RAS 363

April 5, 1999

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
(Shearon Harris Nuclear	)	ASLBP No. 99-762-02-LA
Power Plant)	)	
	)	

ORANGE COUNTY'S
SUPPLEMENTAL
PETITION TO INTERVENE

I. INTRODUCTION

Pursuant to the 10 C.F.R. § 2.714(b)(1) and the Licensing Board's Initial Prehearing Order of February 24, 1999, Orange County hereby supplements its request for hearing and petition to intervene by filing its contentions in the above-captioned license amendment proceeding. Orange County's contentions challenge the adequacy of the application submitted by Carolina Power & Light Co. ("CP&L"), which seeks leave for expansion of spent fuel pool storage capacity at the Shearon Harris nuclear power plant. The contentions also challenge the Nuclear Regulatory Commission ("NRC" or "Commission") Staff's failure to comply with the National Environmental Policy Act ("NEPA") in considering the application.

Orange County's contentions are based on the license amendment application and related documents. The application, which was submitted to the NRC on December 23, 1998, consists of a letter plus nine "Enclosures."[1] The contentions are also based on the NRC Staff's proposed No

1 Enclosure 7 is a nonproprietary version of Enclosure 6, which contains technical information supporting the license application. Although Orange County has obtained a copy of the proprietary information in Enclosure 6, none of the contentions in this pleading rely on

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Significant Hazards determination, which was published in the Federal Register on January 13, 1999, 64 Fed. Reg. 2,237 ("Federal Register Notice"). Other documents relied on by Orange County are referenced in each specific contention.

The contentions are supported by the Declaration of Dr. Gordon Thompson (April 5, 1999) ("Thompson Declaration), which is attached as Exhibit 1. In addition, the contentions are supported by two other documents previously prepared by Dr. Thompson: a February 12, 1999, Declaration of Dr. Gordon Thompson, which was submitted in support of Orange County's comments on the NRC's proposed No Significant Hazards determination ("Thompson No Significant Hazards Declaration," attached as Exhibit 2 to this pleading); and a report entitled "Risks and Alternative Options Associated with Spent Fuel Storage at the Shearon Harris Nuclear Power Plant" ("Thompson Report," attached as Exhibit 3). Finally, Contention 3 (Inadequate Quality Assurance) is also supported by the Declaration of David A. Lochbaum, Nuclear Safety Engineer, Union of Concerned Scientists, Concerning Technical Issues and Safety Matters Involved in the Harris Nuclear Plant License Amendment for Spent Fuel Storage (March 31, 1999) ("Lochbaum Declaration," attached as Exhibit 4. Mr. Lochbaum's Declaration also supports those portions of Contentions 4 and 5 which relate to risks posed by quality assurance problems at Harris.

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proprietary information.

II. STANDARD FOR ADMISSIBILITY OF CONTENTIONS

The standard for admissibility of contentions is set forth in 10 C.F.R. § 2.714(b)(i)-(iii). As summarized by the Licensing Board in *Private Fuel Storage, L.L.C.* (Independent Spent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 178 (1998):

> For a proffered legal or factual contention to be admissible, it must be pled with specificity. In addition, the contention's sponsor must provide (1) a brief explanation of the bases for the contention; (2) a concise statement of the alleged facts or expert opinion that will be relied on to prove the contention, together with the source references that will be relied on to establish those facts or opinion; and (3) sufficient information to show there is a genuine dispute with the applicant on a material issue of law or fact, which must include (2) references to the specific portions of the application (including the accompanying environmental and safety reports) that are disputed and the supporting reasons for the dispute, or (b) the identification of any purported failure of the application to contain information on a relevant matter as required by law and reasons supporting the deficiency allegation.

In evaluating whether this standard is satisfied, the Licensing Board may not reach the merits of a contention, as parties should not be required to prove their contentions before they are admitted to the proceeding. *Sierra Club v. NRC*, 862 F.2d 222, 228 (9th Cir. 1988).

III. CONTENTIONS

As directed by the Licensing Board in its Initial Prehearing Order, Orange County has divided its contentions into three groups: Technical, Environmental, and Miscellaneous (although there are no miscellaneous contentions at present.) These contentions are supported by the Thompson Declaration (Exhibit 1), the Thompson No Significant Hazards Declaration (Exhibit 2), and the Thompson Report (Exhibit 3). Dr. Thompson, a physicist with extensive experience in nuclear safety matters, is the Executive Director of the Institute for Resource and Security Studies. Contention 3 (Inadequate Quality Assurance), and those aspects of NEPA Contentions 4 and 5 which are related to quality assurance, are also supported by the Lochbaum

Declaration (Exhibit 4). Mr. Lochbaum, a nuclear engineer with the Union of Concerned Scientists, is also highly experienced in nuclear safety matters. In conformance with 10 C.F.R. § 2.714(b)(2)(ii), the assertions in each contention regarding noncompliance with NRC safety requirements and/or NEPA constitute a summary of the facts and professional opinions to which Dr. Thompson and/or Mr. Lochbaum would testify in a hearing, and the documents identified in the contentions and/or expert declarations constitute the sources and documents on which they would rely.[2]

GROUP I: TECHNICAL CONTENTIONS

Contention 1: Inadequate Emergency Core Cooling and Residual Heat Removal

In order to cool spent fuel storage pools C and D, CP&L proposes to rely on the Unit 1 Component Cooling Water ("CCW") system, coupled with administrative measures to ensure that the heat load from the pools does not overtax the CCW system. CP&L's reliance on the Unit 1 CCW system and administrative measures for cooling spent fuel storage pools C and D will unduly compromise the effectiveness of the residual heat removal ("RHR") system and the Emergency Core Cooling System ("ECCS") for the Shearon Harris plant, such that the plant will not comply with Criteria 34 and 35 of Appendix A to 10 C.F.R. Part 50.

Basis: GDC 34 and 35 establish the NRC's basic requirements for residual heat removal

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2 Orange County notes that with the exception of the Thompson and Lochbaum Declarations and the excerpts of an Energy Information Administration report referenced in Contention 6, which are attached; and the Krass report referenced in Contention 4 (not attached), all of the documents on which it relies are published by the NRC, and therefore are available to the Board and parties. Therefore, it has not attached copies of the documents. If the Board or parties wish to obtain a copy of the Krass report or have any difficulty obtaining other documents, Orange County will provide copies.

and emergency core cooling capability. GDC 34 requires that:

> A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded.
>
> Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming on-site power is not available) the system safety function can be accomplished, assuming a single failure.

GDC 35 requires that:

> A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

GDC 35 also has identical language to GDC 34, requiring that:

> Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming on-site power is not available) the system safety function can be accomplished, assuming a single failure.

In order to cool pools C and D during the recirculation phase of a design-basis loss-of-coolant accident ("LOCA") event at the Harris reactor, CP&L may be obliged to require its operators to divert some CCW system flow from the RHR heat exchangers.[3] This design modification raises issues regarding CP&L's compliance with GDC 34 and GDC 35 because, during the recirculation phase of a LOCA, operation of the RHR system is essential to keeping the reactor core and containment in a safe condition.

CP&L's exploitation of the margin in the CCW system is deemed by CP&L and NRC to

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3 License Amendment Application, Enclosure 9.

constitute an "unreviewed safety question".[4] CP&L's analysis has determined that the proposed addition of pools C and D to the burden of the CCW system "may reduce the margin of safety" at Harris.[5] The NRC Staff has also observed that the "dynamic modeling used [by CP&L] in the thermal-hydraulic analyses identified a decrease in the minimum required CCW system flow rate to the residual heat removal heat exchangers."[6] CP&L asserts, however, that if certain administrative measures are taken, the CCW system has an adequate margin that can be exploited for the purpose of cooling pools C and D.[7] According to CP&L's license amendment application, the bounding heat load from the fuel in pools C and D will be 15.6 million BTU/hour.[8] At present, the CCW system cannot absorb this additional heat load. Thus, CP&L proposes to include in the Technical Specifications for Harris an interim provision that the heat load in pools C and D will not be allowed to exceed 1.0 million BTU/hour.[9] CP&L claims that an additional heat load of 1.0 million BTU/hour can be accommodated by the CCW system, and that the fuel to be placed in pools C and D will not create a heat load exceeding 1.0 million BTU/hour through 2001.[10]

CP&L claims to have justified the safety of the proposed design change in an "Unreviewed Safety Question Analysis," which is summarized in Enclosure 9 to the license amendment application. Enclosure 9 purports to demonstrate that an additional load of 1.0 million BTU/hour is within the marginal capacity of the CCW system. The description in

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4License Amendment Application, Enclosure 9; Federal Register Notice at 2237-2241.
5 License Amendment Application, Enclosure 9 at 2.
6 Federal Register Notice, 64 Fed. Reg. at 2,237.
7 License Amendment Application, Enclosure 9.
8 License Amendment Application, Enclosure 7 at 5-16.
9 License Amendment Application, Enclosure 5.
10 As discussed below, CP&L intends to perform a CCW system upgrade and plant power uprate in the year 2002. However, this is not part of the license amendment application.

Enclosure 9, however, raises more questions than it answers about the adequacy of CP&L's proposed administrative measures to ensure effective residual heat removal and "abundant" emergency core cooling, as required by GDCs 34 and 35. There are at least six significant and relevant issues bearing on CP&L's compliance with GDCs 34 and 35 that remain unaddressed in Enclosure 9.

First, design information in the Final Safety Analysis Report ("FSAR") for the Harris plant suggests that accommodating a design-basis LOCA will already exploit the margin of the CCW system, without any additional load from pools C and D. The CCW system has two heat exchangers, each with a design heat transfer rate of 50 million BTU/hour.[11] During the recirculation phase of a design-basis LOCA, the estimated maximum heat load on the CCW system is 160 million BTU/hour.[12] This heat load substantially exceeds the heat transfer rate of 100 million BTU/hour which would be provided by the two CCW system heat exchangers operating together at their design level.

Second, Enclosure 9 does not address the time dependence of the CCW system heat load during a design-basis LOCA. During a LOCA, the heat load on the CCW system from the RHR system will change over time. Analysis must demonstrate that the CCW system has sufficient margin to accommodate both the RHR system and fuel pool heat loads over time, during the LOCA event and subsequently.

Third, Enclosure 9 fails to address the sensitivity of CCW and RHR system performance to factors that may degrade performance from nominal levels. Relevant factors include heat

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11 Harris FSAR, Table 9.2.2-1, Amendment No. 27.

12According to the Harris FSAR, Table 9.2.1-3, Amendment No. 15, the estimated maximum heat load to be extracted from the CCW system by the service water (SW) system, during a design-basis LOCA, is 160 million BTU/hour.

exchanger fouling and plugging. When the available margin in a heat transfer system is limited, as is clearly the case for the CCW system, performance-degrading factors must be carefully considered and the related analytic assumptions justified. CP&L itself has previously recognized that exploitation of the margin in the CCW system could involve changes in design assumptions that include fouling factors and tube plugging limits, but CP&L fails to address this issue in Enclosure 9.[13]

Fourth, CP&L fails to address the potential for failure of administrative measures, such that the heat load in pools C and D will exceed 1.0 million BTU/hour. The heat load in these pools is not limited by physical processes, and could be exceeded as a result of human errors. The potential for such errors must be carefully considered because the available margin in the CCW system is limited.

Fifth, Enclosure 9 does not address the potential for increased operator error associated with the need for the CCW system to meet the cooling loads of pools C and D while also serving other essential safety functions. The operators' burden of observation, decision-making and action would be increased by the use of the CCW system to cool pools C and D, thereby increasing the potential for operator error. The potential for operator error would already be relatively high during a LOCA event, which would be a stressful event for operators. It would be further increased if, during this event, the operators were required to divert some CCW system flow from the RHR heat exchangers in order to meet the cooling needs of pools C and D, as is proposed by CP&L.

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13 See viewgraphs attached to Memorandum from NRC Staff re: Summary of Meeting with the Carolina Power & Light Company (CP&L) (March 11, 1998) ("CP&L Viewgraphs"). The NRC Memorandum is provided as Attachment C to the Thompson No Significant Hazards Declaration, which is attached as Exhibit 2 to these contentions.

Finally, CP&L does not address the ability of the onsite and offsite electrical power systems to support residual heat removal, emergency core cooling and other essential safety functions during an accident while also meeting the additional burden of cooling spent fuel pools C and D. CP&L proposes to use the existing electrical systems of Harris Unit 1 to supply electricity to the cooling systems of pools C and D, but has provided no analysis to indicate that the available margin in the Unit 1 electrical systems, with or without offsite power, is adequate to meet the needs of pools C and D while also supporting residual heat removal, emergency core cooling and other essential safety functions.

The CP&L Viewgraphs, presented at a March 3, 1998, meeting with the NRC, show that CP&L has considered and rejected or postponed measures that could bring CP&L into compliance with GDC 34 and 35. The Viewgraphs show that during CP&L's planning for the activation of pools C and D, the company considered the construction of an independent system to cool these pools. Within that option, CP&L considered the further possibility of providing dedicated emergency diesel generators to meet the electrical needs of pools C and D if normal electricity supply were unavailable. Construction of an independent cooling system for pools C and D, supported by dedicated emergency diesel generators, could provide the level of safety that was associated with the original design concept for Harris. However, CP&L has not proceeded with this option.

The CP&L Viewgraphs also show that CP&L contemplates a future upgrade of the CCW system, so that this system can accommodate an additional heat load of 15.6 million BTU/hour from pools C and D. This contemplated upgrade is not described in the present license amendment application. Apparently, CP&L intends to perform the upgrade of the CCW system concurrent with a power uprate for the Unit 1 reactor. A 4.5 percent power uprate of the reactor

will be associated with steam generator replacement, and will take effect in about 2002. About two years later, there will be a further power uprate of 1.5 percent. CP&L projects that the CCW system heat load, including the reactor power uprate and the ongoing use of pools C and D, will substantially exceed the capability of the present CCW system. CP&L has made no commitment to undertake a CCW system upgrade, however; and even if this upgrade is implemented, it will not have been accomplished by the time the proposed installation of fuel racks in pools C and D takes place. In the absence of either an independent cooling system for pools C and D or a sufficient upgrade of CCW capability, the proposed license amendment application fails to satisfy GDC's 34 and 35.

Contention 2: Inadequate Criticality Prevention

Storage of pressurized water reactor ("PWR") spent fuel in pools C and D at the Harris plant, in the manner proposed in CP&L's license amendment application, would violate Criterion 62 of the General Design Criteria ("GDC") set forth in Part 50, Appendix A. GDC 62 requires that: "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." In violation of GDC 62, CP&L proposes to prevent criticality of PWR fuel in pools C and D by employing administrative measures which limit the combination of burnup and enrichment for PWR fuel assemblies that are placed in those pools. This proposed reliance on administrative measures rather than physical systems or processes is inconsistent with GDC 62.

Basis: Under the design currently used in Harris pools A and B, CP&L uses two physical measures to prevent criticality of PWR fuel: maintaining a certain physical distance between fuel assemblies; and surrounding each fuel assembly with a neutron-absorbing material.

The PWR fuel assemblies in pools A and B are 10.5 inches apart center-to-center, and the fuel racks contain neutron-absorbing material 0.075 inches in thickness with a boron (B-10) content of 0.02 gram per square cm.[14]

CP&L proposes to amend the Harris Technical Specifications ("Tech Specs") to allow storage of PWR spent fuel in pools C and D in high-density non-flux trap style racks.[15] The PWR racks proposed for pools C and D would allow closer placement of spent fuel assemblies than in pools A and B. Under the design proposed by CP&L, the center-center distance between PWR fuel assemblies in pools C and D would be 9.017 inches. The PWR racks proposed for pools C and D would contain neutron-absorbing material 0.098 inches in thickness with a boron (B-10) content of 0.03 gram per square cm.[16] Because of the reduced center-center distance in pools C and D, there would be a higher potential for criticality than in pools A and B, despite the presence of neutron-absorbing material.

In order to protect against a criticality accident, CP&L proposes administrative measures that would limit the combination of burnup and enrichment of the PWR spent fuel in pools C and D to an "acceptable range." The range of acceptable burnup and enrichment values is shown in Figure 5.6.1 of Enclosure 5. According to CP&L: "The burnup criteria will be implemented by appropriate administrative procedures to ensure verified burnup as specified in the proposed Regulatory Guide 1.13, Revision 2, prior to fuel transfer into Spent Fuel Pools C or D."[17] CP&L further states that: "Strict administrative controls will prevent an unacceptable assembly, as determined by the acceptance criteria stated in Section 4.2, from being transferred to Harris Pools

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14 Harris FSAR, Table 9.1.1-1, Amendment No. 14.
15 License Amendment Application, Enclosure 5 at 5-7.
16 License Amendment Application, Enclosure 7, Revision 3, at 4-6. Revision 3 of Enclosure 7 was served on Orange County by letter dated March 17, 1999.

C and D."[18]

The General Design Criteria in Appendix A to Part 50 constitute some of the most fundamental design requirements for maintaining safety in nuclear power plants. In order to protect against criticality accidents, GDC 62 is quite clear that any measures relied on must be physical rather than administrative. There is no room in the criterion for flexibility or exception. Thus, the administrative measures proposed by CP&L must be rejected as unlawful under GDC 62.

CP&L claims to rely on Draft Regulatory Guide 1.13, Proposed Revision 2 to Reg. Guide 1.13, Spent Fuel Storage Facility Design Basis (December 1981), for the acceptability of administrative measures to prevent criticality. However, a Regulatory Guide, "still less" a draft regulatory guide, does not constitute a regulation. *Louisiana Energy Services* (Claiborne Enrichment Center), LBP-91-41, 34 NRC 332, 354 (1991). Such documents "are useful as guides," but "insofar as the adjudicatory process is concerned, they represent the opinions of one of the parties to that process and as such cannot be viewed as necessarily controlling." *Potomac Electric Power Co.* (Douglas Point Nuclear Generating Station, Units 1 and 2), LBP-76-13, 3 NRC 425, 432 (1976). Therefore, a Reg. Guide cannot be relied on to modify or circumvent the requirements of duly promulgated regulations like the General Design Criteria.

