

• **From:** George Hubbard *NRR*
To: Charles Tinkler, Jason Schaperow, Ralph Caruso
Date: Fri, Mar 31, 2000 8:50 AM
Subject: Fwd: Harris filings re: relevance of Decommissioning study

Input to the Harris hearing board on the activation of pools SFPs C and D. Input is on the relevance of our draft SFP decommissioning report on the intervenor's contentions. The intervenor's comments are of interest in the thermal hydraulics area and consequence area. Thought you would like to be aware of the comments.

Jerry and Raph, Joe Staudenmeier has a copy.

George Hubbard
2870

m/84

From: Richard Laufer *NRR*
To: Christopher Gratton, George Hubbard, Glenn Kelly...
Date: Thu, Mar 30, 2000 9:46 AM
Subject: Harris filings re: relevance of Decommissioning study

The attached files contain the Licensee's, the Intervenor's, and the NRC's March 29th responses to the ASLB request to address the relevancy of the staff's Decommissioning study to the Harris spent fuel pool expansion case.

The parties now have an opportunity to reply to any other parties response by April 5.

Please look at the attached filings from the licensee and intervenor (the intervenor's in particular) and provide Susan Uttal with any comments you have which may be used in our April 5 response. Susan would like any comments by COB Friday, if possible, if not by noon on Monday.

The TAC number for efforts relating to the Harris Hearing is MA5151.

Thanks,
Rich Laufer
415-1373

CC: Richard Correia, Susan Uttal

March 29, 2000

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF RESPONSE TO THE ATOMIC SAFETY AND LICENSING
BOARD'S REQUEST FOR ADDITIONAL INFORMATION

I. INTRODUCTION

On March 21, 2000, the Atomic Safety and Licensing Board's (Board) issued a Memorandum and Order (Requesting Additional Information), seeking the parties' views on the relevance, if any, of the Nuclear Regulatory Commission staff's (Staff) "Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" (Feb. 2000) (Study), to the issues pending before the Board concerning the Board of Commissioners of Orange County's (BCOC) motion requesting the admission of late-filed contentions.¹ As more fully discussed below, the Study is not directly relevant to the issues before the Board.

¹ The Staff notes that BCOC's experts were well aware of the pendency of the Study. Gordon Thompson filed comments on the Initial Draft Study published for comment in June of 1999. David Lochbaum participated in meetings regarding the Study and received a copy of the Study by letter dated February 15, 2000.

II. DISCUSSION

The issue before the Board is whether BCOC has submitted admissible contentions pursuant to NRC regulations and case law. As argued in the "NRC Staff Response to Intervenor's Request for Admission of Late-Filed Contentions" (Staff Response) (March 3, 2000), BCOC has not submitted an admissible contention. The contentions proffered do not meet the standards for admission in an NRC proceeding. See Staff Response at 4, *et seq.* Nothing contained in the Study alters that conclusion. As discussed below, the Study is not directly relevant to the issues pending before the Board, and is, at most, tangentially relevant to the instant proceeding, in that it involves spent fuel pools, albeit in a decommissioning status.²

The Study analyzes and discusses SFP accident risk at decommissioning plants, and states:

Prior to the staff's preliminary risk assessment, the most extensive work on spent fuel pool risk was in support of Generic Issue (GI) 82, "Beyond Design Basis Accidents for Spent Fuel Pools," [NUREG-1353]. This report assessed the SFP risk for operating reactors and concluded that a seismic event was the dominant initiating event for the loss of inventory.

While the staff drew from the GI 82 work in its assessment, it was concluded that because of the significant differences between operating and decommissioning plant spent fuel pool cooling systems, a complete assessment of SFP risk at decommissioning plants should be conducted, considering all potentially significant initiators, and reflecting the unique features found in a shutdown facility.

Study at 10 (citations omitted). The Study did not take issue with the conclusions reached in NUREG-1353. It addressed NUREG-1353 and other studies, and found that they remain valid.

