UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	**)**	
	)	
EXELON GENERATION COMPANY, LLC	**)**	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station, Units 1 and 2)	**)**	
		November 22, 2011

(License Renewal Application)

NATURAL RESOURCES DEFENSE COUNCIL
PETITION TO INTERVENE AND
NOTICE OF INTENTION TO PARTICIPATE

PRELIMINARY STATEMENT

The Natural Resources Defense Council ("NRDC") respectfully submits this petition to intervene in the Nuclear Regulatory Commission ("NRC") relicensing proceeding that will determine the future of the two Limerick nuclear power reactors, located in Limerick, Pennsylvania. The Limerick Generating Station, Units 1 and 2 ("LGS"), have 13 years and 18 years, respectively, of operation remaining on their initial 40 year operating licenses. However, in the initial 27 and 22 years of operation, a lot of changes have occurred that bear directly on whether, when these licenses expire, Exelon Generating Company, LLC ("Exelon"), the current owner of Limerick, should be licensed to continue to operate the reactors for an additional 20 years. In addition, between now and when the current licenses will expire, significant changes are likely to occur that bear directly on the wisdom of allowing further operation of two reactors that will have reached 40 years of age and that may require substantial additional safety measures to qualify for an additional 20 years of operation.

The following Contentions allege that Exelon has failed to conduct a legally adequate environmental analysis because 1) it fails to properly identify and evaluate all new information and ignores or distorts the significance of this new information; 2) the 1989 Supplemental FES upon which it relies to meet its obligation to evaluate severe accident mitigation alternatives is deficient in several significant ways; 3) the 1989 Supplemental FES does not qualify as a legally sufficient severe accident mitigation alternatives analysis within the meaning of 10 C.F.R. § 51.53(c)(3)(ii)(L); and 4) it fails to properly evaluate the alternatives of "No Action" and compare its consequences with those of the proposed action.

In its Environmental Report, Exelon acknowledges some of the new information that bears on the current application. License Renewal Application ("LRA"), Appendix E, Environmental Report ("ER") at 5-4 to 5-9. Exelon focuses on new information that it concedes is directly relevant to a previous analysis conducted by NRC Staff in 1989 which was called a "severe accident mitigation design alternatives ("SAMDA") analysis. The ER, §§ 4.20 and 5.3, incorporates and adopts the NRC Staff's SAMDA analysis as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick. *See* NUREG-0974 Supplement, Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2 Docket Nos. 50-352 and 50-353 Philadelphia Electric Company (August 1989) ("SAMDA"). The SAMDA was prepared as the result of a successful court challenge by a previous intervenor, Limerick Ecology Action ("LEA"). *Limerick Ecology Action, Inc. v. NRC,* 869 F.2d 719 (3rd Cir. 1989). Because of a settlement between LEA and the then owner of Limerick (*see Philadelphia Electric Company* (Limerick Generating Station, Units 1 and 2), LBP-89-24, 30 N.R.C. 152 (1989)) the final SAMDAs analysis issued by NRC Staff was never

evaluated for accuracy, completeness or compliance with the requirements of the National Environmental Policy Act ("NEPA") by the ASLB, the Commission or a federal court. Exelon now relies on that SAMDA analysis, unmodified, to meet its NRC regulatory obligation to fully consider alternatives to the proposed action. *See* 10 C.F.R. §§ 51.45(c), 51.53(c)(2) and 51.53(c)(3)(iii).

Exelon is also required to consider any "new and significant" information that may alter previous environmental conclusions. 10 C.F.R. § 51.53(c)(3)(iv). In its analysis of new and significant information Exelon ignores several additional pieces of new information that bear directly on the previously conducted SAMDA analysis and it dismisses as insignificant the new information it does acknowledge exists without providing a defensible basis for its conclusions. When the full extent of the new and significant information is included, it demonstrates that the SAMDA analysis upon which Exelon relies is inadequate and fails to fulfill its obligations under NRC regulations to fully develop, evaluate and weigh alternatives to the proposed action that would result in mitigating the consequences of a severe accident.

In addition, Exelon fails to fully and properly evaluate the No Action alternative. Exelon ignores the reasonably foreseeable outcome that in the next 13-18 years substantial changes in available electricity system resources may reduce any putative adverse impacts from denying renewed licenses for Limerick. The ER impermissibly restricts its detailed consideration of the possible consequences of license denial to an analysis of new generating capacity. The type of analysis required for appropriate consideration of the environmental consequences of the No Action alternative is substantially different from that used in the ER to evaluate a specific generation alternative.

Limerick presents a major risk to the environment and its extended operation demands the most scrupulous and exacting review by NRC. The facility is sited within a 50 mile radius of nearly 10 million people, including all of Philadelphia, Pennsylvania, Camden and Trenton, New Jersey and Wilmington, Delaware, and on the banks of the Schulykill River, one of Pennsylvania's major scenic rivers, supplying both drinking water and recreation and flowing through the center of Philadelphia, where it becomes the largest tributary of the Delaware River, and eventually flowing into one of the richest water resources in America, the Chesapeake Bay. Exelon's ER fails to provide the basis for that review. Absent substantial improvements by Exelon made as a result of NRC Staff insisting on compliance with NRC regulations, NRC Staff will itself be saddled with carrying out a thorough and accurate review of alternatives to mitigate severe accidents and to properly evaluate the No Action alternative in order to complete the required supplemental environmental impact statement.

STANDING

NRDC is a national non-profit environmental organization with offices in Washington, D.C., New York City, San Francisco, Chicago, Santa Monica, and Beijing. NRDC has a nationwide membership of over 350,000 (plus hundreds of thousands of online activists), including 15,787 members in Pennsylvania, at least 2,894 members living within 50 miles of LGS and approximately 62 members living within 10 miles of the facility. Declaration of Linda Lopez at 4, Nov. 17, 2011. Among its missions, NRDC seeks to maintain and enhance environmental quality, to safeguard the natural world for present and future generations, and to foster the fundamental right of all people to have a voice in the decisions that affect their environment. *Id*. at 5. Since its inception in 1970, NRDC has sought to improve the

environmental, health, and safety conditions at the nuclear facilities operated by the Department of Energy and the civil nuclear facilities licensed by the NRC and their predecessor agencies. Id. at 6. To that end, NRDC utilizes its institutional resources, including legislative advocacy, litigation, and public outreach and education, to minimize the risks that nuclear facilities pose to its members and to the general public. *Id*.

Under the AEA, the Commission must grant a hearing on a license application upon "the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding." 42 U.S.C. § 2239(a)(1)(A). To that end, a petitioner must provide the Commission with information regarding "(1) the nature of the petitioner's right under the governing statutes to be made a party; (2) the nature of the petitioner's property, financial, or other interest in the proceeding; and (3) the possible effect of any decision or order on the petitioner's interest." *Entergy Nuclear Vermont Yankee, L.L.C., and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), 60 N.R.C. 548, 552 (2004) *(citing* 10 C.F.R. § 2.309(d)(1)). "The NRC generally uses judicial concepts of standing in interpreting this regulation." *Entergy Nuclear Vermont Yankee*, 60 N.R.C. at 552. Thus, a petitioner may intervene if it can specify facts showing "that (1) it has suffered or will suffer a distinct and palpable harm constituting injury-in-fact within the zone of interests arguably protected by the governing statutes, (2) the injury is fairly traceable to the action being challenged, and (3) the injury will likely be redressed by a favorable determination." *Id*. at 552-53. In determining whether a petitioner has met the requirements for establishing standing, this Board "construe[s] the petition in favor of the petitioner." *Id*. at 553.

Member organizations such as NRDC may intervene on behalf of their members if they

can "demonstrate that the licensing action will affect at least one of [their] members, . . . identify that member by name and address, and . . . show that [they are] authorized by that member to request a hearing on his or her behalf." *Id*. NRDC members Mr. Charles W. Elliott, Ms. Suzanne Day, and Mr. William White all reside within 50 miles of the LGS and all describe the economic, aesthetic, and environmental interests they wish to safeguard and the harms that the relicensing of LGS without full compliance with the law will pose to those interests. *See*, Declarations of Mr. Charles W. Elliott, Ms. Suzanne Day, and Mr. William White (collectively referenced "NRDC members," and individually referenced by "____ Decl.at __."). The November 22, 2011 Declaration of Drs. Cochran, McKinzie and Weaver ("NRDC Expert Decl.") and the November 22, 2011 Declaration of Christopher E. Paine ("Paine Expert Decl.") affirm the scientific basis for NRDC members' concerns. *See* Attachments 5 and 6 to this Notice and Petition. All of these NRDC's members support this Petition, and have authorized NRDC to intervene in this proceeding and request a hearing on their behalf. *See*, Elliott Decl. at 13, Day Decl. at 10, and White Decl. at 11.

Mr. Charles W. Elliott lives at 604 Cattell Street, in Easton, Northampton County, Pennsylvania, approximately 38 miles from the LGS. Elliott Decl. at 3, 4. Mr. Elliott has been a NRDC member since 1981. *Id*. at 2. One of the reasons Mr. Elliott describes for joining NRDC so long ago was because of his concerns about nuclear energy and the risks of nuclear power reactor accidents following the Three Mile Island accident in 1979. *Id.* Mr. Elliott is personally familiar with LGS in his capacity as counsel for the citizen organization Limerick Ecology Action, Inc., in the original operating license proceedings for Limerick Units 1 and 2 before the NRC and in the petition for review in the related appeal proceedings before the U.S. Court of

Appeals for the Third Circuit. *Id*. at 5, *see also, Limerick Ecology Action v. U.S. NRC*, 869 F.2d 719 (3rd. Cir. 1989). While involved in the prior Limerick proceeding, Mr. Elliott physically toured the facility with members of the Atomic Safety and Licensing Board and other parties during construction, reviewed licensing documents and other material related to safety issues and severe accident risks posed by the Limerick facility, and consulted with experts in nuclear safety and risk assessment concerning the risks of operation of LGS. *Id*. In particular, one of his areas of special concern was to ensure that the Limerick facility ultimately be required to employ cost-effective, state of the art measures to prevent and to mitigate the risks of severe accidents as part of the licensing process. *Id*. Mr. Elliott, who remains unconvinced that the Limerick facility is as safe as it reasonably could be, also notes that the region where he lives has become increasingly populated and urbanized since the time of the original licensing of the facility. *Id*. at 6, 7. Mr. Elliott states that the Lehigh Valley Planning Commission projects significantly increased population growth through 2030. *Id.* at 7. Thus, Mr. Elliott, an informed individual, is concerned that in the event of a severe accident, travel in his area may be impaired, "particularly where the severity, dynamics and consequences of a nuclear reactor accident can be unclear, fast-moving and unpredictable and in light of the fact that nuclear reactor accidents can cause spontaneous and voluntary evacuations for distances of 100 miles or more." *Id*. (citations omitted). And finally, Mr. Elliott is concerned to understand that as part of this relicensing the LGS has not produced an updated study of severe accident consequences at the facility and ways to prevent such an accident and to mitigate its consequences. *Id.* at 9.

Ms. Suzanne Day resides at 3 Taylors Lane in Cinnaminson, New Jersey, an organic family farm that borders the Delaware River, from the windows of her farm she can see the

intake system for the public water supply for three counties, and is 35 miles downwind from the LGS. Day Decl. at 2, 3. Ms. Day has been a NRDC member for approximately 20 years. *Id*. Ms. Day expresses concern that there could be a serious accident at the facility and radiation from the nuclear power plants or that the stored nuclear waste could harm her family, the public health of her community, and the surrounding environment in Pennsylvania and New Jersey. *Id* at 5. Specifically, Ms. Day notes that the "Delaware Valley has grown in population and land use … our roadways are choked routinely just on ordinary weekdays." *Id*. at 7. The failure of the LGS to update its SAMA analysis or the NRC to require such an updated analysis concern her and, if LGS is allowed to operate an additional 20 years past its current license, she would "like to be sure that… they are using the most up to date equipment and strategies to prevent a nuclear accident, to mitigate against bad environmental consequences, and to plan evacuations that would be feasible." *Id*.

Mr. William White lives at 135 Pennsylvania Avenue in Bryn Mawr, Pennsylvania, has been a NRDC member for nearly 40 years. White Decl. at 2,3. His home is approximately 30 miles from the LGS and he is concerned for the potential for an aging nuclear facility to accidently cause leakages of radioactivity. *Id.* at 4. Specifically, he notes that as part of this relicensing he is aware that "the LGS has not produced an updated study of severe accident consequences and ways to prevent such an accident and to mitigate its consequences." *Id*. at 8. Mr. White notes that the area surrounding LGS has changed a great deal since the time LGS performed an analysis of a severe accident, "especially along the Route 422 corridor, with more people and businesses locating there annually." *Id*. The failure of LGS to produce updated studies and plans concerns him and, like the other NRDC standing members, wants to be sure

that if the LGS reactors are allowed to operate for an additional 20 years, they use "the most up-to-date equipment and strategies to prevent a nuclear accident and to mitigate against its environmental consequences." *Id*.

Petitioners' experts discuss in their declarations the inadequacies in the applicant's analysis of potential adverse environmental consequences of LGS relicensing, including inadequate analysis of the consequences of a severe accident. These inadequacies impact NRDC members' right to a complete and accurate assessment of the costs and benefits of the proposed action and alternatives to the proposed action.

As NRDC members explain, they will suffer (or will be under threat of suffering) concrete and particularized injuries from the continued operations of LGS operations without adequate analysis of severe accident mitigation alternatives.[1] Petitioners' experts confirm the science behind these concerns: if LGS is not relicensed, the potential harms will not occur; and even if LGS is relicensed, the potential adverse consequences of a severe accident can be substantially mitigated if cost beneficial mitigation measures are identified and implemented. LGS may not continue operations without a license from the Commission. 42 U.S.C. §2133. Accordingly, LGS and the NRC will have caused these injuries if the proposed new operating license is issued as currently proposed.

By granting Petitioners the relief they request and rejecting LGS's relicensing application or requiring that a SAMA analysis be performed, NRDC's members will obtain redress for their injuries, since the reactor operations will continue beyond the term of their current license or

[1] So long as a Petitioner falls within the zone of interests protected by the statute, and alleges harm that is "concrete and particularized," rather than "conjectural" or "hypothetical," the "requisite injury may either be actual *or threatened*." *Crow Butte Res., Inc*. (License Amendment for the North Trend Expansion), 67 N.R.C. 241, 271 (2008) (emphasis added).

such a renewed license, if issued, will benefit from a properly conducted SAMA analysis. Even if LGS chooses to revise its ER to provide a legally sufficient SAMA analysis, NRDC members will still have obtained redress: NEPA, in its implementing regulation at 10 C.F.R. Part 51 and 10 C.F.R. Part 2, accord procedural rights to those such as NRDC members whose concrete interests may be harmed by the project. By requiring LGS and the NRC staff to comply with these authorities' requirements, our members' procedural rights will have been vindicated. *See Lujan v. Defenders of Wildlife*, 504 U.S. 555, 572 n.7 (1992) ("[P]rocedural rights are special: The person who has been accorded a procedural right to protect his concrete interests can assert that right without meeting all the normal standards for redressability and immediacy.") (internal quotations omitted); *see also Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1 (July 23, 2002) at 10, emphasizing the NEPA obligation to fully develop the record with regard to any SAMA analysis is required "to ensure that the agency does not act upon incomplete information, only to regret its decision after it is too late to correct."

Finally, our members have expressed concerns that fall within the zone of interests protected by NEPA and its implementing regulations. *See, e.g., Ouachita Watch League v. Jacobs*, 463 F.3d 1163, 1173 (11th Cir. 2006) ("[S]ince the injury alleged is environmental, it falls within the zone of interests protected by NEPA . . . ."); *Sabine River Auth. v. U.S. Dep't of Interior*, 951 F.2d 669, 675 (5th Cir. 1992) (plaintiffs' concerns about impacts on water quality and quantity fell within NEPA's zone of interests). Their concerns also fall within the zone of interests protected by the AEA and its implementing regulations. *Sequoyah Fuels Corp. and General Atomics* (Gore, Oklahoma Site), 39 N.R.C. 54, 75 (1994) (membership organization

granted standing by showing that "the health and safety interests of its members are within the AEA-protected zone of interests"); *Babcock and Wilcox* (Apollo, Pennsylvania Fuel Fabrication Facility), 37 N.R.C. 72, 80 (1993) (holding that specified "health, safety, and environmental concerns . . . clearly come within the zone of interests safeguarded by the AEA and NEPA").