In any event, Draft Reg. Guide 1.13 does not support the administrative measures proposed by CP&L. Although Appendix A contains some language implying that the design of spent fuel racks against criticality can take credit for burnup (pages 1.13-13, 14, 15), other parts of the Draft Reg. Guide clearly proscribe such activity. For instance, at page 1.13-9, the Draft

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17 License Amendment Application, Enclosure 7, Revision 3, at 4-4.
18 *Id.* at 4-17.

Reg. Guide states that:

> At all locations in the LWR spent fuel storage facility where spent fuel is handled or stored, the nuclear criticality safety analysis should demonstrate that criticality could not occur without at least two unlikely, independent, and concurring failures or operating limit violations.

(emphasis in original). CP&L's proposed administrative controls on criticality would not satisfy this requirement because only one failure or violation, namely placement in the racks of PWR fuel not within the "acceptable range" of burnup, could cause criticality. Note that "misplacement of a spent fuel assembly" is identified in the Draft Reg. Guide as one of nine "credible normal and abnormal operating occurrences."[19]

A Regulatory Guide is a guidance document, which cannot be interpreted in a manner that contradicts the plain language of the regulations. Because the language at page 1.13-9 is consistent with GDC 62, it overrides any implication in Appendix A that administrative measures for controlling criticality are acceptable. Thus, CP&L's proposed administrative measures for controlling criticality would not be permitted by the Draft Reg. Guide.

Contention 3: Inadequate Quality Assurance[20]

CP&L's proposal to provide cooling of pools C and D by relying upon the use of previously completed portions of the Unit 2 Fuel Pool Cooling and Cleanup System ("FPCCS") and the Unit 2 Component Cooling Water System (CCWS) does not satisfy the quality assurance criteria of 10 C.F.R. Part 50 Appendix B. In particular, CP&L fails to satisfy Criterion XIII, regarding Handling, Storage and Shipping, because it has not demonstrated that the piping and equipment have been stored and preserved since the time of completion in a manner that prevents

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19 *Id.* at 1.13-9.

20 In addition to the Thompson Declaration, this contention is also supported by the Lochbaum Declaration (Exhibit 4).

damage or deterioration. CP&L also fails to satisfy Criterion XVI, regarding Corrective Action, because it has failed to show that it has instituted appropriate measures to correct any damage or deterioration that has occurred since the piping and equipment were installed. In addition, CP&L fails to satisfy Criterion XVII, regarding Quality Assurance Records, because it has not kept records needed to show that all applicable quality assurance requirements are satisfied. Moreover, the "Alternative Plan" submitted by CP&L with its license amendment application fails to satisfy the requirements of 10 C.F.R. § 50.55a for an exception to these requirements. Finally, CP&L's proposal to postpone inspection of embedded portions of previously completed the piping until after issuance of the license amendment must be rejected as insufficient to demonstrate compliance with 10 C.F.R. § 50.55a. The inspection proposed by CP&L is necessary to its showing under § 50.55a that the alternative proposed by the licensee would provide "an acceptable level of quality and safety." This showing must be made before the license amendment is issued, not afterwards.

In making this contention, Orange County notes that the exact scope of piping and equipment for which CP&L lacks QA documentation remains unclear. CP&L implies, but does not explicitly confirm, that the missing records pertain to piping but not to equipment such as heat exchangers. CP&L's Alternative Plan addresses only piping, but CP&L has not confirmed that all of the missing records pertain to piping rather than equipment. Thus, this contention addresses the lack of adequate quality assurance for both piping and equipment.

Basis: Appendix B to 10 C.F.R. Part 50 specifies three quality assurance criteria that are relevant to CP&L's proposed use of previously completed portions of Harris Unit 2 cooling systems. Criterion XIII requires that:

Measures shall be established to control the handling, storage, shipping, cleaning and

> preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, specific moisture content levels and temperature levels shall be specified and provided.

Criterion XVI requires that:

> Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to appropriate levels of management.

Criterion XVII requires that:

> Sufficient records shall be maintained to furnish evidence of activities affecting quality. The records shall include at least the following: Operating logs and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses. The records shall also include closely related data such as qualifications of personnel, procedures, and equipment. Inspection and tests records shall, as a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted. Records shall be identifiable and retrievable. Consistent with applicable regulatory requirements, the applicant shall establish requirements concerning record retention, such as duration, location, and assigned responsibility.

CP&L proposes to provide cooling and cleanup services to pools C and D through use of a FPCCS which will employ previously completed piping and equipment that were originally intended to be part of the FPCCS associated with Harris Unit 2. The previously completed equipment will include heat exchangers, pumps, filters and strainers.[21] The previously completed piping will include all of the embedded and most of the exposed portion of the ASME Section III piping associated with the Unit 2 FPCCS.[22]

CP&L proposes to extract heat from the heat exchangers of the FPCCS for pools C and D by use of the Unit 1 CCWS. Connection of the Unit 1 CCWS to the FPCCS for pools C and D

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21 License Amendment Application, Enclosure 8 at 2.
22 License Amendment Application, Enclosure 8 at 2.

will involve use of previously completed portions of the Unit 2 CCWS. The Unit 2 CCWS was never completed, but portions of it are available to establish a connection between the Unit 1 CCWS and the FPCCS for pools C and D, and CP&L proposes to use these portions to establish such a connection.[23]

Before CP&L's proposed use of previously completed piping and equipment can be deemed compatible with the quality assurance criteria of 10 C.F.R. Part 50 Appendix B, three conditions must be satisfied. First, records must be available, as specified in Appendix B, Criterion XVII, to show that the piping and equipment satisfied all applicable quality assurance requirements when it was completed. Second, the piping and equipment must have been stored and preserved since the time of its completion in the manner specified in Criterion XIII, with accompanying records as specified in Criterion XVII, to ensure that it meets the standards of quality set by Appendix B. Third, measures for corrective action, as specified in Criterion XVI, must have been in effect between the time when the piping and equipment was completed and the time when this piping and equipment is incorporated into new construction in a manner that satisfies Appendix B.

CP&L states that some quality assurance records for the previously completed piping and equipment were "inadvertently discarded" in September 1993.[24] As discussed above, it is not clear whether the components for which documentation was lost consists only of piping, or also includes some equipment. For those components for which quality assurance documentation no longer exists, its is clear that Criterion XVII is not satisfied.

CP&L proposes a "10CFR50.55a Alternative Plan" to demonstrate that the previously completed piping was "constructed to the appropriate level of quality and safety and in compliance with construction code requirements."[25] However, CP&L's license amendment application is silent about the storage and preservation of previously completed piping and

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23 License Amendment Application, Enclosure 8 at 6.
24 License Amendment Application, Enclosure 8 at 11.
25 License Amendment Application, Enclosure 8 at 11.

equipment between December 1983, when Unit 2 was cancelled, and the present. Thus, there is no evidence in the application that Criteria XIII and XVI have been satisfied during this period, with accompanying records as specified in Criterion XVII.

This is not a mere formality, but a potential safety issue. When piping and equipment remain unused for long periods, they can suffer degradation which impairs their ability to perform their function, with potential adverse effects on safety. As described in the attached Lochbaum Declaration, this can present an undue challenge to safety systems.[26] The potential fouling and/or degradation of piping in nuclear power plant cooling systems has also been the subject of several NRC notices to licensees, alerting them to "problems which can occur if equipment is improperly stored or laid up during construction or extended plant outages." *See* Information Notice No. 85-56, "Inadequate Environmental Control for Components and Systems in Extended Storage or Layup" (July 15, 1985). *See also* Information Notice No. 85-30, "Microbiologically Induced Corrosion of Containment Service Water System" (April 19, 1985); NRC Information Notice No. 94-38, "Results of a Special NRC Inspection at Dresden Nuclear Power Station Unit 1 Following a Rupture of Service Water Inside Containment" (May 27, 1994); NRC Inspection Procedure 92050, "Review of Quality Assurance for Extended Construction Delay."

CP&L's Alternative Analysis does not describe any program for maintaining the idle piping in good condition over the intervening years between construction and implementation of the proposed license amendment; nor has it described a program for identifying and remediating potential corrosion and fouling. In the absence of such information, the Alternative Analysis is inadequate to satisfy 10 C.F.R. 50.55a or Appendix B to Part 50.

CP&L's Alternative Plan is also deficient because a significant portion of the previously completed piping is embedded in concrete, with the result that inspection is now difficult or impossible. According to CP&L, quality assurance records are missing for 40 large bore piping

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26 Lochbaum Declaration, par. 11.

field welds, of which 37 welds are in the Unit 2 FPCCS piping, with 15 of those 37 welds being embedded in concrete.[27] At the time of construction, quality assurance procedures called for non-destructive examination ("NDE") of these welds, involving access to the pipe exterior. According to EP&L, "Obviously, this level of NDE cannot be reperformed on the field welds embedded in concrete. . . ."

CP&L has contracted with a vendor to provide remote camera inspection of "greater than one third" of the embedded field welds.[28] Remote camera inspection can provide only limited information about weld quality, and cannot provide the level of quality assurance that is available from NDE. Thus, inspection to the original standard cannot be provided for any of the embedded field wells, and as many as two thirds of these welds will receive no inspection of any kind. Moreover, the remote camera inspection is scheduled to occur during the modification of pools C and D, when pool levels are lowered and welded piping blanks are removed.[29] Presumably, this will not occur until after the license amendment is granted. The requirements of 10 C.F.R. § 50.55a must be met upon licensing, however, not deferred until afterwards. The results of the remote camera inspection are not likely to yield clear "yes" or "no" answers regarding weld quality or whether significant degradation or fouling has occurred. The interpretation of these results, and whether they satisfy section 50.55a, must be subject to questioning in this proceeding.

Moreover, CP&L's approach for the two-thirds of the embedded welds that will receive no inspection is inadequate to provide the level of quality and safety required by section 50.55a. CP&L attempts, through the assembling of circumstantial evidence, to confirm that the welds

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27 License Amendment Application, Enclosure 8 at 5.
28 License Amendment Application, Enclosure 8 at 7.
29 *Id.*

were actually inspected.[30] This is not an adequate substitute for actual documented evidence that inspections were conducted and the welds found to be in acceptable condition. The rationale is additionally objectionable if the actual inspections on the one-third of the welds that can receive a limited inspection are postponed. In summary, it is completely unsupportable to accept this aspect of the Alternative Plan in a licensing decision, without requiring that available concrete information that could shed light on its reliability be provided.

GROUP II: ENVIRONMENTAL CONTENTIONS

Contention 4: Proposed License Amendment Not Exempt From NEPA

CP&L errs in claiming that the proposed license amendment is exempt from NEPA under 10 C.F.R. § 51.22.

Basis: In its "Environmental Evaluation," Enclosure 3 to the license amendment application, CP&L asserts that the proposed license amendment was evaluated against the NRC's criteria in 10 C.F.R. § 51.22 for a categorical exclusion from preparation of an EIS. Although CP&L does not identify the particular categorical exclusion in 10 C.F.R. § 51.22 that it relies on, it provides an analysis which compares the proposed design and projected impacts to the original design and impacts that were reviewed in the original licensing proceeding for Shearon Harris.

As discussed below in Section A, CP&L's assertions regarding the insignificance of the proposed changes to the Shearon Harris design are without merit. Moreover, as discussed in Section B below, assuming that CP&L intended to justify the categorical exclusion under 10 C.F.R. § 51.22(b)(9), the applicable standard, the proposed license amendment does not satisfy that standard.

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30 License Amendment Application, Enclosure 8 at 10.

A. CP&L's Analysis

According to CP&L, spent fuel pools C and D will be:

> similar in design with that originally conceived and approved for construction for this portion of the Harris plant. All four pools were included in the original four unit design of the Harris Nuclear Plant, and the completion and operation of these pools continued to be reflected in plant license documentation up to and including the issuance of the operating license for Units 1 & 2 (ref. NUREG-1038, dated Nov. 1983) and the associated environmental report (ref. Shearon Harris Nuclear Power Plant Environmental Report, Amendment 5, dated Dec. 1982). The most notable difference between the previously licensed and currently proposed designs is that, rather than having a separate operating unit to provide auxiliaries such as CCW for cooling and RWST for makeup, the current design will utilize Unit 1 facilities for those functions. Nonetheless, the design of the fuel pools themselves, including cooling and cleanup systems, will be essentially the same as that previously reviewed, and the differences which do exist between the current design and that originally licensed are not of a scope or nature as to have a significant bearing on environmental impact.

Enclosure 3 at 1.

CP&L seriously understates the differences between the design of pools C and D and the original Harris design. The differences are significant, including the sharing of the Unit 1 CCW system and its electrical support systems, the introduction of administrative measures to control the heat load on the CCW, the substitution of administrative measures for physical systems in preventing criticality, and the reliance on piping and equipment which may be degraded and for which no quality assurance documentation exists. Finally, CP&L proposes to double the inventory of spent fuel whose safety is to be guaranteed by these questionable design changes, thus doubling the consequences of any accident that may occur.

1. Cooling design

As discussed in Contention 1 above, the original Harris design called for the use of the Unit 2 CCW system to provide cooling water to spent fuel pools C and D. However, Unit 2 was never built. Thus, CP&L proposes to use Unit 1 safety systems to ensure adequate cooling of

pools C and D. These systems include the CCW system and its electricity supply, including backup diesel generators. This is a significant difference from the original Shearon Harris design, which raises serious questions regarding CP&L's compliance with NRC General Design Criteria for emergency core cooling systems and residual heat removal. *See* Contention 1, which is adopted and incorporated by reference herein.

2. Design for criticality prevention

As discussed in Contention 2 above, which is adopted and incorporated herein by reference, the current Harris design relies on physical measures to prevent criticality: spacing between spent fuel assemblies, and neutron-absorbing material surrounding the fuel assemblies. In sharp contrast to the current design, CP&L proposes to decrease the spacing between spent fuel assemblies, and substitute administrative measures to ensure that criticality is prevented. This not only violates GDC 62, but also increases the potential for a criticality accident.

3. Reliance on piping and equipment without QA documentation

Another major difference between the current Harris design and the proposed design is that CP&L intends to rely on coolant piping and equipment for which no quality assurance documentation exists. Moreover, CP&L has provided no evidence that it has maintained the piping and equipment in a manner to safeguard against fouling and deterioration. *See* Contention 3, which is adopted and incorporated herein by reference.

4. Significant increase in inventory of radioactive material

Under the current license, CP&L has a total of 1,128 PWR spaces and 2,541 BWR spaces in pools A and B. Thompson Report, Table A-11. The proposed license amendment would permit 1,952 PWR spaces and 2,763 BWR spaces, for a total of 4,715 spaces. This would roughly double the storage capacity at Harris. Thompson No Significant Hazards Declaration,

par. 44. In fact, if the license amendment is granted, the Shearon Harris plant would become the largest spent fuel storage facility east of the Mississippi River. This, also, is a major design difference between the original Harris design and the proposed design.

B. Noncompliance with 10 C.F.R. § 51.22(b)(9)

Neither CP&L nor the NRC Staff addresses the applicability of 10 C.F.R. § 51.22(b)(9), which appears to be the only applicable provision that might exempt CP&L from NEPA's requirements. In fact, although the NRC is ultimately responsible for compliance with NEPA, the NRC's Federal Register Notice proposing the license amendment makes no representations at all regarding compliance with NEPA.

Section 51.22(b)(9) permits the Staff to forego preparation of an EIS "with respect to installation or use of a facility component located within the restricted area, as defined in part 20" of NRC regulations, if, *inter alia,* the amendment "involves no significant hazards consideration." Although the Staff did not address this regulation specifically, it did conclude in the Federal Register Notice that the proposed amendment poses no significant hazards considerations. 64 Fed. Reg. at 2,237-2,240. Because the Staff's no significant hazards determination is relevant to whether CP&L's license amendment application is exempt from NEPA, it is addressed herein.

The NRC standard for making a No Significant Hazards determination is found in 10 C.F.R. § 50.92, which provides that the NRC may find that a license amendment poses no significant hazards considerations if it would not:

> (1) Involve a significant increase in the probability or consequences of an accident previously evaluated;
> (2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or
> (3) Involve a significant reduction in a margin of safety.

As discussed in the Thompson No Significant Hazards Declaration, none of these criteria is satisfied by the proposed license amendment.

1. Significant Increase in Probability of an Accident Previously Evaluated

In the Federal Register Notice, the Staff concludes that operation of the Harris facility in accordance with the proposed license amendment would not involve a significant increase in the probability of an accident previously evaluated. 64 Fed. Reg. at 2,238. According to the Staff a previous analysis concerning expansion of pool storage capacity at Harris analyzed the following accident scenarios:

a. A spent fuel assembly drop in a Spent Fuel Pool.
b. Loss of Spent Fuel cooling flow.
c. A seismic event.
d. Misloaded fuel assembly.

Id. The Staff concludes that because there will be no significant increase in the probability of any of these accidents, "there is be no significant increase in the probability of an accident." *Id.*

As discussed in Contentions 1, 2, and 3, and in the Thompson No Significant Hazards Declaration, this claim is incorrect, for several reasons. First, the Staff fails to consider the increased probability of a fuel handling accident. Activation of pools C and D will roughly double the total number of fuel handling operations to be conducted at Harris. Assuming that the general nature of fuel handling operations continues as before, the probability of a fuel assembly drop or misloaded fuel assembly, integrated over the entire period of the Harris operating license, will increase significantly, by a factor of two. If probability is integrated over the remaining period of the Harris operating license, rather than over its total duration, then activation of pools C and D will more than double the probability of a fuel assembly drop or a misloaded fuel assembly. A criticality accident could be caused by misloading of fuel assemblies in pools C and

D, as described in Contention 2.

