in the case. In contrast, the summary disposition rules simply require the factual issue to be "material."[27] The Subpart K rules provide that a hearing may be held only if the Commission's decision "is likely to depend in whole or in part" on the resolution of the factual dispute. This is a stricter threshold than simple materiality. It implies that the factual issue must play a central role in the ultimate outcome of the case as a whole. Failing that, no adjudicatory hearing may be held.

E. BCOC Does Not Intend to Submit Facts or Data on Which to Base a Genuine and Substantial Dispute, Nor Has It Retained Experts Capable of Addressing the Board's Questions.

It may appear self-evident, but a genuine and substantial factual dispute requires the opposing parties to identify and argue relevant *facts*. Applicant, as discussed in detail below, has assembled data, analyses, and expert evaluations to support its position. The facts are presented in sworn affidavits by a team of individuals in various disciplines who have the relevant education, training, knowledge, experience, and access to identify and discuss relevant facts. These facts are interpreted by experts with the education, training, knowledge and experience to understand the facts, apply state-of-the-technology probabilistic assessment methodologies, and provide expert opinions necessary to answer

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26 10 C.F.R. § 2.749 (1997).

27 Id. § 2.749(d).

the Board's questions. The NRC Staff, we understand, has also expended significant effort to do likewise.[28]

BCOC has not retained individuals who by education, training, knowledge or experience are capable of attesting to relevant facts or evaluating their significance. BCOC continues to rely solely on Dr. Gordon Thompson to attempt to address the wide range of technical issues involved in analyzing the complex accident scenario that he postulated.[29] This would be a daunting task for any one individual – even one with strong technical credentials. As the Board has found previously, however, Dr. Thompson's "expertise relative to reactor technical issues seems largely policy-oriented rather than operational."[30] Dr. Thompson's deposition during this phase of the proceeding once again confirmed that he lacks relevant knowledge and technical expertise to make a substantive contribution to an adjudicatory hearing.

While Dr. Thompson claims to be an expert "for purposes of this proceeding" capable of leading a team of experts on a multi-year research process to address the Board's questions on his own postulated scenario,[31] his answers to questions suggest otherwise:

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28 Parry Dep. at 46-47 (describing the use of information from a variety of experts to answer the Board's questions).

29 Thompson Dep. at 28.

30 See Licensing Board Memorandum and Order (Ruling on Designation of Issues for an Evidentiary Hearing) slip op. at 51 n.9 (May 5, 2000); See Order at 9.

31 Thompson Dep. at 56.

Q Have you taken any specific seminars or other courses after your doctorate at Oxford that would include -- would be categorized as education on reactor accidents?

A No.

Q Have you performed any accident analyses using the codes that are accepted by the Nuclear Regulatory Commission or the regulatory commissions of any other country as appropriate to analyze reactor accidents?

A I have worked with consequence codes, but not codes that pertain to the incontainment aspects of reactor accidents.

. . .

Q I've been -- I've tried to be very careful to ask this question each time, and I want to just now sum. As I understand it, with respect to all of the studies in which you have mentioned, you have not yourself performed any original calculations or accident analyses using codes on reactor accidents? Is that true?

A That is correct, yes.

. . .

Q In connection with your deposition [i]n October, when asked the question are you licensed as a nuclear plant operator, you responded no. Is that still correct?

A That is still correct.

Q Have you been trained to operate a nuclear power plant, you answered no. Is that still correct?

A That is correct.

Q Have you been an engineer at a nuclear power plant, you said no, is that correct?

A That is correct.

Q Have you ever implemented procedures at a nuclear plant, and you stated no, is that correct?

A That is still correct.

Q Is that also true with respect to procedures for emergency planning at a nuclear power plant, have you ever done that? Implemented procedures?

A No, I have not been involved in implementing emergency response procedures.

Q Have you ever written procedures for a nuclear plant, you said no?

A That's correct.

Q Have you ever written emergency planning procedures for a nuclear plant?

A No, I have not.

Q Have you ever worked in any capacity at a nuclear power plant, you said no. Is that still correct?

A That is still correct.[32]

Turning specifically to his ability to address the Board's question 1 and provide the overall probability of the postulated scenario, Dr. Thompson again had nothing to offer:

Q Have you ever performed a PRA at a nuclear power plant?

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32 Thompson Dep. at 10, 23, 63-64. Dr. Thompson has argued that he does not "have to be a qualified expert in a design or operational function" to provide meaningful information in this proceeding. Id. at 46. However, Dr. Thompson's answers to questions reveal his confusion due to lack of familiarity with nuclear plant operations. For example he described a steam generator tube rupture event as one where "flow out of the reactor coolant system *via a LOCA in one of the coolant pump seals*, will carry material from the core *to the point of rupture of the steam generator tubes.*" Id. at 39-40 (emphasis added).

> A I have not.
>
> Q Have you ever been on a team that performed a PRA at a nuclear power plant?
>
> A I have not.
>
> Q Have you ever done a peer review of a PRA for a nuclear power plant?
>
> A By a peer review, I take it that you mean the sort of review that would be commissioned by the staff as a team effort involving an in-depth review, and I think the answer to that is no.[33]

Further, Dr. Thompson consistently admitted that he had not identified, nor was even planning to identify, *any* facts to present to the Board supporting BCOC's contention. For example, in exploring how Dr. Thompson would address the postulated inability to restart spent fuel pool cooling or makeup systems due to extreme radiation doses (Step 5 of his postulated scenario), he testified:

> A *A definitive answer* to question five [Step 5 of the postulated scenario] is not – *cannot be provided by anyone.* The best that any individual or any group of experts can provide in answer to question five or issue number five, at the top of page 13, is a combination of analysis and judgement. That a – *the best that one could do* in addressing that issue would be to assemble a team of people with varying expertise. . . . And this team would

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33 Thompson Dep. at 109 (emphasis added); see also id. at 114-119 (where Dr. Thompson demonstrated his lack of familiarity and understanding of even the basic vocabulary of PRA analyses or whether there was any industry standard for such PRAs in the nuclear industry). Dr. Thompson is also of the opinion "that the present state-of-the-art has not expanded substantially beyond NUREG-1150." Id. at 158. Both Dr. Burns and Dr. Parry disagree and have stated that significant improvements to the PRA process have occurred in the decade since NUREG-1150 was considered state-of-the-art. See Burns Aff. ¶ 11; Parry Dep. at 22.

> conduct analysis and judgement and would come up with a *statement* about the inability to restart pool cooling.
>
> . . .
>
> Q You don't have a team. How are you going to do this?
>
> . . .
>
> A Now in order to support such a contention, *we do not need to perform the analysis* that I described, because it's - - I readily admit that this is [a] team effort that would require years of work and has never been done. And by definition, *BCOC cannot provide such an analysis* . . . All that is necessary is to show that the use of *a set of reasonable assumptions and supported by some scoping calculations* shows that there is a - - that the probability is characterized in some manner, and I will, in my brief, characterize the probability carefully, in such a manner that a preparation of an EIS is required.
>
> Q But the Board asked us to answer a question. They didn't ask us to tell them how we couldn't answer it. Each party is asked to answer the question. Are you telling me that you are not going to answer this question because you are unable to come up with a best estimate of the overall probability of step five?
>
> A *No party to this proceeding can provide a probability number or even a set of numbers with some uncertainty range in response to question five* that has a scientific quality to it. And whatever is said by any party will not meet the standards of science. It will involve assumptions and judgements. And *my brief will make statements* and may include in step five numerical statements in some bounding sense . . . [34]

Step 5 requires an ability to calculate internal and external doses in the Harris fuel handling building to determine personnel access for providing makeup water to the spent

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[34] Thompson Dep. at 51, 56-58 (emphasis added).

fuel pools. Dr. Thompson was unable to explain how he could address this issue other than with "scoping calculations:"[35]

> Q How will you calculate whether or not there will be contamination in the fuel handling building and in what levels, compartments in the fuel handling building?
>
> A *The most that I can provide in this brief will be scoping calculations.* I will not, as indicated previously, be running models to make such an estimation, nor do I believe that any party can provide credible modeling results in this time frame.
>
> Q What is the pressure that would be required to breach the access between the reactor auxiliary building and the fuel handling building?
>
> A In order to answer that question, you have to know all of the entire envelope of interface between the two buildings, and that's a very complicated envelope of interface. You have to follow all the ventilation ducts.
>
> Q Have you done that?
>
> A That's a major task.
>
> Q Do you intend to do it?
>
> A That sort of task is obviously beyond the scope of what I can do in this time frame.
>
> Q How can you make a *scoping calculation* if you don't know whether or not there is any credible scenario even with bypass that will get radioactive contamination into the fuel handling building?

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35 His lack of any relevant education, training, knowledge or experience in this area may explain, in part, Dr. Thompson's misguided reliance on a 1983 figure issued by the *U.S. Department of Health and Human Services* as the *sole* basis for his conclusion that personnel will be precluded from site access in the event of the postulated scenario. Id. at 160, 182-3.

A Well, I repeat that a - - on this time frame, no party can provide such an analysis that is credible according to the standards that I set forth earlier for a team effort, which I repeat would take years of work and a lot of scientific debate to produce the best available scientific answer to this problem.

Q So what will be the basis for your assumptions if you can do no analysis?

A A *scoping calculation* is one in which you make a variety of simplifying assumptions, which you must state clearly if the scoping analysis is to have any value. And the results are to be regarded as indicative and not definitive. But the context for that is that no party can provide definitive answers.

. . .

Q Are you a health physicist?

A No.

Q Excuse me?

A No.

Q Do you have training in health physics?

A I do not.

Q Education in health physics?

A I do not.

Q Have you ever performed for a nuclear power plant or any other facility a calculation of doses that would occur at any point in a plant as a result of a release of radiation?

A I have not performed such a calculation. I am, however, familiar with the science involved. And I am

> qualified to make - - to perform a *scoping calculation* of that nature.[36]

However, Dr. Thompson's one attempt at performing useful "scoping calculations" strongly supports our position regarding his lack of competence. The single example of such a calculation in this proceeding is contained in his February 1999 report to BCOC, in which Dr. Thompson presents a "scoping analysis" to provide "insight" into the heat transfer pathways in the Harris spent fuel pools.[37] After considering decay heat output, upper bound of temperature rise, heat transfer by conduction, convective cooling by steam, and cooling by thermal radiation, Dr. Thompson calculated that when one-tenth of a spent fuel assembly is submerged, this "yields a T of 9,800 degrees C," where T is "the temperature of steam leaving the top of the fuel assembly."[38] This absurd result is remarkable because it is a steam temperature over one and a half times the temperature of *the surface of the sun.*[39]

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36 Id. at 66-67, 71-72 (emphasis added). Merely being "familiar with the science involved" leads to uniformed "analyses" such as comparing the frequency of a boiling water reactor in-containment spent fuel pool boiling event with the core damage frequency from the Harris IPE, simply because the probabilities are "at a similar level." Id. at 178-79. Even though he admitted that this comparison "doesn't prove anything," Dr. Thompson still based his conclusion "that pool accidents could be a major contributor to risk at Harris" upon it. Id. at 179.

37 G. Thompson, "Risks and Alternative Options Associated With Spent Fuel Storage at the Shearon Harris Nuclear Power Plant," Appendix D, D-3 (February 1999); Orange County's Request for Admission of Late-Filed Environmental Contentions, Exhibit 3 (January 31, 2000).