NRDC members therefore have standing to intervene in their own right: they have met the requirements for injury-in-fact, causation, and redressability, and their concerns fall within the zone of interests protected by NEPA, the AEA, and their implementing regulations. They will be affected by LGS's proposed relicensing and failure to provide a legally adequate SAMA analysis, have provided their names and addresses, and have authorized NRDC, of which they are members, to intervene in this proceeding on their behalf. Thus, Petitioners have standing to pursue this action. *Entergy Nuclear Vermont Yankee*, 60 N.R.C. at 553.

NOTICE OF INTENT TO PARTICIPATE

Pursuant to 10 C.F.R. § 2.309 and the Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF–39 and NPF–85 for an Additional 20-Year Period, Exelon Generation Company, LLC, Limerick Generating Station (76 Fed. Reg. 52992, Aug.24, 2011), Petitioner NRDC hereby submits contentions regarding Exelon's application for renewal of its licenses to operate Limerick Units 1 and 2 for an additional 20 years, or until 2044 and 2049, respectively. As demonstrated below, these contentions should be admitted because they satisfy the NRC's admissibility requirements in 10 C.F.R. § 2.309.[2]

As noted above, several members of NRDC live within 50 miles of the Limerick reactors,

[2] By Order of the Commission dated October 17, 2011, the time for filing a Petition to Intervene by NRDC was extended to November 22, 2011.

have authorized NRDC to represent their interests in environmental protection in this proceeding and, thus, pursuant to 10 C.F.R. § 2.309(d)(1), NRDC has standing for purposes of raising its concerns in this proceeding.

PETITION TO INTERVENE

I. APPLICABLE LEGAL STANDARDS

A. Standards of Admissibility

Proffered contentions must put "other parties in the proceeding on notice of the petitioners' specific grievances" in order to "give [] them a good idea of the claims they will be either supporting or opposing." *Duke Energy Corp.*, (Oconee Nuclear Station, Units 1, 2 and 3) 49 NRC 328, 333 (1999). Accordingly, in order to ensure "a clearer and more focused record for decision," 69 Fed. Reg. 2182, 2202 (Jan. 14, 2004), an admissible contention will provide (1) a specific statement of the legal or factual issue proposed; (2) a brief explanation of its basis; (3) a demonstration that the issue is within the scope of the proceeding; (4) a demonstration that the issue is material to the findings the NRC must make to support the action involved in the proceeding; (5) a concise statement of the alleged facts or expert opinions, including references to specific sources and documents that support the petitioners' position and upon which the petitioner intends to rely at hearing; and (6) sufficient information to show that a genuine dispute exists with regard to a material issue of law or fact, including references to specific portions of the application that the petitioner disputes or, when the application is alleged to be deficient, the identification of such deficiencies and supporting reasons for this belief. *See* 10 C.F.R. § 2.309(f).

The contention rule has not become a "fortress to deny intervention" despite its 1989

fortification. *Duke Energy Corp.* (Oconee Nuclear Power Plant), 49 NRC at 335 (*quoting Philadelphia Elec. Co.* (Peach Bottom Atomic Power Sta., Units 2 and 3), 8 AEC 13, 20-21 (1974), *rev'd in part*, CLI-74-32, 8 AEC 217 (1974), *rev'd in part*, *York Committee for a Safe Environment v. N.R.C.*, 527 F.2d 812 (D.C. Cir. 1975)). Indeed, "[t]he Commission and its Boards regularly continue to admit for litigation and hearing contentions that are material and supported by reasonably specific factual and legal allegations." *Duke Energy*, 49 NRC at 333. Nor have more recent revisions materially changed the admissibility standard for contentions. *PPL Susquehanna, LLC*, 65 NRC 281, 303 (2007). *See also Entergy Nuclear Operations, Inc.*, LBP-03-08, 68 N.R.C. 43, 60 *et. seq.* (2008).

Although an intervenor cannot use discovery or cross-examination as a "fishing expedition" in hopes of turning up supporting facts, there is also no requirement that the substantive case be made at the contention stage. *Entergy Nuclear Generation Co. et al.* (Pilgrim Nuclear Power Station), ASLB Oct. 16, 2006, 2006 WL 4801142 at slip op. 85 (*quoting Oconee*, 49 NRC at 342)).

> The Commission has also, however, explained that the requirement at § 2.309(f)(1)(v) "does not call upon the intervenor to make its case at [the contention] stage of the proceeding, but rather to indicate what facts or expert opinions, be it one fact or opinion or many, of which it is aware at that point in time which provide the basis for its contention. A petitioner does not have to provide a complete or final list of its experts or evidence or prove the merits of its contention at the admissibility stage. And, as with a summary disposition motion, the support for a contention may be viewed in a light that is favorable to the petitioner so long as the admissibility requirements are found to have been met. The requirement "generally is fulfilled when the sponsor of an otherwise acceptable contention provides a brief recitation of the factors underlying the contention or references to documents and texts that provide such reasons.

Id. at 84 (*quotations and citations omitted*). "A contention may be plausible enough to meet the admission standards even if it is ultimately denied on the merits." *Entergy Nuclear Vermont*

Yankee, LLC (Vermont Yankee), LBP-06-20, 64 N.R.C. 131, 160 (2006).

In addition, a contention of "omission" that focuses on the absence of a required analysis in the application is admissible and not deemed speculative because of any lack of detail regarding the potential content of the missing information. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-08-13, 64 N.R.C. 43, 86, n. 194 (2008).

B. Specific Statement of the Issue of Law or Fact to be Raised or Controverted

First, a petitioner must clearly identify the issue of law or fact that it will raise or dispute. 10 C.F.R. § 2.309(f)(1)(i).

C. Brief Explanation of the Basis of the Contention

Next "a petitioner must provide some sort of *minimal* basis indicating the *potential* validity of the contention." Final Rule, *Rules of Practice for Domestic Licensing Proceedings - Procedural Changes in the Hearing Process*, 54 Fed. Reg. 33,168, 33,170 (Aug. 11, 1989) (emphasis added). This minimal basis need not be "an exhaustive list of possible bases, but simply enough to provide the alleged factual or legal bases in support of the contention." *Vermont Yankee*, 64 N.R.C. at 147 (*quoting Louisiana Energy Serv., LP* (National Enrichment Facility), 60 NRC 619, 623 (2004)).

D. Showing that the Contention is Material to Findings that the NRC Must Make in Support of the Proposed Action

A proposed contention must concern an issue that is "material" to the findings the NRC must make. 10 C.F.R. § 2.309(f)(1)(iv). A "material" issue is one that would make a difference in the outcome of the proceeding. 54 Fed. Red. at 33,172. "This means that there should be some significant link between the claimed deficiency and either the health and safety of the public or the environment." *Vermont Yankee*, 60 NRC 548, 557 (Nov. 22, 2004).

E. Concise Statement of the Alleged Facts or Expert Opinions in Support of Petitioners' Position

A petitioner must also demonstrate that each proposed contention is supported by "a concise statement of the alleged facts or expert opinions which support the . . . petitioner's position on the issue . . . together with references to the specific sources and documents on which [it] intends to rely." 10 C.F.R. § 2.309(f)(1)(v). This does not mean, though, that a petitioner must "make its case at this stage of the proceeding." 54 Fed. Reg. at 33,170. Rather, the petitioner must simply "indicate what facts or expert opinions, be it one fact or opinion or many, of which it is aware at that point in time which provide the basis for its contention." *Id.* Moreover, "a 'Board may appropriately view Petitioners' support for its contention in a light that is favorable to the Petitioner.'" *Vermont Yankee,* 60 NRC at 555 *(quoting Arizona Public Service Co.* (Palo Verde Nuclear Station), 34 NRC, 149, 155 (Aug. 16, 1991)).

F. Sufficient Information to Show that a Genuine Dispute Exists with the Applicant or Licensee on a Material Issue of Law or Fact

NRC set forth factors relevant to determining if a genuine dispute exists when it adopted the current version of 10 C.F.R. § 2.309(f)(1):

> This will require the intervenor to read the pertinent portions of the license application, including the Safety Analysis Report and the Environmental Report, state the applicant's position and the petitioner's opposing view. Where the intervenor believes the application and supporting material do not address a relevant matter, it will be sufficient for the intervenor to explain why the application is deficient.

54 Fed. Reg. at 33,170.

As set forth in detail in the following contentions, NRDC easily satisfies the admissibility standard with respect to each contention. Further, as set forth below and as required by 10 C.F.R. § 2.309(f)(1)(iii), NRDC will show that each contention is within the scope of the

proceeding.

II. NRDC CONTENTIONS

CONTENTION 1-E[3]

APPLICANT'S ENVIRONMENTAL REPORT (§ 5.3) ERRONEOUSLY CONCLUDES THAT NEW INFORMATION RELATED TO ITS SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES ("SAMDA") ANALYSIS IS NOT SIGNIFICANT, IN VIOLATION OF 10 C.F.R. § 51.53(c)(3)(iv), AND THUS THE ER FAILS TO PRESENT A LEGALLY SUFFICIENT ANALYSIS OF SEVERE ACCIDENT MITIGATION ALTERNATIVES

BASES

1. Applicant's Environmental Report -Operating License Renewal Stage, Limerick Generating Station, Units 1 and 2 ("ER") misinterprets and/or misuses new information regarding increased population in the area within 10 miles of the plant and thus fails to account for the significant increase in total person-rems of exposure that could occur in the event of a severe accident. ER at 5-7. This population was substantially underestimated in the 1989 SAMDA analysis upon which the Applicant continues to rely[4], and thus the ER substantially understates or fails to analyze the potential adverse impact in terms of person-rems of collective exposure from a severe accident at Limerick and the potential benefits of mitigation measures that would avoid those exposures.

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[3] "E" indicates the contention is environmental.

[4] The ER, § 5.3, incorporates and adopts as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick, an analysis done by NRC Staff in 1989 known as a severe accident mitigation design alternatives ("SAMDAs") analysis. *See* NUREG-0974 Supplement, Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2 Docket Nos. 50-352 and 50-353 Philadelphia Electric Company (August 1989)("SAMDA").

NRDC Expert Decl. ¶¶ 22-30.

2. The ER misinterprets and/or misuses new information regarding increased population in the area within 50 miles of the plant and thus fails to account for the significant increase in total person rems of exposure that will occur in the event of a severe accident. ER at 5-7. This population was substantially underestimated in the 1989 SAMDA analysis upon which the Applicant continues to rely, and thus the ER substantially understates the potential adverse impact, in terms of person-rems of collective exposure, from a severe accident at Limerick and the potential benefits of mitigation measures that would avoid those exposures. NRDC Expert Decl. ¶¶ 22-30

3. The ER fails to analyze the significance of radiation exposure to an increased population following a severe accident and fails to consider more than a very narrow group of mitigation measures identified in the 1989 SAMDA analysis. It ignores new and significant information regarding potential mitigation alternatives that have been considered for other BWR Mark II containment reactors that were not considered in the original SAMDA analysis and ignores new and significant information regarding additional plausible severe accident scenarios. ER at § 5.3. Thus the ER fails to demonstrate that with the accurate distribution and number of persons who will be exposed in the event of a severe accident and all reasonable mitigation alternatives considered, there will be no significant change in the SAMDA analysis and there will be no cost beneficial mitigation alternatives.[5] NRDC Expert Decl. ¶¶ 7-17 and 22-30.

[5] The original SAMDA analysis identified "several candidate SAMDAs [that] might be cost effective" but dismissed them because of reliance on a PRA analysis by the then owner of Limerick that Staff conceded "staff has not verified." SAMDA at 15.

4. The ER analysis of the significance of exposure of an increased population to harmful radionuclides following a severe accident ignores new and significant information based on an analysis of actual core damage events at light water reactors in general, and BWRs in particular. Such an action demonstrates that the CDF probability for Limerick is likely higher than the estimate relied upon in the 1989 SAMDA analysis and updated CDF probabilities on which applicant continues to rely (ER at 5-6). Thus the ER conclusion that the new information regarding the population at risk from a severe accident does not constitute significant information is based on non-conservative assumptions that understate the likely damage from a severe accident at Limerick. NRDC Expert Decl. ¶¶ 18-30.

5. The ER analysis of the significance of including information regarding the potential economic impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI, a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA, Camden and Trenton, NJ and Wilmington, DE. The ER thus fails to evaluate the impact of a properly conducted economic analysis on the assessment of the environmental consequences of a severe accident at Limerick. NRDC Expert Decl. ¶¶ 31-39.

6. The ER ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia and thus understates the impact of a properly conducted economic analysis on the environmental consequences of a severe accident at Limerick. NRDC Expert Decl. ¶ 39.

7. The ER fails to include an analysis of the impacts to the quality of the human environment that were not discussed in the ER, for example, loss of family homestead, possessions, abandonment of livestock and domestic animals, pain and suffering, including that associated with loss of one's job or possessions, and uncertainties associated with the safety of the food supply.

SUPPORTING EVIDENCE

8. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 2-E

APPLICANT'S ENVIRONMENTAL REPORT (§ 5.3) IN RELYING ON A SAMDA[6] ANALYSIS FROM 1989 FAILS TO COMPLY WITH 10 C.F.R. §§ 51.45, 51.53(c)(2) AND 51.53(c)(3)(iii) BECAUSE IT DOES NOT INCLUDE AN ACCURATE OR COMPLETE ANALYSIS OF "ALTERNATIVES AVAILABLE FOR REDUCING OR AVOIDING ADVERSE ENVIRONMENTAL EFFECTS," DOES NOT "CONTAIN SUFFICIENT DATA TO AID THE COMMISSION IN ITS DEVELOPMENT OF AN INDEPENDENT ANALYSIS" OF ALTERNATIVES AND DOES NOT CONTAIN AN ADEQUATE "CONSIDERATION OF ALTERNATIVES FOR REDUCING ADVERSE IMPACTS . . . FOR ALL CATEGORY 2 LICENSE RENEWAL ISSUES."

BASES

1. The ER relies on an arbitrarily limited and outdated list of SAMDA candidates for

[6] The ER, § 5.3 incorporates and adopts as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick, the SAMDA analysis done by NRC Staff in 1989. This contention focuses on the numerous deficiencies in that SAMDA analysis and, because Exelon chooses to adopt it as the SAMA analysis for this license renewal proceeding, it is referred to here as the "SAMA" analysis.

evaluation. Thus the ER fails to demonstrate any support for the proposition that it cannot identify any severe accident mitigation measures that would be cost-effective to implement. NRDC Expert Decl. ¶¶ 7-15.

2. The ER analysis of SAMDAs relies on an inaccurate analysis of the population that could be exposed in the event of a severe accident within both 10 miles and 50 miles of Limerick, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 22-30.

3. As a result of using inadequate and outdated meteorological data, the ER analysis of SAMAs relies on an inaccurate analysis of the dispersion of harmful radionuclides from the site in the event of a severe accident, thus potentially understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 45-48.

4. The ER analysis of SAMDAs relies on an inaccurate estimate of the core damage frequency for these reactors, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 18-21.

5. The ER analysis of SAMDAs relies on inaccurate analyses of the evacuation time that would be required in the event of a severe accident, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 40-44.

6. The ER analysis of SAMDAs contains no analysis of the economic impact of a severe

accident on areas within 50 miles of the reactors, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 31-39

7. The ER analysis of SAMDAs relies on inaccurate and unreliable methodologies to attempt to evaluate the impact on the SAMDA analysis of new information regarding increased population exposed in the event of a severe accident, consideration of the economic cost of a severe accident, a limited and outdated list of SAMA candidates, and increased dollar value assigned to person-rems of exposure averted. As a consequence the ER thus understates the significance of this new information and fails to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 7-48.

SUPPORTING EVIDENCE

8. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 3-E

APPLICANT'S ENVIRONMENTAL REPORT ERRONEOUSLY CONCLUDES THAT THE SAMDA ANALYSIS CONDUCTED IN 1989 IS A SAMA ANALYSIS WITHIN THE MEANING OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AND THUS THE ER IS DEFICIENT FOR ITS FAILURE TO INCLUDE A SAMA ANALYSIS.