While the focus of this report is the risk associated with wet storage of spent fuel during decommissioning, the staff was alert to any implications on the storage of spent fuel during power operation. With regard to power operation, the resolution of Generic Issue (GI) 82, "Beyond Design Basis Accidents for Spent Fuel Pools," and other studies of operating reactor spent fuel pools concluded that existing

² It should be noted that the Study has been issued as a draft, for comment.

requirements for operating reactor spent fuel pools are sufficient.

Study at 22-23.

Thus, the Study was limited to decommissioning plants³ and did not change the conclusions in the reports dealing with SFPs at operating reactors. The findings and conclusions in those studies, including NUREG-1353, remain valid for spent fuel pool risk for operating plants. Moreover, the Study does not add anything to the issues already raised and argued in the prior pleadings of the parties.⁴

There is nothing in the Study that supports BCOC's assertion that its postulated scenario is probable, and is not remote and speculative for the Harris spent fuel pools. In fact, the Study does not address the postulated scenario because the Study does not address SFP accident risks at operating plants. The Study does demonstrate that the probability of a SFP accident at a decommissioning plant is very low. Study at 3, 16. *See also* Study at 18-19.

The Study, while dealing with SFPs at decommissioning plants, also demonstrates that BCOC's assertion that spent fuel that has decayed for as much as nine years is vulnerable to exothermic reactions is remote and speculative. The Staff determined that five years was the bounding age for susceptibility to exothermic reactions in SFPs at decommissioning plants for the sequences studied, and stated that site specific studies would be required to utilize lesser time periods. Study at A1-9. As the fuel ages, the susceptibility decreases, so that after five years the risk of a zirconium fire is remote. Study at 2. Nothing in the Study alters the fact that the event BCOC postulates has not been shown to be credible for the Harris SFPs.

³ The reason stated for undertaking the Study was to improve the regulatory framework applicable to decommissioning plants. *See* Study at 4.

⁴ *See* "Orange County's Request for Admission of Late-Filed Contentions" (January 29, 2000); "Applicant's Response to BCOC's Late-Filed Environmental Contentions" (March 3, 2000); Staff Response; "Orange County's Reply to Applicant's and Staff's Oppositions to Request for Admission of Late-Filed Environmental Contentions" (March 13, 2000).

The Study does not address the occurrence of BCOC's postulated event: degraded core accident with containment bypass or failure, causing inaccessibility to the SFP building, complete loss of SFP cooling for an extended period of time causing the SFP coolant to heat up to the boiling point and then boil down, again over an extended period of time⁵ and finally, a self-perpetuating exothermic reaction in SFPs C and D. BCOC did not meet its burden to demonstrate that there is a credible basis for its postulated accident scenario and nothing in the Study suggests that the postulated scenario is anything but remote.

CONCLUSION

The findings and conclusions of the Study are limited to SFP accident risks at decommissioning plants and are not material to the issues before the Board. The technical findings which may have some relevancy to the instant matter do not provide support or basis for BCOC's late-filed contentions. There is no material information, not previously addressed in the prior studies or the pleadings previously submitted by the parties, that provides a basis for BCOC's proposed contentions. Thus, the Study is not directly relevant or material to the issues before the Board.

Respectfully submitted,

Susan L. Uttal
Counsel for NRC staff

Dated at Rockville, Maryland
this 29th day of March 2000.

⁵ The Study noted that events leading to an exothermic reaction provide for a long response time. Study at 2 .