38 Id. at D-4.

39 The temperature of the sun is approximately 6,000 degrees C. See Solar and Heliospheric Observatory, Frequently Asked Questions, http://sohowww.nascom.nasa.gov/explore/faq/sun.htm#surface.

Applicant submits that BCOC's burden to demonstrate the need for an adjudicatory hearing is more than asking a few questions about assumptions and providing dubious scoping calculations. BCOC must address the Board's questions with facts and its own defensible calculation of the probability of its postulated scenario. BCOC must also demonstrate that it would have something to contribute to an adjudicatory hearing. BCOC's only expert has confirmed that BCOC has not dedicated the resources to provide a meaningful response to the Board's questions, nor does BCOC's expert have the education, training, knowledge, or experience to address the issues.[40] An adjudicatory hearing is not required to respond to uninformed calculations that suggest that spent fuel temperatures could exceed those on the sun.

F. BCOC Cannot Sustain its Burden to Demonstrate an Adjudicatory Hearing is Required in this Proceeding.

In order to obtain an adjudicatory hearing on its Contention EC-6, Subpart K requires BCOC to place facts into evidence that are material and central to the ultimate decision in this case and that create a genuine and substantial dispute of fact with the evidence presented by Applicant and/or the NRC Staff. Congress explicitly reserved adjudicatory hearings on spent fuel storage expansion to disputes of material facts that *can only be* resolved with sufficient accuracy by the introduction of evidence in an adjudicatory hearing. Applicant submits that BCOC has demonstrated again that it does not possess the technical capability to establish a genuine and substantial dispute of fact.

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40 Dr. Thompson had not completed any work to address the probability of any of the seven steps of his postulated scenario as of his deposition on October 16,

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Further, Dr. Thompson is not in a position to make a meaningful contribution to any hearing. The Board is certainly capable of resolving any factual issues in dispute between the Applicant, NRC Staff and BCOC on the written record and oral argument. Of course, the legal questions would never require a hearing. Here, Subpart K presents an insurmountable burden to BCOC.

III. THE NATIONAL ENVIRONMENTAL POLICY ACT DOES NOT REQUIRE PREPARATION OF AN EIS TO ADDRESS THE CONSEQUENCES OF BCOC'S POSTULATED SCENARIO

A. National Environmental Policy Act Requirements Are Well-Established.

National Environmental Policy Act of 1969[41] ("NEPA") prescribes a process by which the federal government considers the environmental impacts of proposed actions. Federal agencies must prepare an Environmental Impact Statement ("EIS") for "major Federal actions *significantly* affecting the quality of the human environment." [42] NEPA forces an agency to take a "hard look" at environmental consequences and ensures that the agency has adequately considered and disclosed the environmental impacts of its actions.[43] It is well settled, however, that "NEPA itself does not mandate particular

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2000, and he had a relatively modest budget for additional work prior to the November 20, 2000, filing. See Thompson Dep. at 26-28, 149.

41 42 U.S.C. §§ 4321 - 4347 (2000).

42 Id. § 4332(2)(C) (emphasis added).

43 Robertson v. Methow Valley Citizens Council, 490 U.S. 346, 350 (1989); Baltimore Gas & Electric Co. v. NRDC, 462 U.S. 87, 97 (1983); Kleppe v. Sierra Club, 427 U.S. 390, 410 n.21 (1976).

results."[44] If "the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs."[45] The fundamental legal question in applying NEPA is, therefore, whether the cognizant federal agency "has adequately considered and disclosed the environmental impact of its actions."[46]

Not every possible environmental impact must be considered or included in an EIS. An "agency must allow all *significant* environmental risks to be factored into the decision whether to undertake a proposed action."[47] NEPA activities are subject to a "rule of reason," requiring consideration only of "reasonably foreseeable" environmental impacts.[48] Only impacts that are "likely," "foreseeable," or "reasonably foreseeable" need be discussed in an EIS.[49] A "reasonably foreseeable" environmental impact is one "sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision."[50] Under NEPA, an EIS need only provide "a reasonably

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44 Robertson, 490 U.S. at 350; Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 558 (1978).

45 Robertson, 490 U.S. at 350; Kleppe, 427 U.S. at 410, n.21; Dubois v. U.S. Dept. of Agric., 102 F.3d 1273, 1284 (1st Cir. 1996).

46 Baltimore Gas & Electric Co., 462 U.S. at 98; see also Robertson, 490 U.S. at 350; Kleppe, 427 U.S. at 409-410.

47 Baltimore Gas & Electric Co., 462 U.S. at 100 (emphasis added); see also Vermont Yankee, 435 U.S. at 553; Dubois, 102 F.3d at 1285.

48 San Luis Obispo Mothers for Peace v. NRC, 751 F.2d 1287, 1300-01 (D.C. Cir. 1984), rehearing en banc granted on other grounds, 760 F.2d 1320 (D.C. Cir. 1985), aff'd en banc, 789 F.2d 26, cert. denied 479 U.S. 923 (1986).

49 Sierra Club v. Marsh, 976 F.2d 763, 767 (1st Cir. 1992).

50 Dubois, 102 F.3d at 1286; see also, Sierra Club, 976 F.2d at 767.

thorough discussion of the *significant* aspects of the probable environmental consequences."[51] An EIS is not required where there is no *substantial* question whether federal actions will significantly affect the quality of the human environment.[52] An environmental assessment may be prepared to determine whether an agency action will have a significant environmental effect, requiring an EIS, or whether it will not (in which case no EIS is required).[53]

It has long been established that an agency is not required to blindly evaluate every environmental risk contrived by opponents of an action. NEPA does *not* require consideration of "remote and speculative" impacts.[54] An agency "need not speculate about all conceivable impacts" of a proposed action.[55] "The requirement is not to explore every extreme possibility which might be conjectured."[56] The "rule of reason" governing

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51 Carmel-By-The-Sea v. DOT, 95 F.3d 892, 899 (9th Cir. 1996) (emphasis added); see also Dubois, 102 F.3d at 1286; Sierra Club, 976 F.2d at 767; Environmental Defense Fund v. Hoffman, 566 F.2d 1060, 1067 (8th Cir. 1977).

52 Idaho Sporting Congress v. Thomas, 137 F.3d 1146, 1149-50 (9th Cir. 1998); 10 C.F.R. § 51.14 (1997) (NRC regulations defining "Finding of No Significant Impact"); 40 C.F.R. § 1508.13 (1997) (Council of Environmental Quality ("CEQ") regulations implementing NEPA).

53 10 C.F.R. § 51.14 (1997) (defining "Environmental Assessment" and "Finding of No Significant Impact"); 40 C.F.R. §§ 1508.9, 1508.13 (1997) (same).

54 Vermont Yankee, 435 U.S. at 551 (quoting NRDC v. Morton, 458 F.2d 827 837-38 (D.C. Cir. 1972)); San Luis Obispo, 751 F.2d at 1300; Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), CLI-90-04, 31 NRC 333, 335 (1990).

55 Dubois, 102 F.3d at 1286.

56 Carolina Environmental Study Group v. US, 510 F.2d 796, 801 (D.C. Cir. 1975).

NEPA interpretation provides that an agency need not consider "remote and speculative risks."[57] As the San Luis Obispo en banc court succinctly stated:

> At some point the probability of an occurrence becomes so infinitesimal that it would be absurd to say that a hearing about it is required. Thus, no one would argue, or so we would assume, that the Commission had to consider the possibility that a space satellite might fall on the [licensee's] plant. . . . It can be shown that the danger posited by [the opposition] here falls into the same range of improbability.[58]

This holding recognizes that to make an EIS "something more than an exercise in frivolous boilerplate" the extent of the required analyses "must be bounded by some notion of feasibility." [59]

Further, an EIS is also not required to include a "worst case analysis" of possible, but substantially uncertain, environmental impacts.[60] Indeed, as the Supreme Court has observed, including only reasonably foreseeable environmental impacts in an EIS promotes the purposes of NEPA by focusing on "those consequences of greatest concern to the public and of greatest relevance to the agency's decision."[61] Considering unlikely

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57 Yankee Atomic Electric Co. (Yankee Nuclear Power Station), LBP-96-2, 43 NRC 61, 89 (1996) (citing Limerick Ecology Action v. NRC, 869 F.2d 719 (3rd Cir. 1989)).

58 San Luis Obispo Mothers For Peace v. NRC, 789 F.2d 26, 36 (D.C. Cir. 1986) (en banc).

59 Vermont Yankee, 435 U.S. at 551.

60 Robertson, 490 U.S. at 354-56; see also Vermont Yankee, 31 NRC at 334.

61 Id. at 356.

worst-case impacts "distort[s] the decision making process by *overemphasizing highly speculative harms*."[62]

Here we will show that the probability of the seven-step accident scenario postulated by BCOC falls into the same range of improbability as a space satellite falling on the Harris plant. As the Court held in San Luis Obispo, here it would be "absurd" to say a hearing is required. The postulated scenario is "remote and speculative" in the extreme and NEPA does not require consideration of such speculative consequences.

B. The NRC Staff's Decision Not to Prepare an EIS Was Supported by Overwhelming Evidence that the Additional Environmental Impacts of the License Amendment Are Insignificant.

Licensing Boards have consistently — and correctly — accepted NRC Staff determinations that license amendments related to storing spent fuel in fuel pools have no significant environmental impacts and, therefore, do not require an EIS. Here, the NRC Staff's Environmental Assessment ("EA") of the proposed spent fuel pool expansion found that amending the Harris license to allow use of spent fuel pools C and D will have no significant environmental impact.[63] The Staff's EA was in addition to the "hard look" that the Commission has given to this issue through generic rulemaking. As discussed above, NEPA requires nothing more.[64]

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62 Id. (emphasis added).

63 Carolina Power & Light Company Docket No. 50-400 Shearon Harris Nuclear Power Plant, Unit 1 Environmental Assessment and Finding of No Significant Impact (December 15,1999); 64 Fed. Reg. 71,514 (1999) (hereinafter "EA").

64 See, e.g., Baltimore Gas & Elec., 462 U.S. at 101.

The scope and depth of the Staff's EA was appropriate to the requested action. The Staff considered radioactive waste treatment, gaseous radioactive wastes, solid radioactive wastes, radiological impacts, accidents and alternatives.[65] With regard to accidents, the Staff considered design basis *and* beyond design basis events.[66] In particular, the Staff noted that in "the unlikely event of a total loss of the cooling system, makeup water sources are available to replace coolant lost through evaporation or boiling."[67] The Staff concluded that "the potential for environmental impact from severe accidents is negligible."[68] The Staff took a very "hard look" and appropriately found no significant impact from the proposed action. The facts clearly support the Staff's determination.

Despite this rigorous assessment of potential environmental impacts by the NRC Staff, BCOC insists that the proposed action is being "taken without a proper understanding of the phenomena that could occur."[69] Further, Dr. Thompson charges that

> [T]he staff has been has been *irresponsible* in licensing this and the industry has been irresponsible in doing it and applying for it, and the irresponsibility derives from the fact that neither side of -- neither industry nor the NRC has ever bothered to do a really thorough job of finding out what the implications are.[70]

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65 EA at 3-9.

66 Id. at 5.

67 Id. at 6.

68 Id.

69 Thompson Dep. at 91.

70 Id. at 92 (emphasis added).

Dr. Thompson does not define what his concept of a 'thorough job' is, other than it "would be a complex enterprise that would take years to do properly."[71] This is not, however, required by NEPA.