BASES

1. NRC Staff has identified factors that must be included for a legally adequate SAMA

analysis by adopting NEI-05-01 Rev. A (Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document (Nov. 2005)). *See* 72 Fed. Reg. 45466, 45467 ("The staff finds that NEI 05-01, Revision A, describes existing NRC regulations, and facilitates complete preparation of SAMA analysis submittals").

2. The 1989 SAMDA analysis fails to include many of these factors including:

a.no analysis of the economic consequences of a severe accident; NRDC Expert Decl. ¶¶ 31-39.

b. inaccurate population projections for the 50 mile EPZ; NRDC Expert Decl. ¶¶ 22-30.

c. inadequate range of alternatives to mitigate the consequences of a severe accident; NRDC Expert Decl. ¶¶ 7-15.

d. inaccurate CDF calculations; NRDC Expert Decl. ¶¶ 18-21.

e. inaccurate meteorological data; NRDC Expert Decl. ¶¶ 45-48;

f. incomplete analyses of plausible severe accident scenarios; NRDC Expert Decl. ¶¶ 16-17; and

g. inaccurate calculation of evacuation times in the event of an accident. NRDC Expert Decl. ¶¶ 40-44.

3. The 1989 SAMDA analysis fails to assess the impact of all relevant factors, including those enumerated in 2 above, using MELCOR Accident Consequence Code Systems ("MACCS")2 or an equally capable NRC approved up-to-date probabilistic safety assessment severe accident consequences code system.

4. Thus, the 1989 SAMDA analysis is not sufficient to excuse Exelon from conducting a full SAMA analysis as required by 10 C.F.R. § 51.53(c)(3)(ii)(L).

SUPPORTING EVIDENCE

5. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 4-E

APPLICANT'S ENVIRONMENTAL REPORT (§ 7.2) FAILS TO ADEQUATELY CONSIDER THE NO ACTION ALTERNATIVE IN VIOLATION OF 10 C.F.R. §§ 51.45 (c), 51.53(c)(2) AND 51.53(c)(iii).

BASES

1. The ER violates 10 C.F.R. § 51.45(c) because it omits an analysis that "considers and balances the environmental effects of the proposed action" and the alternative of No Action. Paine Expert Decl. at ¶¶ 4-7.
2. The ER violates 10 C.F.R. § 51.45(c) because it unreasonably and arbitrarily limits its analysis of the No Action alternative in a manner that fails, "to the fullest extent practicable, [to] quantify the various factors considered" and neglects discussion of "important qualitative considerations or factors that cannot be quantified." Paine Expert Decl. at ¶¶ 4-10.
3. The ER violates 40 C.F.R. § 1502.14(d) and 10 C.F.R. Part 51, Subpart A, Appendix A, § 4, by improperly and illogically narrowing discussion of the No Action alternative to consideration of (1) decommissioning impacts and (2) power generation alternatives that would "equivalently satisfy the purpose and need for the proposed action" by "replacing

the generating capacity of LGS" with "single discrete generation sources." Paine Expert Decl. at ¶¶ 5-7.

4. The ER violates 10 C.F.R. § 51.53(c) by failing to thoroughly consider the environmental impacts and likely consequences under the No Action alternative of denying relicensing now, 13 years before the existing license for Limerick 1will expire and 18 years before the existing license for Limerick 2 will expire, including the expected growth in demand side management and renewable energy sources, and fails to quantify and balance the environmental costs of those consequences against the environmental costs of relicensing the Limerick reactors, including the properly analyzed cost of a severe accident. Paine Expert Decl. at ¶¶ 4-10.

SUPPORTING EVIDENCE

5. The bases for this contention are support by the Declaration of Christopher E. Paine, which is Attachment 6 to this Notice and Petition.

III. NRDC'S CONTENTIONS ARE WITHIN THE SCOPE OF THE PROCEEDING

Each of NRDC's contentions is within the scope of this license renewal proceeding, which is described in Parts 51 and 54. *See Florida Power & Light Co.* (Turkey Point Nuclear Power Plant), CLI-01-17, 54 NRC 3, 6-13 (Jul. 19, 2001); Nuclear Power Plant License Renewal, 60 Fed. Reg. 22,461 (May 8, 1995). A license renewal application review typically implicates issues that fall into one of two broad areas: safety/aging management issues, and environmental impacts. NRDC's contentions are focused on environmental impacts.

The scope of the environmental review is defined by 10 C.F.R. Part 51, the NRC's

"Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NUREG-1437 (May 1996)), and the initial hearing notice and order. *See, e.g., Vermont Yankee,* 64 N.R.C. at 148-49. Some environmental issues that might otherwise be germane in a license renewal proceeding have been resolved generically for all plants and are normally, therefore, "beyond the scope of a license renewal hearing." *Turkey Point*, 54 NRC at 15; *see* 10 C.F.R. § 51.53(c)(3)(i). These "Category 1" issues are classified in 10 C.F.R. Part 51, Subpart A, Appendix B. Category 1 issues may be raised when a petitioner (1) demonstrates that there is new and significant information subsequent to the preparation of the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437) ("GEIS") regarding the environmental impacts of license renewal; (2) files a petition for a rulemaking with the NRC; or (3) seeks a waiver pursuant to 10 C.F.R. § 2.335.[7] *See Turkey Point*, 54 NRC at 10-12; *see also* 10 C.F.R. § 51.53(c)(3)(iv) (new and significant information).

NRDC's environmental contentions primarily relate to a Category 2 issue, *i.e.* whether the ER has appropriately addressed the issue of mitigation alternatives for severe accidents. *See* 10 C.F.R. Part 51, Subpart A, Appendix B. NRDC's contentions focus on 1) the failure of the ER to identify all of the new information relative to an analysis of mitigation alternatives for severe accidents and the failure of the ER to justify its conclusion that the new information recognized by Exelon is not significant; 2) the failure of the ER to provide a legally sufficient SAMA analysis because of the obvious deficiencies in the SAMDA analysis upon which Exelon relies to meet its obligations to thoroughly evaluate mitigation alternatives for severe accidents;

[7] Because NRC regulations specifically provide that only a "party to an adjudicatory proceeding" can seek a waiver,10 C.F.R. § 2.335, any determination that a regulation precludes any of NRDC's contentions must be held in abeyance until NRDC has been admitted to the proceeding as a "party" and has had an opportunity to pursue any necessary waiver petition.

and 3) the ER's mistaken conclusion that NRC "staff has . . . previously considered severe accident mitigation alternatives for the applicant's plant" (10 C.F.R. § 51.53(c)(3)(ii)(L)) by conducting the 1989 SAMDA analysis.

A. New and Significant Information (Contention 1-E)

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321-37, requires all federal agencies to examine environmental impacts that could be caused by their discretionary actions. The Supreme Court has identified NEPA's twin aims as (1) obligating a federal agency to consider every significant aspect of the environmental impact of a proposed action and (2) ensuring that the federal agency will inform the public that it has indeed considered environmental concerns in its decision-making process. *Baltimore Gas & Elec. Co. v. Natural Resources Defense Council*, 462 U.S. 87, 97 (1983); *see also* 42 U.S.C. § 4332(2)(c) (identifying requirements of an EIS). As a federal agency, the NRC must comply with NEPA. *Calvert Cliffs Coordinating Comm. v. United States Atomic Energy Commission*, 449 F.2d 1109 (D.C. Cir. 1971) (NEPA applies to NRC predecessor). NEPA requires that NRC take a "hard look" at alternatives, including SAMAs, and to provide a rational basis for rejecting alternatives that are decidedly cost-effective. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); *accord Limerick Ecology*, 869 F.2d at 737 and *Bowman Transp., Inc. v. Arkansas-Best Freight System, Inc*. 419 U.S. 281, 285-286; *see also Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-11-17, __N.R.C. __ (July 17, 2011) *petition for interlocutory review pending*.

Moreover, NEPA imposes continuing obligations on NRC after it completes an environmental analysis. An agency that receives new and significant information casting doubt

upon a previous environmental analysis must reevaluate the prior analysis. *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). This requirement is codified in the NRC's own regulations. *See* 10 C.F.R. §§ 51.53(c)(iv) and 51.92(a)(2).

Exelon incorporates the SAMDA analysis performed during the operating license process as its SAMA analysis for purposes of this request for a new operating license. ER at §§ 4.20 and 5.3. However, 10 C.F.R. Part 51, Subpt. A, Appendix A, § 1(b) provides that the techniques of incorporation by reference and adoption described respectively in 40 CFR §§ 1502.21 and 1506.3 of CEQ's NEPA regulations may only be used as appropriate to aid in the presentation of issues, eliminate repetition or reduce the size of an environmental impact statement and the use of such adoption is not allowed except where the prior information "meets the standards for an adequate statement under these regulations." 40 C.F.R. § 1506.3(a).

A key requirement of NEPA is that the information upon which an environmental impact statement is based must be based on "accurate scientific analysis, expert agency comments, and public scrutiny [which] are essential to implementing NEPA." *Native Ecosystems Council v. U.S. Forest Svc.*, 418 F.3d 953, 964, 965 (9th Cir. 2005). If the ER relies on, or adopts, environmental analyses that are outdated, inaccurate or incomplete, NRC cannot rely on the ER because, by doing so, it would not have taken the requisite "hard look" by simply relying on the incorrect assumptions or data provided by the licensee. 40 C.F.R. § 1501(b). Accordingly, NEPA requires that an EIS must contain "high quality" information and "accurate scientific analysis," and furthermore obligates Staff to "independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement." 10 C.F.R. § 51.70(b); *see also* 10 C.F.R. § 51.92(a); 40 C.F.R. § 1502.24 (Staff must ensure "the professional

integrity, including scientific integrity, of the discussions and analyses in environmental impact statements.") Since NRC Staff relies on the ER for much of its NEPA analysis, particularly the SAMA analysis, if, as here, the SAMA analysis is defective, absent diligent enforcement of its own regulations and guidance by NRC Staff, the FSEIS will be similarly deficient. Thus, Exelon's inadequate analysis of severe accident mitigation alternatives will necessarily have a profound impact on this licensing proceeding and the ability of the NRC to comply with its NEPA obligations.

In its decisions, the Commission has emphasized that the SAMA process is designed to assist the NRC in making decisions. *Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1 (July 23, 2002) at 10, emphasizing that even though NEPA does not require implementation of any particular SAMA, the obligation to fully develop the record with regard to any SAMA is required "to ensure that the agency does not act upon incomplete information, only to regret its decision after it is too late to correct." *Id*. Thus, the ER as written will not fulfill the goal of providing NRC Staff with the information needed for its SAMA analysis unless the information upon which the analysis offered by Exelon is based on accurate, current and complete information.

Not surprisingly, the NRC's license renewal application regulations also reiterate this obligation. 10 C.F.R. § 51.53(c)(3)(iv) provides that an ER must contain "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." Exelon accepts this obligation but, as the preceding contentions demonstrate, Exelon's ER is deficient in its attempt to meet this obligation both because it ignores new information and because it incorrectly assesses the significance of the information it

concedes is new.

The Commission recently reiterated the criteria that should be applied in determining whether new information is significant. It held "[t]he new information must present 'a seriously different picture of the environmental impact of the proposed project from what was previously envisioned.'" *Union Elec. Co. et al.*, CLI-11-05, 2011 NRC LEXIS 6, 50 (Sept. 9, 2011). As the attached Declaration of Drs. Cochran, McKinzie and Weaver amply demonstrates the new information that is dismissed by Exelon as insignificant and the additional new information ignored by Exelon would, if properly analyzed, present a "seriously different picture of the environmental impacts" of the proposed license renewal by substantially expanding the number of potential mitigation measures and substantially increasing the environmental impact of a severe accident and the benefits to be gained by mitigating those impacts. In addition, disputes about whether new information is "significant" are inherently factual and not appropriate for resolution at the contention admissibility stage. *See Entergy Nuclear Operations, Inc*. (Indian Point Energy Center), LBP-08-13, 68 N.R.C. 43, 190-191 (N.R.C. 2008).

In this case Exelon, while recognizing that changes to the previous analysis of severe accident mitigation alternatives might be warranted if new information were significant (ER at § 5.3), undertakes, at best, a breezy analysis of the significance of new information, even using a SAMA analysis at a plant that was markedly different than Limerick – a different type of reactor, a different environmental setting - rather than run its own technically competent sensitivity analyses to determine how new information might alter both the scope and viability of mitigation alternatives.

B. The Adequacy of Exelon's Analysis of Severe Accident Mitigation Alternatives (Contention 2-E)

In order to meet the requirements of 10 C.F.R. § 51.53(c)(3)(ii)(L) and to comply with the mandate of the Federal Court in *Limerick Ecology Action*, Exelon asserts that severe accident mitigation alternatives have already been considered for Limerick. ER at § 4.20. In order to meet its burden of proof, Exelon must demonstrate that the previous analysis, which it asserts meets its NEPA and NRC obligations contains "high quality" information and "accurate scientific analysis," and that all the information contained in that analysis reliable. *See* 10 C.F.R. § 51.70(b); *see also* 10 C.F.R. § 51.92(a); 40 C.F.R. § 1502.24 (Staff must ensure "the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements.").[8] In numerous respects, as identified in the bases for Contention 2-E, the analysis which Exelon offers as meeting the obligations to conduct a thorough severe accident mitigation alternatives analysis is deficient. Challenges to the adequacy of a SAMA analysis are well within the scope of a license renewal proceeding. *See e.g. Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1.

C. The 1989 SAMDA Is Not A SAMA (Contention 3-E)

Exelon asserts that the 1989 Supplemental FES is the "previously considered severe accident mitigation alternatives for the applicant's plant" contemplated by 10 C.F.R. § 51.53(c)(3)(ii)(L)). However, that concept does not bless any analysis, regardless of how deficient it may be, merely because NRC Staff calls it a "severe accident mitigation alternatives

[8] Since it is a Staff analysis that Exelon asserts meets its SAMA obligations, the standards applicable to the Staff in preparing such an analysis should be used to judge the legal sufficiency of the document.

[analysis] for the applicant's plant". First, the standard against which the analysis must be measured is NEPA since it was NEPA that the Third Circuit enforced when it found the previous efforts to consider mitigation alternatives at Limerick were deficient. *Limerick Ecology Action*, 869 F. 2d at 741. The deficiencies identified in Contention 2-E, coupled with the total failure to consider critical factors that are essential for a valid consideration of mitigation alternatives, as set forth in Contention 3-E, provide ample basis to reject the 1989 FES Supplement as meeting the NEPA standards. Second, Exelon's assertion that the 1989 FES Supplement meets the NEPA mitigation alternative evaluation standard is no substitute for a demonstration by Exelon that its assertion is correct. As the Commission observed, in a different context, "[w]e do not simply take the applicant at its word." *Entergy Nuclear Vt. Yankee, LLC* (Vt. Yankee Nuclear Power Station), CLI-10-17, 72 N.R.C. __, slip op. at 45 (July 8, 2010). Exelon must provide some evidence and analysis to support its assertion that the 1989 FES Supplement is in fact a SAMA analysis within the meaning of the NRC Regulation. Exelon has not done that. Third, the adequacy of the 1989 FES Supplement has never been tested or independently evaluated because the Petitioner in that case reached a settlement with the then-owner of Limerick before the ASLB could consider the adequacy of Staff's analysis.[9] *Philadelphia Electric Company* (Limerick Generating Station, Units 1 and 2), LBP-89-24, 30 N.R.C. 152 (1989).

D. Failure to Consider No Action Alternative (Contention 4-E)

Contention 4 is a contention of omission and the Commission has recognized that

[9] The Statement of Consideration that accompanied the GEIS issuance in 1996 included a statement that the 1989 FES Supplement met that standard for 10 C.F.R. § 51.53(c)(3)(ii)(L). 61 Fed. Reg. 28467, 28481 (June 5, 1996). However, that was not a determination by the Commission, did not occur in the context in which the adequacy of the Supplement was at issue and, of course, is not a binding determination by the Commission.

Contentions of Omission are appropriate and within the scope of a relicensing proceeding. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-08-13, 64 N.R.C. 43, 86, n. 194 (2008). The applicant's ER is required to adequately consider the No Action alternative to comply with 10 C.F.R. §§51.45(c), 51.53.(c)(2) and 51.53(c)(iii).