The Staff also ignores the fact that there has been no previous analysis of the effects on the probability of a reactor accident caused by CP&L's reliance on Unit 1 safety systems to cool pools C and D. Activation of pools C and D will add to the CCW heat load of the existing Harris systems. Although CP&L and the NRC assert that the CCWS has sufficient capacity to handle the additional load, they concede that the additional heat load reduces the margin of safety in the CCWS. Moreover, CP&L can only stay within the safety margin by taking administrative measures to ensure that the heat burden of the spent fuel pools will not exceed a certain level. *See* Contention 1. CP&L's reliance on administrative measures to ensure that loads on the CCWS fall within the safety margin significantly reduces the reliability of the CCWS. If CP&L were to make an administrative error and the heat in the spent fuel pool consequently exceeded the limit, the CCWS could not be relied on to perform its safety function for either the reactor or the spent fuel pools. The decreased reliability of the CCWS is compounded by the fact that CP&L proposes to rely on coolant piping for which the documentation of compliance with NRC quality assurance requirements does not exist.

Activation of pools C and D will also add to the electric load, including the load carried by the electric system for normal operations and the backup electricity supply provided by Unit 1 diesel generators. If the spent fuel pooling system overtaxes the electrical system, it could result in either a reactor or spent fuel pool accident. The probability of failure of the Unit 1 electric supply as a result of the addition of pools C and D to the system has not been evaluated in any previous analysis, nor is it even addressed in CP&L's license amendment application or the Federal Register notice.

Finally, the addition of pools C and D to the Unit 1 safety systems will add to the burden

of work on the Unit 1 operators, thus increasing the probability of human error Again, these effects are not addressed in any previous analysis.

Taken together, the effects identified above may either eliminate or significantly decrease the margin of safety at the Harris reactor. The effect would be to substantially increase the probability of a severe reactor accident involving the offsite release of radiation from the reactor core. If the CCWS cooling capacity is inadequate, or if its function is interrupted by a loss of electrical power, it could lead to a severe reactor accident and a consequent release from the core.

The significance of CP&L's proposed design changes to the evaluation of severe reactor accidents is borne out by previous risk studies done by CP&L and the NRC Staff. CP&L and the Staff have performed three severe reactor accident studies regarding the Harris plant. The first severe reactor accident analysis is reported in NUREG-0972, the Final Environmental Statement ("FES") for the licensing of the plant. In conformance with the Commission's Severe Accident Policy Statement, 50 Fed. Reg. 32,138 (August 8, 1985), Generic Letter 88-20 (November 23, 1988), and Generic Letter 88-20 Supp. 4 (June 28, 1991) ("Supp. 4"), CP&L later performed two additional severe accident analyses for the Shearon Harris plant: an Individual Plant Examination ("IPE") in August of 1993, and an Individual Plant Examination of External Events ("IPEEE") in June of 1995. According to Supp. 4, the purposes of IPEs and IPEEEs include: (1) to gain a qualitative understanding of the overall likelihood of core damage and radioactive material release; and (2) if necessary, to reduce the overall likelihood of core damage and radioactive material releases by modifying hardware and procedures that would help prevent or mitigate severe accidents.

Both the FES and the IPE address accidents involving the reactor. For the set of reactor

accidents postulated in the FES, the FES states that, "[a]ssuming protective actions are taken, the risk to the environment as a result of accidents is of the same order of magnitude as the risk from normal operation, although accidents have a potential for early fatalities and economic costs not associated with normal operation." *Id.* at 5-85.

According to the IPE performed by CP&L, the frequency of severe core damage at Harris is 7×10^{-5} per reactor-year. This must be considered a "point" estimate, because the Harris IPE does not provide an uncertainty band or probability density function. The IPE for Harris also identified a set of potential accident sequences that are associated with significant releases of radioactive material to the atmosphere, in six release categories. The IPE predicts that accident sequences involving a LOCA will account for 40 percent of Harris' core damage frequency, while sequences involving station blackout (loss of electrical power) will account for 26 percent of the core damage frequency. The 40 percent contribution of LOCAs to core damage frequency is due to LOCAs with injection failure (17 percent) and LOCAs with recirculation failure (23 percent).

As discussed in the Thompson Report at B-5, the NRC has compiled and compared IPE findings for all US commercial nuclear reactors.[31] Reported core damage frequencies tend to be significantly higher for PWRs than for boiling-water reactors ("BWRs"). Reported core damage frequencies tend to be higher for 3-loop Westinghouse (W-3) PWRs than for 2-loop and 4-loop Westinghouse PWRs and PWRs made by Combustion Engineering (CE) and Babcock & Wilcox (B&W). *Id.* The Harris reactor is a 3-loop Westinghouse PWR. From its compilation of IPE findings, the NRC concluded that sequences involving LOCAs (especially LOCAs with

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31 US Nuclear Regulatory Commission, NUREG-1560, Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance (3 vols) (December 1997).

recirculation failure) and station blackout are major contributors to estimated core damage frequency at 3-loop Westinghouse PWRs. Thompson Report at B-5. This conclusion is consistent with the Harris IPE findings outlined above. The NRC noted that the 3-loop Westinghouse PWRs exhibit a relatively high dependence of front-line safety systems on service water (SW), component cooling water (CCW) and heating, ventilating & air conditioning (HVAC) systems.

The various factors described above, taken together, reasonably could be found to result in a significant increase in the probability of an accident at Shearon Harris. Therefore, they should have been evaluated in determining whether the proposed license amendment poses no significant hazards, such that it should be exempted from the requirements of NEPA. Orange County notes in this regard that it has not performed an analysis to quantify the extent by which the probability of an accident at the Harris reactor would be increased by activation of pools C and D. That is not Orange County's responsibility. It is the burden of the applicant and the NRC Staff to demonstrate that they have given reasonable consideration to factors that could significantly increase the probability of an accident at Shearon Harris, and evaluate whether that probability is in fact significant.

2. Significant Increase in Consequences of Accident Previously Evaluated

The Staff is also incorrect in stating that the consequences of previously evaluated accidents will not increase. 64 Fed. Reg. at 2,238. According to the Staff:

> The consequences of the previously postulated scenarios for an accidental drop of a fuel assembly in the Spent Fuel Pool have been re-evaluated for the proposed change. The results show that such [sic] the postulated accident of a fuel assembly striking the top of the storage racks will not distort the racks sufficiently to impair their functionality.

Id. Therefore, the Staff concludes that "the consequences of a loss of Spent Fuel Pool cooling

have been evaluated and found to have no increase." *Id.*

The Staff fails to recognize that a previously considered severe reactor accident may also affect the spent fuel pools, thus leading to a release from the pools. As discussed in Appendix C of the Thompson Report, severe accidents associated with the Harris IPE's six release categories would, if they occurred at Harris Unit 1, almost certainly lead to a consequent severe accident affecting the spent fuel pools at the Harris plant, including pools C and D if these were in use. A severe accident at the Harris reactor, accompanied by containment failure or bypass, would prevent access to the spent fuel pools by plant personnel, and thus prevent them from cooling or replenishing the water in the pools. *Id.* at C-5. The fuel would be partially or completely uncovered within a period of perhaps ten days. If accident response efforts involved adding water to the pools after the fuel had been completely uncovered, they would run the risk of exacerbating the accident by inhibiting convective circulation of air in the pools.[32] *Id.* at C-5, D-1 – D-10.

As discussed above in Contention 4, the proposed amendment would roughly double the inventory of spent fuel assemblies stored in the Shearon Harris spent fuel pools. This could have the potential of doubling the release of radioactivity from the pools in the event of a severe accident. Accordingly, the consequences of a previously considered accident would be significantly increased by the proposed license amendment.

The radioisotope cesium-137 is one important indicator of the hazard potential posed by a nuclear facility. This isotope has a half-life of 30 years, emits intense gamma radiation, and is released comparatively readily during severe accidents. The 1986 Chernobyl accident released

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32 To the extent that this scenario involves issues not previously considered, it is also discussed in subsection 3 below.

about 90,000 TBq (27 kg) of cesium-137 to the atmosphere, which accounted for most of the offsite radiation exposure attributable to that accident. Official estimates indicate that this exposure will cause 50-100 thousand extra cancer fatalities worldwide over the next 70 years.[33] Using the rule of thumb that a PWR assembly contains four times as much cesium-137 as a BWR assembly, if both have been discharged for an equal period, pools C and D could hold about 150% more cesium-137 than can be stored under the current design. *See* Thompson Report at 9-10, A-6 – A-7, Appendix E, for further discussion of the Harris cesium inventory and impacts of a release.

Severe accidents could affect some or all of the Harris pools. Thus, the potential doubling of radioactivity in the pools could significantly increase the consequences of such accidents.

3. Possibility of a New or Different Kind of Accident

Under its regulations, the NRC may not make a no significant hazard determinations if it finds that a proposed license amendment would create even the *possibility* of a new or different kind of accident not previously evaluated. The Staff may not rationalize the amendment by addressing the merits of how likely the accident is to occur. *San Luis Obispo Mothers for Peace v. U.S. NRC*, 799 F.2d 1268 (9th Cir. 1986).

According to the Federal Register notice, the only kind of accident that might conceivably be considered new is the accidental drop of a fuel rack; but that accident was already considered in relation to pool B. 64 Fed. Reg. at 2,239. Thus, the Staff concludes that the proposed license amendment would not create the possibility of a new or different kind of

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33 Allan S Krass, Consequences of the Chernobyl Accident (Cambridge, Massachusetts: Institute for Resource and Security Studies, December 1991).

accident from any accident previously evaluated.

The Staff's conclusion is incorrect, in a number of respects. First, the introduction of administrative measures to maintain heat loads and burnup levels below certain levels creates new opportunities for accidents caused by human error, which have not previously been considered for the Harris plant. The reliance on piping and equipment for which quality assurance has not been adequately documented, and whose quality may not be capable of verification, also creates the potential for new accidents not previously considered.

Moreover, although severe reactor accidents have previously been considered for the Harris plant, it does not appear that consideration has ever been given to the potential for a severe reactor accident to cause a severe spent fuel pool accident in the event that personnel are unable to gain access to the plant following a reactor accident in order to restore pool cooling and provide water makeup. *See* discussion in subsection 2 above. The Staff also ignores the fact that neither CP&L nor the NRC Staff has ever performed an evaluation of severe spent fuel pool accidents at Harris, including fuel heat-up caused by partial uncovering of the fuel. *See* Thompson Report, Appendix D.

Moreover, the NRC Staff has never performed an adequate evaluation of the potential for severe pool accidents at any plant. Since the early 1980's, the EIS's for the licensing of all U.S. nuclear plants have considered the potential for severe accidents. This consideration has been based on the findings of the Reactor Safety Study (WASH-1400). The Reactor Safety Study's consideration of spent fuel pool accidents, and the NRC's subsequent re-consideration of such accidents, have been summarized by the NRC as follows:

> "The risk of beyond design basis accidents in spent fuel storage pools was examined in WASH-1400. It was concluded that these risks were orders of magnitude below those involving the reactor core because of the simplicity of the spent fuel storage pool design:

(1) the coolant is at atmospheric pressure, (2) the spent fuel is always subcritical and the heat source is low, (3) there is no piping which can drain the pool and (4) there are no anticipated operational transients that could interrupt cooling or cause criticality.

The reasons for the re-examination of spent fuel storage pool accidents are twofold. First, spent fuel is being stored instead of reprocessed. This has led to the expansion of onsite fuel storage by means of high density storage racks, which results in a larger inventory of fission products in the pool, a greater heat load on the pool cooling system, and less distance between adjacent fuel assemblies. Second, some laboratory studies have provided evidence of the possibility of fire propagation between assemblies in an air cooled environment. Together, these two reasons provide the basis for an accident scenario which was not previously considered."[34]

Despite this recognition that pool accidents represent a new, credible accident scenario, the NRC Staff has never given pool accidents the level of analysis that has been given to reactor accidents through WASH-1400, NUREG-1150, EIS's, and IPE's. *See* Thompson Report, Appendix B.

An appropriate level of analysis of severe pool accidents would apply PRA techniques to estimate the potential for water loss from pools, as described in Appendix C of the Thompson Report. It would consider the potential for pool-reactor accident interactions, as outlined on page B-7 of the Thompson Report. It would examine the potential for exothermic reactions, doing so in the manner specified in Appendix D of the Thompson Report.

A severe pool accident is not a remote and speculative event. Its lower bound of probability is set by the probability of a severe reactor accident with containment failure or bypass, because such an accident would almost certainly lead to a pool accident, as explained above. A severe reactor accident with containment failure or bypass is recognized as a credible event by the NRC for purposes of evaluating environmental impacts in EIS's, as well as requiring emergency planning for the ten and fifty mile Emergency Planning Zones around nuclear plants. In addition, licensees are obligated to perform IPE's to examine the site-specific

34 E.D.Throm, NUREG-1353, Regulatory Analysis for the Resolution of Generic Issue 82,

potential for accidents of this type.

A severe pool accident could occur at Harris in its present design configuration. The probability of a pool accident could be increased by CP&L's proposed activation of pools C and D because that activation would increase the probability of a reactor accident, as discussed above. In addition, the consequences of a pool accident would increase because of the greater inventory of radioactivity. Thus, the possibility exists of a class of severe pool accident scenarios that have not been previously evaluated, either generically or for the Harris site. The potential and nature of this class of accidents could be examined by the use of PRA techniques that have been developed to examine severe reactor accidents.

The increased inventory of spent fuel at the Harris plant also significantly increases the opportunities for sabotage during transportation, handling, and storage of the spent fuel. While the NRC has previously declared that it is unable to make a meaningful assessment of the risks of sabotage, this evaluation was made many years ago. *See Limerick Ecology Action v. NRC,* 869 F.2d 719, 741-42 (3rd Cir. 1989). Events of recent years have demonstrated that sabotage is a reasonably foreseeable and significant threat whose risks must be addressed in an EIS, whether or not those risks can be quantified. These events include the 1983 bombing of the Marine barracks in Beirut; the 1993 bombing of the World Trade Center; the February 1993 intrusion into the Three Mile Island site, in which the intruder crashed his station wagon through the security gate and rammed it under a partly opened door in the turbine building; the 1995 bombing of the Federal Courthouse in Oklahoma City; the plot to bomb the United Nations Building, FBI offices in New York City, the Lincoln Tunnel, the Holland Tunnel, and the George Washington Bridge; the 1995 release of SARIN, a nerve gas in the Tokyo subway; and the 1998

"Beyond Design Basis Accidents in Spent Fuel Pools" at ES-1 (April 1989).

bombing of the U.S. embassies in Tanzania and Kenya. *See also* Thompson Report at B-4 (mock raids on U.S. nuclear plants have succeeded in at least 14 of 57 instances since 1991).

The fact that the risk of sabotage may not be easily quantifiable is not an excuse for failing to address it in an EIS. As provided in the Council on Environmental Quality's regulations implementing NEPA, 40 C.F.R. § 1502.22, the agency must make an attempt to evaluate reasonably foreseeable significant adverse effects, if the costs of obtaining the information are not exorbitant. Even if the costs of obtaining the information are exorbitant, the agency must acknowledge that the information is unavailable, make a statement of the relevance of the information to the evaluation of impacts in the EIS, summarize existing relevant and credible scientific evidence, and provide the agency's evaluation of the impacts based on generally accepted theoretical approaches or research methods. *See also* 10 C.F.R. § 51.71 ("To the extent that there are important qualitative considerations or factors that cannot be quantified, these considerations or factors will be discussed in qualitative terms.").

In considering the environmental impacts of sabotage, it is particularly important to consider SAMDAs which could mitigate the impacts of sabotage. Using dry cask storage would substantially reduce the vulnerability of the Harris/Brunswick/Robinson spent fuel to acts of sabotage or terrorism. As discussed at page 12 of the Thompson Report, sabotage/terrorism events at a dry cask storage installation could release only a small fraction of the radioactive material that could be released from the Harris spent fuel pools. It is much easier to drain a spent fuel pool and cause an accident than it is to penetrate and release the radioactive contents of dry casks holding the same amount of spent fuel.

4. Significant Reduction in a Margin of Safety.

The Staff's conclusion that the operation under the license amendment would not involve

a reduction in a safety margin is without merit. The information provided in the license amendment application clearly demonstrates that the plant's safety margin would be significantly reduced by the proposed license amendment. As discussed in the Thompson No Significant Hazards Declaration, Section I, activation of pools C and D will create an additional heat load on the existing CCW system. CP&L proposes to meet this load in the short term by exploiting the margin in the CCW system. The safety margin will be reduced even further if, during a LOCA, the operators must divert CCW flow from the RHR system cooling to the spent fuel pools. This will increase stress on the operators and create opportunities for human error. Thus, the reduction in the CCW safety margin caused by the increased heat load is significant. Certainly, the NRC has provided no reason to conclude that it is not significant. Moreover, as pools C and D become filled and the reactor receives a power uprate, the load on the CCW system will increase further. CP&L offers no assurance that the present margin of safety will be restored by upgrading the CCW system to accommodate these burdens.

The Staff also fails to address the impact on the margin of safety caused by CP&L's proposal to use a cooling system for pools C and D using piping that will not satisfy ASME code requirements. *See* Contention 3 and Thompson No Significant Hazards Declaration, pars. 23 and 50. As Dr. Thompson observes, this action could potentially cause a significant reduction in margins of safety for pool cooling. CP&L's Alternative Plan has not been subjected to any public scrutiny or rigorous review. It deserves, at the least, thorough consideration at a licensing hearing before the license amendment is issued.