Courts affirm an agency's decision not to prepare an EIS (or not to supplement an existing EIS) unless they find the decision was "arbitrary and capricious."[72] In deciding whether an agency decision was arbitrary and capricious, the court considers whether the agency based its decision on "the relevant factors and whether there has been a clear error of judgment."[73]

A court, however, may not substitute its judgment for the agency's, once the agency has considered the relevant factors.[74] Where the issue turns on expert opinion, and the experts disagree, an agency is entitled to "rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive."[75] Deference to the NRC's expertise is especially appropriate when, as

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71 Id. at 56.

72 See, e.g., Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 375-78 (1989) (affirming agency decision not to further supplement an EIS); Kelley v. Selin, 42 F.3d 1501, 1518 (1995) (affirming agency decision, based on an EA, not to prepare an EIS).

73 Marsh, 490 U.S. at 378. Accord Kelley, 42 F.3d at 1518-19.

74 Kelley, 42 F.3d at 1518.

75 Marsh, 490 U.S. at 378. For examples of agency decisions judged arbitrary and capricious, all conspicuously different from the Staff's decision here, see Carmel-By-The-Sea, 95 F.3d at 900 (agency ignored new wetlands, with rare grasses, pointed out to it by other agencies and relied on wetlands surveys that it knew were outdated); Dubois, 102 F.3d at 1292-93 (agency failed to supplement its EIS despite expanding a ski area, primarily outside the area considered in the EIS and outside the area of the existing permit; widening existing trails and

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here, it is "making predictions, within its area of special expertise, at the frontiers of science."[76] To overturn the Staff's determination, and find that additional NEPA analysis may be required for the Harris spent fuel pool expansion, a court would have to find that the Staff has made a "clear error of judgment" in determining that BCOC's postulated scenario is "remote and speculative" *and* is significant enough to warrant consideration pursuant to NEPA *and* is not bounded by the consequences of other severe accident scenarios that have been addressed.

Licensing Board and Appeals Board decisions rejecting contentions that an EIS is required before licenses can be amended regarding storage of spent fuel are clearly correct. In the one case where the Licensing Board admitted a contention claiming that an EIS *was* required because of the possibility of the kind of zircaloy cladding reaction that BCOC relies on, the Appeal Board reversed the Licensing Board.[77] Although the Commission reversed and remanded the case back to the Appeal Board, the issue was

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eliminating buffers between them; developing new ski trails, access roads, and lifts on land previously designated as a woodland, and adding a 28,500 square foot lodge facility not previously considered); Idaho Sporting Congress, 137 F.3d at 1150-51 (agency's environmental assessment of water-quality impacts in one area with riparian buffers as narrow as 25 feet relied on a report for a different area with different characteristics; that report was premised on riparian buffers 100 feet wide was not to be applied to any other area). In contrast, the use of spent fuel pools here is "within the spectrum of alternatives" considered in the FES, and accordingly does not require a further analyses. Dubois, 102 F.3d at 1292-93.

76 Baltimore Gas, 462 U.S. at 103.

77 Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-919, 30 NRC 29, 43-52 (1989).

limited to providing an adequate basis for the decision.[78] Most recently, a Millstone Licensing Board rejected similar contentions, based on the same flawed February 1999 report prepared by Dr. Gordon Thompson, claiming that re-racking spent fuel at Millstone would significantly increase the probability of severe accidents and, therefore, required an EIS.[79] The mere postulation of an event, without supporting facts, was not sufficient to sustain a challenge to the Staff's determination that such a postulated event was not required to be considered in an EIS.[80]

C. A Determination That BCOC's Postulated Scenario is Remote and Speculative is Consistent With Qualitative Guidelines, Commission Precedent, and Controlling Legal Authority.

The NRC has not established a quantitative value for determining whether an occurrence is too remote and speculative to be considered in NEPA analyses. Licensing Boards and the Commission have, however, had occasion to review the issue, as discussed further below. The Commission has also developed a policy statement that contains *qualitative* safety goals for the operation of nuclear power plants. In our view, the Commission has explicitly, and properly, avoided establishing a bright line test for "remote and speculative." Taken together, and viewed in the light of the body of applicable federal NEPA case law, however, a frequency of occurrence value emerges – a

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78 Vermont Yankee, 31 NRC at 336.

79 Northeast Nuclear Energy Co. (Millstone Nuclear Power Station), LBP-00-2, 51 NRC 25 (2000).

80 See also Duke Energy Corp. (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328 (1999).

value below which it is reasonable and appropriate to consider an event remote and speculative for NEPA purposes notwithstanding the postulated consequences.

In Vermont Yankee Nuclear Power Corporation (Vermont Yankee Nuclear Power Station),[81] the Commission reviewed an Appeal Board decision that a postulated accident[82] with a probability on the order of 10^{-4} per reactor year was remote and speculative and, therefore, did not require NEPA review. The Vermont Yankee intervenor's sought consideration, in a supplemental EIS, of a postulated accident with potential consequences greater than those previously evaluated by the NRC Staff in its NEPA review.[83] The intervenors had submitted documents implying an estimated upper limit probability of the postulated accident sequence as being on the order of 2.6×10^{-4} per reactor year. The Appeal Board determined that the postulated accident was too remote and speculative to consider. The Commission remanded the case and directed the Appeal Board to develop further "information on the plausibility or probability of" the postulated accident sequence:

> We are reluctant either to endorse or reject a holding that accidents of this probability should be considered remote and speculative, both because such a determination may be unnecessary here and because such a decision could have broader ramifications for the NRC's regulatory program that are better explored outside the scope of a particular case involving only a few parties. Therefore, to the extent that [the Appeal Board's decision] amounts to a holding

81 31 NRC 333 (1990).

82 The accident sequence proposed consisted of a spent fuel pool cladding fire caused by a failure of spent fuel pool cooling, with the cooling failure caused by combustion of hydrogen gas following a reactor accident. Id. at 334.

83 Id. at 334.

> that an accident with a probability on the order of 10^{-4} per reactor year is remote and speculative, we vacate that part of the Appeal Board's decision without prejudice to a later Commission determination on what the limits should be.[84]

The Commission had "difficulty" with relying on unsupported analyses as the bases for the "train of logic of the Appeal Board's decision" that the accident sequence of events was remote and speculative.[85] The Commission instructed the Appeal Board to obtain more fully developed information.

> The Appeal Board bridged the gap between the technical documents and the scenario in the contention by assuming, conservatively, that the probability of that scenario could be no greater than certain scenarios actually analyzed in the technical documents. If the scenarios in the technical documents were remote and speculative, then, a fortiori, the scenario in the contention must be remote and speculative as well. Our opinion makes clear that *future decisions that accident scenarios are remote and speculative must be more specific and more soundly based on the actual probabilities and accident scenarios being analyzed.*[86]

This clarification makes clear that the Commission did not reject the Appeal Board's determination that the accident sequence was remote and speculative because a frequency of 10^{-4} per reactor year was too high. Instead, the Commission remanded the issue because the Commissioners could not determine if 10^{-4} was the actual frequency value. The Commission explicitly reserved to itself, but did not reject, a determination that an accident probability of 10^{-4} per reactor year was remote and speculative.

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84 Id. at 335.

85 Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), CLI-90-07, 32 NRC 129, 131-32 (1990).

86 Id. at 132 (emphasis added) (internal citations omitted).

> If the Appeal Board finds that an accident probability on the order of 10^{-4} per reactor year is appropriate for the entire accident sequence postulated in this contention, the case should be returned to the Commission for further review. Otherwise, the Appeal Board should modify or confirm its judgment as to the remote and speculative nature of the accident on the basis of the accident probability derived on remand.[87]

Further, it is significant to the question before this Board that the Commission authorized the Vermont Yankee Appeal Board to itself determine the remote and speculative question if the probability was below 10^{-4} per year.[88]

Prior to the decision in Vermont Yankee, an Appeal Board had found that a calculated probability of 2.4×10^{-7} per year was sufficiently remote and speculative as to preclude NEPA consideration of the postulated occurrence.[89] In that case, the applicant was required to consider "the chain of events that would have to occur" for a postulated liquid natural gas ("LNG") cloud formed in a collision of a LNG tanker to move over the plant and ignite.[90] Following extensive calculations by the applicant, and detailed reviews by the Licensing Board and the Appeal Board, the Appeal Board found that the

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87 Vermont Yankee, 31 NRC at 336.

88 The issue was not further resolved as the intervenors withdrew before final resolution of the matter. Id.

89 Pub. Serv. Elec. & Gas Co. (Hope Creek Generating Station, Units 1 and 2), ALAB-518, 9 N.R.C. 14 (1979).

90 Id. at 18.

applicant could "show that this event is so unlikely that its environmental impact need not be considered."[91]

The federal courts have also found occurrences with a probability on the order of 10^{-6} per reactor year remote and speculative. An event with a probability of 3.575×10^{-7} per year is "extraordinarily low" and "so extremely low as to be, for any practical purpose, non-existent."[92] "At some point the probability of an occurrence becomes so infinitesimal that it would be absurd to say that a hearing is required."[93] In San Luis Obispo, the District of Columbia Circuit was asked to determine if the NRC was required to hold a hearing on the potential complicating effects of an earthquake on responses to a simultaneous but independently caused radiological accident at a nuclear power plant.[94] The court was clear that events with this, or a lower, probability were not required to be considered pursuant to the agency's emergency planning regulations:

> If the NRC is required to hold hearings on the emergency plans to deal with contingencies of that level of improbability, we can think of no speculative danger that would not require a hearing. Such a conclusion would serve no purpose other than to enable [opponents] to hold up licensing for many more years.[95]

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91 Id. at 39 (citing New England Coalition on Nuclear Pollution v. NRC, 582 F.2d 87, 93-94 (1st Cir. 1978)).

92 San Luis Obispo, 789 F.2d at 40.

93 Even the dissent agreed with this conclusion. "I agree that by definition earthquakes greater than the SSE occur too infrequently to warrant consideration, since the SSE is the strongest earthquake that could ever be expected to hit the [plant] site." Id. at 51 (Wald, J., dissenting).

94 Id. at 28.

95 Id. at 40.

The court's logic is consistent with the Commission's discussion in Vermont Yankee and the Appeal Board decision in Pub. Serv. Elec. & Gas. Finally, all of these decisions are consistent with the Supreme Court's admonition in Vermont Yankee:

> Common sense also teaches us that the 'detailed statement of alternatives' cannot be found wanting simply because the agency failed to include every alternative device and thought conceivable by the mind of man. Time and resources are simply too limited to hold that an impact statement fails because the agency failed to ferret out every possible alternative, regardless of how uncommon or unknown that alternative may have been at the time the project was approved.[96]

Further illumination of consideration of a quantified remote and speculative probability value can be gleaned from the Commission's Safety Goal Policy.[97] The Policy contains two *qualitative* safety goals:

> Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
>
> Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.[98]

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96 Vermont Yankee, 435 U.S. at 551.

97 51 Fed. Reg. 28,044 (1986).

98 Id.

The Commission's intent with the first safety goal is to "require such a level of safety that individuals living or working near nuclear power plants should be able *to go about their daily lives without special concern* by virtue of their proximity to these plants."[99]

The second safety goal represents a decision that a limit should be placed on the "societal risks posed by nuclear power plant operation."[100] The Commission determined it "impractical to calibrate nuclear safety goals by comparing them with coal risks."[101] However, the Commission established "quantitative health effects objectives" to assure "that nuclear risks are *not a significant addition* to other societal risks."[102] The Commission adopted the following two quantitative health effects for measuring the success of the safety goals:

> The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of one percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
>
> The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of one percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.[103]

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99 Id. at 28,045 (emphasis added).