IV. NRDC'S CONTENTIONS MEET ALL OTHER ADMISSIBILITY REQUIREMENTS OF 10 C.F.R. § 2.309(f)(1)

The four contentions offered by NRDC specifically state issues of law or fact that are in dispute and are supported by a brief explanation of the bases for the contentions, which are supported by sufficient information to demonstrate that there is a material issue of law or fact in dispute between Exelon and NRDC. In addition to numerous references to documents that provide support for the contentions, NRDC has also provided a detailed declaration from three highly qualified nuclear experts, all of whom have extensive experience with nuclear issues in general and environmentally related nuclear issues in particular. They provide specific evidence of many flaws in the ER as it relates to severe accident mitigation alternatives, identifying information that Exelon should have included in its ER and explaining the relevance of that information to the ultimate task assigned to it -- *i.e.*, to present a fair assessment of the environmental costs and benefits of the proposed action. In presenting information regarding severe accident mitigation alternatives, Exelon has not met its obligation to submit information that is not only "supporting the proposed action but should also include adverse information." 10 C.F.R. § 51.45(e). Rather, its analysis is decidedly one-sided, stretching credulity in an effort to turn a 22 year old FES Supplement that took a limited look at mitigation alternatives into a thorough evaluation of severe accident mitigation alternatives for Limerick when it must have

known of the vastly more comprehensive analyses being conducted for similar reactors.

CONCLUSION

For all the reasons stated above NRDC should be admitted as a party to the proceeding to pursue the four admissible contentions it has presented.

Respectfully Submitted,

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

Filed this date of November 22, 2011

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing Petition to Intervene and Request for Hearing in the captioned proceeding were served via the Electronic Information Exchange (EIE) on the 22nd day of November 2011, which to the best of my knowledge resulted in transmittal of same to those on the EIE Service List for the captioned proceeding.

Chief Judge Roy Hawkens
Atomic Safety and Licensing Board
Mail Stop: T-3F23
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Roy.Hawkens@nrc.gov

U.S. Nuclear Regulatory Commission
Office of the Secretary of the Commission
Mail Stop: O-16C1
Washington, DC 20555-0001
hearingdocket@nrc.gov

U.S. Nuclear Regulatory Commission
Office of Commission Appellate Adjudication
Mail Stop: O-16C1
Washington, DC 20555-0001
ocaamail@nrc.gov

Exelon Generation Company, LLC
4300 Warrenville Road
Warrenville, IL 60555
J. Bradley Fewell, Deputy General Counsel
Bradley.Fewell@exeloncorp.com

Morgan, Lewis & Bockius LLP
1111 Pennsylvania Avenue, N.W.
Washington, DC 20004
Alex S. Polonsky, Esq.
apolonsky@morganlewis.com
Kathryn M. Sutton, Esq.
ksutton@morganlewis.com
Brooke E. Leach
bleach@morganlewis.com

Office of the General Counsel
U.S. Nuclear Regulatory Commission
Mail Stop O-15D21
Washington, DC 20555-0001
ogcmailcenter@nrc.gov
Catherine Kanatas
catherine.kanatas@nrc.gov
Brian Newell
brian.newell@nrc.gov
Maxwell Smith
maxwell.smith@nrc.gov
Mary Spencer
mary.spencer@nrc.gov
Ed Williamson
edward.williamson@nrc.gov

/Signed (electronically) by/
Geoffrey H. Fettus

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter Of	**)**	
	)	
EXELON GENERATION COMPANY, LLC,	**)**	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station)	**)**	

(License Renewal Application)

DECLARATION OF THOMAS B. COCHRAN, Ph.D., MATTHEW G. MCKINZIE, Ph.D. AND CHRISTOPHER J. WEAVER, Ph.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL

INTRODUCTION

We, Thomas B. Cochran (TBC), Matthew G. McKinzie (MGM), and Christopher J. Weaver (CJW), declare that the following statements are true and correct to the best of our knowledge.[1]

1. (TBC) My name is Thomas B. Cochran. I received my Ph.D. in Physics from Vanderbilt University in 1967. I am currently a consultant to the Natural Resources Defense Council (NRDC) at its Washington, D.C. office. Prior to retiring from NRDC in 2011, I was a senior scientist and held the Wade Greene Chair for Nuclear Policy at NRDC, and was director of its Nuclear Program until 2007. My curriculum vitae is provided in Attachment A.
2. (MGM) My name is Matthew G. McKinzie. I received my Ph.D. in Physics from the University of Pennsylvania in 1995. I am a Senior Scientist in the Nuclear Program and

[1] This Declaration is presented jointly by all three of us but in some instances discrete points are offered by only one or two of us. Each paragraph is preceded by the initials of the Declarant(s) who are offering the information contained in that paragraph.

the Lands and Wildlife Program at NRDC at its Washington, D.C. office. My curriculum vitae is provided in Attachment B.

3. (CJW) My name is Christopher J. Weaver. I received my Ph.D. in Nuclear Engineering from the University of Texas at Austin in May 2011. I am a Project Scientist in the Nuclear Program and Science Center Fellow at NRDC at its Washington, D.C. office. My curriculum vitae is provided in Attachment C.
4. (TBC, MGM, CJW) On June 22, 2011, the Nuclear Regulatory Commission (NRC) received a License Renewal Application (Exelon, 2011a) for Limerick Generating Station (LGS or "Limerick") Unit 1 and Unit 2 from the licensee, Exelon Generation Company, LLC ("Exelon"). The operating license for Unit 1 currently expires on October 26, 2024, and the operating license for Unit 2 currently expires on June 22, 2029 (Exelon, 2011a). The two nuclear power plant units at Limerick are General Electric Type 4 Boiling Water Reactors (BWR) with Mark II containment structures (Exelon, 2011a). Exelon seeks to extend the operating license of Unit 1 until the year 2044, and Unit 2 until the year 2049 (Exelon, 2011a).
5. (TBC, MGM, CJW) Exelon has submitted an Environmental Report (Exelon, 2011b) in conjunction with its License Renewal Application that does not include a Severe Accident Mitigation Alternatives (SAMA) analysis for Limerick. Exelon, citing 10 CFR 51.53(c)(3)(ii)(L) (Exelon, 2011b), claims that it is not required to prepare a SAMA analysis for License Renewal because the NRC staff had previously considered a Severe Accident Mitigation Design Alternatives (SAMDA) analysis in a Supplement (NRC, 1989) to the Limerick Final Environmental Statement (NRC, 1984). The Limerick Final Environmental Statement (FES) is dated April, 1984, and the Supplement to the Limerick

FES (FES Supplement) is dated August 1989. Exelon adopts the 1989 SAMDA analysis as its SAMA analysis. Nonetheless, in its Environmental Report Exelon does recognize that at least four items of new information bear directly on the validity of the previous SAMDA analysis and offers their view as to why this new information is not significant – i.e. why it does not warrant modifying the 1989 SAMDA analysis results (Exelon, 2011b).

6. (TBC, MGM, CJW) In the context of the environmental review for License Renewal conducted consistent with the National Environmental Policy Act (NEPA), the NRC considers new information significant if it presents a seriously different picture of the environmental impact of the proposed project from what was previously envisioned. We have found that new information in seven areas is plausibly significant: 1) additional SAMA candidates analyzed for BWRs; 2) additional accident scenarios analyzed for BWRs; 3) real world information regarding reactor core damage frequency; 4) population within 50 miles Limerick; 5) economic consequences from accident scenarios at Limerick; 6) evacuation speed assumed during accident scenarios at Limerick; and 7) meteorology at Limerick. Taken individually and especially in combination, this new information would plausibly cause a materially different result in the SAMA analysis for Limerick and render the SAMDA analysis upon which Exelon relies incomplete.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT CONSIDER A REASONABLY SUFFICIENT SET OF SAMA CANDIDATES

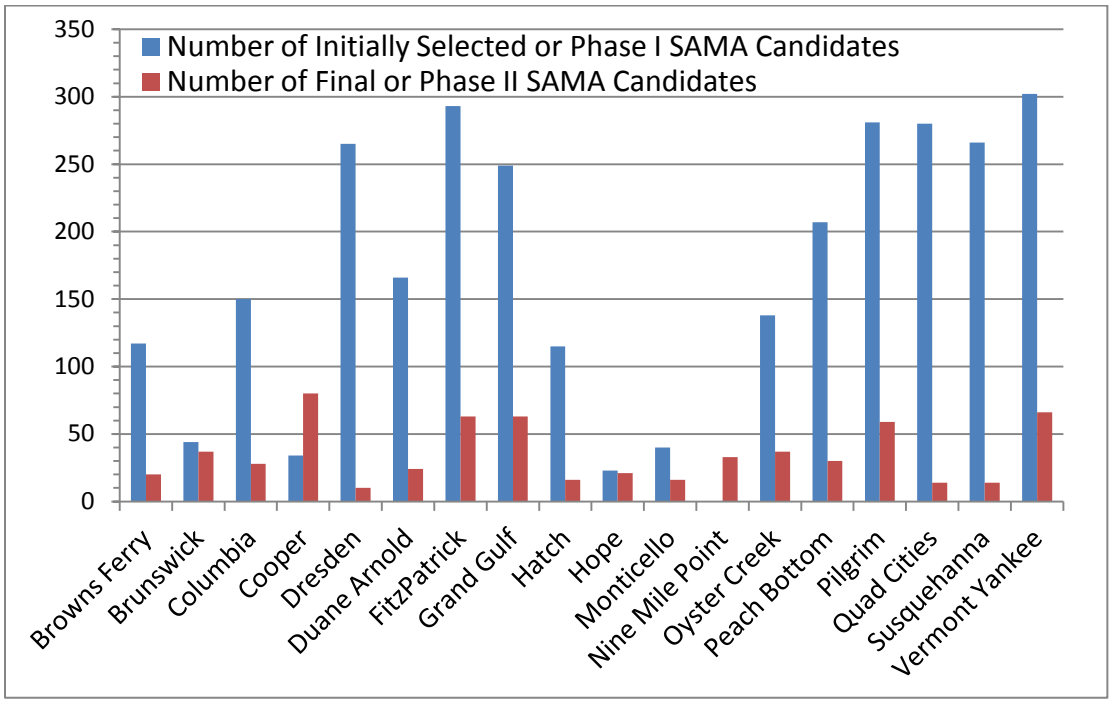
7. (MGM) In 1989, in Limerick Ecology Action v. NRC, the 3rd Circuit ruled that in the absence of an NRC finding that severe accidents are remote and speculative, the cost-

benefits of severe accident mitigation design alternatives (SAMDAs, currently termed SAMAs) should be considered as part of the NEPA analysis. As a direct consequence of this ruling, eight SAMDA candidates were initially considered in the Limerick FES Supplement, and seven final SAMDA candidates given a cost-benefit analysis with respect to person-rem averted (NRC, 1989). However two of these SAMDA candidates had already been implemented at Limerick at that time – the "Decay Heat Sized Vent Without Filter" and the "Low Pressure Reactor Makeup Capability" – and therefore in the FES Supplement the NRC noted that its staff "has not quantified the effectiveness of these SAMDAs in reducing risk." (NRC, 1989). Therefore the Limerick FES Supplement in effect considered only five SAMDA candidates.

8. (MGM) In the Limerick FES Supplement, the NRC staff determined that "while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective, based on a criterion of $1000 per person-rem averted a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified. While the staff has not verified the utility estimates, the staff is convinced that risk is now lower for Limerick than the estimates used in our cost/benefit study." (NRC, 1989). In making this determination, the NRC staff in effect disregarded the SAMDA analysis in the FES Supplement due to forthcoming new and significant information: information which the NRC had not verified, and information for which the impacts on NRC's calculations were not precisely determined.
9. (MGM) Subsequent to the 1989 Limerick FES Supplement, industry lessons learned and NRC studies have produced a large set of SAMA candidates that have been analyzed for License Renewal applications in accordance with NEPA. In contrast to the Limerick FES

Supplement, the cohort of 27 U.S. BWR units at 18 sites undergoing license renewal reviews, or that have recently been granted license renewal, have on average considered 175 Phase I SAMA candidates and 35 Phase II SAMA candidates (Constellation Energy, 2004; Energy Northwest, 2010; Entergy 2006a; Entergy 2006b; Entergy 2006c; Entergy, 2011; Exelon, 2001; Exelon, 2003a; Exelon, 2003b; Exelon, 2005; Florida Power and Light, 2008; Nebraska Public Power District, 2008; Progress Energy, 2004; PSEG Nuclear, 2009; Southern Nuclear Operating Company, 2000; Susquehanna, 2006; Tennessee Valley Authority. 2003; Xcel Energy Corporation, 2005). This data is displayed graphically in Figure 1 for these BWR SAMA analyses.

10. Figure 1: A chart of the numbers of Initially-Selected or Phase I, and Final or Phase II SAMA candidates analyzed with respect to License Renewal for U.S. BWRs .



11. (MGM) In my review of these 18 SAMA analyses conducted for BWR License Renewal Applications, the list of initial or Phase I SAMA candidates were developed by applicants both through examining industry documents and by considering plant-specific

enhancements. These industry documents were a product of industry lessons learned covering the time period subsequent to the 1989 Limerick FES, and in addition include SAMA candidates from the Individual Plant Examination (IPE) and Individual Plant Examination of External Events (IPEEE) processes. These resources constitute new and significant information post-dating the Limerick FES Supplement.

12. (MGM) The 18 SAMA analyses conducted for BWR License Renewal Applications which I reviewed include numerous examples of SAMA candidates for BWR technology that have been determined to be cost-beneficial or potentially cost-beneficial in Phase II of the SAMA candidate evaluations. Table 1 lists cost-beneficial or potentially cost-beneficial SAMA candidates from my review. Examples of or cost-beneficial SAMA candidates for Susquehanna, a GE Type 4 BWR with Mark II containment similar to Limerick Unit 1 and Unit 2, include: "Improve Cross-Tie Capability Between 4kV AC Emergency Buses (A-D, B-C)" and "Procure Spare 480V AC Portable Station Generator" (Susquehanna, 2006). These SAMA candidates were not considered in the Limerick FES Supplement (NRC, 1989). Of the SAMA analyses I surveyed for BWRs, on average four cost-beneficial or potentially cost-beneficial SAMAs were found for each site, with a maximum of 11 cost-beneficial or potentially cost-beneficial SAMAs. Browns Ferry, Nine Mile Point and Peach Bottom had no cost-beneficial or potentially cost-beneficial SAMA candidates identified.
13. (MGM) Table 1: SAMA candidates that were found to be cost- beneficial or potentially cost-beneficial in BWR applications for license renewal. (Constellation Energy, 2004; Energy Northwest, 2010; Entergy 2006a; Entergy 2006b; Entergy 2006c; Entergy, 2011; Exelon, 2001; Exelon, 2003a; Exelon, 2003b; Exelon, 2005; Florida Power and Light,

2008; Nebraska Public Power District, 2008; Progress Energy, 2004; PSEG Nuclear, 2009; Southern Nuclear Operating Company, 2000; Susquehanna, 2006; Tennessee Valley Authority. 2003; Xcel Energy Corporation, 2005).