March 29, 2000

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

**APPLICANT'S RESPONSE TO BOARD'S REQUEST REGARDING RELEVANCE OF
STAFF'S DRAFT FINAL TECHNICAL STUDY OF SPENT FUEL POOL ACCIDENT
RISK AT DECOMMISSIONING PLANTS**

Pursuant to the Licensing Board's March 21, 2000 Memorandum and Order (Requesting Additional Information), Applicant Carolina Power & Light Company ("CP&L" or "Applicant") files this response providing its view on the relevance, if any, of the NRC Staff's February 15, 2000 "Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Plants" ("Decommissioning Study" or "Study") to the admissibility of the January 31, 2000 late-filed environmental contentions of the Board of Commissioners of Orange County ("BCOC"). Because the Decommissioning Study does not relate to the reactor driven accident scenario that BCOC proffers as the basis for its late-filed contentions, the Study is generally irrelevant to the issues before the Board.

The NRC Staff released its Decommissioning Study in draft final form for public comment on February 15, 2000.¹ Decommissioning Study, Cover Letter at 1. The availability of the Decommissioning Study for public comment was formally noticed in the Federal Register on February 22, 2000. 65 Fed. Reg. 8,752 (2000). On March 21, 2000, the Board requested the

¹ The Decommissioning Study is a revised version of the preliminary draft study that was released for public review and comment last June, 1999. See Memorandum dated June 16, 1999 from G. Holahan (NRC/NRR) to J. Zwolinski (NRC/NRR) re: Preliminary Draft Technical Study of Spent Fuel Pool Accidents for Decommissioning Plants; see also Decommissioning Study at 5.

parties to this proceeding to provide their views on the relevance of the Decommissioning Study to the issues before the Board. Applicant addresses the Board's inquiry in terms of the issues currently before the Board, the admissibility of BCOC's four late-filed environmental contentions.²

The Decommissioning Study is not relevant to the admissibility of BCOC's late-filed environmental contentions because it does not address the accident scenario that forms the basis for BCOC's contentions. BCOC's accident scenario is "a 'degraded core' reactor accident" followed by "containment failure or bypass" followed by "extreme radiation doses precluding personnel access," which ultimately leads to loss of spent fuel pool water inventory. Orange County's Reply to Applicant's and Staff's Oppositions to Request for Admission of Late-Filed Environmental Contentions at 8 (March 13, 2000) ("BCOC's Reply to Applicant's and Staff's Responses). In contrast, the Decommissioning Study only addresses permanently shut down and defueled reactors, and therefore sheds no light on reactor accident-driven scenarios.³ The Study states that "the risks from a decommissioning plant are very different from an operating plant" after "fuel is permanently removed from the reactor vessel." Decommissioning Study at 9. Therefore, while the Study does address the issue of hypothetical zirconium oxidation reactions, it explicitly does not include reactor accident-driven scenarios of the type put forward by BCOC as the basis for its contentions. Because the conclusions of the Decommissioning Study do not derive from BCOC's operating reactor-driven accident scenario, it is not relevant to admissibility

² In addition, this Decommissioning Study has little bearing on the two technical contentions (Contentions TC-2 and TC-3) currently pending before the Board for decision pursuant to Subpart K of 10 C.F.R. Part 2. Nothing in the Study undermines or changes anything that Applicant has submitted to the Board in its Subpart K filing and oral argument concerning Contentions TC-2 and TC-3. The Study addresses neither 10 C.F.R. § 50.55a nor General Design Criterion 62. One potentially applicable point is the Study's conclusion that "qualitative risk insights demonstrate conclusively that SFP [Spent Fuel Pool] criticality poses no meaningful risk to the public," which further reinforces both Applicant's and Staff's position on the merits resolution of Contention TC-2. Decommissioning Study at 28 (emphasis added). While this provides further support for Applicant's and Staff's position on Contention TC-2, the Board already has sufficient information on the record to make a decision in the Applicant's favor on Contention TC-2, and need not rely on this further reinforcement of Applicant's position.

³ The Decommissioning Study addresses accident risks "[a]fter a nuclear power plant permanently shuts down and the reactor is defueled." 65 Fed. Reg. at 8,752.

of the contentions, and for that reason the Study was not addressed in Applicant's March 3, 2000 response to BCOC's late-filed contentions. See Applicant's Response to BCOC's Late-Filed Environmental Contentions ("Applicant's Response"). For the same reason, the Decommissioning Study need not be considered by this Board.