100 Id.

101 Id.

102 Id. (emphasis added).

103 Id. at 28,046.

The Commission approved the use of the qualitative safety goals and the qualitative health effects objectives "in the regulatory decisionmaking process."[104] In addition, the Commission proposed a general performance guideline for the NRC Staff in implementing the safety goals and health effects objectives:

> Consistent with the traditional defense-in-depth approach and the accident mitigation philosophy requiring reliable performance of containment systems, the overall mean frequency of a large release of radioactive materials to the environment from a reactor accident should be less than 1 in 1,000,000 per year of reactor operation.[105]

In 1990, the Commission provided further direction to the Staff on implementation of the Safety Goals in response to SECY-89-102.[106] In particular, the Commission stated that the Safety Goal Policy provides "a definition of 'how safe is safe enough' that should be seen as guidance on how far to go when proposing safety enhancements."[107] The Commission did, however, acknowledge that specifying the large early release frequency ("LERF") as an overall mean value "is inherently more conservative than either of the quantitative health effects objectives" but was "within an order of magnitude of the Commission's health objectives and provides a simple goal which has generally been accepted."[108]

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104 Id. at 28,047.

105 Id.

106 Memorandum from Samuel J. Chilk to James M. Taylor, "SECY-89-102 – Implementation of the Safety Goals" (June 15, 1990).

107 Id. at 6.

108 Id. at 2.

The Advisory Committee on Reactor Safeguards ("ACRS"), by letter dated August 13, 1996, recommended, inter alia, that the safety goals should be used as a guide for plant-specific actions.

> We believe the safety goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on the Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria on core damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that the QHOs are met. They should be used in developing detailed guidelines.[109]

The Chairman subsequently requested the Staff to study a number of ACRS recommendations related to the Safety Goals. This work culminated in a March 2000 report to the Commission on the Staff's recommendations for changes to the Safety Goal Policy.[110] The Commission approved the following key Staff recommendations on June 27, 2000:[111]

> Explicitly incorporated the statements that the 'Safety Goals establish a level of safety considered safe enough. They provide guidance on how far to go when proposing safety enhancements.'
>
> Changed the value of LERF to 1×10^{-5} from 1×10^{-6} per reactor year to be consistent with the QHO on early

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109 Letter from T. S. Kress to Shirley A. Jackson, "Risk-Informed, Performance-Based Regulation and Related Matters" 1 (August 15, 1996).

110 SECY-00-0077, "Modifications to the Reactor Safety Goal Policy Statement" (March 30, 2000).

111 Memorandum from Annette L. Viette-Cook to William D. Travers, "Staff Requirements – SECY-00-0077 – Modifications to the Reactor Safety Goal Policy Statement" (June 27, 2000) (hereinafter, "Staff Requirements Memo on SECY-00-0077")

fatalities, the guidance in Regulatory Guide 1.174, and the Regulatory Analysis Guide for backfits.[112]

The Commission also *disapproved* adding a qualitative statement "that there be no adverse impact on the environment" from nuclear plant operation as a part of the Policy Statement.[113] As the Chairman observed, this statement is inconsistent with the concepts of risk and adequate protection, *since adverse impacts cannot always be completely eliminated.*"[114]

D. A Frequency of Occurrence of One-in-a-Million Per Year Is a Reasonable Quantitative Threshold For Consideration of Remote and Speculative Events

The Commission recognizes that nuclear plant safety cannot be guaranteed and not all adverse environmental impacts from the operation of nuclear power plants can be completely eliminated. The Commission, through the Safety Goal Policy, has provided qualitative guidance on what is "safe enough" and has assigned a quantitative value for the frequency of large radioactivity releases to the environment that satisfies the goal. The ACRS has weighed in on the safety goals, the LERF value, and its application to risk informing spent fuel pool safety decisions. The Commission, the NRC Staff and the ACRS all agree that 1×10^{-5} per reactor year is the appropriate value for the frequency of large early releases of radioactivity and prompt fatalities.

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112 SECY-00-0077 at 5, 9.

113 Staff Requirements Memorandum on SECY-00-0077.

114 Commission Voting Record – SECY-00-0077, Comments of Chairman Meserve (June 27, 2000) (emphasis added).

It is Applicant's conclusion, therefore, that events with a best estimate probability value of **1 x 10^{-6}** per reactor year or less can and should be considered too remote and speculative to require any consideration pursuant to NEPA. This value is conservatively within the bounds of values considered remote and speculative by Appeal Boards, the Commission, and federal courts. This value is an order of magnitude below the LERF value of 10^{-5}, agreed by the NRC Staff, the Commission, and the ACRS as protective of human and environmental safety from the impacts of nuclear power plant operation, and below which plant design does not need to be changed. It is also well and commonly understood (i.e., "one in a million chance") as unlikely and unnecessary to consider in the normal course of daily life.

From a practical standpoint, 1 x 10^{-6} provides an order of magnitude "margin" between the LERF, which defines what is "safe enough," and the point at which unlikely events do not have to be considered. Events with a best-estimate probability between 10^{-5} and 10^{-6} can be viewed as deserving a "hard look" to ensure that mitigation (e.g., design change) is not warranted under the circumstances. This marginal area, therefore, provides decision makers flexibility to address case specific concerns while establishing a reasonable limit on the extent of their discretion.[115]

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115 Applicant recognizes that ACRS comments suggest a "decommissioned spent fuel pool LERF" of 10^{-7} (worst case) because of the potential consequences of multiple cores releasing ruthenium during a spent fuel fire. Ruthenium, however, decays with a half-life of approximately 1 year, so the conditions of concern (i.e., "elevated" risk) are only present for the initial few years following discharge from the reactor. Kunita Aff. ¶ 27. In the Harris case, spent fuel pools C and D will contain greater than five-year old fuel, so only a small, if any, amount of undecayed Ruthenium will remain. Id. ¶ 28.

Risk is the product of probability and consequences. However, a severe accident with release itself produces unacceptable consequences. If a severe accident satisfies the regulatory threshold of unacceptable consequence, then identifying the consequences beyond that which are unacceptable becomes an interesting theoretical exercise, but not one that provides useful information for a decisionmaker. Even if one considered consequences that were 10 times greater than that from a severe accident with a safety goal LERF of 1×10^{-5}, the acceptable probability of occurrence would simply be a factor of ten less or 1×10^{-6}. BCOC's own expert, with his extraordinary concern for the consequences of the postulated scenario, agreed with this proposition.[116]

Dr. Burns, who has participated in a high percentage of all nuclear plant PSA/PRAs, describes in the ERIN Report a "de minimus" point, or the point at which events may be so remote and speculative as to be below what can be rationally considered.[117] He has indicated that, for practical purposes, this point is a frequency of 1×10^{-6} per year. Risk reduction below the "de minimus" point might be accomplished by eliminating a product or service; however, in most cases society has decided that this is not suitable because it interferes with individual freedom and may in fact introduce new or competing risks that may be larger than the risks being "eliminated."[118] The ERIN Report concludes that events with frequencies below one in a million per year (1×10^{-6} per year) can be considered to be sufficiently low in frequency such that

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116 Thompson Dep. at 191-93.

117 Burns Aff., Attach. C, App. B § B.3.

118 Id.

additional efforts by society to reduce the frequencies below this level are not considered warranted and these risks can be referred to as "remote and speculative."[119]

One in a million appears to be a cutoff for the Commission as well. The Commission approved a frequency of 1×10^{-6} as the cutoff for evaluating low risk accidents associated with the shipment of the Trojan reactor vessel. The Commission found this value was low enough to dismiss without further evaluation. No EIS was required.[120] In evaluating the environmental impacts from Oconee license renewal, the staff reviewed licensee's risk estimate for core damage frequency ("CDF") for internal and external events, which was 8.9×10^{-5} per year, (total external 6.3×10^{-5} and total internal 2.6×10^{-5}). In evaluating cutoff values for event analyses, the licensee used 4.5×10^{-7} for screening internal events and 8.5×10^{-7} per year for external events.[121] The NRC staff accepted these values, which are close to the proposed 1×10^{-6} cutoff, and events with lower probabilities were not included in the EIS.[122]

This conclusion is also consistent with the holding of Limerick Ecology Action v. NRC.[123] In that case, the court determined that consideration of the potential environmental effects of certain severe accidents was required because the Commission was not exempted from NEPA requirements by compliance with the Atomic Energy Act

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119 Id. § B.4.

120 SECY-98-231, "Authorization of the Trojan Reactor Vessel Package for One-time Shipment for Disposal" (October 2, 1998).

121 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants," Supplement 2 § 5.2.3.1 (1999).

122 Id. § 5.2.3.2.

("AEA") and could not exclude "consideration of design alternatives through a generic policy rather than through careful consideration."[124] The court was, therefore, "unwilling to conclude" that the Commission would have precluded consideration of the excluded design alternatives on the basis that the underlying risks were remote and speculative.[125] However, had the Commission properly (i.e., "through careful consideration") concluded that the risks were remote and speculative, the design alternatives at issue could have been excluded from NEPA analyses. In the instant case, and for any explicit Commission endorsement of a quantitative remote and speculative criterion, the Commission would certainly adopt a number arrived at "through careful consideration."

IV. A STATE-OF-THE-TECHNOLOGY PROBABILISTIC ANALYSIS ESTABLISHES THAT THE FREQUENCY OF OCCURRENCE OF BCOC'S POSTULATED SCENARIO AT HARRIS IS SO LOW THAT IT IS HIGHLY REMOTE AND SPECULATIVE

A. Answer to Board Question 1: The Best Estimate Probability of BCOC's Postulated Scenario is on the Order of a Few Chances in One Hundred Million.

In its Order, the Board first asked the parties to address the following issue:

> What is the submitting party's best estimate of the overall probability of the sequence set forth in the chain of seven events in the CP&L and BCOC's filings, set forth on page 13 supra? The estimates should utilize plant-specific data

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123 869 F.2d 719 (3rd Cir. 1989) (hereinafter "LEA").

124 Id. at 741.

125 Id.

> where available and should utilize the best available generic data where generic data is relied upon.[126]

Applicant has determined that the best estimate overall probability of the postulated scenario is less than 3 in one hundred million (2.65×10^{-8}) per year. This value clearly supports the conclusion that the postulated scenario is remote and speculative. The remainder of this section will discuss how this probability was calculated, and the uncertainties, sensitivities, conservatisms, and confidence in the result.

B. The Methodology Employed and Expertise Brought to Bear in Addressing Board Question 1 Was State-of-the-Technology and Relied Heavily on Harris-Specific Information.

Applicant retained ERIN to perform a Harris-specific PSA to assist CP&L in addressing this question. ERIN is an industry leader in risk management and applying reliability and performance-based technologies to various situations and activities at nuclear power plants. ERIN personnel have been involved in numerous risk analysis projects performed since WASH-1400, "The Reactor Safety Study," in 1975. ERIN's experience and that of the lead analyst for this project, Dr. Edward Burns, are unsurpassed in the industry. ERIN has developed many of the state-of-the-technology methods used in PSAs and is actively involved in the American Society of Mechanical Engineers ("ASME") Committees which are developing the PSA standard.[127]

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126 Order at 17.