Nuclear Power Plant	Number of Cost-Beneficial or Potentially Cost-Beneficial SAMAs and List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial	
Brunswick	7	Portable DC generator; Diverse EDG HVAC logic; Provide alternate feeds to panels supplied only by DC bus 2A-1; Provide an alternate means of supplying the instrument air header; Proceduralize battery charger high voltage shutdown circuit inhibit; Portable EDG fuel oil transfer pump; Use fire water as a backup for containment spray
Columbia	3	Reduce CCFs between EDG-3 and EDG1/2; Improve the fire resistance of cables to the containment vent valve; Improve the fire resistance of cables to transformer E-TR-S
Cooper	11	Portable generator for DC power to supply the individual panels; Revise procedure to allow bypass of RCIC turbine exhaust pressure trip; Improve training on alternate injection via FPS; Revise procedures to allow manual alignment of the fire water system to RHR heat exchangers; Proceduralize the ability to crossconnect the circulating water pumps and the service water going to the TEC heat exchangers; Create ability for emergency connection of existing or new water sources to feedwater and condensate systems; Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment; Provide an alternate means of supplying the instrument air header; Proceduralize the use of a fire pumper truck to pressurize the fire water system; Generation Risk Assessment implementation into plant activities; Modify procedures to allow use of the RHRSW system without a SWBP
Duane Arnold	2	Provide an alternate source of water for the RHRSW/ESW pit; Increase the reliability of the low pressure ECCS RPV low pressure permissive circuitry. Install manual bypass of low pressure permissive
Grand Gulf	3	Procedural change to cross-tie open cycle cooling system to enhance containment spray system; Enhance procedures to refill CST from demineralized water or service wather system; Increase operator training for alternating operation of the low pressure ECCS pumps (LPCI and LPCS) for loss of SSW scenarios.
Monticello	6	Enhanced DC Power Availability (provide cables from DG-13, the security diesel, or another source to directly power division II 250V battery chargers or other required loads); Enhance Alternate Injection Reliability (include the RHRSW and FSW valves in the maintenance testing program); Additional Diesel Fire Pump for FSW system (proceduralize the use of a fire truck to pressurize and provide flow to the fire main for RPV injection); Refill CST (develop emergency procedures and ensure viability of refilling the CSTs with FSW); Divert Water from Turbine Building 931-foot elevation; Manual RCIC Operation
Oyster Creek	7	Allow 4160 VAC bus IC and ID crosstie; Provide an alternate method for IC shell level determination; Portable DC battery charger to preserve IC and EMRV operability along with adequate instrumentation; Reduce fire impact in dominant fire areas; Operator Training; Protect Combustion Turbines; Upgrade Fire Pump House structural integrity

Nuclear Power Plant	Number of Cost-Beneficial or Potentially Cost-Beneficial SAMAs and List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial	
Pilgrim	5	Enhance procedures to make use of AC bus cross-ties; Enhance procedures to make use of DC bus cross-ties; Provide redundant DC power supplies to DTV valves; Proceduralize use of the diesel fire pump hydro turbine in the event of EDG A failure or unavailability; Proceduralize the operator action t feed B1 loads via B3 When A5 is unavailable posttrip Similarly, feed B2 loads via B4 when A6 is unavailable post trip
Susquehanna	2	Improve Cross-Tie Capability Between 4kV AC Emergency Buses (A-D, B-C); Procure Spare 480V AC Portable Station Generator
Vermont Yankee	3	Shield injection system electrical equipment from potential water spray; Improve operator action: Defeat low reactor pressure interlocks to open LPCI or core spray injection valves during transients with stuck open SRVs or LOCAs in which random failures prevent all low pressure injection valves from opening; Install a bypass switch to bypass the low reactor pressure interlocks of LPCI or core spray injection valve

14. (CJW) In addition to these currently-documented SAMAs, there are technological options that should plausibly be reviewed as SAMA candidates due to the fact that they address issues related to prolonged station blackout (SBO) and improvement to safety-related systems. One possible SAMA candidate is to replace the emergency DC-powered valve actuators and speed controls for the steam-driven Safety-Related Turbines with a self-powered digital speed control and electrically-actuated valve-control system. This SAMA candidate would allow critical emergency core cooling pumps to run for days under SBO conditions. Another plausible SAMA candidate for Limerick relates to a concern raised in a recent Government Accountability Office report, that industry has limited ability to measure changes in safety-related pipe wall thickness caused by corrosion and located underground without costly excavation (GAO, 2011). To address this issue, nuclear plant operators could employ the use of non-destructive inspection techniques such as robotic crawlers that can navigate complex geometries to perform in-line pipe inspection. This SAMA candidate can potentially provide quantitative analysis without the need for expensive surface preparations.

15. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the absence of SAMA candidates analyzed in the FES Supplement. Foremost this is because a new SAMA analysis for Limerick was not performed in support of license renewal using a set of SAMA candidates derived from new and significant information acquired by industry and by the NRC since 1989.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT CONSIDER ADDITIONAL ACCIDENT SCENARIOS FOR BWRS THAT COULD ALTER PREVIOUSLY ASSUMED ACCIDENT CONSEQUENCES

16. (CJW) The Limerick FES Supplement does not consider accident scenarios involving: prolonged SBO events, multiunit events, seismically-induced fire events, or seismically-induced flooding events. In *The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident*, the NRC staff noted that "prolonged SBO and multiunit events present new challenges to EP facilities that were not considered when the NRC issued NUREG-0696. The accident at Fukushima has clearly shown that these events are a reality." (NRC, 2011a) With respect to seismically-induced fire and flooding events, the NRC Generic Safety Issue 172 (GSI-172) was closed in 2002 based on IPEEE results, and as a result the NRC established no new requirements to prevent or mitigate seismically induced fires or floods (NRC, 2002). However the NRC Near-Term Task Force concludes that the NRC should re-evaluate the closure of GSI-172 in light of plant experience in Japan and the potential for common-mode failures of plant safety equipment as the result of seismically induced fires and floods (NRC, 2011a).

17. (TBC, MGM, CJW) The Limerick Environmental Report for License Renewal Application does not remedy the absence of additional accident scenarios for BWRs that could plausibly alter previously assumed accident consequences. The Limerick Environmental Report fails to consider extended SBO events, multiunit events, seismically-induced fire events, or seismically-induced flooding events.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT INCLUDE OR ASSESS REAL WORLD INFORMATION REGARDING CORE DAMAGE FREQUENCY, WHICH INDICATES THAT THE CORE DAMAGE FREQUENCY USED IN THE SAMDA ANALYSIS IS LIKELY IN ERROR AND NOT CONSERVATIVE

18. (TBC) The Limerick SAMDA analysis relies on a Core Damage Frequency (CDF) of 4.2×10^{-5} per year (NRC, 1989) and the Environmental Report submitted by the applicant cites an estimate of CDF, which only includes internal events, for Limerick Units 1 and 2 of 3.2×10^{-6} per year based on a Probabilistic Risk Assessment (PRA) (Exelon, 2011b). In a recent update to the licensee's IPEEE model to include internal fire risks as well as internal events in its PRA, the license calculated a total CDF of 1.8×10^{-5} per year for these hazard groups (NRC, 2011b). Because the PRA is based on modeling assumptions that contain a large number approximations, large uncertainties and omissions, the absolute value of a CDF calculated using PRA is not a reliable predictor of the actual CDF value.
19. (TBC) Worldwide, I calculate that there have been approximately 429 light water reactors (LWR) that have operated approximately 11,500 reactor-years, and that five of these LWRs (Three Mile Island Unit 2, Greifswald Unit 5, Fukushima Daiichi Units 1, 2,

and 3) have experienced core damage as CDF is defined in NUREG-1150 Vol. 1, pg 2-3. Thus, for this class of nuclear power reactors, LWRs, the CDF is approximately 4.3×10^{-4} per reactor-year based on the historical record. I calculate that in the United States there have been approximately 116 LWRs that have operated approximately 4,100 reactor years. One of these LWRs (Three Mile Island Unit 2) experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors the CDF is approximately 2.4×10^{-4} per reactor-year based on the historical record. The Limerick reactors, BWRs with Mark 2 containments, are similar in many respects to Fukushima Daiichi Units 1, 2 and 3, BWRs with Mark 1 containments. While no U.S. BWRs have experienced core damage as defined by NUREG-1150, I calculate that worldwide there have been approximately 117 BWRs that have operated approximately 3,300 reactor-years. Three of these BWRs (Fukushima Daiichi Units 1, 2, and 3) have experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors worldwide the CDF is approximately 9×10^{-4} per reactor-year based on the historical record.

20. (TBC) In sum, the global CDFs for all LWRs and the subset of BWRs based on historical data are much greater than the theoretical value calculated by the applicant for Limerick Units 1 and 2, as is the U.S. historical CDF for LWRs. If a larger CDF is assumed in a PRA, then the calculated cost of severe accidents within a SAMA analysis would be increased proportionally, and thus it would be more likely that the economic viability of the measures to mitigate such accidents would be cost-beneficial.
21. (TBC, MGM, CJW) We do not argue that any of the above CDF estimates based on the historical evidence represent the most accurate CDFs for Limerick Units 1 and 2. In our

judgment the most accurate values of CDF probably lie somewhere between the theoretical values calculated by the applicant and one or more of the U.S. or global values based on the historical record. However, the CDFs used in a Limerick SAMA analysis should be evidence based. The applicant's estimates of CDF are non-conservative and a Limerick SAMA analysis would benefit from a sensitivity analysis in which higher core damage frequencies are assumed. Given the historical operating record of similar reactors, we assert that it is simply not credible to assume the CDF for older BWR reactors in the United States, such as Limerick Units 1 and 2, to be as low as 1.8×10^{-5} per reactor year, i.e., about one core damage event per 55,000 reactor-years of operation. A range of CDF values including values close to those estimated from the global historical evidence should be used in the SAMA analyses for Limerick Units 1 and 2. This issue should be analyzed and discussed in the Limerick environmental report and the final environmental impact statement.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT RELY ON INCORRECT DEMOGRAPHIC DATA

22. (MGM) The cost- benefit ratios calculated in the 1989 SAMDA analysis rely on population data for the 50-mile zone around Limerick derived from 1980 census data (Exelon, 2011b). The 1984 FES stated that the area within 10 miles of Limerick experienced a decrease in population of 4.2% from 1970 to 1980, and the area with within 50 miles experienced a decrease in population of less than 0.2% between 1970 and 1980. Noting this trend, the NRC staff remarked that "…the area has not experienced—nor is it likely to experience—the growth anticipated." (NRC, 1984).

23. (MGM) By contrast, data from the 1990 Census, the 2000 Census, and the 2010 Census does show a substantial growth in population in the 10-mile and in the 50-mile zones around Limerick over the last thirty years. Census data for 1990, 2000 and 2010 were analyzed using ESRI ArcGIS 10 Geographic Information Systems (GIS) software, summing the total population in each census tract intersecting the 10-mile or 50-mile zones around Limerick (Census Bureau, 1990; Census Bureau, 2000; Census Bureau, 2011). The results of this GIS analysis can be seen in Table 2. By 1990, the Census population within the 10-mile zone already exceeded the year 2000 projection in the Limerick Final Environmental Statement by 40 percent. The 2010 Census population within the 10-mile zone is more than 200 percent of the 1980 value used in the Limerick SAMDA study. The 2010 Census population within the 50-mile zone around Limerick is 21 percent larger than the 1980 population used in the Limerick SAMDA analysis.

24. (MGM) Table 2: Census population data for 1990, 2000 and 2010 analyzed for the 10-mile and 50-mile zones around Limerick (Census Bureau, 1990; Census Bureau, 2000; Census Bureau, 2011) and projected to the years 2030 and 2049, and population data used in the 1984 Final Environmental Impact Statement (NRC, 1984).

	10-Mile Zone around Limerick	**50-Mile Zone around Limerick**
1980 Population (1984 Limerick FES)	156,354 People	6,863,983 People
2000 Population (1984 Limerick FES)	158,607 People	7,253,880 People
1990 Population (U.S. Census)	221,701 People	7,334,214 People
2000 Population (U.S. Census)	251,287 People	7,751,181 People
2010 Population (U.S. Census)	318,582 People	8,300,122 People
Calculated Average Annual Population Growth Rate (1990-2010)	*4,844 People per Year*	*48,295 People per Year*
2030 Projected Population	415,463 People	9,266,030 People
2049 Projected Population	507,500 People	10,183,643 People

25. (MGM) This large discrepancy between the population data used for the 1989 SAMDA analysis and the subsequent Census data represents new information. This new information could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different benefit/cost results in a new SAMA analysis for Limerick. Radiation doses resulting from an accident at Limerick have not been calculated for over 1.4 million people now living within 50 miles of these reactors.
26. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the population errors in the 1989 Limerick SAMDA analysis. Foremost this is because a new SAMA analysis for Limerick was not performed in support of license renewal with revised population data. But in addition, Exelon commits errors in the 2011 Environmental Report in an effort to claim that the population data is not significant new information.
27. (MGM) First, the licensee states that the 50-mile zone population in 2030 is projected to be 9,499,925, and 2030 was the latest year out in time considered because: “this was the farthest future year to which population data for most counties within the 50-mile radius were projected.” (Exelon, 2011b). By contrast, SAMA analyses for nearly all other BWR license extensions relied on projected populations out to the end of the extended license, for example: Browns Ferry cited population projections to the year 2036 (Tennessee Valley Authority, 2003), Brunswick to 2036 (Progress Energy, 2004), Columbia to 2040 (Energy Northwest, 2010), Cooper to 2034 (Nebraska Public Power District, 2008), Dresden to 2031 (Exelon, 2003a), Fitzpatrick to 2034 (Entergy, 2006a), Grand Gulf to 2044 (Entergy, 2011), Hope Creek to 2046 (PSEG Nuclear, 2009), Monticello to 2030

(Xcel Energy Corporation, 2005), Oyster Creek to 2029 (Exelon, 2005), Peach Bottom to 2034 (Exelon, 2001), Quad Cities to 2032 (Exelon, 2003b), Susquehanna to 2044 (Susquehanna, 2006), and Vermont Yankee to 2032 (Entergy, 2006c). Populations were extrapolated out to the end of the renewed license terms in these SAMA studies in order to calculate person-rem of radiation exposure with respect to the maximum potential population within the 50-mile zones around the units during the re-licensing period. As shown in Table 2, the year 2030 population within the Limerick 10-mile zone is projected to be 415,463, and the year 2049 projected population in the 10-mile zone is projected to be 507,500. As also shown in Table 2, the year 2030 population within the Limerick 50-mile zone is projected to be 9,266,030, and the year 2049 population in the 50-mile zone is projected to be 10,183643. Under Exelon's current License Renewal Application, Limerick Unit 2 would be operating in the year 2049 while relying on a SAMDA analysis performed with population data obtained 69 years earlier.

28. (MGM) Second, the licensee states that the "relationship between the population surrounding a nuclear plant and the estimated dose following a severe accident is approximately linear" and therefore "increase in population within 50 miles of the LGS site would yield an approximate 39% increase in dose values over those calculated in the LGS June 1989 Update." (Exelon, 2011b). My examination of SAMA analyses performed for other BWR license renewals shows that the relationship between population surrounding a reactor and the estimated dose from a severe accident is not necessarily linear. For example, the Oyster Creek BWR (619 MWe) has a 50-mile population of 5.4 million, and the SAMA frequency-weighted total dose risk is 36 person-rem per year (Exelon, 2005). The Pilgrim BWR (685 MWe) has a greater 50-mile

population of 7.5 million, but the SAMA frequency-weighted total dose risk is calculated to be three times less: 13.6 person-rem per year (Entergy, 2006b). The estimated dose from a severe accident depends not just on the total population but also through prevailing winds on the geographic distribution of the population, which can change with time.

29. (MGM) Third, the licensee argues that "none of the SAMDAs in the LGS June 1989 Update would become cost beneficial if 2030 population numbers were assumed, the new information concerning population increase is not judged to be significant." (Exelon, 2011b). This statement is incorrect as it relies on an assumed linear relationship between total 50-mile population and estimated dose. But more importantly, the 1989 Limerick SAMDA analysis stated in conclusion that "…while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective, based on a criterion of $1000 per person-rem averted, a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified." (NRC, 1989). Therefore contrary to the claim of the licensee in the License Renewal Application Environmental Report, the Limerick 1989 Supplement did find some of the eight initial SAMDA candidates to be potentially cost effective in that analysis. Those findings were subsequently questioned by the NRC staff due to uncertainties in averted dose and cost for the SAMDA candidates – uncertainties created by the 1989 owner's PRA analysis that NRC Staff had not yet evaluated.

