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 J. WEAVER, Ph.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL IN SUPPORT OF MOTION FOR WAIVER

INTRODUCTION

I, Christopher J. Weaver (CJW), declare that the following statements are true and correct to the best of my knowledge.[1]

1. (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 A.
2. (TBC, MGM, CJW) On June 22, 2011, the Nuclear Regulatory Commission (NRC) received a License Renewal Application (Exelon, 2011a) for Limerick Generating Station

[1] This Declaration incorporates by reference and includes specific portions of the previous Declaration filed on November 19th 2011by myself, Thomas B. Cochran, Ph.D. (TBC) and Matthew G. McKinzie, Ph.D. (MGM) Portions of the previous declaration that are included but were primarily supported by either Dr. Cochran or Dr. McKinzie, are identified at the outset of each paragraph by the initials of the Declarant(s) who are offering the information contained in that paragraph.

(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).

3. (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).
4. (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 several areas is plausibly significant, including, of relevance here: 1) additional SAMA candidates analyzed for BWRs; 2) use of an up-to-date methodology for determining the costs and benefits of these additional SAMA candidates; and 3) economic consequences from accident scenarios 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. These areas of new information are uniquely relevant to the Limerick facility because they are specific to the site where the Limerick facility is located and are specific to the previous SAMDA analysis done for the Limerick facility.

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

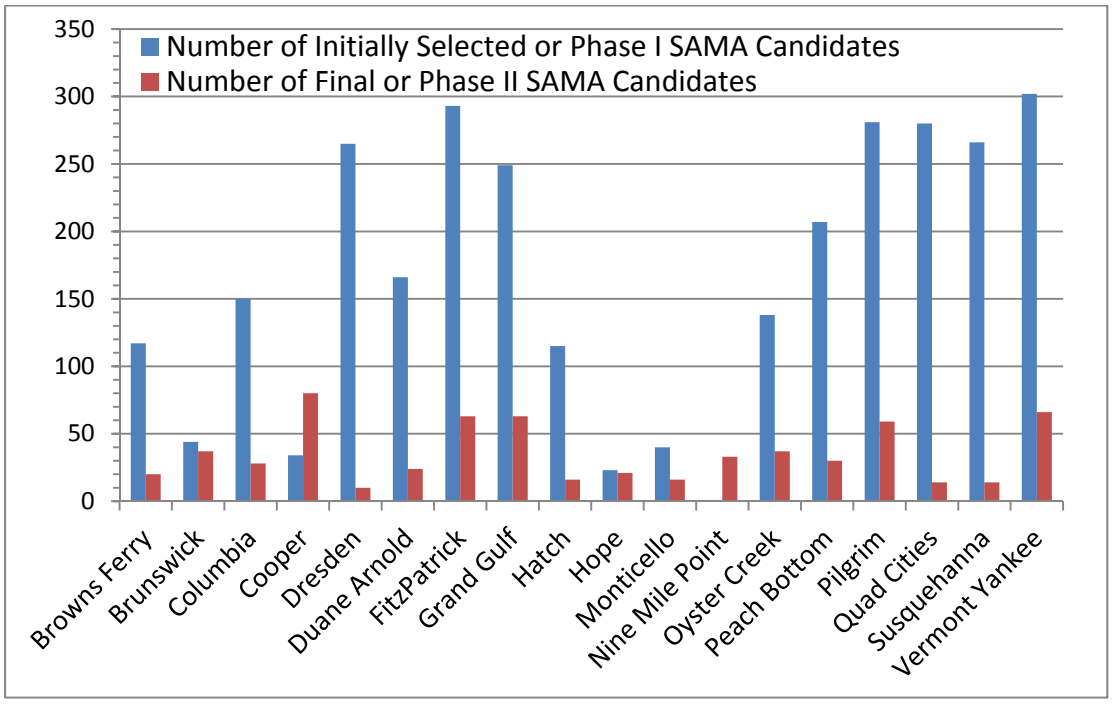
5. (MGM) In 1989, in Limerick Ecology Action v. NRC, the 3rd Circuit ruled that in the absence of an NRC finding that severe accidents are remote and speculative, the cost-benefits of severe accident mitigation design alternatives (SAMDAs, currently termed SAMAs) should be considered as part of the NEPA 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.

6. (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.
7. (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.

8. 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 .



9. (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. Limerick is unique in that it alone, among all the BWR's seeking or obtaining license renewal, has not conducted a systematic consideration of the cost and benefits of these additional mitigation alternatives,

using the most up-to-date methodology, as part of its license renewal application. Without such a systematic analysis it is not possible to determine which, if any, of these additional mitigation alternatives would be cost-beneficial alternatives to Exelon's now proposed license renewal for Limerick.