127 See Burns Aff. ¶¶ 2, 4, and Attach. A, B.

ERIN was tasked by CP&L to determine the best estimate of the overall probability of the postulated scenario occurring at Harris. This analysis was to include not only internal events (i.e., events initiated at Harris such as steam generator tube rupture, loss of coolant accident, station blackout, etc.) as modeled in the updated Harris PSA model, but also sensitivity analyses of the postulated scenario frequency to other possible initiating events, including postulated internal fires and seismic events. ERIN was also to consider the sensitivity of the results to core damage events during shutdown conditions.[128]

The updated Harris PSA is a probabilistic safety assessment model that was originally developed for the Harris IPE pursuant to NRC Generic Letter 88-20. CP&L maintains the updated Harris PSA in a quality manner under procedural controls.[129] The updated Harris PSA includes: (1) event trees that model core damage accident sequences and containment response following a core damage event; (2) fault trees that represent plant systems and failure modes; (3) initiating event, component failure, and human reliability data; and (4) special analyses, such as internal flooding and Interfacing Systems Loss of Coolant Accident ("ISLOCA"). The updated Harris PSA considers internal initiating events (except internal fires) and applies when the reactor is critical. The results of the updated Harris PSA include an estimated annualized CDF for initiating

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128 Id. ¶ 5, Attach. C §§ 1.0 and 2.0. The total effort by ERIN personnel dedicated to analyzing the postulated scenario exceeded 2,000 hours of professional time during the period from August to November, 2000. A significant additional, but more difficult to quantify, effort was expended by CP&L personnel supporting the ERIN effort. Id. ¶ 7.

events. The analysis was performed pursuant to Generic Letter 88-20, Supplement 4. The IPEEE considered (1) seismic risk, (2) internal fire risk, and (3) risk from other external events (e.g., high winds, tornadoes, and nearby facility accidents).[130]

As part of the evaluation to respond to the Board's question, ERIN was asked to perform an independent peer review of the existing updated Harris Level 1 and Level 2 PSA for internal events. The independent peer review determined that the "Harris PSA is robust and has a significant level of detail that is fully supportive of the proposed application" in addressing the postulated scenario.[131]

The analytical methodologies chosen by ERIN to determine the best estimate overall probability of the postulated scenario are characteristic of past nuclear power plant PSAs (also referred to in the literature as probabilistic risk assessments ("PRAs")) and incorporate state-of-the-technology methods.[132] To the extent possible, site specific analyses and information from the updated Harris PSA and IPEEE were used for the

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129 Laur Aff. ¶ 7.

130 Laur Aff. ¶ 5. The pedigrees of the Harris PSA and Harris IPEEE are discussed in the Laur Affidavit ¶¶ 4-8 and Burns Affidavit ¶ 13 and Attach. C § 3.0.

131 Burns Aff. ¶ 13. The independent peer review report is found in Attachment B to the Laur Affidavit. ERIN personnel developed the peer review programs for the vendor owners' groups and have participated in essentially all of the PSA peer reviews completed or scheduled to date in U.S. nuclear power plants. Id. ¶ 4. Regarding the updated Harris PSA, the ERIN reviewers concluded: "On balance this PSA is viewed as one of the best-documented PSAs that the reviewers have seen." Laur Aff., Attach. B § 3.

132 PSA methodology has significantly evolved over the past ten years in the nuclear industry, building on the methods, data, and approaches used in the NRC's

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probabilistic analysis performed by ERIN. The documents were only a starting point because they do not address loss of spent fuel pool cooling nor a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding in the spent fuel pool, which are part of the postulated scenario.[133] The analysis required the incorporation of the unique Harris design features, including the size and location of the Harris fuel handling building and the multitude of spent fuel pool makeup systems and makeup pathways.[134] Where site specific information was not available, the best available generic studies were used as appropriate.

CP&L staff provided detailed calculations (including the Harris PSA), system descriptions, interviews with operating personnel, and procedure interpretations.[135] CP&L technical and operations personnel expended a great deal of effort researching and analyzing Harris-specific information in support of ERIN. In particular, Steven Edwards managed the efforts of a team of Harris engineers in performing the calculations establishing the time to heat up the Harris spent fuel pools to boiling, and after boiling

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mandated IPE process. The current PSA methods and technology are significantly improved beyond those used in the IPE process. Burns Aff. ¶ 11.

133 Id. ¶ 13. The methodology employed by ERIN is discussed in detail in Burns Aff., Attach. C § 2.0.

134 The Harris fuel handling building , spent fuel pools, and associated equipment are described in Edwards Affidavit ¶¶ 12 – 14 and McCartney Affidavit ¶¶ 4 – 21. The multitude of pathways for makeup water to the spent fuel pools is described in detail in McCartney Affidavit ¶¶ 22 – 34.

135 Burns Aff. ¶ 8; information provided by CP&L to ERIN is summarized in the Laur Affidavit; Edwards Affidavit; McCartney Affidavit; DeVoe Affidavit; and Morgan Affidavit.

has started, the additional time necessary to boil the pool level to the top of the fuel racks.[136] Mr. Edwards also provided ERIN with the spent fuel pool gate alignments expected during operation with pools C and D in operation.[137]

CP&L staff provided ERIN information on the multitude of methods to provide cooling and makeup water to the Harris spent fuel pools under normal and emergency conditions.[138] Eric McCartney, an experienced senior reactor operator, also provided ERIN with Harris-specific information on the configuration and operation of doors, locks, emergency lighting, and protective equipment available to operators.[139] In addition, he established the best estimate times for operators to access and align the alternate spent fuel pool cooling and makeup flow paths.[140]

ERIN personnel made multiple Harris site visits to confirm the as-built design of certain key Harris buildings, systems and components.[141] CP&L personnel performed an owner's review of the draft probabilistic analysis to ensure accuracy of the Harris site specific information.[142]

In the following sections, we discuss in more detail the methodology for the calculation of the overall probability and the results.

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136 Edwards Aff. ¶¶ 3, 15-18, 22.

137 Id. ¶ 13.

138 McCartney Aff. ¶¶ 25-34.

139 Id. ¶¶ 17-21.

140 Id. ¶¶ 26-34.

141 Burns Aff. ¶ 8.

142 Laur Aff. ¶ 9.

C. The Probability of Initiating Events – A Severe Reactor Degraded Core Accident with Containment Bypass, Loss of Spent Fuel Pool Cooling and a Large Early Release of Fission Products Outside of Containment – Is Extraordinarily Low and Beyond the Harris Design Basis.

The postulated scenario begins with a very low probability, beyond design basis, degraded core, severe accident event at the Harris reactor (Step 1) with failure of the large dry Harris containment or bypass of the containment (Step 2). ERIN evaluated these two steps using probabilistic safety assessment techniques. For the internal events (i.e., initiating events at Harris such as steam generator tube rupture, loss of coolant accident, station blackout, etc.), the contribution to steps 1 and 2 was taken from the updated Harris PSA plus the updated ISLOCA analysis that was used to obtain a best estimate of the ISLOCA contribution (i.e., to be consistent with the best estimate frequencies obtained in other parts of the Harris PSA).[143] ERIN also performed a sensitivity analysis to evaluate the potential contribution from fire initiating events, seismic events, and shutdown (rather than at-power) events. The Harris IPEEE was used for Harris-specific information regarding the fire and seismic events, as well as screening other external events. Generic industry data developed by the NRC was used to evaluate the shutdown events.[144]

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143 Burns Aff. ¶ 15. The independent peer reviewers had found the ISLOCA analysis in the Harris PSA overly conservative and it was updated to be useful in providing the best estimate calculation of the postulated scenario. Id. ¶ 13.

144 Id. ¶ 15. The accident sequence frequency development for each of the contributors are described in Burns Affidavit, Attach. C § 4.0.

Step 3 of the postulated scenario requires the loss of spent fuel cooling and makeup systems to the Harris spent fuel pools. ERIN performed a probabilistic evaluation of the loss of all spent fuel pool cooling and makeup systems, which included SFPCCS cooling failures (random, human error, test/maintenance and common cause); SFPCCS cooling support system failures, including support system failures that may have contributed to the core damage accident sequence initiating event; and consequential failures of SFPCCS cooling or its support systems due to adverse environmental conditions caused by containment failure or bypass.[145] The addition of a separate, redundant SFPCCS for spent fuel pools C and D provides alternate makeup paths in the event the SFPCCS cannot be restarted. One of the conclusions reached by ERIN was that overall probability of the first six steps of the postulated scenario is somewhat less with the addition of the SFPCCS for spent fuel pools C and D providing a redundant cooling system and alternate makeup water pathways for the spent fuel pools.[146]

Step 4 of the postulated scenario assumes extreme radiation doses precluding personnel access and Step 5 assumes an inability to restart any pool cooling or makeup systems due to extreme radiation doses. For all sequences identified in Steps 1 and 2,

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145 Burns Aff. ¶ 16.

146 Id. See McCartney Aff. ¶¶ 24 - 29 for a discussion of the additional makeup water pathways created by the addition of the redundant SFPCCS for spent fuel pools C and D.

CP&L calculated radiation levels for the specific areas in which access would be necessary in order to respond to Step 3.[147]

To determine these levels, Michael DeVoe, a CP&L engineer with over 21 years of design and safety analyses experience, calculated a best estimate reactor core radioisotope inventory to support the ERIN analyses.[148] Mr. DeVoe provided his results to Ben Morgan of CP&L.[149] Mr. Morgan combined the best estimate core inventory and the fractions of the core inventory released in each event obtained from ERIN to calculate the expected dose rates in the specified areas.[150] Using these dose rates, Mr. Morgan determined access restrictions applicable to each analyzed event, which were provided to ERIN.[151]

ERIN probabilistically considered and modeled the adverse impacts of extreme radiation and extreme conditions of steam or heat from the containment failure, the containment bypass, or boiling of the spent fuel pools on both personnel access and equipment survivability. ERIN made an extensive effort to characterize plant conditions, especially in the reactor auxiliary building and the fuel handling building (i.e., the areas containing critical equipment). ERIN performed a deterministic evaluation of the plant

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147 Burns Aff. ¶ 17; see also Morgan Aff. ¶¶ 8, 15, 17, 18, 19. The probabilistic evaluation of the loss of all SFPCCS and makeup systems for the spent fuel pools is discussed in Burns Affidavit. ¶ 16, Attach. C § 4.0, and Apps. A, C, D and E.

148 DeVoe Aff. ¶ 6.

149 Id. Aff. ¶ 12.

150 Id. ¶ 5. A more complete description of the dose calculations, including the widely accepted standards and methods used, can be found in Morgan Affidavit ¶¶ 6-16.

thermal hydraulic response and the transport of radionuclides to characterize issues such as access, timing, and adverse conditions on equipment.[152]

ERIN utilized the Modular Accident Analysis Program ("MAAP") computer model to analyze the transient flow conditions due to the postulated accident sequences and containment failure modes. MAAP is the most widely used severe accident analysis code and has been reviewed extensively by the NRC and its contractors in support of NRC Generic Letter 88-20. MAAP includes best estimate models to represent accident progression beginning with normal operation and extending to potential radionuclide release to the environment. The Harris-specific MAAP calculations also yielded the fission product release, transport, and deposition effects in the reactor auxiliary building and fuel handling building. These results provided one input to the CP&L dose calculations used to assess personnel access to specific areas and to ERIN's assessment of equipment survivability.[153]

The annual frequency contributions of each of the internal events is summarized in Table 5-1 of the ERIN Report (which is reprinted in the Burns Affidavit at 14). The total internal events contribution is calculated to be 7.67×10^{-6}. The sensitivity analyses for the annual frequency contribution from fire induced events is calculated at 9.80×10^{-7}

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151 Id. ¶¶ 17-19.