The margin of safety is also affected by CP&L's proposal to provide electrical service to pools C and D from the existing Unit 1 system, which includes the Unit 1 dedicated emergency diesel generators. These diesel generators already serve the safety systems in Unit 1 and spent

fuel storage pools A and B. By adding pools C and D to the load carried by the Unit 1 diesel generators, CP&L would add stress on the diesel generators and on the plant operators in the event of a loss of offsite power. These effects could significantly reduce the margin of safety at the Harris reactor and the fuel pools. The additional strain on the emergency diesel generators is not described either in the Federal Register notice or in CP&L's license amendment application.

Contention 5: Environmental Impact Statement Required

The proposed license amendment is not supported by an Environmental Impact Statement ("EIS"), in violation of NEPA and NRC's implementing regulations. An EIS should examine the effects of the proposed license amendment on the probability and consequences of accidents at the Harris plant. As required by NEPA and Commission policy, it should also examine the costs and benefits of the proposed action in comparison to various alternatives, including Severe Accident Design Mitigation Alternatives and the alternative of dry cask storage.

Basis: NEPA requires federal agencies to prepare an EIS before undertaking any major federal action which may significantly affect the quality of the human environment. 42 U.S.C. § 4332(C). The NRC's implementing regulations at 10 C.F.R. § 51.20(a) also require the NRC to prepare an EIS for any licensing or regulatory action which "is a major Federal action significantly affecting the quality of the human environment." Where aspects of the proposed action are addressed by a previously prepared EIS, an new EIS must be issued if there remains "major federal action" to occur, and if there is new information showing that the remaining action will affect the quality of the human environment "in a significant manner or to a significant extent not already considered." *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). *See also* 10 C.F.R. § 51.92(a), which requires supplementation where the

proposed action has not been completed, if: "(1) there are substantial changes in the proposed action that are relevant to environmental concerns; or (2) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." Although § 51.92 technically does not apply here, where the action proposed in the original Shearon Harris EIS has already been taken, the criteria provide applicable guidance for these circumstances.

The factual basis for this contention is provided in Contention 4, which is adopted and incorporated herein by reference. As discussed in Contention 4, CP&L proposes to make significant changes to the Harris design, which were not previously evaluated in any safety or environmental review. Moreover, these design changes are likely to have a significant effect on both the probability and the consequences of an accident at the Harris plant. Previous severe accident analyses have shown that LOCA and loss of power accidents are significant contributors to accident risk at Harris, thus making it imperative to inquire into the effect of the proposed design changes on the risks of accidents at Harris.

Moreover, as discussed in Contention 4, a significant potential for severe pool accidents exists and has not been previously considered, either in specific reference to Harris or generically. This potential could be examined by the extension of PRA techniques that have been used to consider reactor accidents, with findings incorporated in EIS's.

An EIS must also examine the costs and benefits of the proposed action, and compare them to other reasonable alternatives. 10 C.F.R. § 51.71. In particular, the EIS must consider such reasonably available alternatives as dry cask storage, for which CP&L already has an application pending for the Brunswick plant (see Contention 6). In addition, the EIS must consider Severe Accident Design Mitigation Alternatives, such as dry cask storage; low-density

pool storage; installation of an independent cooling system for pools C and D (considered but apparently rejected by CP&L; *see* Contention 1); earlier upgrade of the CCW system; and installation of safety grade equipment for restoring cooling and water makeup to the spent fuel pools in the event of a severe reactor accident that prevents access to the pools. Consideration of SAMDAs is required in a NEPA analysis for an initial licensing decision, *Limerick Ecology Action v. NRC,* 869 F.2d 719, 736-741 (3rd Cir. 1989), and therefore must necessarily be required in any EIS prepared for this license amendment.

Contention 6: Scope of EIS Should Include Brunswick and Robinson Storage

The EIS for the proposed license amendment should include within its scope the storage of spent fuel from the Brunswick and Robinson nuclear power plants.

Basis: As recognized in *Vermont Yankee Nuclear Power Corporation* (Vermont Yankee Nuclear Power Station), LBP-88-19, 28 NRC 145 (1988), there is no independent utility to the racking of a spent fuel pool: the only reason for the application is to permit the expansion of spent fuel storage at the plant. Here, the purpose of the proposed expansion is not only to store spent fuel generated by Harris, but also to accommodate fuel from Brunswick and Robinson.

Indeed, CP&L has a global plan for storage of spent fuel from its three North Carolina reactors, including the option of dry cask storage at Brunswick. In 1989, CP&L applied for an ISFSI license for Brunswick. License Application Under 10 C.F.R. Part 72 . A review of the correspondence indexed by the NRC Public Document Room does not show that this application was ever withdrawn; and therefore it appears that the application is still pending. The Department of Energy's Energy Information Administration also reports that "The ISFSI at the Brunswick plant will be used only as a backup if shipping of spent nuclear fuel to the Harris

plant is prohibited."[35] Thus, although the dry cask storage option exists and has been partially developed, it has been given no serious consideration.

Contention 7: Even if no EIS required, Environmental Assessment Required

Even if the Licensing Board finds that no EIS is required, it must order the preparation of an EA.

Basis: As the Licensing Board ruled in *Vermont Yankee*, LBP-87-17, an agency's evaluation of alternatives "is governed by two sections of NEPA, §§ 102(2)(C) and 102(2)(E), 42 U.S.C. §§ 4332(2)(C) and 4332(2)(E). The former section is applicable only when an EIS is required; the latter applies whether or not an EIS is prepared." 25 NRC at 858. As discussed in Contention 4, the proposed license amendment is not exempt from NEPA. Orange County believes that an EIS is required, because the proposed license amendment poses significant risks that have not previously been considered by the NRC or CP&L. Even if no EIS is required, however, the NRC must still prepare an EIA that evaluates "unresolved conflicts concerning alternative uses of available resources," as required by Section 102(2)(E) of NEPA. Here, there are significant unresolved conflicts regarding the appropriate use of space and resources for the storage of spent fuel generated by the Harris, Brunswick, and Robinson nuclear plants. Dry cask storage clearly is an option, and in fact CP&L has applied for an ISFSI license for Brunswick. Orange County believes that dry cask storage, potentially combined with low density pool storage, is far and away the wisest use of resources, achieving the greatest minimization of risk to public health and safety. An EA should be prepared which examines the proposed action in

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35 EIA Report, SR/CNEAF/96-01, "Spent Nuclear Fuel Discharges from U.S. Reactors, 1994" at 46-47 (February 1996). A copy of the relevant pages is attached as Exhibit 5.

comparison to this alternative, as well as Severe Accident Design Mitigation Alternatives.

Contention 8: Discretionary EIS Warranted

Even if the Licensing Board determines that an EIS is not required under NEPA and 10 C.F.R. § 51.20(a), the Board should nevertheless require an EIS as an exercise of its discretion, as permitted by 10 C.F.R. §§ 51.20(b)(14) and 51.22(b).

Basis: NRC regulations in 10 C.F.R. §§ 51.20(b)(14) and 51.22(b) provide for the preparation of an EIS where, upon its own initiative or request from any party, the Commission finds that "special circumstances" exist. Special circumstances "include the circumstances where the proposed action involves unresolved conflicts concerning alternative uses of available resources within the meaning of section 102(2)(E) of NEPA."

Orange County submits that this case presents such "special circumstances," generally arising from the fact that the proposed expansion of spent fuel pool storage capacity at the Harris plant is part of a larger plan by CP&L for the management of spent fuel generated by three different reactors: Harris, Robinson, and Brunswick. Even if the Licensing Board finds that no EIS is required here, the NRC should nevertheless prepare an EIS in its discretion, in order to evaluate unresolved conflicts concerning the use of available resources in for management of spent fuel from CP&L's three reactors.

As recognized in *Vermont Yankee Nuclear Power Corporation* (Vermont Yankee Nuclear Power Station), LBP-88-19, 28 NRC 145 (1988), there is no independent utility to the racking of a spent fuel pool: the only reason for the application is to permit the expansion of spent fuel storage at the plant. Here, the purpose of the proposed expansion is not only to store spent fuel generated by Harris, but also to accommodate fuel from Brunswick and Robinson. The record

shows no evaluation by the NRC of the need for additional storage capacity at any of the three plants, or whether CP&L's proposal constitutes the wisest use of available resources to meet the need. As discussed above in Contention 5, it is clear that there is space at the Brunswick plant for dry cask storage, and that CP&L contemplates dry cask storage there if its proposal for wet storage at Harris fails. Thus, although the dry cask storage option exists and has been partially developed, it has been given no serious consideration.

If the proposed license amendment is approved, Shearon Harris will become the largest spent fuel storage facility east of the Mississippi River. As discussed above in Contention 4, the inventory of cesium-137 in the Harris spent fuel pools will be greatly increased, thus greatly increasing the consequences of reasonably foreseeable severe accidents. The decisions of whether to use wet or dry storage at Harris, and whether to ship fuel or leave it onsite at Brunswick and Robinson, should not be based on whether shipments to Harris are prohibited, but on which storage alternative is most cost-beneficial, taking into account both environmental and economic considerations. Orange County submits dry cask storage is a far wiser use of resources from an environmental viewpoint, because it does not entail the risks of a loss of coolant from the spent fuel pools. Moreover, CP&L's proposal to consolidate spent fuel from Harris, Brunswick, and Robinson into high density racked pools at one site significantly increases the risk posed by wet storage.

Orange County strongly disputes CP&L's choices regarding the allocation of resources for continued spent fuel storage for its three North Carolina reactors. In light of this conflict regarding the use of available resources, Orange County requests the preparation of an EIS for storage of spent fuel from the Harris, Brunswick, and Robinson nuclear plants.

Another compelling reason to prepare an EIS for CP&L's spent fuel management

proposal is to address the apparent conflict between the CP&L proposal and NRC's Waste Confidence decision. NRC regulations at 10 C.F.R. § 51.23 encode the Commission's "Waste Confidence" determination that, *inter alia*,:

> There is reasonable assurance that at last one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.

In contradiction of this finding, the CP&L license amendment application gives, as the rationale for the requested spent fuel pool storage capacity expansion, the fact that "DOE spent fuel storage facilities are not available *and are not expected to be available for the foreseeable future.*" License Application, Enclosure 1 at 1 (emphasis added). Having made a determination that a repository will be available during the next quarter-century, the NRC should evaluate the apparent conflict with CP&L's determination that the resource will be *unavailable.* It should be noted in this regard that the Commission has been quite strict in forbidding state and local governments and intervenor groups from challenging its determination that a repository will be available in the next quarter century. *See, e.g., Private Fuel Storage, L.L.C. , supra,* LBP-98-7, 47 NRC at 241; *Vermont Yankee, supra,* LBP-87-17, 25 NRC at 853-54. The Commission must be equally strict in enforcing this decision against licensees. The Commission should not leave unexamined a licensee decision to make major changes to its spent fuel storage program, where that decision is based on a lack of confidence in the Waste Confidence rulemaking.

IV. CONCLUSION

For the foregoing reasons, Orange County's contentions should be admitted for litigation in this proceeding.

Respectfully submitted,

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April 5, 1999

April 5, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE NRC STAFF

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT	)	Docket No. 50-400
(Shearon Harris Nuclear	)	
Power Plant)	)	
	)	

DECLARATION OF DR. GORDON THOMPSON

I, Gordon Thompson, declare as follows:

A. Introduction

1. I am the executive director of the Institute for Resource and Security Studies (IRSS), a nonprofit, tax-exempt corporation based in Massachusetts. Our office is located at 27 Ellsworth Avenue, Cambridge, MA 02139. IRSS was founded in 1984 to conduct technical and policy analysis and public education, with the objective of promoting peace and international security, efficient use of natural resources, and protection of the environment.

2. I received an undergraduate education in science and mechanical engineering at the University of New South Wales, in Australia. Subsequently, I pursued graduate studies at Oxford University and received from that institution a Doctorate of Philosophy in mathematics in 1973, for analyses of plasmas undergoing thermonuclear fusion. During my graduate studies I was associated with the fusion research program of the UK Atomic Energy Authority.

3. During my professional career, I have performed technical and policy analyses on a range of issues related to international security, energy supply, environmental protection, and sustainable use of natural resources. Since 1977, a significant part of my work has consisted of technical analyses of safety and environmental issues related to nuclear facilities. These analyses have been sponsored by a variety of nongovernmental organizations and local, state and national governments, predominantly in North America and western Europe. Drawing upon these analyses, I have provided expert testimony in legal and regulatory proceedings, and have served on committees advising US government agencies. A copy of my resume is attached as Attachment 2 to the Declaration of Dr. Gordon Thompson (February 12, 1999) ("Thompson No Significant Hazards Declaration"), which is attached as Exhibit 2 to Orange County's Supplemental Petition to Intervene.

4. I have reviewed the December 23, 1998, license amendment application filed by Carolina Power and Light (CP&L) for an amendment to Facility Operating License No. NPF-63, which seeks permission to activate spent fuel storage pools C and D at the Shearon Harris nuclear power plant. I have also reviewed the NRC's Federal Register notice for the proposed license amendment, the Final Safety Analysis Report for the Shearon Harris Nuclear Power Plant, and the Final Environmental Statement related to the operation of Shearon Harris Nuclear Power Plant, Units 1 and 2 (NUREG-0972, October 1983). In addition, I reviewed various correspondence and technical documents relating to the proposed license amendment and to risks of spent fuel storage, which are identified in Orange County's contentions.

5. I participated in the preparation of Orange County's contentions regarding the proposed license amendment. The factual assertions and expressions of technical judgment in those contentions summarize the facts and professional opinions to which I would testify if called as a witness in this proceeding, and the documents cited in the contentions constitute documents that I would rely on in my testimony.

****

I declare, under penalty of perjury, that the foregoing is true and correct.

Executed on 5 April 1999.

G. R. Thompson

Gordon Thompson

EXHIBIT 1

April 5, 1999

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
(Shearon Harris Nuclear	)	
Power Plant)	)	
	)	

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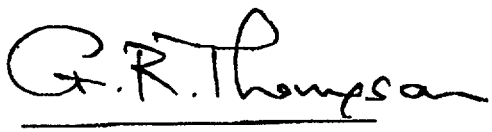
Executed on 5 April 1999.



Gordon Thompson

EXHIBIT 2

February 12, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE NRC STAFF

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT	)	Docket No. 50-400
(Shearon Harris Nuclear	)	
Power Plant)	)	
	)	

DECLARATION OF DR. GORDON THOMPSON

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2. This Declaration pertains to an application by Carolina Power and Light (CP&L) for an amendment to Facility Operating License No. NPF-63, which covers the Shearon Harris nuclear power plant. The staff of the Nuclear Regulatory Commission (NRC) has reviewed CP&L's application and proposes to determine that the amendment request involves no significant hazards consideration. The NRC has sought public comments on the proposed determination.[1] Through this Declaration, I offer comments on the NRC staff's proposed determination. I have prepared these comments pursuant to an agreement by IRSS to provide technical information and other services to Orange County, North Carolina.

B. My Professional Background

3. I received an undergraduate education in science and mechanical engineering at the University of New South Wales, in Australia. Subsequently, I pursued graduate studies at Oxford University and received from that institution a Doctorate of Philosophy in mathematics in 1973, for analyses of plasmas undergoing thermonuclear fusion. During my graduate studies I was associated with the fusion research program of the UK Atomic Energy Authority.

[1] Federal Register: January 13, 1999 (Volume 64, Number 8), pages 2237-2241.

4. During my professional career, I have performed technical and policy analyses on a range of issues related to international security, energy supply, environmental protection, and sustainable use of natural resources. Since 1977, a significant part of my work has consisted of technical analyses of safety and environmental issues related to nuclear facilities. These analyses have been sponsored by a variety of nongovernmental organizations and local, state and national governments, predominantly in North America and western Europe. Drawing upon these analyses, I have provided expert testimony in legal and regulatory proceedings, and have served on committees advising US government agencies. My CV is provided here as Attachment A.

C. Scope of My Review

5. In preparation of this Declaration, I reviewed the NRC's Federal Register notice for the proposed license amendment, the Final Safety Analysis Report for the Shearon Harris Nuclear Power Plant, the Final Environmental Statement related to the operation of Shearon Harris Nuclear Power Plant, Units 1 and 2 (NUREG-0972, October 1983), and CP&L's application for the proposed license amendment. I also reviewed various correspondence and technical documents relating to the propose license amendment and to risks of spent fuel storage, which are identified below.

6. The information that has been provided by the NRC and CP&L to date does not contain all of the detail that I would need to provide a complete, final statement about the hazards associated with the proposed license amendment. I would expect to review the full body of detailed evidence and present my final evaluation in the context of a hearing. However, even the limited information provided so far is adequate to permit me to identify serious safety concerns which preclude the NRC from making a "no significant hazards" determination. These issues should be addressed through the systematic, public process that a prior licensing hearing can provide.

D. The "No Significant Hazards" Standard

7. The NRC has stated its standard for determining that a license amendment request involves no significant hazards consideration.[2] The standard is met if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

8. In my professional opinion, based on the preliminary evidence provided by the NRC and CP&L, operation of the Shearon Harris plant in accordance with the license amendment proposed by CP&L will violate all three of the conditions set forth in the preceding paragraph. Therefore, the NRC staff should reverse its position and should

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[2] Ibid.

determine that CP&L's license amendment request does not involve no significant hazards consideration.

E. The License Amendment in Context - Spent Fuel Management at Harris

9. Before discussing my concerns about the safety implications of the proposed license amendment, I provide here some background information about spent fuel management at the Harris plant and CP&L's proposal to increase the spent fuel storage capacity at Harris. Unless specified otherwise, the information presented here is drawn from CP&L's license amendment application or from CP&L's Final Safety Analysis Report (FSAR) for the Harris plant.