While not relevant to BCOC's "degraded core" reactor accident scenario, the Decommissioning Study does make several points on other issues that further reinforce the Applicant's position regarding rejection of BCOC's late-filed environmental contentions. These points may be helpful to the Board in making its decision on admissibility of the late-filed contentions.

The Decommissioning Study concludes that many make-up sources are available, from both on-site and off-site sources, to provide make-up water to offset a loss of spent fuel pool water due to evaporation. In addition to a plant's existing make-up systems, the Study notes that make-up water is available from other on-site systems, such as the plant's firewater system ("firewater pumps"), as well as off-site systems, including "fire engine[s]," "the local fire department," or "use of a fire brigade." Decommissioning Study at 12, 18-19. The Study notes that these additional on-site and off-site make-up sources, over and above the numerous pool make-up systems already available, can themselves provide the amount of water necessary to supplement "the small losses due to evaporation." Id. at 12. While the make-up sources identified in the Study are generic, and not Harris-specific, they do demonstrate that, as a general matter, several redundant, alternative means are available to provide make-up water to spent fuel pools. Numerous Harris-specific make-up water sources are identified in Applicant's March 3, 2000 response to BCOC's late-filed contentions. Applicant's Response at 12. As Applicant noted in its March 3, 2000 response, BCOC completely fails to address the numerous on-site and off-site make-up systems available at Harris to add water to the spent fuel pools, and therefore lacks the requisite basis with specificity for an admissible contention. See Applicant's Response at 12-13. The Decommissioning Study further underscores BCOC's failure to address the numerous on-site and off-site sources available to provide make-up water to the spent fuel pools

to offset a loss of water due to evaporation, and further reinforces the lack of basis for BCOC's alleged accident scenario at Harris.

Again consistent with Applicant's position, the Decommissioning Study concludes that "a lot of time [is] available" to take the recovery actions necessary to offset a loss of pool water due to evaporation. Decommissioning Study at 18. Applicant's Response points out that, even using BCOC's analysis, about four months would be available at Harris to offset any loss of water due to evaporation. Applicant's Response at 13-14. The Decommissioning Study also notes that the ability to take timely action is further aided by the many indications of loss of pool cooling that are available to operators, including "control room alarms and indicators, local temperature measurements, and eventually increasing area temperature and humidity and low pool water level from boil-off." Decommissioning Study at 18. BCOC has failed to provide a credible scenario wherein Harris operations would be unable to restore any of the numerous make-up water supply systems to the Harris spent fuel pools at any time during the four month period following a reactor accident.

On the subject of sabotage and plant physical security, the Decommissioning Study reiterates the essential Commission conclusion that the accident risk from sabotage cannot be quantified. Decommissioning Study at 35. Applicant's Response showed that BCOC's sabotage contention must be rejected under governing Commission NEPA case law, which holds that "the risk of sabotage is simply not yet amenable to a degree of quantification that could be meaningfully used in the [NEPA] decisionmaking process." Applicant's Response at 19 (citing Philadelphia Electric Co. (Limerick Generating Station, Units 1 and 2), ALAB-819, 22 NRC 681, 701 (1985); Comm'n rev. denied, 23 NRC 125 (1986), aff'd Limerick Ecology Action v. NRC, 869 F.2d 719, 742 (3rd Cir. 1989)). On this same subject of sabotage risk, the Decommissioning Study also concludes that "PRA analyses in general, do not include events due to sabotage. No established method exists for estimating the likelihood of a sabotage event." Decommissioning Study 35. Thus, the Study confirms the Commission's position regarding analysis of sabotage risks, and confirms Applicant's position that BCOC's sabotage contention

must be rejected.