152 Burns Aff. ¶ 17.

153 Id. ¶ 17, Attach. C § 4.0 and App. A, C, E; Morgan Aff. ¶ 5.

and the estimate of shutdown events is 5.00×10^{-7}.[154] The annual frequencies for steps 1 through 5 of the postulated scenario are exceedingly low, already lower than the safety goal for LERF and, of course, beyond the Harris design basis. The requirement of yet another improbable event by the postulated scenario in step 6 only highlights the extremely remote probability of occurrence of this event at Harris.[155]

D. The Probability of Recovery of Spent Fuel Pool Cooling at Harris Before Evaporation Uncovers the Spent Fuel, After the Highly Unlikely Initiating Events Required By BCOC's Postulated Scenario, is Quite High Due to the Unique and Robust Design of the Harris Fuel Handling Building and the Multiple Alternate Sources of Makeup Water.

Step 6 of the postulated scenario requires the loss of most or all spent fuel pool water through evaporation and the inability to restart spent fuel cooling or add makeup water to the spent fuel pool before the spent fuel is uncovered. To evaluate this step, ERIN performed a deterministic evaluation that included a calculation by CP&L of the time to boil and evaporate the water in the spent fuel pool after loss of all cooling.[156] With a worst case heat load in spent fuel pools A and B (i.e., immediately after

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154 The sensitivity analysis for seismic contribution was not broken down in the same manner as for the internal events, fire and shutdown internal events. The sensitivity analyses will be discussed in greater detail infra § IV.D.

155 As Dr. Parry of the NRC Staff stated in his deposition, "The first step in this scenario is a degraded core accident. The second is a containment failure. The probabilities are so - - or the frequency of those events has been assessed, and it is judged that the frequency is sufficient to meet the agency's safety goals, which, and I think in terms of those safety goals, if you look at [NUREG-]1150, they certainly demonstrate a degree of prudence associated with the frequencies of such accidents." Parry Dep. at 83.

156 The results of that calculation are set forth in Section 2.0 of the ERIN Report, Burns Affidavit, Attach. C § 2.0 and Edwards Affidavit ¶¶ 15 - 25.

refueling), CP&L calculated that it would take over eight (8) days after all SFPCCS cooling and makeup is lost to uncover the fuel. (It would take over 100 days for the water in spent fuel pools C and D to evaporate with the 1.0 MBTU heat load permitted by the License Amendment Application.)[157] Based on the ability to restore spent fuel pool level and prevent uncovering of any spent fuel with the most limiting makeup sources credited, ERIN conservatively assumed access to critical plant areas to restore SFPCCS cooling or makeup to the spent fuel pools to be required within 96 hours.[158]

The size and compartmentalization of the Harris fuel handling building influences its accident response. In addition, there are a substantial number of systems and pathways for establishing water makeup to the spent fuel pools. The addition of a redundant SFPCCS for spent fuel pools C and D provides additional pathways for injection of makeup water to the spent fuel pools. ERIN determined that access to at least one makeup water lineup was possible within 96 hours for all of the initiating accident sequences with containment failure or bypass.[159]

The results of ERIN's probabilistic analysis are described in Section 5.0 of the ERIN Report and are summarized in Table 5-1.[160] The first column in Table 5-1 expresses the results of the calculation of the annual core damage frequency for severe accident event initiators with containment failure or bypass (discussed in the previous

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157 Edwards Aff. ¶ 22.

158 Burns Aff. ¶ 18.

159 Id. ¶ 18, Attach. C, App. E. The various makeup water pathways are described in Burns Affidavit, Attach. C, App. A and McCartney Affidavit at ¶¶ 25-34.

160 Burns Aff. ¶ 21 and Attach. C § 5.0.

section). The second column provides the results of the probabilistic assessment of Steps 1 through 6 for each severe accident initiator, taking into account the probability that Harris personnel could restore spent fuel pool makeup within 96 hours. The cumulative results of the internal events initiated sequences indicate that the loss of effective spent fuel pool cooling has a best estimate annual occurrence probability of 2.65×10^{-8}. This value is the best estimate answer to Question 1.[161]

As Table 5-1 shows, the external events and shutdown events were also evaluated to determine whether these events alter the conclusion reached based on the internal events assessment. CP&L and ERIN recognized that the uncertainties associated with these events are greater than those in the dominant internal events analyses. Consequently, several conservatisms were incorporated into the modeling, which produced inflated point estimate values. As indicated in Table 5-1, the point estimate annualized probability for the total fire events contribution was 2.94×10^{-9} (or an order of magnitude less than the total internal events contribution). The total seismic contribution was based on data with large uncertainties, an approximate model, and greater conservatisms. Furthermore, it was difficult to analyze in the context of the postulated scenario because a seismic event less than the design basis earthquake cannot be an initiator of Steps 1 and 2, and a seismic event sufficient to cause breach of the spent fuel pools is outside of the postulated scenario (because the loss of cooling to the spent fuel must be by evaporation (Step 6) and not draindown of the spent fuel pools from a breach

161 Id. ¶ 21.

of pool integrity). While the point estimate annualized probability contribution due to seismic initiated events of 8.65×10^{-8} is higher than for internal events, it was judged by ERIN not to alter the conclusions reached based on the internal events analysis.[162]

Finally, the CDF associated with internal events during shutdown refueling outages was estimated by ERIN to be on the same order of magnitude as that calculated for power operation. This determination was based on generic studies rather than Harris-specific PSA, because shutdown internal events are not included in the Harris PSA. In any case, the generic results for pressurized water reactors were judged by ERIN to be applicable to Harris. The use of these core damage results and an assessment of the containment failure or bypass led to an assessment of the postulated scenario that is consistent with the estimate of the probability reached for the dominant internal events.[163]

As requested by the Board, the analysis performed was a best estimate analysis using the best available technical information representative of Harris. The best estimate is used for decision making because the use of upper bounds (or lower bounds) may introduce biases into the decisionmaking process that are not properly characterized, i.e., the biases may be unevenly applied (widely varying levels of conservatism) with the resulting upper bound yielding a distortion of the importance of individual components of the analysis and potentially of the overall results. Such biases could then lead to

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162 Id. Dr. Thompson agreed that seismic structural failure was not a contributor to the postulated scenario. Thompson Dep. at 127. In any event, in San Luis Obispo the court rejected consideration of the effects on a nuclear plant of earthquakes greater than the design basis safe shutdown earthquake – and that was in *California*. See note 92-93, supra.

improper decisions regarding the importance of individual elements of the analysis. It may also lead to the improper allocation of resources to address conditions or postulated events that have been "conservatively" treated in an upper bound evaluation. The best estimate of the postulated scenario can be further understood in the context of the uncertainties surrounding the quantification.[164]

There are uncertainties surrounding any calculated probability. The NRC, its contractors, and the industry have made substantial efforts to understanding the uncertainties in nuclear power plant risk analyses. These efforts have led to methods development, understanding of the contributors to the uncertainty distributions, and the identification of alternative ways to provide decision makers with effective ways of characterizing the risk spectrum. The evolving consensus in the industry on the treatment of uncertainties is that the use of focused sensitivity evaluations to characterize the change in the results as a function of changes in the inputs provides a physically meaningful method of conveying the degree of uncertainty associated with the analysis. Therefore, ERIN developed extensive sensitivity cases in connection with its analysis that portray the changes in the postulated scenario frequency if input variations occur. The results of the sensitivity analyses provide greater confidence in the validity of the best estimate results.[165]

Footnote continued from previous page

163 Burns Aff. ¶ 22.

164 Id.

165 Id. ¶ 24 and Attach. C § 5.0.

E. The Probability of a Self-Sustaining Exothermic Oxidation Reaction of Zircaloy Cladding of the Old, Cold Spent Fuel to be Stored in Harris Spent Fuel Pools C and D is Highly Unlikely in Any Event.

Step 7, initiation of a self-sustaining exothermic oxidation reaction in spent fuel pools C and D, was not evaluated by ERIN. A rigorous probabilistic assessment would have required the development of new thermal hydraulic models. There was insufficient time to undertake such development work. Furthermore, the probability of reaching Step 7 was calculated to be exceedingly low, as noted in the preceding section. In this regard, ERIN took the same approach as the NRC in NUREG-1353 and assumed that the conditional probability of a self-sustaining exothermic oxidation reaction was 1.0 for purposes of the best estimate analysis of the probability of the postulated scenario.[166]

This is considered to be a very conservative assumption. Actual spent fuel has been heated up in air to a temperature of approximately 800° C under controlled laboratory conditions without a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding occurring.[167] Anecdotal evidence also exists that shows a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding does not occur for air cooled spent nuclear fuel.[168] Between late 1977 and early 1981, CP&L shipped 290 PWR fuel assemblies from Robinson to Brunswick in over 40 shipments using air coolant in the shipping cask. At the time of shipment, this spent fuel had cooled between

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166 Id. ¶ 20.

167 See Kunita Aff., Attach. B, reference 7.

168 Id. ¶ 26.

2.7 and 6.5 years. There is no evidence that there was anything unusual about these assemblies when they were unloaded after receipt at Brunswick.[169]

CP&L's Principal Engineer for Spent Fuel Management, Robert Kunita, undertook a review of the literature relating to the oxidation of zirconium and the potential for a self-sustaining exothermic oxidation reaction in the zircaloy cladding of the spent fuel to be stored in Harris spent fuel pools C and D in the event of evaporation of the pool water and uncovery of the spent fuel.[170] Mr. Kunita is an expert in the design, materials, performance, decay heat rate, storage and transportation of spent nuclear fuel. Mr. Kunita has been professionally responsible for matters involving nuclear fuel since 1966, when he joined the nuclear core design team for Admiral Hyman Rickover's Light Water Breeder Reactor Project, which subsequently ran successfully at the Shippingport Reactor. Mr. Kunita has been employed by CP&L for 27 years.[171]

Mr. Kunita determined that the literature contains a limit (3 kilowatts per metric ton) for use in determining whether a self-sustaining exothermic oxidation reaction is likely for spent fuel with a particular decay heat rate.[172] For spent fuel with heat outputs less than 3 kilowatts per metric ton, no self-sustaining zircaloy exothermic oxidation reaction will occur even if cooling is lost because the available energy is insufficient to initiate and sustain the reaction. For spent fuel with a heat output above 3 kilowatts per

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169 Id.

170 Id. ¶¶ 14-16.

171 Id., Attach. A.

172 Id. ¶ 19.

metric ton, it is unclear whether an uncontrolled exothermic oxidation reaction will occur, because the limit is very conservative.[173]

Mr. Kunita determined that spent fuel planned for storage in Harris spent fuel pools C and D has too low a decay heat rate to raise the zircaloy cladding to the critical cladding oxidation temperature and is, therefore, highly unlikely to undergo a self-sustaining exothermic oxidation reaction.[174] The primary contribution to heat generation rate in spent fuel is the radioactive decay of material in the fuel, referred to as decay heat. Decay heat is primarily a function of the combination of the burnup of the spent fuel, in megawatt-days per metric ton of uranium (MwD/Mtu), and the age (or "decay time") of the fuel. The decay heat rate drops rapidly with time after the spent fuel is discharged from the reactor and after approximately five years the decay heat is only a small fraction of when the spent fuel was first removed from the reactor.