10. The Harris plant features one pressurized-water reactor (PWR). The core of this reactor contains 157 fuel assemblies, with a center-center distance of about 8.5 inches. The Harris plant was to have four reactors but only one was built. A fuel handling building was built to serve all four reactors. This building contains four fuel pools (A, B, C, D), a cask loading pool and three fuel transfer canals, all interconnected but separable by gates. Pools A and B contain fuel racks. Pools C and D are flooded but do not contain racks. The cooling and water cleanup systems for pools C and D were never completed.

11. Pool A now contains six PWR racks (360 fuel assembly spaces) and three BWR racks (363 spaces), for a total pool capacity of 723 fuel assemblies. Pool B contains twelve PWR racks (768 spaces) and seventeen BWR racks (2,057 spaces), and is licensed to store one additional BWR rack (121 spaces), for a total pool capacity of 2,946 fuel assemblies. Thus, pools A and B now have a combined capacity of 3,669 fuel assemblies. The center-center distance in pools A and B is 10.5 inches for PWR fuel and 6.25 inches for BWR fuel.

12. Pools A and B store spent fuel from the Harris reactor and from CP&L's Brunswick plant and Robinson plant. The Brunswick plant has two boiling-water reactors (BWRs) while the Robinson plant has one PWR. Shipment of spent fuel from Brunswick and Robinson to Harris is said by CP&L to be necessary to allow core offload capacity in the pools at Brunswick and Robinson.

13. CP&L seeks an amendment to its operating license so that it can activate pools C and D at Harris. By activating these pools, CP&L expects to have sufficient spent fuel storage capacity for all four CP&L reactors (Harris, Robinson and the two Brunswick reactors) through the end of their current operating licenses.

14. CP&L plans to install racks in pool C in three campaigns (approximately in 2000, 2005 and 2014), to create 927 PWR spaces and 2,763 BWR spaces, for a total pool capacity of 3,690 fuel assemblies. Thereafter, CP&L plans to install racks in pool D in two campaigns (approximately in 2016 and at a date to be determined), to create 1,025 PWR spaces. Thus, the ultimate capacity of pools C and D will be 4,715 fuel assemblies. The center-center distance will be 9.0 inches for PWR fuel and 6.25 inches for BWR fuel.

15. The PWR racks in pools C and D have a smaller center-center distance than the racks in pools A and B (9.0 inches instead of 10.5 inches). This arrangement allows more PWR fuel to be placed in a given pool area but also means that PWR fuel in pools C and D is more prone to undergo criticality. In response, CP&L proposes to include in the Technical Specifications for Harris a provision that PWR fuel will not be placed in pools C and D unless it has relatively low enrichment and high burnup.[3]

F. Some Technical Safety Issues Raised By the Proposed License Amendment

16. CP&L's plan for the activation of pools C and D raises a variety of technical safety issues. This section of my Declaration describes some of those issues. Later parts of the Declaration relate these issues to the NRC's standard for a "no significant hazards" determination.

17. NRC regulations require that spent fuel storage pools must be cooled by safety grade cooling systems. When the Harris plant was designed, the intention was that pools C and D would be cooled by the component cooling water (CCW) system for the second unit of the Harris plant.[4] That unit was never built, and therefore the Unit 2 CCW system does not exist. In the absence of a second CCW system, CP&L plans to cool pools C and D by connecting their cooling systems to the CCW system of the first unit. This system already provides cooling to pools A and B and serves other, important safety functions. Attachment B provides supporting information.[5] It should be noted that CP&L considered, but has not pursued, the option of cooling pools C and D by a new, independent system that could have had dedicated emergency diesel generators. Attachment C provides information in support of this point.[6] Three significant safety issues are raised by the fact that the spent fuel pool cooling arrangement originally designed for pools C and D of the Harris plant was not completed. These issues relate to the heat loading of the existing CCW system, the load on the existing emergency diesel generators, and the loss of some important quality assurance documentation for cooling piping at pools C and D.

18. **Heat load.** According to CP&L's license amendment application, the bounding heat load from the fuel in pools C and D will be 15.6 million BTU/hour.[7] At present, the CCW system cannot absorb this additional heat load. Thus, CP&L proposes to include in

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[3] License amendment application, Enclosure 5.

[4] The Harris pools have their own closed-circuit cooling systems, which can transfer heat to the relevant CCW system through heat exchangers.

[5] Attachment B is a portion of a set of viewgraphs (titled "Harris Spent Fuel Pool 'C' and 'D' Activation") shown by CP&L representatives during a meeting with NRC staff on 16 July 1998.

[6] Attachment C is an NRC staff memo about a meeting between CP&L representatives and NRC staff on 3 March 1998, together with a portion of a set of viewgraphs (titled "HNP Spent Fuel Pool 'C' and 'D' Activation") shown by CP&L during that meeting.

[7] License amendment application, Enclosure 7, page 5-16.

the Technical Specifications for Harris an interim provision that the heat load in pools C and D will not be allowed to exceed 1.0 million BTU/hour.[8] CP&L claims that an additional heat load of 1.0 million BTU/hour can be accommodated by the existing CCW system, and that the fuel to be placed in pools C and D will not create a heat load exceeding 1.0 million BTU/hour through 2001.

19. Apparently, CP&L contemplates a future upgrade of the CCW system, so that the CCW system can accommodate an additional heat load of 15.6 million BTU/hour from pools C and D. This contemplated upgrade is not described in the present license amendment application. Attachment C indicates that CP&L plans to perform the upgrade of the CCW system concurrent with a power uprate for the Harris reactor. Apparently, a 4.5 percent power uprate will be associated with steam generator replacement, and there will be a subsequent further power uprate of 1.5 percent. A chart in Attachment C shows that the projected CCW heat load, including the reactor power uprate and the use of pools C and D, will substantially exceed the capability of the present CCW system.

20. To summarize, CP&L's short-term plan (through 2001) for cooling pools C and D is to exploit the margin in the existing CCW system, so as to accommodate an additional heat load of 1.0 million BTU/hour. CP&L's longer-term plan is to upgrade the CCW system, in a manner not yet specified, so as to accommodate an additional heat load of 15.6 million BTU/hour. The CCW upgrade must also accommodate an increase in the rated power of the Harris reactor. Attachment B indicates CP&L's expectation that the design of the CCW upgrade will commence in mid-1999 and will be completed in early 2001, one year after pool C enters service.

21. In order to avoid exceeding the available margin in the existing CCW system while cooling pools C and D, CP&L may be obliged to require its operators to divert some CCW flow from the residual heat removal (RHR) heat exchangers during the recirculation phase of a design-basis loss-of-coolant accident (LOCA) event at the Harris reactor.[9] This raises a safety issue because, during the recirculation phase of a LOCA, operation of the RHR system is essential to keeping the reactor core and containment in a safe condition. Both CP&L and the NRC have identified the proposed additional heat load on the Unit 1 CCW system as an "unreviewed safety question," i.e., a safety question that has not been previously reviewed by the NRC Staff.[10] It should be noted in this context that exploitation of the margin in the existing CCW system may involve changes in design assumptions that include fouling factors and tube plugging limits. See Attachment C. The discussion of CCW capability which is provided in Enclosure 9 of CP&L's license amendment application is insufficient to determine the nature and significance of the assumptions made by CP&L.

22. **Backup diesel generators.** The cooling systems for pools C and D will draw electrical power from the electrical systems of the existing Harris plant. If electricity

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[8] License amendment application, Enclosure 5.

[9] License amendment application, Enclosure 9.

[10] Ibid; Federal Register notice for this application.

supply to the cooling pumps for pools C and D is interrupted, the pools will heat up and eventually boil. CP&L says that pools C and D will begin to boil after a time period "in excess of 13 hours", assuming a bounding decay heat load of 15.6 million BTU/hour.[11] To prevent the onset of pool boiling in the event of a loss of offsite power, the Harris operators may be obliged to provide electrical power to pools C and D from the emergency diesel generators, which also serve pools A and B and the reactor. In the present license amendment application, CP&L does not address the ability of the emergency diesel generators to meet the additional electrical loads associated with pools C and D. CP&L does mention in the Harris FSAR the potential for connecting "portable pumps" to bypass the pool cooling pumps should the latter be inoperable.[12] However, the characteristics, capabilities and availability of such portable pumps are not addressed in the present license amendment application. Meeting the electrical load of pools C and D from the systems of the existing Harris plant is a safety issue because it could increase the probability of design-basis or severe accidents at the Harris reactor or at pools A through C.

23. **Lack of QA documents.** Activation of pools C and D will require the completion of their cooling and water cleanup systems, and the connection of their cooling systems to the existing CCW system. CP&L states that approximately 80% of the necessary piping was completed before the second Harris reactor was cancelled.[13] However, some of the quality assurance documentation for the completed piping is no longer available. Much of the completed piping is embedded in concrete and is therefore difficult or impossible to inspect. To address this situation, CP&L proposes an Alternative Plan to demonstrate that the previously completed piping and other equipment is adequate for its purpose.[14] Nevertheless, the cooling systems for pools C and D will not satisfy ASME code requirements. Attachment D provides supporting information.[15] Failure to satisfy ASME code requirements could increase the probability of design-basis or severe accidents at pools C and D.

G. The Degree of Hazard Posed by Spent Fuel Storage at Harris

24. The NRC and CP&L have performed and published site-specific analyses which provide information about potential severe accidents at the Harris reactor. However, to my knowledge neither NRC nor CP&L has performed any site-specific analysis which

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[11] License amendment application, Enclosure 7, page 5-8.

[12] Harris FSAR, page 9.1.3-4, Amendment No. 48.

[13] License amendment application, Enclosure 1, page 4.

[14] License amendment application, Enclosure 8.

[15] Attachment D is a portion of a set of viewgraphs (titled "10CFR50.55a Alternative Plan") shown by CP&L representatives during a meeting with NRC staff on 16 July 1998.

examines potential severe accidents affecting any of the Harris fuel pools, including pools C and D.

25. The NRC examined severe reactor accidents in its Final Environmental Statement for the Harris plant.[16] Site-specific consequence modelling was performed by the NRC for hypothetical accidents that released as much as 82 percent of the inventory of cesium isotopes in the reactor core. CP&L has submitted to the NRC an Individual Plant Examination (IPE) for the Harris plant.[17] In addition, CP&L has submitted a similar analysis (an IPEEE) for "external" initiating events.[18] The IPE and IPEEE studies examined the potential for severe reactor accidents that could release substantial amounts of radioactivity.

26. In the absence of similar studies for the Harris pools, one must perform scoping calculations to indicate the degree of hazard posed by spent fuel storage at Harris. The degree of hazard is important when one considers the relevance of a safety issue to a determination of "no significant hazards". If preliminary evidence about a safety issue suggests the potential for accidents with either high probability or large consequences, then the NRC staff should not make a determination of "no significant hazards".

27. The radioisotope cesium-137 is one important indicator of the hazard potential posed by a nuclear facility. This isotope has a half-life of 30 years, emits intense gamma radiation, and is released comparatively readily during severe accidents. The 1986 Chernobyl accident released about 90,000 TBq (27 kg) of cesium-137 to the atmosphere, which accounted for most of the offsite radiation exposure attributable to that accident. Official estimates indicate that this exposure will cause 50-100 thousand extra cancer fatalities worldwide over the next 70 years.[19]

28. The core of the Harris reactor contains 157 PWR fuel assemblies. At shutdown, this core contains about 155,000 TBq (47 kg) of cesium-137.[20] When a spent fuel assembly is discharged from the reactor, it will contain more cesium-137 than the average assembly at shutdown. CP&L plans an eventual, aggregate capacity in the Harris pools of 3,080 PWR assemblies and 5,304 BWR assemblies. Note that the cesium-137 content in each BWR assembly will be about one quarter the cesium-137 content in each PWR assembly,

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[16] NRC, Final Environmental Statement related to the operation of Shearon Harris Nuclear Power Plant, Units 1 and 2, NUREG-0972, October 1983.

[17] CP&L, Shearon Harris Nuclear Power Plant, Individual Plant Examination Submittal, Final Report, 31 August 1993.

[18] CP&L, Shearon Harris Nuclear Power Plant Unit No. 1, Individual Plant Examination for External Events Submittal, June 1995.

[19] Allan S Krass, Consequences of the Chernobyl Accident (Cambridge, Massachusetts: Institute for Resource and Security Studies, December 1991).

[20] NRC, Final Environmental Statement, page 5-50.

if both assemblies have been discharged for an equal period.[21] After discharge, the content of cesium-137 in a fuel assembly will decay exponentially with a half-life of 30 years.

29. As a simplified illustration, assume that all fuel assemblies in the Harris pools have been discharged for an equal period. Further assume that all four pools are full and contain 3,080 PWR assemblies and 5,304 BWR assemblies. The pools will then contain as much cesium-137 as 4,406 PWR assemblies. (3,080 + 5,304 x 1/4 = 4,406) Note that 4,406 PWR assemblies represent 28 cores of the Harris reactor.

30. If an accident can be postulated that releases to the environment a significant fraction of the cesium-137 in the Harris pools, then it is clear that the consequences of this accident would be large. The offsite radiation exposure could be an order of magnitude larger than the exposure from the Chernobyl accident. Activation of pools C and D could lead to an accident which creates offsite radiation exposure as much as two times higher than the exposure that would arise from a similar accident involving only pools A and B.

H. Loss of Water from Spent Fuel Pools at Harris

31. Loss of water from one or more of the Harris pools could initiate a release to the environment of a significant fraction of the cesium-137 in the pools. This potential exists because the cladding of PWR or BWR fuel is a zirconium alloy which can react exothermically with air or steam. Thus, if the water in a fuel pool is removed and the fuel is partially or totally uncovered, one must be concerned about the possibility of a runaway air-zirconium or steam-zirconium reaction. Such a reaction could release cesium-137 and other radioisotopes from affected fuel into the fuel building. That building was not designed to contain radioisotopes released during a vigorous exothermic reaction in the pools, and it can be assumed that most of the volatile radioisotopes entering the building from the affected fuel would be released from the building as an atmospheric plume.

32. Several reports prepared by or for the NRC have examined the conditions under which a runaway zirconium reaction might occur.[22] However, these reports have concentrated almost entirely on a postulated condition of instantaneous, complete loss of water from a pool. Such a condition is unrealistic in any scenario which preserves the configuration of the spent fuel racks. If water is lost by drainage or evaporation and no makeup occurs, then complete loss of water will always be preceded by partial

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[21] The ratio of one quarter derives from the parameters shown in the license amendment application, Enclosure 7, page 5-15.

[22] Relevant reports include: V L Sailor et al, Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82, NUREG/CR-4982, July 1987; E D Throm, Regulatory Analysis for the Resolution of Generic Issue 82, "Beyond Design Basis Accidents in Spent Fuel Pools", NUREG-1353, April 1989; and R J Travis et al, A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shutdown Nuclear Power Plants, NUREG/CR-6451, August 1997.

uncovering of the fuel. If makeup is considered, the water level could fall, rise or remain static for long periods.

33. Partial uncovering of the fuel will often be a more severe condition than complete loss of water because, during partial uncovering, convective heat loss is suppressed by the residual water at the base of the fuel assemblies. As a result, longer-discharged fuel with a lower heat output may undergo a runaway steam-zirconium reaction during partial uncovering while it would not undergo a runaway air-zirconium reaction if the pool were instantaneously emptied.

34. I am aware of only one instance in which reports produced by or for the NRC address the hazard posed by partial uncovering, namely in a report prepared for the NRC by Sandia Laboratories and published in 1979.[23] Part of this report did address a situation of partial uncovering, but used a crude heat transfer model and neglected to consider the onset of a steam-zirconium reaction. Nevertheless, the report found (page 76) that ".....an incomplete drainage can potentially cause a more severe heatup problem than a complete drainage, if the residual water remains near the baseplates". A portion of the 1979 Sandia report is provided here as Attachment E. An internal NRC memo mentions the consideration of partial uncovering in the 1979 Sandia report.[24]. Otherwise, it appears that the NRC has ignored the hazard posed by partial uncovering. This hazard was not reflected in the regulatory analysis whereby the NRC purportedly resolved Generic Issue 82.[25]

35. In a situation of falling water level, a fuel assembly might first undergo a runaway steam-zirconium reaction, then switch to an air-zirconium reaction as water falls below the base of the rack and convective air flow is established. In this manner, a runaway air-zirconium reaction could occur in a fuel assembly that is too long-discharged (and therefore produces too little heat) to suffer such a reaction in the event of instantaneous, complete loss of water. Conversely, a rising water level could precipitate a runaway steam-zirconium reaction in a fuel assembly that had previously been completely uncovered but had not necessarily suffered a runaway air-zirconium reaction while in that condition. The latter point is highly significant in the context of emergency measures to recover control of a pool which has experienced water loss. Inappropriate addition of water to a pool could exacerbate the accident.

36. The NRC's failure to consider partial uncovering of fuel should be borne in mind when one reviews NRC-sponsored reports that purport to address the hazard posed by water loss from a fuel pool. This hazard should be re-analyzed through detailed modelling. The modelling should consider both partial and complete uncovering and the

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[23] Allan S Benjamin et al, Spent Fuel Heatup Following Loss of Water During Storage, NUREG/CR-0649, March 1979.

[24] Internal NRC Memorandum from J T Han to M Silberberg, "Response to a NRR request to review SNL studies regarding spent fuel heatup and burning following loss of water in storage pool", 21 May 1984.

[25] E D Throm, op cit.

transition from one of these states to the other. Also, the modelling should cover: (1) thermal radiation, conduction, and steam or air convection; (2) air-zirconium and steam-zirconium reactions; (3) variations along the fuel rod axis; and (4) radial variations within a representative fuel rod, including effects of the pellet-cladding gap. Experiments will probably be required to support and validate the modelling.