Though it only addresses permanently shut down, defueled reactors, the Decommissioning Study demonstrates that the Staff is aware of the accident risks associated with a postulated zirconium fire in a spent fuel pool. The Staff's continued analysis and understanding of these accident risks inform the Staff's evaluation of hypothetical severe accidents, including "a zirconium cladding fire," in the Environmental Assessment ("EA") for the subject license amendment, and its subsequent conclusion in the EA that "the potential for environmental impact from severe accidents is negligible." 64 Fed. Reg. 71,514, 71,515 (1999). BCOC's assertion that the Staff was unaware of "new information [that] has become available regarding the risks of storing spent fuel in pools" over the past 20 years is simply inconsistent with the Staff's analysis in the Decommissioning Study. The Study demonstrates that the Staff was well informed of spent fuel pool accident risks, including a hypothetical "zirconium cladding fire" accident, when the Staff stated its EA conclusions regarding accident risks for the Harris license amendment application.

In summary, as a general matter the Decommissioning Study is not relevant to the "degraded core" reactor accident scenario postulated by BCOC and therefore provides no support for BCOC's contentions. The Study does provide some further support for several of Applicant's positions opposing admission of the contentions, but there is sufficient reason to reject all four of BCOC's environmental contentions based on the parties' filings to date, without any need for support from the Decommissioning Study.

Respectfully submitted,

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Dated: March 29, 2000

March 29, 2000

UNITED STATES OF AMERICA
 NUCLEAR REGULATORY COMMISSION
 BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

**ORANGE COUNTY'S RESPONSE TO
 BOARD'S INFORMATION REQUEST**

Introduction

Pursuant to the Board's Memorandum and Order (Requesting Additional Information) (March 21, 2000), Orange County hereby submits its views regarding the relevance of a recent NRC Staff draft study to the environmental issues raised by Orange County in this proceeding. The study, NRC Staff's Draft Final Technical Study of Spent Fuel Accident Risk at Decommissioning Plants ("Draft Study"), was noticed at 65 Fed. Reg. 8,752 (February 22, 2000). This response is supported by the Declaration of Dr. Gordon Thompson in Support of Orange County's Response to Board's Information Request (March 24, 2000), which is attached as Exhibit 1.

As discussed below, the Draft Study has limited relevance to the County's environmental contentions, but supports those contentions in important respects. The Draft Study narrowly focuses on the evaluation of spent fuel pool accidents that could occur during decommissioning, after a nuclear reactor has ceased operating. In contrast, the County's concerns relate to the accident risk when fuel pools -- specifically, Harris pools C and D -- operate in close proximity

2

to an operating reactor and other fuel pools. Moreover, the Draft Study's analysis of the risks of spent fuel pool drain-down accidents is seriously deficient, principally because it ignores the phenomena associated with partial exposure of fuel assemblies. By ignoring these phenomena, the Draft Study significantly underestimates the overall risks of spent fuel pool accidents.

Despite its limitations, the Draft Study confirms the County's position in several key respects. First, the Study confirms that the consequences of a spent fuel pool accident could be catastrophic, causing significant and long-term health and environmental damage over a huge geographic area. Second, it is clear from the Draft Study that there are key aspects of spent fuel pool accident behavior that have yet to be properly investigated. This lack of complete information precludes any confident assertion that the risk of a spent fuel pool accident is too remote to warrant close investigation in an Environmental Impact Statement ("EIS"). Third, the Draft Study acknowledges the availability of an alternative that would completely avoid the risk of a fuel pool accident: dry cask storage. Although there may be disagreement regarding the likelihood of a spent fuel pool accident, it is sheer folly to ignore an alternative that would completely eliminate the risk of such a massive catastrophe.