30. (MGM) I also note that the 1984 FES, the 1989 FES Supplement, the 2011 License Renewal Application and its Environmental Report do not discuss or analyze uncertainty in offsite dose calculations for Limerick related to census undercount or to transient

populations. Beginning in the 1990s, demographers have commonly understood that the U.S. Census is subject to a systematic undercount of minority populations (Census Monitoring Board, 2001), a trend which has greater significance in urban areas like Philadelphia. In addition, the Census undercounts tourist and commuter populations. If an accident at Limerick occurred during a weekday, the population at risk may have a very different geographic distribution than if the accident occurred at night or on the weekend.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT FAIL TO CONSIDER OFF-SITE ECONOMIC COST RISKS

31. (MGM) Exelon confirms in the Limerick Environmental Report that the SAMDA analysis in the 1989 FES Supplement did not compute cost- benefit values for SAMDA candidates with respect to their reduction in land contamination subject to long-term interdiction, or the reduction in associated economic cost, from a severe accident (Exelon, 2011b). Economic cost risk calculations are now a codified component of SAMA cost- benefit assessments and have been performed as an integral part of other License Renewal Applications submitted to the NRC. New information pertaining to economic risk could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different cost- benefit results in a new SAMA analysis for Limerick. The proximity of Limerick to the city of Philadelphia, with substantial economic activities and assets, reinforces this conclusion.
32. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the lack of economic risk assessment in the 1989 SAMDA study. Principally this is because a new SAMA analysis for Limerick was not performed in support of

license renewal including economic cost risk. But in addition, the licensee commits errors in the 2011 Environmental Report in an effort to claim that economic risk is not significant new information.

33. (MGM) In its 2011 Environmental Report, the licensee claims that the economic cost of a severe accident at Limerick "can be estimated using information from other license renewal applications." The example of Three Mile Island Nuclear (TMI) Station Unit 1 Environmental Report for License Renewal is cited, and the licensee argues that the Three Mile Island finding that economic cost risk is 70% larger than the off-site exposure cost risk is representative (Exelon, 2011b). This argument is incorrect: an examination of 18 SAMA analyses performed in support of License Renewal Applications for BWR shows that the ratio of economic cost risk to exposure cost risk exhibits a wide variation, as shown by example in Table 3. Claiming that economic cost risk simply scales with the exposure cost risk assumes that economic productivity and assets scale with population density, which may not true when considering low-income communities, for example North Philadelphia. TMI is also an inappropriate example to use in estimating the economic risk for Limerick because TMI is a Pressurized Water Reactor (PWR) rather than a BWR, with correspondingly different accident scenario source terms, and Harrisburg near TMI is smaller and less urban economic center than Philadelphia near Limerick.

34. (MGM) Table 3: A comparison of dose risk cost and economic risk cost for selected SAMA performed for BWR License Renewal Applications (Exelon, 2003a; Entergy, 2011; PSEG Nuclear, 2009; Constellation Energy, 2004; Exelon, 2005; Entergy, 2006b; Exelon, 2003b; AmerGen, 2008).

Nuclear Plant	Weighted Population Dose Risk (person-rem/year)	Weighted Population Dose Risk Cost ($/year)	Offsite Economic Risk Cost ($/year)	Percentage Change in Off-Site Economic Cost over Off-Site Economic Exposure Cost
Dresden	10.23	$20,460.00	$18,408.00	-10.0%
Grand Gulf	0.486	$972.00	$1,240.00	+27.6%
Hope Creek	22.9	$45,800.00	$155,000.00	+238.4%
Nine Mile Point Unit 1	22.5	$45,000.00	$86,000.00	+91.1%
Nine Mile Point Unit 2	50.9	$101,800.00	$125,000.00	+22.8%
Oyster Creek	36	$72,000.00	$118,000.00	+63.9%
Pilgrim	13.6	$27,200.00	$45,900.00	+68.8%
Quad Cities	1.67	$3,340.00	$2,806.87	-16.0%
Three Mile Island Unit 1	32.61	$65,220.00	$112,259.00	+72.1%

35. (MGM) Economic risk to the east of Limerick is dominated by the economic productivity of the city of Philadelphia and its surrounding region. The 2010 gross domestic product for all industries in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area which lies within the Limerick 50-mile zone was computed to be $347 billion, or more precisely $346,932,000,000.00 (Bureau of Economic Analysis, 2011). Personal income summaries for the 23 counties in Delaware, Maryland, New Jersey and Pennsylvania which substantially overlap the 50-mile zone around Limerick is given in Table 4 (Bureau of Economic Analysis, 2011). The sum of 2009 personal income in the three Pennsylvania counties that overlap the 10-mile EPZ is approximately $93 billion, and the sum of 2009 personal income in all of the counties that substantially overlap the 50-mile zone around Limerick is approximately $497 billion.

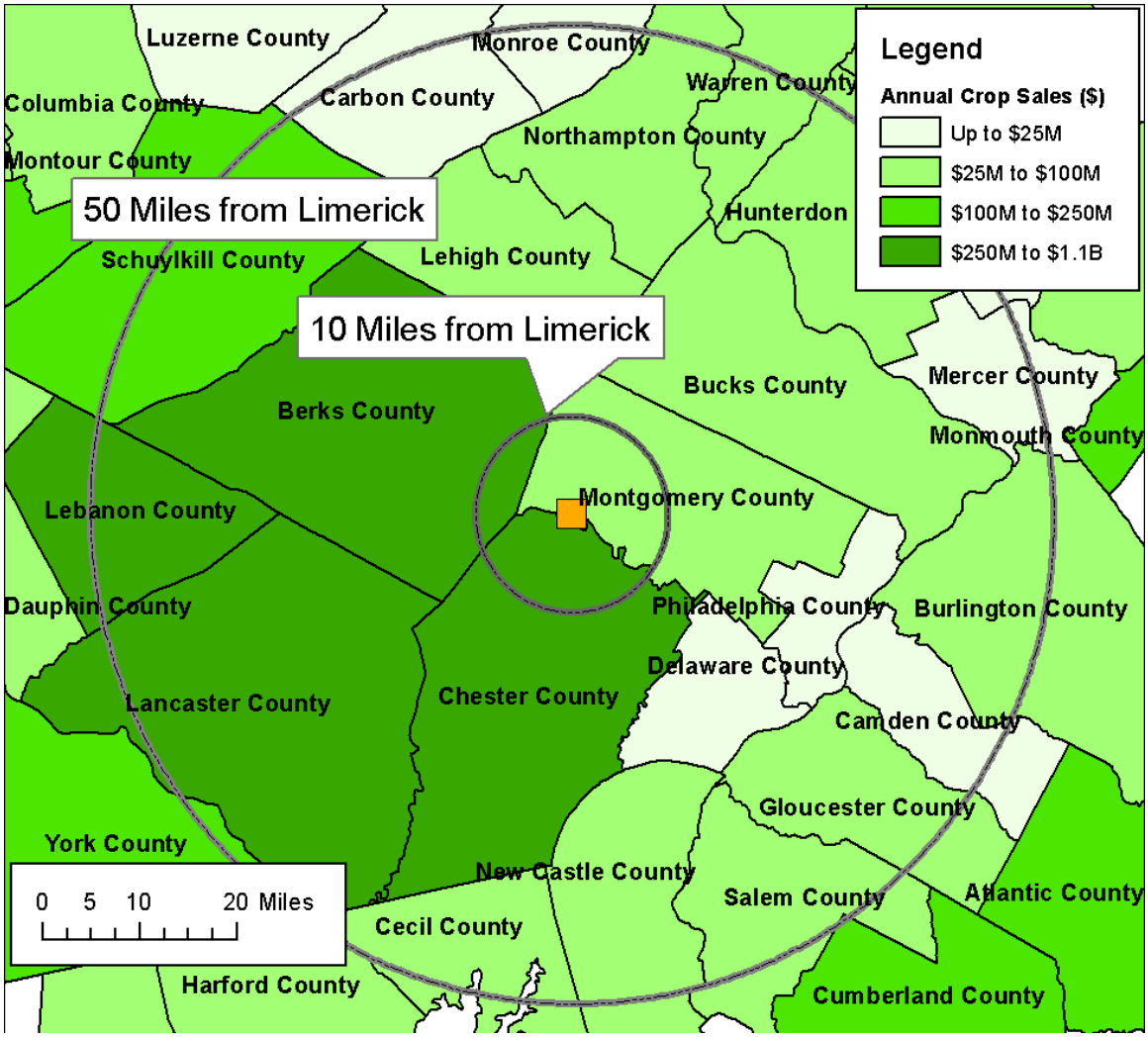
36. (MGM) Table 4: Personal income in dollars for the year 2009 summed for the indicated county (Bureau of Economic Analysis, 2011).

County Name, State	2009 Personal Income Summed by County
Counties Overlapping the Limerick 10-mile EPZ	
Berks County, PA	$14,793,423,000.00
Chester County, PA	$28,453,609,000.00
Montgomery County , PA	$49,654,050,000.00
Total in Counties Overlapping 10-mile EPZ	***$92,901,082,000.00***
Counties Outside the Limerick 10-mile EPZ and Overlapping the 50-mile zone	
Bucks County, PA	$31,862,647,000.00
Carbon County, PA	$2,007,062,000.00
Delaware County, PA	$27,524,171,000.00
Lancaster County, PA	$18,450,403,000.00
Lebanon County, PA	$4,809,208,000.00
Lehigh County, PA	$13,586,500,000.00
Monroe County, PA	$5,298,681,000.00
Northampton County, PA	$11,152,782,000.00
Philadelphia County, PA	$54,125,507,000.00
Schuylkill County, PA	$4,569,375,000.00
Total Pennsylvania	***$359,188,500,000.00***
New Castle County, DE	$23,500,800,000.00
Total Delaware	***$23,500,800,000.00***
Cecil County, MD	$3,715,479,000.00
Total Maryland	***$3,715,479,000.00***
Burlington County, NJ	$20,751,126,000.00
Camden County, NJ	$21,379,186,000.00
Gloucester County, NJ	$11,478,111,000.00
Hunterdon County, NJ	$8,497,001,000.00
Mercer County, NJ	$19,024,257,000.00
Salem County, NJ	$2,541,629,000.00
Somerset County, NJ	$22,679,780,000.00
Warren County, NJ	$4,673,941,000.00
Total New Jersey	***$111,025,031,000.00***
Total	***$497,429,810,000.00***

37. (MGM) Agriculture is an important component to the economic risk to the west of Limerick has. As an example of data pertinent to determining economic risk that is absent from the Limerick FES Supplement but found universally in SAMA analyses conducted

for other BWR License Renewal Applications, I have displayed U.S. Bureau of Agriculture statistics on crop sales by county within the 50-mile zone around Limerick in Figure 2 (USDA, 2011). As can be seen in this figure, Lancaster County to the southwest of Limerick had over $1 billion in crop sales in 2007, Chester Counties had about one-half billion dollars in crop sales in 2007, and Berks County had bout $400 million in crops sales in 2007 (USDA, 2011).

38. (MGM) Figure 2: US Bureau of Agriculture data on annual crop sales in the area surrounding Limerick in 2007 (USDA, 2011).



39. (CJW) As documented in a number of studies on considerations for decontamination costs (Chanin, 1996; Luna, 2008), the cost to cleanup fission products in a densely populated and developed region, such as the Philadelphia metropolitan area, could be significantly larger on a per capita basis than previously estimated. The reports state that input parameters used in analyses for less densely populated areas are inappropriate for highly populated urban areas. Without considerable modifications to the input values used by accident consequence codes such as MELCOR Accident Consequences Code System (MACCS2), the analysis could result in large underestimations of the decontamination costs associated with the off-site economic costs of a severe accident.

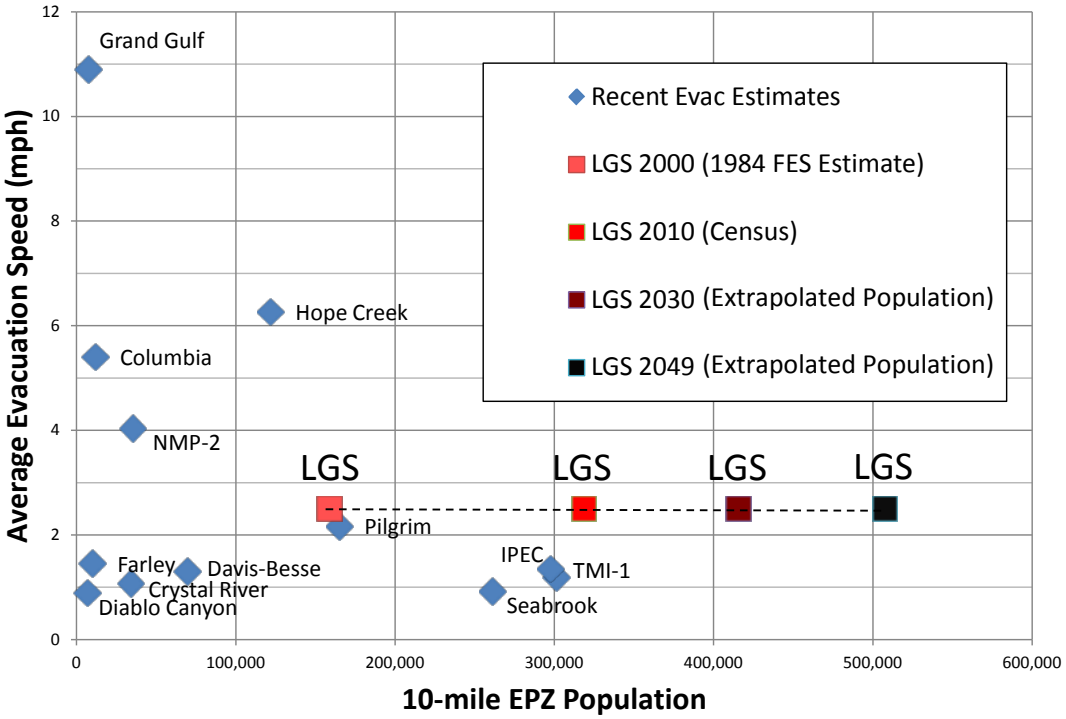
THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT USE FLAWED EVACUATION SPEED ASSUMPTIONS

40. (CJW) An important step in calculating the offsite exposures for a SAMA analysis is to accurately model the evacuation within the 10-mile Emergency Planning Zone (EPZ). A typical nuclear accident evacuation assumption is a 95% response, i.e. 5% of the population does not evacuate during an accident. Other site-specific parameters needed for accurate evacuation modeling are the evacuation start time delay, and the radial evacuation speed. These input parameters can be obtained from the emergency action plans for the site in question, and studies on the evacuation dynamics which incorporates information such as the road network, traffic congestion, and other external effects (KLD, 2003).
41. (CJW) The 2005 Nuclear Energy Institute SAMA Guidance Document, which the NRC staff recommends using during license renewal, states: “Population dose may be significantly affected by radial evacuation speed, and uncertainties may be introduced

during derivation of a single evacuation speed from emergency plan information… Therefore, perform sensitivity analysis to show that variations in this parameter would not impact the results of the analysis." (NEI, 2005). The evacuation modeling performed in the 1984 FES appears to overestimate the evacuation speed based on comparisons with SAMA analyses in support of other reactor re-licensing, and does not include an uncertainty analysis.

42. (CJW) The only evacuation speed that was assumed in the 1984 Limerick evacuation modeling was 2.5 miles per hour (mph). The Indian Point Energy Center (IPEC) estimated that the evacuation of their entire EPZ, containing about 297,000 permanent residents, would take 9.25 hours, including a 2-hour delay, or mobilization time, for the start of evacuation (KLD, 2003). Factoring in this mobilization time would result in an actual evacuation duration for IPEC of 7.42 hours, resulting in an average evacuation speed of 1.35 mph. Both the year 2010 and projected year 2049 population within the Limerick EPZ are greater than that for IPEC, and suggest that an updated analysis of the evacuation scenarios needs to be performed for Limerick to account for the likely reduction in evacuation speeds. A reduced evacuation speed would likely increase the offsite exposure following a release because the complete dose is dependent on the exposure time. The evacuating population could remain in the plume pathway for extended periods in turn increasing their dose, which could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different benefit/cost results in a new SAMA analysis for Limerick. Figure 3 plots evacuation speeds assumed in selected SAMA analyses against the total population within the 10-mile EPZ.

43. (CJW) Figure 3: A chart of base case evacuation speeds plotted against EPZ populations from License Renewal Application SAMA analyses for selected nuclear power plants (blue diamond symbols). The populations for the Limerick EPZ is given for the FES Supplement (light red square symbol), the 2010 Census (red square symbol), and population extrapolations to the year 2030 (dark red square symbol) and to the year 2049 (black square symbol).