37. Until the problem of water loss is re-analyzed in this manner, there is no basis for determining when fuel has been discharged for a sufficiently long period that it will not suffer a runaway zirconium reaction in the event of water loss. If the problem were to be properly analyzed through validated models, such a determination could be made within some margin of error, but the determination should consider site-specific factors. For example, the detailed design of a rack might be an important site-specific factor.

38. No determination of this kind has been made for pools C and D at Harris, nor does the methodology now exist to make such a determination. In any case, there is nothing in the license amendment application and its proposed modifications to the Harris Technical Specifications which prohibits the placing of freshly discharged fuel in pools C and D. Reports previously prepared for the NRC concede that freshly discharged fuel can experience a runaway air-zirconium reaction in the event of complete water loss.

39. A variety of events, alone or in combination, could lead to partial or complete uncovering of spent fuel in the Harris pools. This class of events should be subjected to the kind of systematic analysis that is performed in an IPE and an IPEEE. Relevant events include: (1) an earthquake, cask drop, aircraft crash, human error, equipment failure or sabotage event that leads to direct leakage from the pools; (2) siphoning of water from the pools through accident or malice; (3) interruption of pool cooling, leading to pool boiling and loss of water by evaporation; and (4) loss of water from active pools into adjacent pools or canals that have been gated off and drained. Interactions with the Harris reactor should be considered. For example, a reactor accident might release radioactivity that precludes personnel access to the plant for purposes of maintaining or restoring pool cooling.

I. Increased Probability or Consequences of Accidents Previously Evaluated

40. The Federal Register notice of this license amendment application claims that the probability of a spent fuel assembly drop or a misloaded fuel assembly is not significantly increased if the license amendment is approved and pools C and D are activated. This claim is false, because activation of pools C and D will roughly double the total number of fuel handling operations to be conducted at Harris. Assuming that the general nature of fuel handling operations continues as before, the probability of a fuel assembly drop or misloaded fuel assembly, integrated over the entire period of the Harris operating license, will increase significantly, by a factor of two. This point has been made by David Lochbaum of the Union of Concerned Scientists, in a 22 January 1999 letter to the NRC Commissioners. A copy of his letter is provided here as Attachment F. If probability is integrated over the remaining period of the Harris operating license, rather than over its total duration, then activation of pools C and D will more than double the probability of a fuel assembly drop or a misloaded fuel assembly.

41. A spent fuel assembly drop or a misloaded fuel assembly are members of a broader class of accidents that could arise during the movement of fuel from other CP&L stations to Harris, and during fuel movement within Harris. This class of accidents will include design-basis accidents and severe accidents. Assuming that the general nature of fuel movement continues as before, the probability of accidents in this class, integrated over the entire period of the Harris operating license, will double if pools C and D are activated. If integrated over the remaining period of the operating license, the probability will more than double.

42. The PWR racks in pools C and D will be safe against criticality for a comparatively narrow range of fuel enrichment and burnup. Thus, assuming that the general nature of fuel movement continues as before, the probability of a criticality accident will be significantly increased if pools C and D are activated. This probability will increase on a per-movement basis, so it will more than double when integrated over the entire period of the Harris operating license. The consequences of a criticality accident may also be significantly increased.

43. Activation of pools C and D will add to the electrical load and CCW heat load of existing Harris systems. It will also add to the burden of work on the Harris operators. These effects will increase the probability of two categories of design-basis or severe accidents. First, they will significantly increase the probability of accidents associated with the Harris reactor, because the reactor's CCW and electrical systems and its operators will be under greater stress. Second, they will significantly increase the probability of accidents at the Harris pools that are attributable to interruptions in cooling and electricity supply and to increased operator stress. Also, the inability of cooling piping at pools C and D to meet ASME code requirements could significantly increase the probability of design-basis or severe accidents at these pools.

44. As mentioned in paragraph 24 above, to my knowledge there has been no site-specific analysis of severe accidents affecting any of the Harris pools. To the extent that such accidents have been previously evaluated, their consequences will be significantly increased by the activation of pools C and D. The fuel storage capacity of these pools will roughly double the storage capacity at Harris, creating the potential for a doubled inventory of radioactivity. Severe accidents could affect some or all of the Harris pools. As I have discussed in paragraph 30 above, the potential doubling of radioactivity in the pools could significantly increase the consequences of severe accidents.

J. Possibility of New or Different Kinds of Accident from any Accident Previously Evaluated

45. To my knowledge, there has been no site-specific evaluation of the probability or consequences of severe accidents at pools A and B at Harris. A variety of severe accidents are possible and should be subjected to the kind of systematic analysis that is performed in an IPE and IPEEE. The NRC has performed evaluations of accidents involving loss of water from fuel pools, generically and for sites other than Harris.

However, these evaluations are seriously deficient because they failed to consider partial uncovering of fuel. To summarize, at pools A and B there exists the possibility of new or different kinds of accident from any accident previously evaluated. The same possibility will exist at pools C and D if these are activated.

46. Provision of electrical power, including power from emergency diesel generators, and CCW service from the existing Harris plant to pools C and D could introduce the potential for design-basis or severe accidents that are new or different from any accident previously considered. The IPE and IPEEE studies performed for Harris did not address the provision of electrical power and CCW service to pools C and D. As an example of the potential for new or different accidents, the need to provide cooling to pools C and D will place increased stress on the CCW system, the emergency diesel generators, and the plant operators during a design-basis LOCA.

47. Severe accidents at some or all of the Harris pools could lead to offsite radiation exposure an order of magnitude larger than the exposure from the Chernobyl accident. Activation of pools C and D could significantly increase both the probability and consequences of such accidents. Thus, CP&L's proposed license amendment poses a "significant hazard" by any reasonable definition of that term.

J. Significant Reductions in Margins of Safety.

48. Activation of pools C and D will create an additional heat load on the existing CCW system. CP&L proposes to meet this load in the short term by exploiting the margin in the CCW system. In my professional opinion, the reduction in the CCW safety margin caused by the increased heat load is significant. Both the NRC and CP&L have also recognized that increasing the heat load on the CCW system constitutes an unreviewed safety question. The safety margin will be especially reduced if, during a LOCA, the operators must divert water from the RHR to the spent fuel pools. This will increase stress on the operators and create opportunities for human error.

49. As pools C and D become filled and the reactor receives a power uprate, the load on the CCW system will increase further. CP&L offers no assurance that the present margin of safety will be restored by upgrading the CCW system to accommodate these burdens.

50. CP&L proposes to activate pools C and D using cooling systems that will not satisfy ASME code requirements. This action could potentially cause a significant reduction in margins of safety for pool cooling. CP&L's Alternative Plan has not been subjected to any public scrutiny or rigorous review. It deserves, at the least, thorough consideration at a licensing hearing before the license amendment is issued.

51. CP&L proposes to provide electrical service to pools C and D from the existing (Unit 1) electrical system at Harris, having rejected the option of dedicated emergency diesel generators to serve pools C and D. The existing diesel generators already serve the safety systems in Unit 1 and spent fuel storage pools A and B. By adding pools C and D to the load carried by the Unit 1 diesel generators, CP&L would add stress on the diesel generators and on the plant operators. In the event of a loss of offsite power, these effects could significantly reduce the margin of safety at the Harris reactor and the fuel pools.

L. Environmental Review

52. As discussed above, the original design of the Shearon Harris plant called for cooling of spent fuel pools C and D by the Unit 2 CCW system. The FEIS for the operating license presumably based its conclusions on this design. I have seen no analysis by the NRC Staff, either in the 1983 FEIS or in a subsequent Environmental Impact Statement or Environmental Assessment, of the environmental impacts of altering the Shearon Harris design to provide for cooling of pools C and D by the Unit 1 CCW system.

M. Conclusions

53. From the preliminary evidence presented by the NRC and CP&L, I conclude that operation of the Shearon Harris plant in accordance with the license amendment proposed by CP&L will violate all three of the NRC's conditions for a determination of "no significant hazards." Therefore, the NRC staff should reverse its position and should determine that CP&L's license amendment request does not involve no significant hazards consideration.

54. The proposed license amendment raises serious safety concerns which deserve prior consideration at a licensing hearing.

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I declare, under penalty of perjury, that the foregoing facts provided in my Declaration are true and correct to the best of my knowledge and belief, and that the opinions expressed herein are based on my best professional judgment.

Executed on 12 February 1999.

G. R. Thompson

Gordon Thompson

ATTACHMENT A

INSTITUTE FOR RESOURCE AND SECURITY STUDIES

Curriculum Vitae:
GORDON R. THOMPSON

December 1996

Professional expertise

Consulting technical and policy analyst in the fields of energy, environment, sustainable development, and international security.

Education

- Ph.D. in applied mathematics, Oxford University (Balliol College), 1973.
- B.E. in mechanical engineering, University of New South Wales, Sydney, Australia, 1967.
- B.Sc. in mathematics & physics, University of New South Wales, 1966.

Current appointment

- Executive director, Institute for Resource & Security Studies (IRSS), Cambridge, MA.

Project sponsors and tasks (selected)

- Environmental School, Clark University, Worcester, MA, 1996: session leader at the Summer Institute, "Local Perspectives on a Global Environment".
- Nuclear Free Local Authorities, UK, 1996: review of the safety of high level radioactive waste storage at the Sellafield complex.
- Greenpeace Germany, Hamburg, 1995-1996: a study on war, terrorism and nuclear power plants.
- HKH Foundation, New York, and Winston Foundation for World Peace, Washington, DC, 1994-1996: studies and workshops on preventive action and its role in US national security planning.
- Carnegie Corporation of New York, Winston Foundation for World Peace, Washington, DC, and others, 1995: collaboration with the Organization for Security and Cooperation in Europe to facilitate improved coordination of activities and exchange of knowledge in the field of conflict management.
- World Bank, 1993-1994: a study on management of data describing the performance of projects funded by the Global Environment Facility (joint project of IRSS and Clark University).
- International Physicians for the Prevention of Nuclear War, 1993-1994: a study on the international control of weapons-usable fissile material.

- Government of Lower Saxony, Hannover, Germany, 1993: analysis of standards for radioactive waste disposal.
- University of Vienna (using funds supplied by the Austrian government), 1992: review of radioactive waste management at the Dukovany nuclear plant, Czech Republic.
- Sandia National Laboratories, 1992-1993: advice to the US Department of Energy's Office of Foreign Intelligence.
- US Department of Energy and Battelle Pacific Northwest Laboratories, 1991-1992: advice for the Intergovernmental Panel on Climate Change regarding the design of an information system on technologies that can limit greenhouse gas emissions (joint project of IRSS, Clark University and the Center for Strategic and International Studies).
- Winston Foundation for World Peace, Boston, MA, and other funding sources, 1992-1993: development and publication of recommendations for strengthening the International Atomic Energy Agency.
- MacArthur Foundation, Chicago, IL, W. Alton Jones Foundation, Charlottesville, VA, and other funding sources, 1984-1993: policy analysis and public education on a "global approach" to arms control and disarmament.
- Energy Research Foundation, Columbia, SC, and Peace Development Fund, Amherst, MA, 1988-1992: review of the US government's tritium production (for nuclear weapons) and its implications.
- Coalition of Environmental Groups, Toronto, Ontario (using funds supplied by Ontario Hydro under the direction of the Ontario government), 1990-1993: coordination and conduct of analysis and preparation of testimony on accident risk of nuclear power plants.
- Greenpeace International, Amsterdam, Netherlands, 1988-1990: review of probabilistic risk assessment for nuclear power plants.
- Bellerive Foundation, Geneva, Switzerland, 1989-1990: planning for a June 1990 colloquium on disarmament and editing of proceedings.
- Iler Research Institute, Harrow, Ontario, 1989-1990: analysis of regulatory response to boiling-water reactor accident potential.
- Winston Foundation for World Peace, Boston, MA, and other funding sources, 1988-1989: analysis of future options for NATO (joint project of IRSS and the Institute for Peace and International Security).
- Nevada Nuclear Waste Project Office, Carson City, NV (via Clark University, Worcester, MA), 1989-1990: analyses of risk aspects of radioactive waste management and disposal.
- Ontario Nuclear Safety Review (conducted by the Ontario government), Toronto, Ontario, 1987: review of safety aspects of CANDU reactors.
- Washington Department of Ecology, Olympia, WA, 1987: analysis of risk aspects of a proposed radioactive waste repository at Hanford.

- Conduct of research on plasma theory (while a PhD candidate), as an associate staff member, Culham Laboratory, UK Atomic Energy Authority, 1969-1973.
- Service as a design engineer on coal-fired plants, New South Wales Electricity Commission, Sydney, Australia, 1968.

Publications (selected)

- *Safety of the Storage of Liquid High-Level Waste at Sellafield* (with Peter Taylor), Nuclear Free Local Authorities, UK, November 1996.
- *Assembling Evidence on the Effectiveness of Preventive Actions, their Benefits, and their Costs: A Guide for Preparation of Evidence, Version 1.0,* IRSS, Cambridge, MA, August 1996.
- *War, Terrorism and Nuclear Power Plants,* Working Paper No. 165, Peace Research Centre, Australian National University, Canberra, October 1996.
- "The Potential for Cooperation by the OSCE and Non-Governmental Actors on Conflict Management" (with Paula Gutlove), *Helsinki Monitor,* Volume 6 (1995), Number 3.
- "Potential Characteristics of Severe Reactor Accidents at Nuclear Plants", "Monitoring and Modelling Atmospheric Dispersion of Radioactivity Following a Reactor Accident" (with Richard Sclove, Ulrike Fink and Peter Taylor), "Safety Status of Nuclear Reactors and Classification of Emergency Action Levels", and "The Use of Probabilistic Risk Assessment in Emergency Response Planning for Nuclear Power Plant Accidents" (with Robert Goble), in D. Golding, J. X. Kasperson and R. E. Kasperson (eds), *Preparing for Nuclear Power Plant Accidents,* Westview Press, Boulder, CO, 1995.
- *A Data Manager for the Global Environment Facility* (with Robert Goble), Environment Department, The World Bank, June 1994.
- *Preventive Diplomacy and National Security* (with Paula Gutlove), Winston Foundation for World Peace, Washington, DC, May 1994.
- *Opportunities for International Control of Weapons-Usable Fissile Material,* ENWE Paper #1, International Physicians for the Prevention of Nuclear War, Cambridge, MA, January 1994.
- "Article III and IAEA Safeguards", in F. Barnaby and P. Ingram (eds), *Strengthening the Non-Proliferation Regime,* Oxford Research Group, Oxford, UK, December 1993.
- *Risk Implications of Potential New Nuclear Plants in Ontario* (prepared with the help of eight consultants), a report for the Coalition of Environmental Groups, Toronto, submitted to the Ontario Environmental Assessment Board, November 1992 (3 volumes).
- *Strengthening the International Atomic Energy Agency,* Working Paper No. 6, IRSS, Cambridge, MA, September 1992.

- *Design of an Information System on Technologies that can Limit Greenhouse Gas Emissions* (with Robert Goble and F. Scott Bush), Center for Strategic and International Studies, Washington, DC, May 1992.
- *Managing Nuclear Accidents: A Model Emergency Response Plan for Power Plants and Communities* (with six other authors), Westview Press, Boulder, CO, 1992.
- "Let's X-out the K" (with Steven C. Sholly), *Bulletin of the Atomic Scientists*, March 1992, pp 14-15.
- "A Worldwide Programme for Controlling Fissile Material", and "A Global Strategy for Nuclear Arms Control", in F. Barnaby (ed), *Plutonium and Security*, Macmillan Press, UK, 1992.
- *No Restart for K Reactor* (with Steven C. Sholly), Working Paper No. 4, IRSS, Cambridge, MA, October 1991.
- *Regulatory Response to the Potential for Reactor Accidents: The Example of Boiling-Water Reactors*, Working Paper No. 3, IRSS, Cambridge, MA, February 1991.
- *Peace by Piece: New Options for International Arms Control and Disarmament*, Working Paper No. 1, IRSS, Cambridge, MA, January 1991.
- *Developing Practical Measures to Prevent Climate Disruption* (with Robert Goble), CENTED Research Report No. 6, Clark University, Worcester, MA, August 1990.
- "Treaty a Useful Relic", *Bulletin of the Atomic Scientists*, July/August 1990, pp 32-33.
- "Practical Steps for the 1990s", in Sadruddin Aga Khan (ed), *Non-Proliferation in a Disarming World*, Proceedings of the Groupe de Bellerive's 6th International Colloquium, Bellerive Foundation, Geneva, Switzerland, 1990.
- *A Global Approach to Controlling Nuclear Weapons*, Occasional Paper published by the Institute for Resource and Security Studies, October 1989.
- *IAEA Safety Targets and Probabilistic Risk Assessment* (with three other authors), Greenpeace International, Amsterdam, August 1989.
- *New Directions for NATO* (with Paul Walker and Pam Solo), published jointly by IRSS and the Institute for Peace and International Security (both of Cambridge, MA), December 1988.
- "Verifying a Halt to the Nuclear Arms Race", in F. Barnaby (ed), *A Handbook of Verification Procedures*, Macmillan Press, UK, 1990.
- "Verification of a Cutoff in the Production of Fissile Material", in F. Barnaby (ed), *A Handbook of Verification Procedures*, Macmillan Press, UK, 1990.