DISCUSSION

A. Draft Study's Scope Gives It Limited Relevance

The Draft Study has limited relevance to the environmental contentions raised by Orange County, because it addresses the risks of spent fuel pool accidents in a plant that is being decommissioned, *i.e.*, where the reactor has been permanently shut down. Thus, the Draft Study does not address several features of an operating nuclear power plant that are relevant to the evaluation of risk at Harris.

3

First, the Draft Study does not address the relationship between degraded-core reactor accidents and the potential for severe accidents in fuel pools. An accident scenario of concern to Orange County involves a degraded-core reactor accident followed by a period during which the plant is inaccessible due to high radiation levels. As discussed in Contention EC-1 at pages 8-9, loss of water from the spent fuel pools by evaporation is virtually inevitable under these circumstances. During the process of evaporation, there will be a period when the fuel assemblies are partially exposed. There is a high probability that partial or total exposure of the fuel assemblies will lead to a runaway exothermic reaction (fire) in the pools.

Second, although the Draft Study gives some attention to the potential for propagation of exothermic reactions from "younger" fuel to "older" fuel, it does not make a thorough study of the accident risks at an operating plant, where a significant supply of younger fuel is always present.¹

Third, although the Draft Study discusses some scenarios for criticality accidents, it does not address the risk of a criticality accident that arises from the placement of low-burnup fuel assemblies in a pool where the licensee relies on credit for burnup to prevent criticality. This class of event may be the most significant contributor to the risk of a criticality accident at the Harris plant. Thus, the Draft Study's conclusion that the risk of a criticality accident is "sufficiently small" (*see* page A3-1) does not take into consideration key characteristics of the Harris nuclear power plant.

B. The Draft Study Is Flawed.

¹ Here "younger" and "older" refers to the age of spent fuel after its discharge from a reactor.

The Draft Study has significant inadequacies with respect to the comprehensiveness of its treatment of a subject it purports to evaluate, *i.e.*, the risk of zirconium fires in decommissioning nuclear power plants. Most significantly, the Draft Study completely overlooks the implications of partial drainage of a pool. This omission is illogical, given that a state of partial drainage would always occur *before* a state of total drainage, and must be considered as an inevitable link in the chain of events involving loss of water from a spent fuel pool. The state of partial drainage should be examined thoroughly because it has different characteristics than a state of total drainage: (1) older fuel is more vulnerable to ignition in a state of partial drainage than in a state of total drainage, because convective heat transfer is suppressed by the presence of residual water at the base of the fuel assemblies (*see* Thompson Report at page D-6); (2) partial drainage will lead to a steam-zirconium reaction rather than the air-zirconium reaction that will occur following total drainage (*see id.* at page D-6.); and (3) a steam-zirconium reaction during partial drainage will produce hydrogen gas which could reach explosive concentrations in the atmosphere of the fuel handling building, potentially leading to a breach in that building (*see id.* at page D-1).

The County notes that its expert, Dr. Gordon Thompson, commented on the lack of a discussion of partial drain-down in an earlier version of the Draft Study that was issued in the summer of 1999. *See* letter from Gordon Thompson to Richard F. Dudley (September 30, 1999), attached as Exhibit 2. The Draft Study does not directly respond to Dr. Thompson's letter, but mentions the raising of the partial drain-down issue by an un-named stakeholder. *Id.* at page A7-3. The Draft Study also claims to have addressed the partial drain-down issue as follows:

The staff has also considered a scenario with a rapid partial draindown to a level at or below the top of active fuel with a slow boiloff of water after the draindown. This could occur if a large breach (sic) occurred in the liner at or below the top of active fuel.

5

Section 5.1 of NUREG/CR-0649 analyzes the partial draindown problem. For the worst case draindown and a lower bound approximation for heat transfer to the water and the building the heatup time slightly less than the heatup time for the corresponding air cooled case. More accurate modeling could extend the heatup time to be comparable to or longer than the air cooled case.