44. (CJW) Finally, the FES Supplement for Limerick does not contain a sensitivity analysis with regard to evacuation speeds as described in the NRC SAMA guidance document. SAMA analyses for other nuclear power plants have provided the results of a sensitivity analysis, exploring the offsite exposure doses as a percentage change from the base speed result. I find that doses are characteristically determined for a 50% reduction in the evacuation speed, for which the resulting collective dose ranges anywhere from a few percent difference to as much as 15 percent higher. Therefore the sensitivity analysis

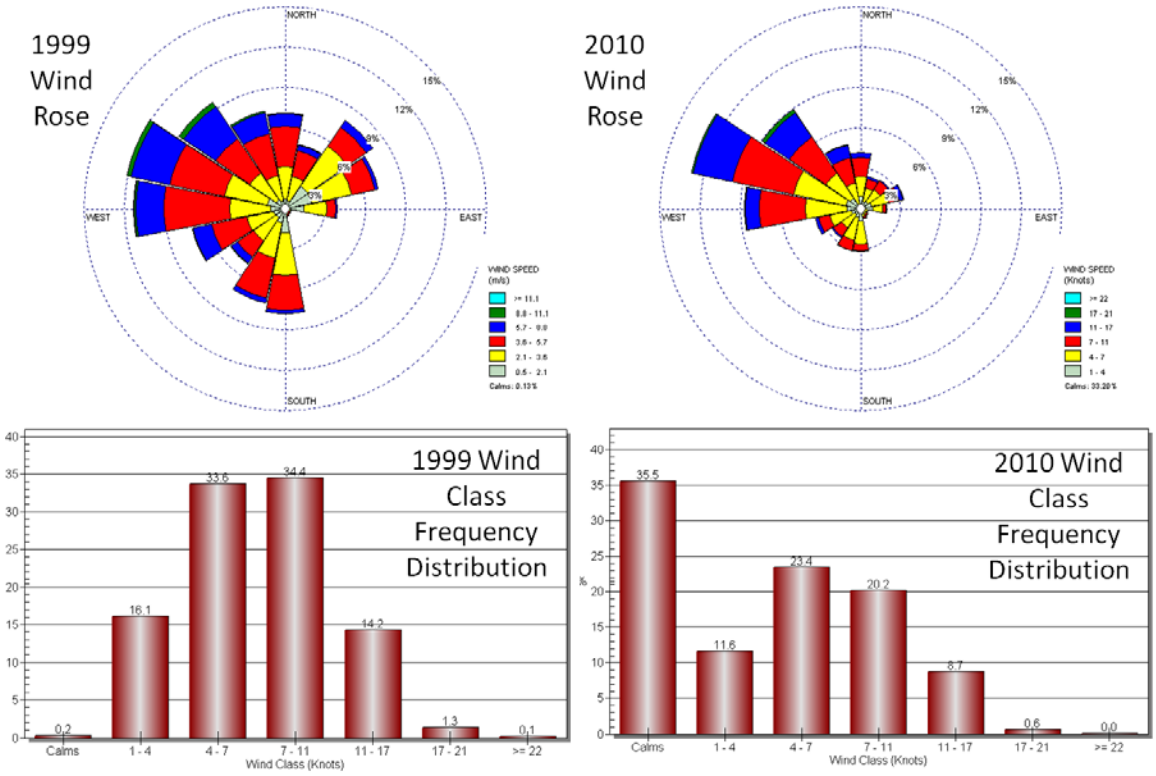
performed for SAMA analysis at other nuclear power plants reinforces that a reduction in evacuation speed from an updated SAMA analysis for Limerick could materially alter the assessment of impacts of a severe accident and the cost- benefit results of certain mitigation alternatives.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT RELY ON 1976 METEOROLOGY

45. (MGM) The Limerick FES Supplement relies on hourly wind data measurements for the single year 1976 (NRC, 1984). A review of other SAMA analyses submitted for License Renewal demonstrates that applicants used information current to the relicensing period, and screened wind data to determine whether this meteorology was characteristic of the site or represented atypical weather patterns. The SAMDA analysis in the Limerick FES Supplement is deficient in that the averaged wind speed along 16 compass directions used in the cost-benefit calculations would predate the end of the license renewal period by as much as 73 years. Nor has Exelon demonstrated that it determined the wind data for 1976 is characteristic of the site. Meteorological data, in particular prevailing wind directions and speeds, is a significant component in establishment of the baseline consequences of a severe accident, particularly when the population is clustered in an urban center along several compass directions downwind from the nuclear power plant.
46. (MGM) I have reviewed and analyzed hourly historical weather data from the Pottstown, Pennsylvania weather station, named KPTW, maintained by the Federal Aviation Administration. This weather station is located at latitude 40.240 North, longitude 75.550 West, which is approximately two miles northeast of Limerick. I downloaded hourly wind data at this station for the available years beginning in 1999 (Penn State, 2011), and

created wind rose and wind class frequency distribution charts using the software WRPLOT View by Lakes Environmental. Yearly-averaged wind roses and wind class frequency distributions at Pottstown are shown for the year 1990 and the year 2010 in Figure 4. I have found that the 1999 meteorology differs significantly from the 2010 meteorology for Pottstown. In 1999, northerly, northeasterly and southerly winds are a significant component to the wind rose, whereas in 2010 the winds are dominated by north-northwesterly, northwesterly and westerly winds, which is a pattern more like the 1976 data used for the Limerick SAMDA analysis (NRC, 1984). I have found that the wind class frequency distributions for 1999 and 2010 are also very different: 1999 was a much windier year in Pottstown, the most probable wind class for 2010 in Pottstown being calm. With respect to the Limerick SAMDA, wind data needs to be analyzed for representative patterns for direction and speed to properly estimate the off-site dose to surrounding populations.

(MGM) Figure 4: Yearly-averaged wind rose data from the Federal Aviation Administration's KPTW station located in Pottstown, Pennsylvania, approximately two miles northeast of Limerick. Shown at left are the 1999 wind rose and wind class frequency distribution, and shown at right are the 2010 wind rose and wind class frequency distribution.



47. (MGM) In addition, a 2008 study by Pennsylvania State University projects a warmer, wetter Pennsylvania, with a longer growing season and significantly less snow by the middle of the current century (Shortle, 2009). These predicted changes in the Pennsylvania climate could plausibly case a materially different result in analyzing the baseline consequences of a severe accident as winds and atmospheric stability depend strongly on ambient temperature.

SUMMARY: NEW AND SIGNIFICANT INFORMATION COULD MATERIALLY ALTER THE ASSESSMENT OF IMPACTS OF A SEVERE ACCIDENT AND THE COST-BENEFIT RESULTS OF MITIGATION ALTERNATIVES AT LIMERICK, INCLUDING NEW SAMA CANDIDATES

48. (TBC, MGM, CJW) A SAMA analysis entails five main steps: (1) the establishment of the baseline consequences of a severe accident, including off-site exposure costs and off-site economic costs; (2) the identification of SAMA candidates; (3) preliminary or Phase I screening of SAMA candidates; (4) final or Phase II Screening and cost-benefit evaluation of SAMA candidates; and (5) sensitivity analysis. We find that the Limerick FES Supplement is inadequate regarding all five steps of the SAMA analysis process. Building on industry lessons learned and NRC studies, hundreds of SAMA candidates have been identified for BWRs since the Limerick FES Supplement was published in 1989, and numerous SAMA candidates for BWRs have been analyzed to be cost-beneficial or potentially cost-beneficial in reducing risk. The Limerick FES Supplement relies on outdated and inappropriate population data, evacuation speeds and meteorology, neglects to calculate economic costs entirely, and uses $1000 per person-rem for dose risk costs, rather than $2000 per person-rem. A sensitivity analysis was not performed in the FES Supplement. These problems are not remedied in the 2011 Limerick Environmental Report.

49. (TBC, MGM, CJW) Our review of 18 SAMA analyses prepared by other BWR License Renewal applicants demonstrate that accurate site-specific data leads to results pertinent to individual cases. For example, the SAMA analysis for Hatch concluded that: “The area surrounding HNP is predominantly agricultural and forested land with sparse population. As a result, the baseline risk of the plant is low both for population doses and economic risk. This limits the potential averted risk from any severe accident modifications.”

(Southern Nuclear Operating Company, 2000). Limerick represents an opposite extreme case from Hatch, as Limerick is located in an area of high population density and high economic productivity. We have found that new information in seven areas – 1) additional SAMA candidates analyzed for BWRs; 2) additional accident scenarios analyzed for BWRs; 3) real world information regarding reactor core damage frequency; 4) population within 50 miles Limerick; 5) economic consequences from accident scenarios at Limerick; 6) evacuation speed assumed during accident scenarios at Limerick; and 7) meteorology at Limerick – are plausibly significant. Taken individually and in combination, this new information would plausibly cause a materially different result in the SAMA analysis for Limerick. Given that applicants are required by law to perform a SAMA analysis for License Renewal as a component of assessing environmental impacts under NEPA, Exelon's License Renewal Application would therefore be incomplete.

Pursuant to 28 U.S.C. § 1746, we declare that the foregoing is true and correct to the best of our knowledge, information and belief, and that this declaration was executed in Washington, DC on November 22, 2011.

/s/ Dr. Thomas B Cochran (electronic signature approved)

/s/ Dr. Matthew G. McKinzie (electronic signature approved)

/s/ Dr. Christopher J. Weaver (electronic signature approved)

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Attachment A: Curriculum Vitae for Thomas B. Cochran

Dr. Thomas B. Cochran is a consultant to the Natural Resources Defense Council (NRDC) where he began working in 1973. Prior to retiring in 2011, he was a senior scientist and held the Wade Greene Chair for Nuclear Policy at NRDC, and was director of its Nuclear Program until 2007. He has served as a consultant to numerous government and non-government agencies on energy, nuclear nonproliferation, nuclear reactor and nuclear waste matters. He is a member of the Department of Energy's Nuclear Energy Advisory Committee (NEAC) and three of its subcommittees: the NEAC Nuclear Reactor Technology Subcommittee, the NEAC Infrastructure/Facilities Subcommittee and the NEAC International Subcommittee. Previously he served as a member of DOE's Environmental Management Advisory Board, Fusion Energy Sciences Advisory Board and Energy Research Advisory Board, the Nuclear Regulatory Commission's Advisory Committee on the Cleanup of Three Mile Island and the TMI Public Health Advisory Board.

Dr. Cochran initiated NRDC's Nuclear Weapons Databook Project. He also initiated a series of joint nuclear weapons verification projects with the Soviet Academy of Sciences. These include the Nuclear Test Ban Verification Project, which demonstrated the feasibility of utilizing seismic monitoring to verify a low-threshold test ban, and the Black Sea Experiment, which examined the utility of passive radiation detectors for verifying limits on sea-launched cruise missiles.

Dr. Cochran is the author of *The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique* (Washington, DC: Resources for the Future, 1974); and co-editor/author of the *Nuclear Weapons Databook, Volume I: U.S. Nuclear Forces and Capabilities* (Cambridge, MA: Ballinger Press, 1984); *Volume II: U.S. Nuclear Warhead Production* (1987); *Volume III: U.S. Nuclear Warhead Facility Profiles* (1987); *Volume IV: Soviet Nuclear Weapons* (1989); and *Making the Russian Bomb: From Stalin to Yeltsin* (Boulder, CO: Westview Press, 1995). In addition, he has published numerous articles and working papers, including those in *SIPRI Yearbook* chapters, *Arms Control Today*, and the *Bulletin of the Atomic Scientists*. He has co-authored (with Dr. Robert S. Norris) the article on "Nuclear Weapons" and in the 1990 printing of *The New Encyclopedia Britannica* (15th edition), revised and updated in the *Encyclopedia Britannica*, 2011 Ultimate DVD (Copyright 2010, Encyclopedia Britannica**).**

Dr. Cochran's publications can be found at http://www.nrdc.org/nuclear/cochran/cochranpubs.asp One of his most recent publications (with Christopher E. Paine) is "Nuclear Islands: International Leasing of Nuclear Fuel Cycle Sites to Provide Enduring Assurance of Peaceful Use," *The Nonproliferation Review*, Vol. 17, No. 3, November 2010, pp. 441-474.

Dr. Cochran received his Ph.D. in Physics from Vanderbilt University in 1967. He was assistant Professor of Physics at the Naval Postgraduate School, Monterey, California, from 1967 to 1969, Modeling and Simulation Group Supervisor of the Litton Mellonics Division, Scientific Support

Laboratory, Fort Ord, California, from 1969 to 1971, and from 1971 to 1973, he was a Senior Research Associate at Resources for the Future.

Dr. Cochran is the recipient of the American Physical Society's Szilard Award and the Federation of American Scientists' Public Service Award, both in 1987. As a consequence of his work, NRDC received the 1989 Scientific Freedom and Responsibility Award by the American Association for the Advancement of Science (AAAS). Dr. Cochran is a Fellow of the American Physical Society and the AAAS and a member of the American Nuclear Society, the Health Physics Society and Sigma Xi.

Attachment B: Curriculum Vitae for Matthew G. McKinzie

EDUCATION

Ph.D. (experimental nuclear physics): 1995; University of Pennsylvania, Philadelphia, PA; Dissertation Advisor: Prof. H. T. Fortune; Dissertation Title: "Inelastic Scattering and Single and Double Charge Exchange Reactions within the A=27 Isobaric Multiplet"

B.A. (physics): 1988; Bard College, Annandale-on-Hudson, NY

EMPLOYMENT HISTORY

July 2007- present: Senior Scientist, Nuclear Program and Lands and Wildlife Program, **Natural Resources Defense Council**, 1200 New York Ave., N.W., Suite 400, Washington, DC

June 1997 - June 2003: Project Scientist, Nuclear Program, **Natural Resources Defense Council**, 1200 New York Ave., N.W., Suite 400, Washington, DC

September 1995 – May 1997: Postdoctoral Associate, Peace Studies Program, Mario Einaudi Center for International Studies, **Cornell University**, Ithaca, NY

June 1988 – July 1995: Graduate Research Assistant, Department of Physics, **University of Pennsylvania**, Philadelphia, PA

Summers 1988-1992: Summer Graduate Research Student, **Los Alamos National Laboratory**, Los Alamos, NM

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D. R. Benton, H. T. Fortune, J. M. O'Donnell, R. Crittenden, M. McKinzie, E. Insko, R. Ivie, D. Smith, and J. D. Silk, "Pion double charge exchange on nickel isotopes and generalized seniority," *Physical Review C (Nuclear Physics)* **47**, pg. 140 (1993).

Attachment C: Curriculum Vitae for Christopher J. Weaver

EDUCATION

Ph.D., Mechanical Engineering – Nuclear & Radiation Engineering Program, May 2011
University of Texas at Austin

Master of Science, Mechanical Engineering – Nuclear & Radiation Engineering Program, May 2008
University of Texas at Austin

Bachelor of Science, Physics, December 2005
Louisiana State University (Baton Rouge, LA)

PROFESSIONAL EXPERIENCE

- **Natural Resources Defense Council (NRDC), Washington, D.C. (July 2011 – Present)**
    - Project Scientist – Nuclear Program
    - Science Center Fellow
- **University of Texas at Austin, Austin, TX (Sept 2006 – May 2011)**
    - Graduate Research Assistant

RESEARCH EXPERIENCE

- **Nuclear Engineering Teaching Laboratory (NETL), UT Austin (Sept 2006 – May 2011)**
    - Developed PYRAMDS (Python for Radioisotope Analysis and Multi-Detector Suppression) code for the analysis of List Mode gamma detector data with a focus on fission product detection limit improvements through the use of a multi-detector system (Dissertation Research).
    - Developed an aerosol sampler to improve detection in nuclear explosion monitoring through the use of cascade impactors. Including design, manufacture, and performance characterization of said aerosol sampler as deliverables (Thesis Research).
    - Provided operational support during field tests for Signature Science, LLC (Austin, TX) to develop atmospheric aerosol samplers. Personal focus on the applicability of radioactive sample collection and analysis.
    - Co-developed research project proposing a hypothetical advanced fuel cycle partnership in Southeast Asia for presentation at GLOBAL 2009 (Paris, France).

Focus on fuel cycle simulation and economic analysis during steady-state environment.