- "Severe Accident Potential of CANDU Reactors," Consultant's Report in *The Safety of Ontario's Nuclear Power Reactors*, Ontario Nuclear Safety Review, Toronto, February 1988.
- *Nuclear-Free Zones* (edited with David Pitt), Croom Helm Ltd, Beckenham, UK, 1987.
- *Risk Assessment Review For the Socioeconomic Impact Assessment of the Proposed High-Level Nuclear Waste Repository at Hanford Site, Washington* (edited; written with five other authors), prepared for the Washington Department of Ecology, December 1987.
- *The Nuclear Freeze Revisited* (written with Andrew Haines), Nuclear Freeze and Arms Control Research Project, Bristol, UK, November 1986. Variants of the same paper have appeared as Working Paper No. 18, Peace Research Centre, Australian National University, Canberra, February 1987, and in *ADIU Report*, University of Sussex, Brighton, UK, Jan/Feb 1987, pp 6-9.
- *International Nuclear Reactor Hazard Study* (with fifteen other authors), Greenpeace, Hamburg, Federal Republic of Germany (2 volumes), September 1986.
- "What happened at Reactor Four" (the Chernobyl reactor accident), *Bulletin of the Atomic Scientists*, August/September 1986, pp 26-31.
- *The Source Term Debate: A Report by the Union of Concerned Scientists* (with Steven C. Sholly), Union of Concerned Scientists, Cambridge, MA, January 1986.
- "Checks on the spread" (a review of three books on nuclear proliferation), *Nature*, 14 November 1985, pp 127-128.
- Editing of *Perspectives on Proliferation*, Volume I, August 1985, published by the Proliferation Reform Project, IRSS.
- "A Turning Point for the NPT ?", *ADIU Report*, University of Sussex, Brighton, UK, Nov/Dec 1984, pp 1-4.
- "Energy Economics", in J. Dennis (ed), *The Nuclear Almanac*, Addison-Wesley, Reading, MA, 1984.
- "The Genesis of Nuclear Power", in J. Tirman (ed), *The Militarization of High Technology*, Ballinger, Cambridge, MA, 1984.
- *A Second Chance: New Hampshire's Electricity Future as a Model for the Nation* (with Linzee Weld), Union of Concerned Scientists, Cambridge, MA, 1983.
- *Safety and Waste Management Implications of the Sizewell PWR* (prepared with the help of six consultants), a report to the Town & Country Planning Association, London, UK, 1983.
- *Utility-Scale Electrical Storage in the USA: The Prospects of Pumped Hydro, Compressed Air, and Batteries*, Princeton University report PU/CEES #120, 1981.

- *The Prospects for Wind and Wave Power in North America,* Princeton University report PU/CEES # 117, 1981.
- *Hydroelectric Power in the USA: Evolving to Meet New Needs,* Princeton University report PU/CEES # 115, 1981.
- Editing and part authorship of "Potential Accidents & Their Effects", Chapter III of *Report of the Gorleben International Review,* published in German by the Government of Lower Saxony, FRG, 1979--Chapter III available in English from the Political Ecology Research Group, Oxford, UK.
- *A Study of the Consequences to the Public of a Severe Accident at a Commercial FBR located at Kalkar, West Germany,* Political Ecology Research Group report RR-1, 1978.

Expert presentations and testimony (selected)

- Center for Russian Environmental Policy, Moscow, 1996: presentation at a forum in parallel with the G-7 Nuclear Safety Summit.
- Lacey Township Zoning Board, New Jersey, 1995: testimony regarding radioactive waste management.
- Ontario Court of Justice, Toronto, Ontario, 1993: testimony regarding Canada's Nuclear Liability Act.
- Oxford Research Group, seminar on "The Plutonium Legacy", Rhodes House, Oxford, UK, 1993: presentation on nuclear safeguards.
- Defense Nuclear Facilities Safety Board, Washington, DC, 1991: testimony regarding the proposed restart of K-reactor, Savannah River Site.
- Conference to consider amending the Partial Test Ban Treaty, United Nations, New York, 1991: presentation on a global approach to arms control and disarmament.
- US Department of Energy, hearing on draft EIS for new production reactor capacity, Columbia, SC, 1991: presentation on tritium need and implications of tritium production options.
- Society for Risk Analysis, 1990 annual meeting, New Orleans, special session on nuclear emergency planning: presentation on real-time techniques for anticipating emergencies.
- Parliamentarians' Global Action, 11th Annual Parliamentary Forum, United Nations, Geneva, 1990: presentation on the potential for multilateral nuclear arms control.
- Advisory Committee on Nuclear Facility Safety, public meeting, Washington, DC, 1989: submission on public access to information and on government accountability.
- Peace Research Centre, Australian National University, seminar on "Australia and the Fourth NPT Review Conference", Canberra, 1989: proposal of a universal nuclear weapons non-proliferation regime.

- Carnegie Endowment for International Peace, Conference on "Nuclear Non-Proliferation and the Role of Private Organizations", Washington, DC, 1989: options for reform of the non-proliferation regime.
- US Department of Energy, EIS scoping hearing, Columbia, SC, 1988: appropriate scope of an EIS for new production reactor capacity.
- International Physicians for the Prevention of Nuclear War, 6th and 7th Annual Congresses, Koln, FRG, 1986 and Moscow, USSR, 1987: relationships between nuclear power and the threat of nuclear war.
- County Council, Richland County, SC, 1987: implications of severe reactor accidents at the Savannah River Plant.
- Maine Land Use Regulation Commission, 1985: cogeneration potential at facilities of Great Northern Paper Company.
- Interfaith Hearings on Nuclear Issues, Toronto, Ontario, 1984: options for Canada's nuclear trade and Canada's involvement in nuclear arms control.
- Sizewell Public Inquiry, UK, 1984: safety and radioactive waste implications of the proposed Sizewell nuclear plant.
- New Hampshire Public Utilities Commission, 1983: electricity demand and supply options for New Hampshire.
- Atomic Safety & Licensing Board, US Nuclear Regulatory Commission, 1983: use of filtered venting at the Indian Point nuclear plants.
- US National Advisory Committee on Oceans and Atmosphere, 1982: implications of ocean disposal of radioactive waste.
- Environmental & Energy Study Conference, US Congress, 1982: implications of radioactive waste management.

Miscellaneous

- Married, two children.
- Extensive experience in public speaking before professional and lay audiences, and in interviews with print and broadcast journalists.
- Author of numerous newspaper, newsletter, and magazine articles and book reviews.

Contact information

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Harris Spent Fuel Pool 'C' and 'D' Activation

Project Update
July 16, 1998

ATTACHMENT B

CP&L

Background

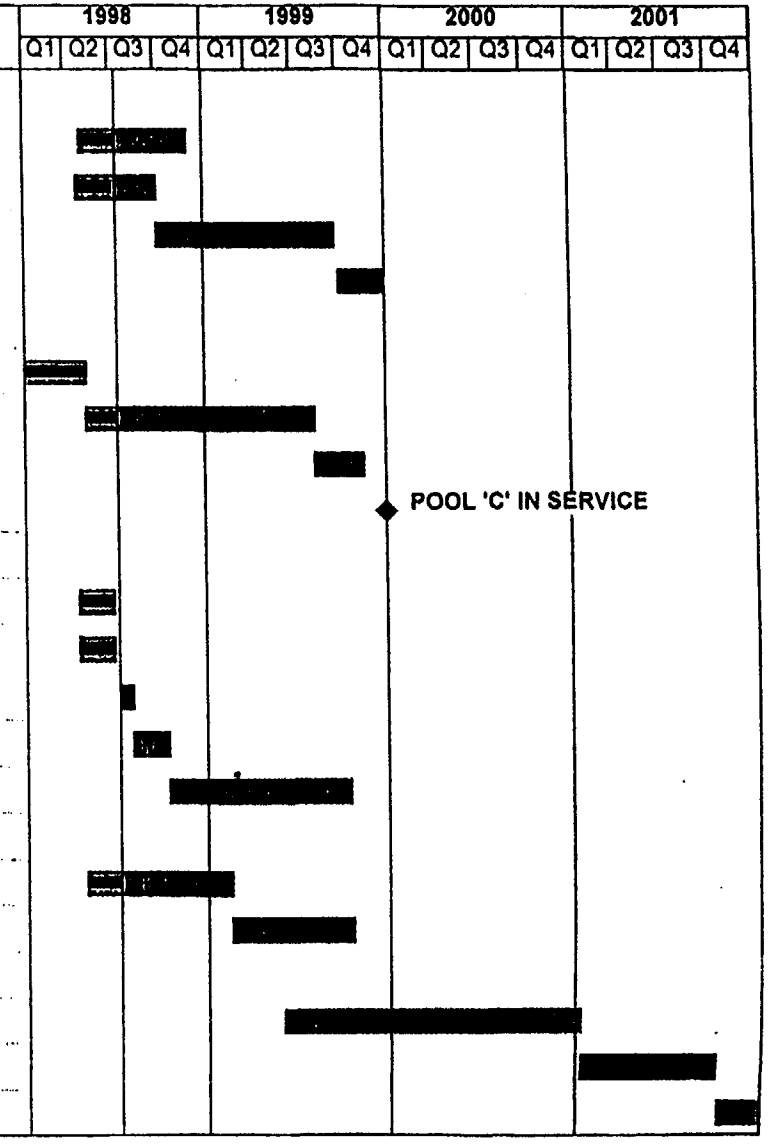
- Original HNP Design
  - Four (4) nuclear units; four (4) fuel pools; two (2) cooling systems
  - Pools 'A' and 'B' to support Units 1 and 4
  - Pools 'C' and 'D' to support Units 2 and 3
  - A separate, fully-redundant, 100% capacity cooling and cleanup system for each set of pools
    - Pool 'C' and 'D' cooling system to be supported by Unit 2 CCW and Unit 2 electrical systems

Background (Continued)

- Units 2, 3 and 4 canceled in early 1980's,
  - All four pools completed
  - Pools 'A' and 'B' placed in service to support HNP Unit 1 and spent fuel shipping from BNP and RNP
  - Cooling system for pools 'C' and 'D' was not completed
    - Construction stopped when unit 2 canceled in 1983
- Plan at time of Unit 1 license was to complete cooling system and place pools 'C' and 'D' in service when necessary
- Fuel Pool 'C' is needed in early 2000 to support spent fuel shipping requirements from BNP and RNP

Schedule

ID	PROJECT	Task Name
1	PHASE 1 COOLING	
2		SFPC DESIGN
3		CCW DESIGN
4		INSTALLATION
5		SYS TEST
6	RACKS	
7		DESIGN/ANALYSIS
8		RACK FABRICATION
9		INSTALL RACKS
10		
11	LICENSING	
12		50.55A
13		T.S. CHANGE
14		NRC MEETING
15		REVISE SUBMITTAL/CCW USQ
16		NRC REVIEW/APPROVE
17	SUPPORT PROJECTS	
18		DESIGN
19		INSTALLATION
21	PHASE 2- CCW UPGRADE	
22		DESIGN
23		INSTALLATION
24		OUTAGE TIE-INS



ATTACHMENT C

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 11, 1998

LICENSEE: CAROLINA POWER AND LIGHT COMPANY

PLANT: SHEARON HARRIS, UNIT 1

SUBJECT: SUMMARY OF MEETING WITH THE CAROLINA POWER AND LIGHT COMPANY (CP&L)

On March 3, 1998, the staff met with representatives of Carolina Power & Light Company (CP&L) to discuss the Shearon Harris Nuclear Power Plant (SHNPP) 'C' and 'D' spent fuel pools activation project. Enclosure 1 is a list of meeting attendees. Enclosure 2 is a copy of the handout provided at the meeting. The CP&L presentation included background information, a discussion of licensing activities, and the project schedule.

Background

Originally, SHNPP was intended to be a four unit site with four fuel pools (A,B,C, and D) and two Fuel Pool Cooling and Cleanup systems (FPCCS). Although three of the four units were canceled, the construction of all four pools and one of the FPCCS was completed. Also, a portion of the piping for the other FPCCS was installed. Currently pools 'A' and 'B' are in service and not only store SHNPP fuel, but also store spent fuel from other CP&L plants (Brunswick Units 1& 2, and Robinson). Pools 'C' and 'D' are not in service.

CP&L has determined that pools 'C' and 'D' will be needed to ensure all four units maintain a prudent operating reserve for core off loads. According to CP&L, pool 'C' is needed by early 2000 to support fuel shipments from Brunswick and Robinson. In order to place pools 'C' and 'D' in service, the FPCCS and pool racking must be completed for pools 'C' and 'D'.

Licensing Activities

CP&L identified three licensing activities associated with the completion of pools 'C' and 'D'. The first is a potential unreviewed safety question (USQ) associated with the modification of the Unit 1 Component Cooling Water (CCW) System. Although the Unit 1 CCW system was not originally designed to cool the FPCCS for pools 'C' and 'D', CP&L has determined that the Unit 1 CCW system has sufficient margin to accept the 'C' and 'D' FPCCS load. The original design was for the Unit 1 CCW to cool the FPCCS for pools 'A' and 'B', and for the Unit 2 CCW system to cool the FPCCS for pools 'C' and 'D'. The staff asked several questions about the spent fuel pool, the FPCCS, and CCW system designs. The staff also inquired about SHNPP fuel handling practices.

The second licensing activity discussed involved piping certification for the 'C' and 'D' FPCCS. A portion of the piping for the 'C' and 'D' FPCCS is already installed, with some embedded in concrete, making approximately 14 field welds inaccessible. CP&L inadvertently disposed of the piping certification records for the installed piping, which makes it unable to demonstrate that the piping satisfies the design requirements of American Society of Mechanical Engineers (ASME) Code Section III. CP&L stated that it intends to request relief from ASME Code Section III. The staff stated that a relief request from the requirements of ASME Code

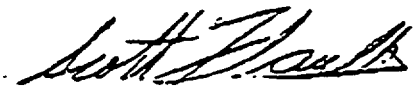
Section III would not be appropriate. The staff recommended that CP&L propose an alternative method, as allowed by 10 CFR 50.55a, that provides an acceptable level of safety and quality. CP&L agreed with the staff's comments and stated that a relief request was not the appropriate terminology for its request. CP&L stated that it intends to propose a piping certification plan, which includes tests and inspections, as an alternative method to the requirements of ASME Code Section III.

CP&L also intends to submit a Technical Specification (TS) change for high density racks in pools 'C' and 'D'. The TS change would modify SHNPP spent fuel capacity.

Schedule

CP&L stated that the TS change and the piping certification plan will be ready for submittal this summer, and the CCW USQ will be ready by fall. Due to the complex nature of this review, the staff recommended that CP&L make one complete submittal that includes all three licensing activities as oppose to three separate submittals. The staff also recommended that CP&L may want to meet with the staff again in the summer to discuss, in more detail, the TS change and the piping certification plan.

CP&L agreed with the staff's recommendations, and intends to submit one amendment encompassing all three licensing activities in the fall. CP&L stated that approval is needed by the end of 1999.



Scott C. Flanders, Project Manager
Project Directorate II-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-400

cc w/enclosures:
See next page

HNP Spent Fuel Pool 'C' and 'D' Activation

Project Status

March 3, 1998

CP&L

Enclosure 2

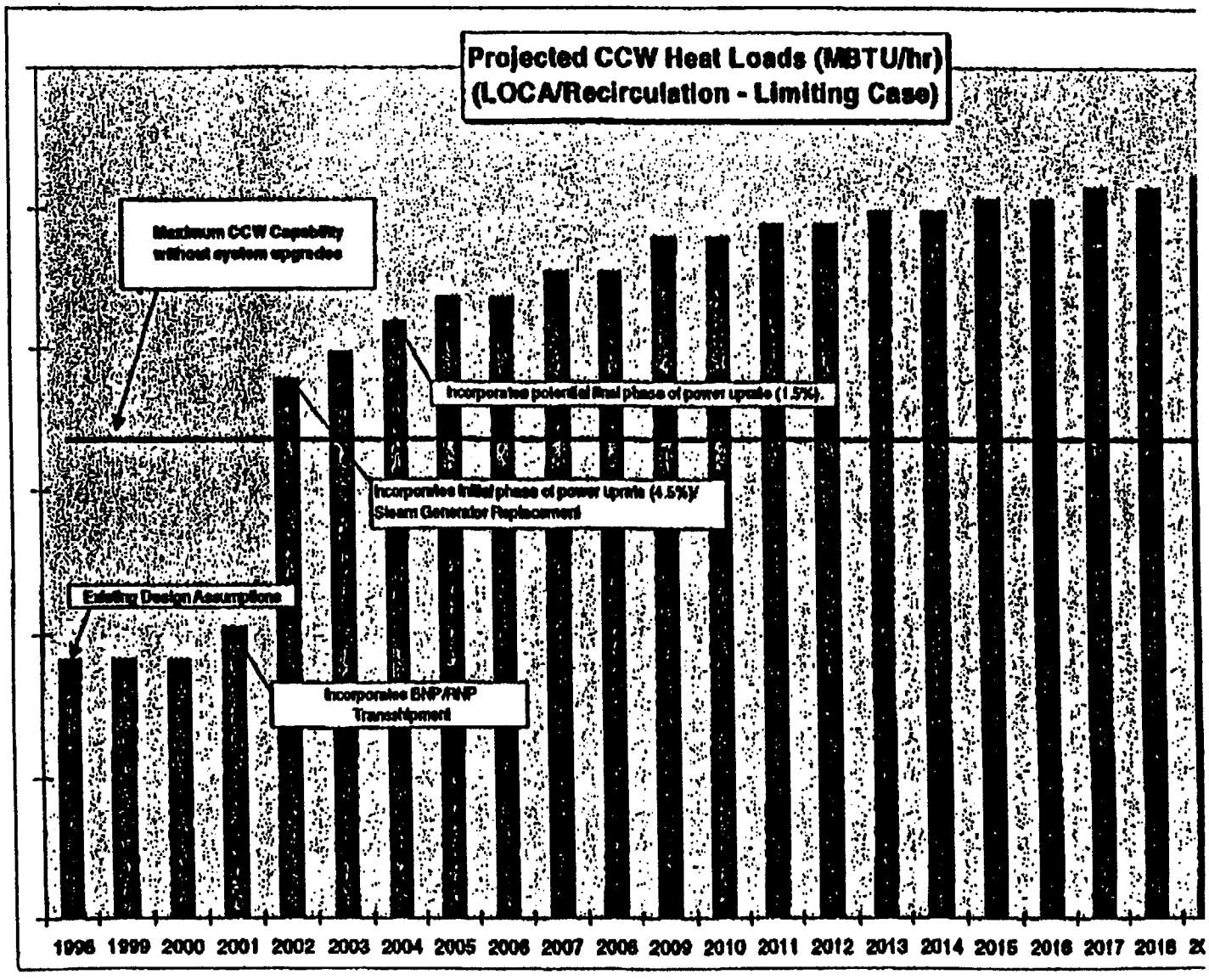
SFP Cooling Options Considered

- Independent Cooling
  - With and without dedicated emergency diesel generators
- Unit 1 Component Cooling Water (CCW)
  - 'As Is' (current design assumptions)
  - CCW with some changes in design assumptions (fouling factors, tube plugging limits, flow rates, IST limits, etc.)
  - CCW with system modifications to improve thermal-hydraulic performance
- Dry storage facilities instead of pools 'C' and 'D'