Id. at page A1-9. In fact, NUREG/CR-0649 constitutes the *only* report in which the NRC Staff has ever looked at the issue of partial drainage. As discussed in the Thompson Report at pages D-7 and D-8, NUREG/CR-0649 is deficient in its treatment of the partial drainage case, but nevertheless supports Dr. Thompson's concerns.

NUREG/CR-0649 used a crude heat transfer model. It did not analyze radiative heat transfer along the axis of a fuel assembly. Therefore, it could not estimate the maximum cladding temperature, which would occur in the mid-height region of the exposed portion of the fuel rods. Also, it did not consider the steam-zirconium reaction, or address the potential for propagation of exothermic reactions to nearby assemblies. Finally, it assumed a larger center-center distance (13 inches) than would exist for PWR fuel in Harris pools C and D (9 inches). Nevertheless, NUREG/CR-0649 clearly shows that a state of partial drainage would be more conducive to the initiation of a runaway exothermic reaction than a state of total drainage. Correction of the analytic deficiencies in NUREG/CR-0649 would make this effect even more prominent.

The Draft Study is also inadequate with respect to its discussion of spent fuel pool accident consequences. The Draft Study acknowledges that zirconium fires in spent fuel pools can have very severe consequences because they may involve releases from multiple reactor cores. *See id.* at 2, 3, 6. However, the Draft Study implies that the consequences of a spent fuel pool accident would ultimately be less than those of a reactor accident because there would be a

6

long lead time to initiate and implement protective responses, including offsite responses such as evacuation and relocation of populations.² *Id.* at 30. This suggestion that the consequences of a spent fuel pool accident can be resolved by a leisurely evacuation ignores the fact that the consequences of a severe fuel pool accident include long-term contamination of a very large land area. The Draft Study completely sidesteps the question of where all the people who are relocated will be able to go for the decades that must pass while the land where they live recovers from radioactive contamination. This issue is graphically illustrated by the consequences of the Chernobyl accident, which rendered huge land areas uninhabitable and unsuitable for agriculture for an extended period of time.

In addition, the Staff does not explain the regulatory basis for its assumption of a threshold dose for relocation of 4 rem over a period of 5 years. Draft Study at A4-6. The Reactor Safety Study used, for rural areas, a lower threshold of 10 rem over a period of 30 years. *See* Thompson Report at page E-3. Dose rates at either level would produce a significant increase in cancer mortality in exposed populations. *See* Thompson Report at page E-5. Finally, the Draft Study fails entirely to address the social and economic implications of losing the use of thousands of square kilometers of land for several generations.

C. The Draft Study Acknowledges Significant Information Gaps.

There are a number of significant areas in which the Draft Study concedes that the NRC Staff lacks complete information regarding the risks of severe spent fuel pool accidents. Among

² It is important to note that an assumption in the Draft Study -- namely that there is plenty of time for response measures following a loss of cooling to a spent fuel pool at a decommissioned nuclear plant -- would not be valid for in-plant response measures at an operating nuclear plant if a degraded-core reactor accident, with containment failure or bypass, were to occur. The high radiation fields that would immediately follow this event would preclude the implementation of in-plant response measures such as supplying water makeup to fuel pools.

7

the more stunning of these admissions is the Staff's statement that it "has not performed a sufficient amount of research to fully understand and predict the propagation of zirconium fires in a spent fuel pool." *Id.* at A1-9. Other similar admissions regarding significant information gaps abound. *See, e.g.*, Draft Study at A1-1 (lack of any realistic evaluation of melting and relocation of aluminum or aluminum/boron carbide eutectic); A1-4 (SHARP code used to calculate critical decay times "not significantly benchmarked, validated or verified"); A1-4 ("[m]any assumptions and modeling deficiencies exist in the current calculations" regarding spent fuel heatup); A1-5 (calculations performed "to date" assume that building, fuel and rack geometry remain intact, which may not be valid after the onset of zirconium oxidation); A1-5 (effects that inhibit air flow are not adequately modeled by available studies); A1-6 (important assumptions about air flow mixing are suspect); A3-1 (due to "processes involved and lack of data," it was "not possible to perform a quantitative risk assessment for criticality in the spent fuel pool").