- Conducted initial dissertation research at Argonne National Laboratory in Chicago, IL as part of a 10-week fellowship practicum. ORIGEN modeling of various reactor operational schemes for forensic signatures.
- Conducted environmental sample analysis via neutron activation analysis (NAA) on local fishes. Focus on heavy metal uptake in the liver and flesh of samples.
- Summer Student Laboratory - Taught/conducted various lab classes about radiation statistics and radioanalytical processes (spectroscopy, activation analysis).
- TA for various classes - Presented lectures, administered tests, and grading.

- **ALLEGRO Gravitational Wave Group, LSU (Jan 2003 – Dec 2005)**
  - Assisted with redesign and maintenance of vacuum and cryogenics systems (liquid helium, nitrogen).
  - Designed/built noise- and vibration-proof vacuum pump enclosures to reduce interference with the acoustically and seismically sensitive experiment apparatus.
  - Redesigned and coded research group website front end.
- **Experimental Condensed Matter and Superconductivity Group, LSU (Jan 2002 – Jan 2003)**
  - Repaired cryostat units for quantum phase transition measurements of silicon-based magnetic semiconductors.
  - Performed research duties such as sample preparation, including smelting, annealing, EDM sample cutting, polishing, and liquid helium & nitrogen transfers.

CONFERENCE PRESENTATIONS

- "A Regional Advanced Fuel Cycle Partnership in Southeast Asia" – GLOBAL 2009 Paris, France. Sept 6 – 11, 2009
- "Assessment of non-traditional isotopic ratios by mass spectrometry for analysis of nuclear activities" – MARC VIII Kona, Hawaii April 4 – 11, 2009
- "Evaluation of Heavy Metal Uptake in Micropterus Salmoides (Largemouth Bass) of Lake Austin, TX by Neutron Activation Analysis" – MARC VIII Kona, Hawaii April 4 – 11, 2009
- "Design of Aerosol Sampler to Remove Radon and Thoron Progeny April 4 – 11, 2009

Interference from Aerosol Samples for Nuclear Explosion Monitoring" – MARC VIII Kona, Hawaii

- "Testing of Aerosol Sampler to Remove Radon and Thoron Progeny Interference from Aerosol Samples for Nuclear Explosion Monitoring," 29th Monitoring Research Review (MRR 2007) — Sept 26 – 28, 2007

PUBLICATIONS

- B. Buchholz, S. Bieglaski, S. Whitney, S. Tumey, J. Weaver "Basis for developing samarium AMS for fuel cycle analysis," *Nucl. Instr. Meth. Phys. B* (2010) 268 p. 773-775 — April 2010
- J. Weaver, S. R. F. Biegalski, B. A. Buchholz "Assessment of non-traditional isotopic ratios by mass spectrometry for analysis of nuclear activities," *J Radioanal Nucl Chem.* (2009) 282 p. 709-713. — Dec 2009
- J. Weaver, S. R. F. Biegalski, A. Brand, E. J. Artnak "Design of aerosol sampler to remove radon and thoron progeny interference from aerosol samples for nuclear explosion monitoring," *J Radioanal Nucl Chem*. (2009) 282 p. 687-692. — Dec 2009
- J. Weaver, W. H. Wilson, S. R. F. Biegalski, D. J. O'Kelly "Evaluation of heavy metal uptake in micropterus salmoides (Largemouth Bass) of Lake Austin, TX by neutron activation analysis," *J Radioanal Nucl Chem*. (2009) 282 p. 443-447. — Nov 2009
- S. Biegalski, J. Weaver, S. Waye, O. Ezekoye, and P. Hopke "Testing of Aerosol Sampler to Remove Radon and Thoron Progeny Interference from Aerosol Samples for Nuclear Explosion Monitoring," *29th Monitoring Research Review (MRR 2007) Proceedings*, Denver, CO, p. 719-728. — Sept 26 – 28, 2007
- M. McHugh, W. Johnson, W. Hamilton, J. Hanson, I. Heng, D. McNeese, P. Miller, D. Nettles, J. Weaver, P. Zhang "Calibration of the ALLEGRO resonant detector," *Class. Quantum Grav*. (2005) 22 p. S965-S973 — Aug 2005

ACTIVITIES & HONORS

- Nuclear Forensics Graduate Fellowship Recipient – U.S. Dept of Homeland Security Domestic Nuclear Detection Office (DNDO) — Sept 2008 - Dec 2010
- President, American Nuclear Society – UT Austin Chapter — June 2008 – July 2009
- George A. Heuer, Jr. Ph.D. Endowed Graduate Fellowship Recipient – UT Austin — Fall/Spring 2007
- Victor L. Hand Endowed Scholarship Recipient – UT Austin — Fall/Spring 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter Of	**)**	
	)	
EXELON GENERATION COMPANY, LLC,	**)**	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station)	**)**	

(License Renewal Application)

DECLARATION OF CHRISTOPHER E. PAINE
OF THE NATURAL RESOURCES DEFENSE COUNCIL

INTRODUCTION

I, Christopher Eliot Paine, declare that the following statements are true and correct to the best of my knowledge:

1. I direct the Nuclear Program of the Natural Resources Defense Council (NRDC), from its office in Washington, D.C., where I have been continuously employed for the past 20 years. In this capacity, I participate in intra-organizational deliberations with NRDC power generation and energy efficiency experts concerning the role of nuclear power in the generation mix, and concerning the cost-effective low-carbon alternatives to the construction of new nuclear power plants. In 2010 I authored the publication: "The Nuclear Fuel Cycle, Global Security, and Climate Change: Weighing the Costs and Benefits of Nuclear Power Expansion," [*University of Richmond Law Review*, Vol. 44, Number 3, 66 pages, March 2010], and I have given numerous presentations in the United States and abroad on the risks and benefits of nuclear power.
2. Before joining NRDC I worked for five years as a nuclear arms control, nonproliferation, and nuclear energy adviser to former Senator Edward M. Kennedy of Massachusetts, in

which capacity I performed, among other duties, congressional oversight of NRC licensing activities. Before joining Senator Kennedy's office, I was staff consultant for nuclear nonproliferation policy with the House Subcommittee on Energy, Conservation & Power, consultant to Princeton University's Project on Nuclear Policy Alternatives, legislative director for the Physicians for Social Responsibility, and research fellow at the Federation of American Scientists. I am the author or co-author of dozens of journal articles and NRDC reports on topics involving the civil and military applications of nuclear energy. I received my B.A. in Economics from Harvard College in 1974. My curriculum vitae is provided in Attachment A.

3. On June 22, 2011, the Nuclear Regulatory Commission (NRC) received a License Renewal Application for Limerick Generating Station (LGS) Unit 1 and Unit 2 from the licensee, Exelon Generation Company, LLC ("Exelon"). The operating license for Unit 1 currently expires on October 26, 2024, and the operating license for Unit 2 currently expires on June 22, 2029. The two nuclear power plant units at Limerick are General Electric Boiling Water Reactors (BWR) with Mark II containment structures. Exelon seeks to extend the operation of Unit 1 until the year 2044, and Unit 2 until the year 2049.
4. Exelon has submitted an Environmental Report in conjunction with its License Renewal Application that does not adequately consider the environmental consequences of the "No Action" Alternative. Specifically the ER unreasonably misapplies NRC guidance from the 1996 Generic Environmental Impact Statement (GEIS) that limits the set of reasonable alternatives for meeting "a defined generating requirement… to analysis of single, discrete electric generation sources." (GEIS, 1996, cited at ER, 7-2). As a consequence of this misapplication, the ER arbitrarily limits and unfairly conflates

consideration of the No Action alternative with the same set of alternatives that it deems reasonable for analysis as "single discrete electric generation sources."

5. According to the ER, "Unless replacement generating capacity is provided as part of the no-action alternative, a large amount of base-load generation would no longer be available, and the alternative would not equivalently satisfy the purpose and need for the proposed action. For this reason, the no-action alternative is defined as having two components—replacing the generating capacity of LGS and decommissioning the LGS facility." (ER, 7-3). But, almost by definition, analysis of the No-Action alternative does not involve consideration of alternatives that would "equivalently satisfy the purpose and need for the proposed action," and therefore the required NEPA consideration of "No Action" cannot reasonably be equated with "replacing the generating capacity of LGS," or limited to an analysis of this particular problem.
6. Unlike the Applicant's selection of individual utility-scale power plant alternatives that it subjectively deems reasonable and appropriate to its own business purpose of generating and selling electricity to replace LGS, the likely evolution of electricity system resources in the areas of PJM Interconnection ("PJM") served by LGS is an empirical and analytical question that necessarily involves the consideration of multiple socio-economic factors and technological trends – not merely those deemed appropriate to pursuit of the applicant's specific business interest.
7. Unlike consideration of reasonable alternatives to meet the "defined generating requirement" represented by a particular "baseload" nuclear power plant, mandatory consideration of the environmental impacts of the No Action Alternative – defined as a decision not to relicense LGS Units 1 and 2 -- necessarily involves making an informed

projection of the likely portfolio of PJM electricity system resources available in the region served by LGS beginning 13 years and 18 years hence that could reasonably be expected to supply the energy services currently supplied by LGS. These reasonably foreseeable system resources include all forms of Demand Side Management (DSM), waste heat co-generation, combined heat and power, and distributed renewable energy resources, in addition to the "single, discrete electric generation sources" reviewed by the Applicant as reasonable alternatives to extended operation of Limerick's base load capacity. The ER's analysis of the No Action Alternative fails to consider the environmental impacts of this reasonably foreseeable portfolio of PJM system resources, and thus fails to make the required comparison between the environmental impacts of No Action and the continued operation of LGS for an additional 20 years.

8. The Applicant, Exelon Generation Company, LLC, claims that as a merchant generating company with no direct "business connection" with energy consumers, it is not well-positioned to make the integrated projection of system resources, including all forms of DSM, that could plausibly emerge on the PJM system to replace the energy services supplied by LGS. According to Applicant Exelon Generation's environmental report: "... a private company engaged in generating energy for the wholesale market, such as Exelon Generation, has no business connection to the end users of its electricity and, therefore, no ability to implement DSM. Because a company whose sole business is that of generating electricity and selling energy at wholesale has no ability to implement DSM, the NRC determined that NEPA does not require that an alternative involving electricity demand reduction through DSM be considered when the project purpose is to

authorize a power plant to supply existing and future electricity demand (NRC, 2005)." [ER, p. 7-16]

9. While this may be a fair assessment of the capacities of Exelon Generation Company, LLC, it is not a fair characterization of the business and abilities of the parent company, Exelon. Here is the self-description of subsidiary Exelon Energy's business, from the Exelon website: "As one of the *largest retail energy suppliers* in the country, Exelon Energy delivers traditional *and alternative energy options* to commercial and industrial businesses. Customers have counted on Exelon Energy to provide reliable and cost-effective electricity and natural gas products since 1997. Exelon Energy markets electricity to customers in Illinois and Pennsylvania, and natural gas to customers in Illinois, Michigan, Ohio. Western Pennsylvania customers may choose Exelon Energy as their natural gas supplier. Exelon Energy's locally-based sales representatives have a wealth of experience in energy products and services and bring a depth of knowledge to *the retail energy markets we serve*. They work closely with our customers to develop immediate and long-term energy strategies. Our performance is best proven by our customer loyalty—the vast majority of our customers continue to do business with Exelon Energy year after year."
[http://www.exeloncorp.com/energy/marketing/overview.aspx, emphasis added]. It would appear that parent company Exelon actually does have a "direct business connection" with industrial and commercial electricity customers, and "depth of knowledge" regarding this retail energy market, which, I would note, is ripe with opportunities for demand reduction and, as Exelon Energy itself notes, "alternative energy options."

10. I further note that the Applicant's citation above, to the NRC's determination that NEPA does not require electricity demand reduction through DSM be considered when *the project purpose is to authorize a power plant*, does not reasonably apply to consideration of the No Action Alternative, which involves no such singular purpose, but rather necessarily involves a broader assessment of the likely evolution of electricity system resources over time in response to an NRC determination not to relicense Limerick.
11. In light of the information presented above, the Licensing Board must determine whether it is reasonable to require the Applicant, given its professed lack of expertise regarding DSM and electricity consumers, to complete the required analysis of the No Action Alternative, or whether the NRC staff should perform this assessment in the course of incorporating the Applicant's ER into a draft and final SEIS. What is clear, however, is that NEPA requires such an assessment, and someone is obliged to do it.
12. Moreover, some policy makers in the region served by Limerick Units 1 and 2, will want to consider as a "No Action Alternative" paying higher costs for replacement power in order to avoid all subsequent risks associated with the entire spectrum of potential future nuclear accidents at Limerick Units 1 and 2, including the potential for a severe accident involving a large source term release with winds blowing in a unfavorable direction. In order to properly weigh the costs and benefits of pursuing this alternative, the ER and EIS should present a spectrum of potential releases and their effects along the lines of the referenced analysis that NRDC performed with respect to the Indian Point nuclear plants [See analysis at http://www.nrdc.org/nuclear/indianpoint/files/NRDC-1336_Indian_Point_FSr8medium.pdf]

Pursuant to 28 U.S.C. § 1746, I declare that the foregoing is true and correct to the best of my knowledge, information and belief, and that this declaration was executed in Washington, DC on November 22, 2011.

/s/Christopher E. Paine (electronic signature approved)

References

Exelon Generation Company, LLC (Exelon). 2011. Applicant's Environmental Report Operating License Renewal Stage, Limerick Generating Station, Units 1 and 2, Docket Numbers 50-352 and 50-353, License Numbers NPF-39 and NPF-85, June.

Natural Resources Defense Council (NRDC), 2011. Nuclear Accident at Indian Point: Consequences and Costs, appended to his declaration as Attachment A.

U.S.NRC, 1996. Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants (NUREG-1437 Vol. 1)

Attachment A: Curriculum Vitae for Christopher E. Paine

EDUCATION

Harvard University, B.A. Economics, 1974

Certificate of Training, US Department of Energy, Course in Nuclear Nonproliferation, Washington, D.C., and Los Alamos, N.M., September-October, 1990.

EMPLOYMENT SUMMARY

8/07/- present: *Director, Nuclear Program, Natural Resources Defense Council, Washington, D.C.*

6/91 – 7/07: *Senior Analyst and Deputy Director, NRDC Nuclear Program*

2/87 - 5/91: *Legislative Assistant for Nuclear Energy and Arms Control, Office of Sen. Edward M. Kennedy, United States Senate, Washington, D.C.*

9/86 - 12/87: *Visiting Scholar, Defense and Arms Control Program, Center for International Studies, MIT,* and *MacArthur Writing Fellow-in-residence, Federation of American Scientists, Washington, D.C.*

10/85 - 12/87: *Senior Consultant, Project on Nuclear Policy Alternatives, Center for Energy and Environmental Studies (CEES), Princeton University.*

6/85 - 9/86*: Staff Consultant for Nuclear Nonproliferation Policy, Subcommittee on Energy Conservation and Power, U.S. House of Representatives.*

11/83 - 5/85: *Senior Policy Analyst and Washington Director, Physicians for Social Responsibility;* and *consultant, "Five Continent Peace Initiative," Parliamentarians Global Action, New York, N.Y.*

1/81 - 10/83: *Staff Assistant for Arms Control and Martin Stone Research Fellow, Federation of American Scientists, Washington, D.C.*

8/79 - 12/80: *Research Fellow, Council on Economic Priorities, New York, N.Y., and Associate, Center for Investigative Reporting, Oakland, CA.*

9/76 - 6/79: *Research Associate and freelance writer in military and foreign affairs, Pacific Studies Center, Palo Alto, CA.*

12/73 -12/75: *Staff writer, MIDDLE EAST REPORT, Middle East Research and Information Project, Cambridge, MA., and Washington, D.C.*

PUBLICATIONS (List Available Upon Request)

Over 70 published NRDC reports and articles, many of which appeared in professional journals and general interest magazines such as *Scientific American, Science, Nature, Science and Global Security, Bulletin of the Atomic Scientists, The Nation, Middle East Report,* among others.

OTHER PERTINENT DATA

National Council Member, Federation of American Scientists (elected) 1984-88.

Bulletin of the Atomic Scientists, Contributing Editor, (1985), Columnist (2003-04)

Foreign Languages: Spanish (proficient); Russian (rudimentary)

Clearances Held: (currently inactive) DoD Top Secret; DOE "Q" (1988-91).

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