Cooling System Completion

- Use CCW to provide cooling to fuel pool cooling
  - Phase 1 - Complete fuel pool cooling loop work and tie-ins to CCW (1998-1999)
    - Existing system adequate for near-term operation until power uprate is implemented
  - Phase 2 - Perform CCW system upgrade concurrent with power uprate (1999 - 2001)
    - Final scoping and detailed design/implementation to occur after sufficient power uprate analysis has been completed

Projected CCW Heat Loads



10CFR50.55a Alternative Plan

Project Update
July 16, 1998

CP&L

ATTACHMENT 1

Spent Fuel Storage Facilities - Current Configuration

- Fuel Handling Building completed
  - Embedded piping installed, inspected and tested
  - HVAC system completed
- Unit 1 (South) A and B Spent Fuel Pools and supporting systems completed, operating
- Unit 2 (North) C and D Spent Fuel Pools installed, but supporting systems not completed
  - Spent Fuel Pool Cooling major equipment installed
  - Majority of Spent Fuel Pool Cooling System piping installed
  - Significant portion of CCW piping in Fuel Handling Building installed; but no Unit 2 CCW and RWST available

Completing North Spent Fuel Pool Facilities - ASME Code Compliance

- Partially completed systems were never issued a Partial Data Report
  - No partial N stamp on completed portion of construction
  - Original N Certificate Program no longer maintained
- Field installation records for piping discarded
  - Records purged during document control cleanup effort
  - Includes Code required records for weldments

Conclusion

- Cannot satisfy ASME code requirements in completing North Spent Fuel Pools Cooling Systems using originally constructed portion of piping
- "Alternative Plan" per 10CFR50.55a(3) necessary for completion of construction
  - Requires demonstration of "acceptable level of quality and safety" or hardship without compensating increase in quality and safety

ATTACHMENT E

NUREG/CR-0649
SAND77-1371
R-3

SPENT FUEL HEATUP FOLLOWING LOSS OF WATER DURING STORAGE

Allan S. Benjamin
David J. McCloskey
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Date Published: March 1979

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Washington, DC 20555
Under Interagency Agreement DOE 40-550-75
NRC FIN No. A2050

5. OTHER CONSIDERATIONS

5.1 Effect of Incomplete Drainage

Many spent fuel holder designs provide only a single inlet hole for convective flow through each fuel element, located in the baseplate or near the bottom of the holder. If there is a complete pool drainage, the air must circulate down and under the fuel elements before passing through the baseplate inlet hole into the fuel assembly. An incomplete drainage could block this flow and reduce the effectiveness of natural convective cooling. Open frame configurations are, of course, exempt from this possibility because the flow does not have to pass through an inlet hole in order to gain proximity to the fuel element.

A detailed analysis of spent fuel heatup in the event of an incomplete drainage has not been undertaken. However, an approximate analysis has been performed to estimate the amount of aggravation that might occur if the water ceased to drain after exposing all but the bottom portion of the fuel elements. The analysis is included in Appendix B and is based, among other things, upon upper and lower bound estimates of the thermal radiation absorbed by the water from the hot fuel rods above. The temperature distribution along the rods is prescribed in this analysis according to estimates made of the likely distribution that would occur just prior to the onset of self-sustaining clad oxidation. The amount of heat produced above the water level is then determined together with the amount that could be removed by various mechanisms, including water boiling (latent heat), convection to the steam produced

by boiling (sensible heat), radiation to the building, and convection to the air. If the heat removal rate is determined to be larger than the rate of production, then the configuration is coolable; if the heat removal rate is smaller than the rate of production, overheating resulting in clad rupture or melting will occur.

The results for a 1-year decay time are presented in Table VIII. Consider first the case where the drainage uncovers the upper 80 percent of the fuel rods, leaving the lower 20 percent still covered (third column). The heat transferred to the remaining water by decay from the immersed portions and by radiation from above is 3.6 - 4.9 KW per assembly (line 2c). This implies that about an hour might be required to raise the water temperature to boiling (assuming all the assemblies produce the same decay heat) and that the water recession rate following the inception of boiling will be about 10 cm/h (lines 3 and 4). Meanwhile, the decay heat produced above the water line is about 4.5 KW per assembly (line 5), and the capability for removing heat as the clad temperatures approach the lower limit of self-sustaining oxidation is 5.7 - 8.7 KW per assembly (line 6e). Since the heat removal capability exceeds the heat production (line 7), the geometry is temporarily coolable.

If, however, the drainage were to uncover the whole length of the rods but still to constrict the flow, either by blocking the baseplate holes or by not allowing enough space for unrestricted flow in the base region, then the heat production would exceed the heat removal capability (line 7, first column) and the clad would overheat. The same situation would eventually occur if, rather than immediately draining to this position, the water were to drain part way down the rods and then boil off down to the baseplates over a period of time. Table VIII indicates that there is a good chance of overheating, in

Table VIII.

Estimates of Heat Removal Capability in an Incompletely Drained Pool, One Year Decay Time*

1.	Normalized water level (z_w/L)	0.0	0.1	0.2
2.	Heat transferred to water, per assembly (KW):			
	a. by decay heat	0.0	0.2	0.6
	b. by thermal radiation from above	0.3 - 1.3	1.2 - 2.6	3.0 - 4.3
	c. total	0.3 - 1.3	1.4 - 2.8	3.6 - 4.9
3.	Time to start boiling (hours)	1.0 - 4.3	0.9 - 1.8	0.7 - 1.0
4.	Water surface recession rate (cm/hr)	0.7 - 3.2	3.5 - 7.0	9.0 -12.2
5.	Decay heat produced by spent fuel above water level, per assembly (KW)	5.1	4.9	4.5
6.	Removal of heat produced by spent fuel above water level, per assembly (KW):			
	a. by radiation to water	0.3 - 1.3	1.2 - 2.6	3.0 - 4.3
	b. by radiation to building	0.0 - 0.9	0.0 - 0.9	0.0 - 0.9
	c. by transfer to water vapor	0.2 - 0.8	0.9 - 1.8	2.3 - 3.1
	d. by transfer to air	0.4	0.4	0.4
	e. total	0.9 - 3.4	2.5 - 5.7	5.7 - 8.7
7.	Heat removal surplus (deficit) per assembly (KW), line 6e minus line 5.	(4.2)-(1.7)	(2.4)-0.8	1.2 - 4.2

* PWR spent fuel in cylindrical baskets. One year decay time assumed, uniformly throughout pool. Numerical ranges (e.g., 0.3 - 1.3) give lower and upper-bound estimates. See Appendix B.

fact, if the water were to recede below the level where the lower 10% of the rods is still immersed.

A comparison of the peak clad temperature rise versus time for PWR spent fuel with a 1-year minimum decay time in a well-ventilated room is shown in Figure 26. The temperature rise corresponding to an incomplete drainage down to the bottom of the rods, calculated by utilizing the lower-bound radiation estimate, is compared with previous cases for a complete drainage with varying baseplate hole sizes. The clad oxidation effect has not been calculated for the case of incomplete drainage (blocked inlets), because it is believed to be substantially reduced by the unavailability of oxygen within the assembly. Clearly, a 1-year minimum decay time is not sufficient to preclude overheating for this case.

The approximate method used for bracketing the thermal radiation downward to the water and upward to the building is not considered to be precise enough to allow prediction of the minimum allowable decay time in the event of an incomplete drainage. This problem could be approached by formulating a detailed thermal radiation model to calculate shape factors and include the shadowing of radiating surfaces by fuel rods and tie plates. By incorporating this radiation capability into the overall heat transfer models described in Sections 3.3 and 3.4, a credible prediction of the minimum allowable decay time could be obtained. No attempt to do this, however, has been made.

It is clear, however, that an incomplete drainage can potentially cause a more severe heatup problem than a complete drainage, if the residual water level remains near the baseplates. From a practical point of view, it might be possible to make provisions for either completing the drainage or refilling the pool, if this should happen. However, it would

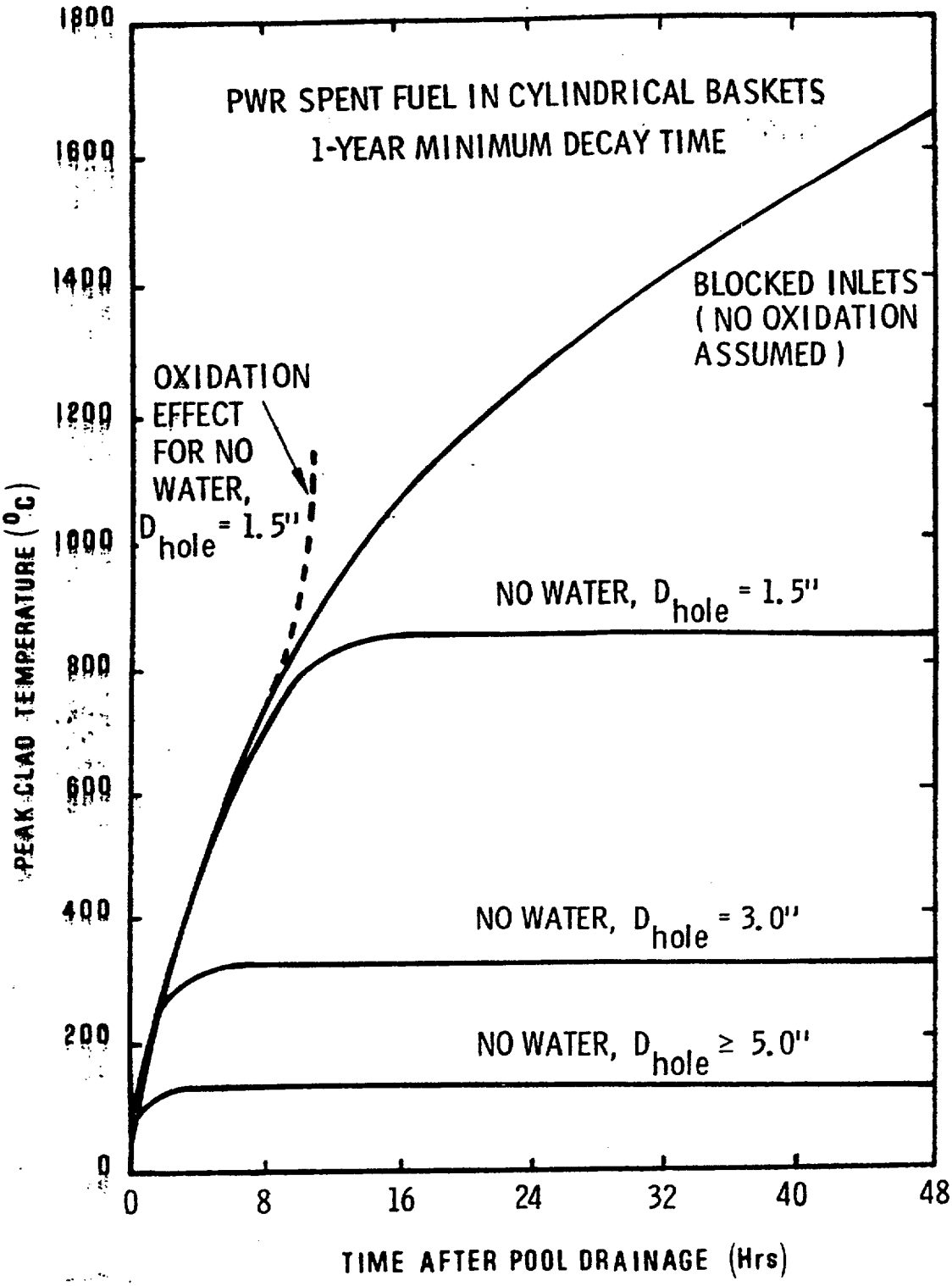

Figure 26. Estimated Heatup of PWR Spent Fuel With Residual Water Sufficient to Block Flow Inlets, Well-Ventilated Room

seem that the special problems associated with an incomplete drainage could best be circumvented by modifying the spent fuel holders to include inlet holes at various elevations along the vertical, rather than just at the baseplate level. According to the predictions, these inlet holes would only be required for the bottom 20 percent of the fuel rod length if the spent fuel were at least a year old. With these additional inlets, the beneficial effect of natural convection would not be cancelled by an incomplete drainage.

5.2 Effect of Surface Crud

Iron oxides are known to deposit upon the outside of the fuel pins during normal operation of the reactor, and these deposits are likely to remain on the fuel pins during storage of the spent fuel. Typically, the iron oxide crud buildup on BWR fuel pins is on the order of 25 to 100 microns and in the form of Fe_2O_3, whereas the buildup on PWR pins is on the order of only 1 to 5 microns and in the form of Fe_3O_4.[16] A calculation was made to determine whether a 100 micron Fe_2O_3 coating on the BWR fuel pins would affect the heatup of these pins during a pool drainage accident, and it was found that the overall effect on the fuel pin temperature was less than one degree.

The question was also raised as to whether some of the crud, which would be contaminated, could be levitated by the air flows produced by natural convection after a pool drainage and thereby produce a health hazard. An analysis of the weight and drag characteristics of iron oxide particles revealed that a BWR fuel assembly having a decay time of 90 days prior to loss of water can produce upward air currents sufficient to levitate a 200-micron sized particle, whereas an assembly allowed to decay for 250 days can levitate a 175-micron sized particle. Since any spallation of the crud would produce particles of roughly the same size as the thickness of the

ATTACHMENT F

UNION OF
CONCERNED
SCIENTISTS

January 22, 1999

Chairman Shirley A. Jackson
Commissioner Nils J. Diaz
Commissioner Greta J. Dicus
Commissioner Edward McGaffigan, Jr.
Commissioner Jeffrey S. Merrifield
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: CURRENT EXAMPLE OF RISK-DEFORMED REGULATION

Dear Chairman and Commissioners:

During the January 11th Commission briefing on risk-informed regulation and during the January 20th briefing on the proposed reactor oversight process, I expressed our concern that the NRC and the nuclear industry are making risk decisions using incomplete and inaccurate data. As a current example, I call your attention to the license amendment application dated December 23, 1998, by the Carolina Power & Light Company involving spent fuel storage at the Harris Nuclear Power Plant and the subsequent proposed no significant hazards consideration determination (*Federal Register*: January 13, 1999, Vol. 64, No. 8) prepared by the NRC staff.

The licensee and the NRC staff have improperly downplayed the risk associated with the proposed activity. Their risk characterization is wrong. The licensee should be required to resubmit a corrected application and another *Federal Register* notice issued with a corrected proposed no significant hazards consideration determination.

The error involves the determination made by the licensee and endorsed by the staff regarding the affect of the proposed activity, namely placing storage racks in Spent Fuel Pools 'C' and 'D' at the Harris plant, on the probability of a fuel handling accident. From the *Federal Register* notice:

> "The probability that any of the accidents in the above list [a spent fuel assembly drop in a spent fuel pool / loss of spent fuel pool cooling flow / a seismic event / misloaded fuel assembly] can occur is not significantly affected by the activity itself. ... The probabilities of accidental fuel assembly drops or misloadings are primarily influenced by the methods used to lift and move these loads. The method of handling loads during normal plant operations is not signficantly changed, since the same equipment (i.e., Spent Fuel Handling Machine and tools) and procedures as those in current use in pools 'A' and 'B' will be used in pools 'C' and 'D.' Since the methods used to move loads during normal operations remain nearly the same as those used previously, there is no significant increase in the probability of an accident."

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It is precisely this type of "smoke and mirrors" shenanigans that we decried during the briefings. The logic seems proper at face value, but it does not take much effort to show that it is wrong. In Enclosure 1 to the license amendment submittal, the licensee reported that the total storage capacity of pools 'A' and 'B' is 3,669 assemblies and that the proposed activity will add 4,715 storage locations in pools 'C' and 'D.' Thus, if the amendment is granted, CP&L will handle – pick up and move – about twice as many irradiated fuel assemblies as they will if the amendment is not granted.

Consider for a moment the old game of Russian roulette using a six-chamber revolver loaded with a single bullet. CP&L and the NRC staff would apparently conclude that the probability of losing the game are not increased whether one or two turns are taken because, after all, the same method and the same equipment are used each turn. Their logic is simply wrong. The probability of a fuel handling accident at Harris will nearly ***double*** if the license amendment request is granted. This material fact contradicts the conclusion of the licensee and the staff that there will be "no significant increase in the probability," unless doubling the risk is not significant.

Luckily, there's an opportunity to fix the mistake this time. Unfortunately, it's not the first, and probably won't be the last, time this mistake is made. The NRC staff made this same mistake in April 1998 when it allowed the Paducah facility to continue operating with its risk doubled.

We have no intention at this time of formally intervening in this Harris licensing action. We trust that the NRC staff will take the necessary steps to have the licensee fix the fundamental flaw in the licensing amendment request before granting it.

Sincerely,

David A. Lochbaum
Nuclear Safety Engineer