Mr. Kunita concluded that because of the low heat load in the old, cold spent fuel to be stored in Harris spent fuel pools C and D, it is highly unlikely that the spent fuel in pools C and D could sustain a zircaloy cladding exothermic oxidation reaction, even if a loss of most or all pool water through evaporation occurred.[175] Thus, while for purposes

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173 Id. ¶ 34.

174 Id. ¶ 35.

175 Id. Interestingly, BCOC's expert conceded in his deposition that this result might be the case:

> Q Look at the seven-step scenario again on page 13. Is it possible that the best estimate of a probability of that scenario is zero? That is, one of the steps itself might be zero.

Footnote continued on next page

of the probabilistic assessment of the best-estimate annual frequency of the postulated scenario Applicant assumed a conditional probability of 1.0 for a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding, the more realistic probability might well be much closer to 0.0. As discussed in the next section, this is one of a number of conservatisms in the analysis.

F. While Applicant Attempted to Provide a "Best Estimate" Probability, the Resulting Analysis Still Contains Conservatisms That Tend to Overstate the Probability of BCOC's Postulated Scenario.

As requested by the Board, the analysis performed was a best estimate analysis using the best available technical information representative of Harris. Despite all prudent attempts to create a best estimate evaluation, there remain some potential residual conservatisms in the quantification. In addition to the highly unlikely assumption that the conditional probability of a self-sustaining exothermic oxidation reaction in zircaloy spent fuel cladding is 1.0 (as discussed supra), among these conservatisms are:

- A substantial fraction of the containment does not interface with the reactor auxiliary building. However, the dominant failure modes for containment appear to be at locations where reactor auxiliary building impacts cannot be ruled out. Therefore, all containment failures are assumed to impact the reactor auxiliary building environment. (This overstates the probability of a harsh or radioactive environment in the

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> A That's conceivable, *yes*. If the *fuel* were of an *age* or a spacing such that when drained, ignition would not occur, then the *probability* of the scenario *would be zero*. In fact, that pertained in the early years of nuclear plant operation when low density open racks were used.

Thompson Dep. at 152-3 (emphasis added).

reactor auxiliary building and fuel handling building which could preclude personnel access to restore makeup water to the spent fuel pools.)[176]

- The spent fuel pool boil off time is taken to be the minimum it can be (8 days), given the plant configuration and the times at which freshly discharged spent fuel could be introduced into spent fuel pools A or B. Only half of that time is allowed for recovery of makeup water to the spent fuel pools.[177]
- The seismic evaluation is subject to large uncertainty and is believed to be a conservative bound because of the assumptions of:
  - Loss of site power with no opportunity for recovery
  - Complete dependence of failures of similar components
  - The early containment failure probability used in the seismic evaluation is the worst case found for any plant damage state. This is likely too conservative when applied to the seismic initiated sequences involving station blackout.[178]
- A conservative approach was taken by assuming that components fail if the room temperature exceeds the manufacturer's recommended value. However, in the case of pump motors, the failure is more a function of time at temperature rather than simply exceeding a temperature limit. Therefore, continued pump operation may be likely even for temperatures exceeding manufacturer specified warranty values.[179]
- Pump motors may also fail due to moisture intrusion. The humid environment in the pump areas following primary containment failure would likely result in moisture intrusion in the component cooling water ("CCW") and emergency service water ("ESW") Booster Pump motors that could potentially result in shorted or grounded circuits. The CCW and ESW Booster Pumps are not credited with continuous operability following containment failure scenarios.[180]
- The treatment of containment isolation failures into the reactor auxiliary building in the base model assumes that access to the reactor auxiliary building and fuel handling building operating deck (286' Elevation) is not

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176 Burns Aff. ¶ 24.

177 Id.

178 Id.

179 Id.

180 Id.

available. This is conservative relative to the deterministic calculations performed to support accessibility. The deterministic calculations indicate that the fuel handling building is not affected by the containment isolation failure.[181]

- Several conservative assumptions are incorporated in the heatup calculations, including: (a) water volume in the cask unloading pool was not considered; (b) no credit is taken for heat transfer to the pool liners, concrete structure, or atmosphere; (c) no credit is taken for any makeup water addition after the initiation of the heatup.[182]

The dose calculations also contain a number of conservatisms.

- The derivation of the in-plant airborne dose factors using MicroShield, modeled each plant area as a rectangular box and calculated the dose rate at the highest dose point, (i.e., the geometric center of the box). This method produced conservative results because it does not account for support structures, installed equipment, and internal walls that shield an individual from some portion of the calculated airborne activity. Also, in some areas, the geometric center of the volume is above head height, so that the actual dose rate to an individual would be lower than calculated. Actual dose rates would also be lower than calculated in plant areas with lower ceilings in part of a space, because an individual would be exposed to less activity from overhead than calculated.[183]

- Access times in areas affected by environmental releases assume that all areas are downwind, (i.e., all entrances to the power block, the water treatment building, and the cooling tower basin are affected by the same release). This is extremely unlikely to occur because of the actual physical separation of these areas and the diverse directions from the release points. As a result, the calculated dose rates in one or more of these locations is very likely conservatively high.[184]

- Deposition was not assumed to remove any activity from the plume and the activity was not decayed during the time it would take the activity to travel from the release point to the location of interest. These assumptions both increase the conservatism of the calculated plume dose rates. The

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181 Id.

182 Edwards Aff. ¶ 20.

183 Morgan Aff. ¶ 21.

184 Id. ¶ 23.

lack of decay during travel time also adds conservatism to the calculated deposition dose rates.[185]

- The dose calculations assumed radioactivity releases from a single point. This resulted in higher calculated doses than would result if the release occurred from multiple locations, as would likely be the case for all scenarios except Steam Generator Tube Rupture ("SGTR").[186]
- Conservative values were used for steam flow rate and ambient temperature in calculating the effective release height for SGTR. This resulted in a lower calculated release height and, therefore, higher calculated dose rates from both shine and plume immersion.[187]
- Dose consequences for personnel on the ground from radioactivity released from the plant vent are not as significant as the dose consequences from radioactivity released through the fuel handing building railroad door. Use of a ground level release for scenarios other than SGTR, therefore, produces dose values more conservative than actually expected because, although some activity could be released from the fuel handling building railroad door, most of the activity released would be from the plant vent.[188]

These conservatisms still inherent in the probabilistic assessment provide additional confidence that the calculated best estimate overall annualized probability of occurrence at Harris for the postulated scenario is 2.65×10^{-8} or less. In addition, Dr. Burns states that his confidence in the results are based on: (1) the quality of the Harris PSA and IPEEE; (2) the quantity of Harris-specific information incorporated in the analyses; (3) the breadth, qualifications, and technical skills of the team performing the work; (4) the quality and capabilities of the technical tools employed; (5) the quality and extent of internal, owner, and independent reviews; (6) the degree of correlation with

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185 Id. ¶ 24.

186 Id. ¶ 25.

187 Id. ¶ 26.

188 Id. ¶ 27.

similar analyses; and (7) the extensive set of sensitivity studies used to explore the uncertainty bands associated with the quantification. For all these reasons, it is Dr. Burns and ERIN's professional opinion, and Applicant's position, that the postulated scenario is so unlikely that it would not be reasonable to consider it further in decision-making for NEPA regarding postulated risks posed by the Harris spent fuel pools. The annual occurrence probability of the postulated scenario is, for example, considerably less than the probability of the recurrence of the ice age or the probability of a meteor strike creating world-wide havoc.[189]

V. THE NUREG-1353 ESTIMATED VALUES ARE NOT RELEVANT TO DETERMINING THE FREQUENCY OF OCCURRENCE OF THE POSTULATED SCENARIO AT THE HARRIS PLANT

A. Answer to Board Question 2: The Probability Value of 2×10^{-6} Per Year Set Forth in the Executive Summary of NUREG-1353 is Not Relevant to BCOC's Postulated Scenario; In Any Event, the Assumed Conditional Probability for a Self-Sustaining Exothermic Reaction Cannot be Higher.

The Board asked the parties to address the following second point:

> The parties should take careful note of any recent developments in the estimation of the probabilities of the individual events in the sequence at issue. In particular, have new data or models suggested any modification of the estimate of 2×10^{-6} per year set forth in the executive summary of NUREG-1353, Regulatory Analysis for the Resolution of Generic Issue 82, Beyond Design Basis Accidents in Spent Fuel Pools (1989)? Further, do any of the concerns expressed in the ACRS's April 13, 2000 letter suggest that the probabilities of individual elements of the sequence are greater than those previously analyzed (e.g., is the chance of occurrence of sequence element seven, an

189 Burns Aff. ¶ 25, Attach. C § 6.0 and App. B.

exothermic reaction, greater than assumed in the decade-old NUREG-1353)?[190]

Based upon the assumptions and methodologies used in NUREG-1353,[191] and an extensive review of available literature, CP&L has concluded that the probability values estimated in NUREG-1353 are not applicable to the postulated scenario. To the extent that the NUREG-1353 probability value for a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding applies to postulated scenario step 7, the NUREG-1353 conditional probability for PWR spent fuel elements is 1.0, which obviously cannot be increased. CP&L also concludes that recent literature does not contain sufficient information to evaluate the conditional probability value for BWR spent fuel elements of 0.25 specified in NUREG-1353. As described above, however, CP&L has used a conservative conditional probability value of 1.0 for step 7 in its analyses responding to the Board's questions in this proceeding.

B. A Literature Review Does Not Suggest Changes to NUREG-1353 Values to the Extent They Are Relevant Here.

To address the Board's points, CP&L directed Robert Kunita to conduct a literature review to identify any developments since 1989 (i.e., the publication date of NUREG-1353,) in the estimation of the probabilities of the individual events in the postulated scenario. Mr. Kunita reviewed an extensive list of documents, identified in Exhibit 2, Attachment D, to evaluate their impact on the estimates contained in NUREG-

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190 Order at 17.

191 NUREG-1353, "Regulatory Analysis for the Resolution of Generic Issue 82, 'Beyond Design Basis Accidents in Spent Fuel Pools'" (1989) (hereinafter "NUREG-1353").

1353. Specifically, the review was to identify any new models or data that could suggest a modification of the 2×10^{-6} per year value for the overall probability of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding resulting from a loss of water from a spent fuel pool and whether the probabilities of the individual elements of the postulated scenario could be greater than previously analyzed.[192]

To the extent that any NUREG-1353 estimated value is applicable to the postulated scenario, Mr. Kunita concluded that the data and models that have been reported since the publication of NUREG-1353 do not suggest any substantive modification of those values.[193] Mr. Kunita is also of the opinion, however, that, with the possible exception of the probability of a loss of spent fuel pool cooling, the estimated values in NUREG-1353 do not appear applicable to the postulated scenario.[194] The NUREG-1353 quantification of accident sequences in spent fuel pools includes structural failures due to: missiles, aircraft crashes, heavy load drops, and beyond design basis earthquakes, reactor cavity and transfer gate pneumatic seal failures, and inadvertent draining.[195] The postulated scenario specifically excludes these initiators (i.e., the postulated scenario only includes initiators that result in the loss of pool water due to evaporation). The frequency of spent fuel damage values resulting from the accident

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192 Kunita Aff. ¶ 29.

193 Id. ¶ 30.

194 Id.

195 NUREG-1353, at 4-13 to 4-28.

sequences postulated in NUREG-1353, therefore, reflect conditions that are not applicable to the Board's questions.