Given the number, range and significance of the areas in which the Staff's understanding of spent fuel pool accidents is admittedly incomplete, spent fuel pool accidents cannot justifiably be ruled out as remote and speculative events. These uncertainties and information gaps further demonstrate, in addition to the information provided in the County's contentions, that there are material factual disputed issues regarding the likelihood of a spent fuel pool accident. These disputed issues demand thorough examination in the context of a hearing.

D. Despite Its Limitations, the Draft Study Supports the County's Position in Important Respects

Despite its limited relevance and analytical inadequacies, the Draft Study does support the County's position in some significant respects. First, the Study acknowledges that "the

consequences of a zirconium fire in a decommissioning plant can be very large.”³ *Id.* at 2. It also acknowledges that zirconium fires in spent fuel pools “potentially have more severe long term consequences than an operating reactor core damage accident, because there may be multiple cores involved, and because there is no containment surrounding the SFP to mitigate the consequences.” *Id.* at 6.

The Draft Study confirms that the relationship between the age of fuel and the likelihood of a zirconium fire, given a loss of water, must be examined on a “case specific basis,” and finds that the decay time required to preclude ignition may be as long as five years. *Id.* at 2. This estimate is for total drainage. For the same situation, Dr. Thompson makes an interim estimate of 3 years for Harris pools C and D. In this instance he is less conservative than the NRC Staff.

In addition, the Draft Study supports the County’s concern regarding the potential for propagation of exothermic reactions from younger to older fuel.⁴ *See* Draft Study at A1-1, Thompson Report at D-7. The Draft Study also shows that an increase in temperature of the atmosphere in the fuel handling building will increase the age at which fuel will ignite following pool drainage. This is a mechanism whereby a fire in Harris pools A and B could make the ignition of fuel in pools C and D more likely. *Id.* at A1-3. These effects call into question the NRC Staff’s argument in opposition to the admission of Contention EC-1 that aged fuel is not

³ For instance, the Draft Study confirms that the consequences of a fuel pool accident could include thousands of cancer fatalities. For example, Table A4-7 indicates that about 26 thousand cancer fatalities, within a 500-mile radius, could be attributed to a hypothetical fuel pool accident at a generic site.

⁴ The Draft Study notes that the propagation of a fire from younger to older fuel may occur not only by direct heat transfer, but also as a result of flow blockage caused by a loss of structural integrity in boral plates or racks. In this regard, it is notable that the Draft Study admits the lack of any “realistic evaluation of melting and relocation of aluminum or aluminum/boron carbide eutectic.” Draft Study at A1-1.

9

subject to exothermic reaction. *See* NRC Staff's Response to Intervenors' Request for Admission of Late-Filed Environmental Contentions at 22 (March 3, 2000).

Finally, and perhaps most importantly, the Draft Study acknowledges that the use of dry cask storage largely eliminates the risk of a zirconium fire, "by limiting the maximum fuel cladding temperature and minimizing the oxygen available." *Id.* at 2, note 1. Given the significant admitted uncertainties and information gaps in the NRC Staff's understanding of spent fuel pool accidents, given the relationship between degraded reactor core accidents and spent fuel pool drain-down events that is demonstrated in the Thompson Report, and given the potentially catastrophic consequences of a severe spent fuel pool accident, there is no rational justification for refusing to consider the dry cask storage alternative in the context of an Environmental Impact Statement.

CONCLUSION

As discussed above, the Draft Study has significant limitations and deficiencies that prevent it from being relied on for the purpose of dismissing Orange County's environmental contentions. In some significant respects however, it confirms Orange County's concerns and supports the admissibility of the County's contentions.

Respectfully submitted,

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10

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