Dr. Burns also reviewed NUREG-1353 in the process of preparing the ERIN report. Dr. Burns noted that while the NUREG-1353 best estimate value of 6.0×10^{-8} per reactor year for loss of spent fuel cooling and makeup due to seismic events is not inconsistent with the ERIN results, the value contains an unspecified beyond design basis contribution, which limits its usefulness.[196] Dr. Burns arrived at the same conclusion as Mr. Kunita: the mean value of 2×10^{-6} per reactor year estimated value in NUREG-1353 is not relevant to analyzing the postulated sequence.[197]

BCOC's expert apparently reached the same conclusion. Dr. Thompson stated in his deposition:

> Q Look on page 17 of Exhibit 2, the second question, for a moment. It says[, t]he parties should take careful note of any recent developments in the estimation of the probabilities of the individual events and the sequence at issue. In particular, have new data or models suggested any modification of the estimate of two-times-ten-to-the-minus-six per year, set forth in the Executive Summary of NUREG-1353, regulation analysis for the resolution of Generic Issue 82, beyond design basis accidents in spent fuel pools, 1989.
>
> What's your answer to that question?
>
> A In my brief, I will certainly respond in every particular to what the Board requests. My recollection at the moment of NUREG-1353 is that it did not address the scenario that's at issue here.

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196 Burns Aff. ¶ 12.

197 Id.

. . .

Q . . . If you look at table 4.7.1, let's look under structural failures. Is it fair to say that missiles, aircraft crashes and heavy load drops are outside the scope of the seven-step sequence that we are about?

A By Board ruling, yes.

Q And, also, by Board ruling, what about pneumatic seal failures?

A Likewise.

Q Inadvertent drainage.

A Likewise.

Q How about loss of cooling makeup?

A As shown by the footnote, that includes seismically induced loss of cooling and makeup. My recollection of this document is that the initiating events for loss of cooling and makeup do not include a degraded core reactor accident.

Q That's your understanding.

A That's my recollection of this document, yes.

Q Okay. Seismic structural failure would not be included either under the Board's scenario, is that correct?

A That's correct, yes.[198]

There appears to be agreement that NUREG-1353 probability values are not applicable to determining the best estimate probability of the postulated scenario.

198 Thompson Dep. at 124-5, 126-7.

C. The Concerns Expressed in the April 13, 2000 ACRS Letter Do Not Suggest That the Probabilities of Individual Elements of the Postulated Scenario Are Greater Than Previously Analyzed.

The ACRS has speculated that the presence of zirconium hydrides in spent fuel cladding may lower the critical cladding oxidation temperature.[199] Mr. Kunita, however, did not identify any analysis that indicated zirconium hydrides would lower the onset temperature of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding below 800°C. Without such information or analysis, Mr. Kunita's heat balance calculations provide the most accurate analyses of the potential for a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding in the Harris spent fuel pools C and D.

In any event, the conditional probability of an exothermic oxidation reaction cannot be greater than that assumed in NUREG-1353 for PWR spent fuel, as NUREG-1353 assumes a conditional probability of 1.0 for this event.[200] Further, as discussed in detail in section IV.E supra, Applicant's literature survey did not identify any analysis that reported a critical cladding oxidation temperature any lower than 800°C. The literature survey did identify several studies that report the critical cladding oxidation temperature for a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding at about 900°C, with NUREG/CR-5597 showing the onset of rapid zircaloy

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199 Letter from Dana A. Powers to Richard A. Meserve, "Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," (April 13, 2000).

200 Kunita Aff. ¶ 31.

oxidation at 1500°K (1227°C).[201] Based on this data, and the specific parameters of the spent fuel to be stored, Mr. Kunita concluded that a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding is highly unlikely in Harris spent fuel pools C and D, despite the NUREG-1353 conditional probability estimate.

VI. NEPA REQUIRES NO FURTHER ANALYSES

Answer to Board Question 3: The NRC Staff Does Not Have to Prepare Additional Environmental Impact Analyses Even If the Board Should Decide a Probability of Occurrence on the Order of a Few Chances in One Hundred Million Per Year is Not Sufficient to Classify BCOC's Postulated Scenario as Remote and Speculative.

As a final point, the Board asked the parties to address the following issue:

> Assuming the Board should decide that the probability involved is of sufficient moment so as not to permit the postulated accident sequence to be classified as "remote and speculative," what would the overall scope of the environmental impact analysis the staff would be required to prepare (i.e., limited to the impacts of that accident sequence or a full blown EIS regarding the amended request)?[202]

In light of the infinitesimal probability of the postulated scenario, existing case law support for much higher probabilities as "remote and speculative," and the arguments in favor of one-in-a-million as a threshold, this question appears moot. However, CP&L has reviewed this matter carefully and has concluded that, under the circumstances, the NRC Staff would not have to prepare additional environmental impact analyses even assuming the Board should decide a probability on the order of a few chances in one

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201 Id. ¶ 16.

hundred million per year is not sufficient to classify the postulated scenario as "remote and speculative."

The fundamental legal question in applying NEPA is, as discussed supra, whether the cognizant federal agency "has adequately considered and disclosed the environmental impact of its actions."[203] This has been done with respect to the potential environmental impacts of spent fuel storage generically, specifically at Harris, and at every other nuclear plant in the country. As discussed in Section III.B. supra, NEPA requires nothing more than a "hard look." The Commission has given the potential environmental impacts of wet, dry, short-term, and long-term storage of spent nuclear fuel a very, very hard look for operating plants, decommissioning plants, and independent spent fuel storage facilities. In considering what emergency planning should remain in place for a shutdown, decommissioning plant, the Commission continues to this day to take a hard look at potential accidents and consequences of the long-term storage of spent fuel.

With respect to Harris, the FES issued at the time of the operating license considered the environmental impacts of operation of all four spent fuel pools (for what was understood at the time to be two operating units, with additional storage of spent fuel shipped from CP&L's other nuclear units). The quantity of spent fuel assumed to be stored at the time of the Harris FES exceeds the quantity of spent fuel that can be stored

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Footnote continued from previous page

202 Order at 17.

203 Baltimore Gas & Electric Co., 462 U.S. at 98; see also Robertson, 490 U.S. at 350; Kleppe, 427 U.S. at 409-410.

pursuant to the License Amendment Application presently before this Board.[204] Further, in its 1999 Environmental Assessment, the NRC Staff explicitly stated that the license amendment "does not involve the use of any resources not previously considered" in the FES.[205]

The "environmental risks" of BCOC's postulated scenario at Harris are bounded by the existing NEPA analyses.

> The environmental impacts that have been considered include potential radiation exposures to individuals and to the population as a whole, the risk of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. These impacts could be severe, but the likelihood of their occurrence is judged to be small. . . . *The overall assessment of environmental risk of accidents*, assuming protective action, shows that *it is on the same order as the risk from normal operation*, although accidents have a potential for early fatalities and economic costs that cannot arise from normal operations. *The risks* of early fatality from potential accidents at the site *are small in comparison with risks of accidental deaths from other human activities* in a comparably sized population.[206]

Indeed, the theoretical consequences and limiting time to restore cooling or makeup water to the spent fuel pools at Harris are driven by the higher heat load of the fuel stored in spent fuel pools A and B. Spent fuel pools C and D add almost no potential risk

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204 See Note 4, supra. However, the postulated scenario was also analyzed for the assumed maximum 15.6 MBTU/hr heat rate in spent fuel pools C and D that could be achieved in the future after modifications to cooling systems. Burns Aff. ¶ 18; Edwards Aff. ¶¶ 20 - 22.

205 EA at 9.

206 FES § 5.9.4.6 (emphasis added).

because, under the postulated scenario, it would take over 100 days to evaporate the water in those pools[207] and, because of the low heat rate, the probability of a self-sustaining exothermic oxidation reaction of zircaloy spent fuel cladding is highly unlikely, perhaps impossible.[208] The environmental risks of the proposed activity in the License Amendment Application are, therefore, bounded by the already licensed activity in spent fuel pools A and B.

CP&L has established that the best estimate probability of occurrence of the postulated scenario is on the order of 2.65×10^{-8} per year, which is nearly *three orders of magnitude* (i.e., a factor of 1,000) below the LERF.[209] BCOC's worst case scenario involves a *complete* release of radioactivity from a fire involving *all* the fuel elements in *all* Harris spent fuel pools when they are *completely* filled with freshly discharged fuel from approximately 30 reactor cores. Using the generally accepted definition of risk (i.e., probability times consequences), the environmental risk of BCOC's worst case postulated environmental impact is, therefore, *still one to two orders of magnitude less* than the risk the NRC Staff already considered in the FES.[210] There is nothing significant or relevant

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207 Edwards Aff. ¶ 22.

208 Kunita Aff. ¶ 35.

209 See discussion section III.C, supra.

210 Dr. Thompson conceded during his deposition that if LERF were an acceptable safety goal, and an accident had a potential consequence an order of magnitude greater than the LERF accident, but also had a annual probability of occurrence an order of magnitude less, then the risk was equivalent. Thompson Dep. at 191-93.

about such an unlikely occurrence and there is no basis to order the NRC Staff to *further* analyze consequences that are dwarfed by those already considered.

In summary, the potential consequences of the seven-step postulated scenario have received all the consideration and analysis required by NEPA, whether or not it is deemed "remote and speculative." The case law is absolutely clear that an agency must prepare a supplement to an EIS only if there are *significant new* circumstances or information *relevant* to environmental concerns from the proposed action or its impacts. BCOC has failed to demonstrate that the postulated scenario is significant or adds new information relevant to the environmental impacts from Harris. Further, CP&L has shown that the environmental risks of the postulated scenario, even under worst case conditions and assuming consequences greater than those from a severe degraded core accident, are bounded by the existing Harris FES. There is no reason to require further analyses and NEPA does not so require.

VII. ACTIONS REQUESTED OF THE BOARD

Applicant CP&L respectfully submits that, at the conclusion of oral argument, the Board should, pursuant to 10 C.F.R. § 2.1115, "promptly by written order":

1. Determine that no issue of law or fact shall be designated for resolution in an adjudicatory hearing.

2. Dispose of Contention EC-6. The License Amendment Application to permit commissioning of spent fuel pools C and D for storage of up to 1.0 MBTU/hr of spent nuclear fuel increases neither the probability nor potential consequences of accidents at Harris. In fact, the addition of a redundant spent fuel pool cooling and cleanup system for spent fuel pools C and D provides alternative makeup water paths to the spent fuel pools and reduces the probability of the postulated scenario. The postulated scenario is highly "remote and speculative" and the environmental risk is

insignificant and is bounded by the existing environmental risk of the licensed activity and by existing NEPA analyses.

3. Find as a matter of fact and conclude as a matter of law that the NRC Staff has satisfied its obligations pursuant to NEPA and need not prepare a supplemental environmental assessment or environmental impact statement.

4. Dismiss this proceeding.

Respectfully submitted,

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Dated: November 20, 2000

1035326

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT	)	Docket No. 50-400-LA
COMPANY	)	
(Shearon Harris Nuclear Power Plant)	)	ASLBP No. 99-762-02-LA

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "Summary of Facts, Data, and Arguments On Which Applicant Proposes to Rely at the Subpart K Oral Argument Regarding Contention EC-6," dated November 20, 2000, with supporting affidavits, in the form of Exhibits, were served by electronic mail transmission on this 20th day of November, 2000, and that all documents served by electronic mail, plus the remaining Exhibits and Attachments, will be served by next day delivery service on the persons listed below.

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