10. (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. Whether any of these cost-beneficial mitigation alternatives would be cost-beneficial at Limerick has not been determined, or even considered, in Exelon's Environmental Report.
11. (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

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	
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 water 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
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

12. (CJW) In addition to these currently-documented SAMAs, there are technological options that should plausibly be reviewed as SAMA candidates for Limerick 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.
13. (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 additional SAMA candidates, if properly evaluated, would be specific to the Limerick facility using a site-

specific methodology, such as one employing the use of MELCOR Accident Consequence Code Systems (MACCS2).

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

14. (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).
15. (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.

16. (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

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

17. (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.

18. (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.
19. (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.

20. (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%

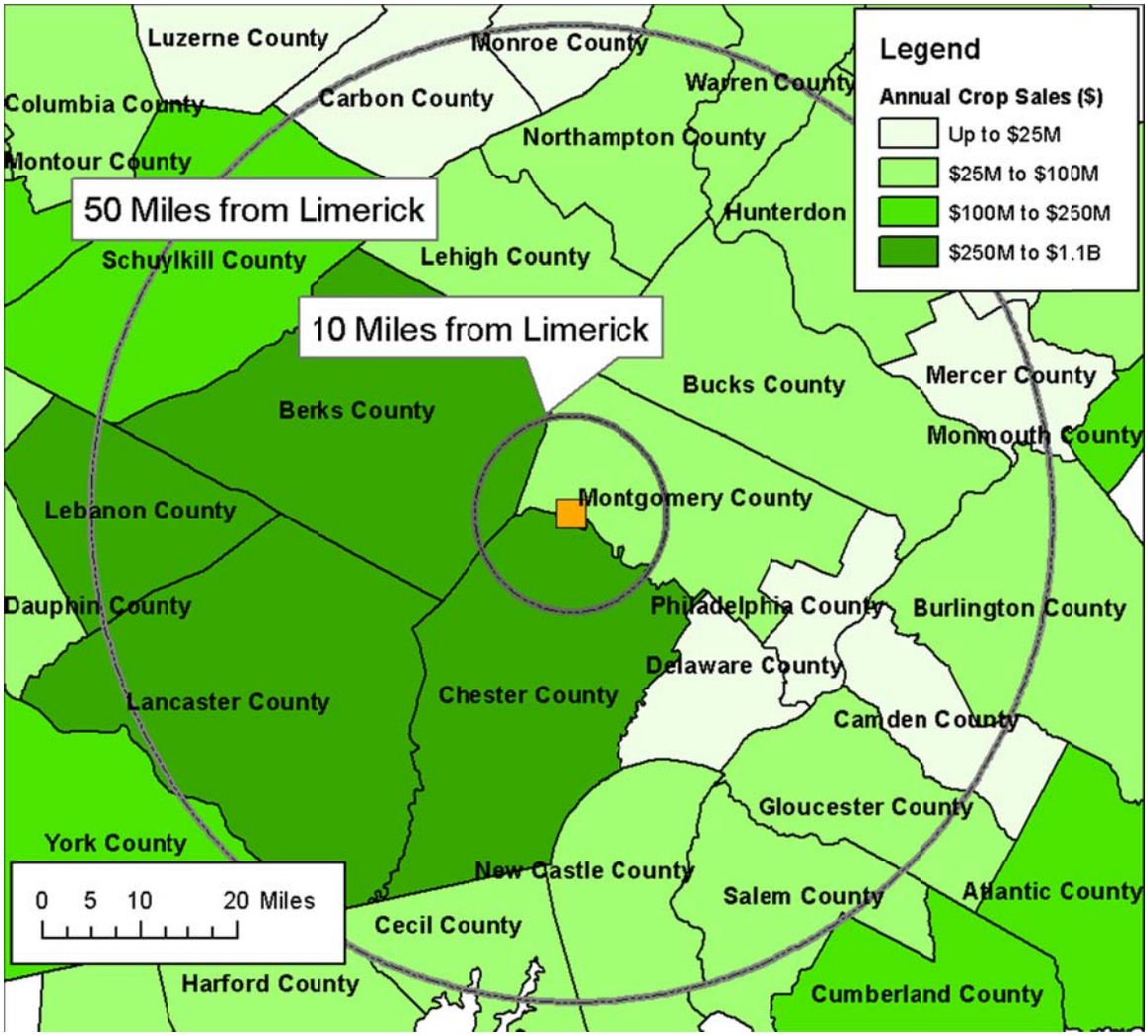
21. (MGM) Economic risk to the east of Limerick is dominated by the economic productivity of the city of Philadelphia and its surrounding region. The 2010 gross domestic product for all industries in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area which lies within the Limerick 50-mile 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.

22. (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***

23. (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).
24. (MGM) Figure 2: US Bureau of Agriculture data on annual crop sales in the area surrounding Limerick in 2007 (USDA, 2011).



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

25. (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 neglects to calculate economic costs entirely. A sensitivity analysis was not performed in the FES Supplement. These problems are not remedied in the 2011 Limerick Environmental Report. The Commission has already recognized in its regulations governing environmental analyses for license renewal that all SAMA analyses are inherently site specific Category 2 issues which cannot be addressed generically. 10 C.F.R. Part 51, Subpart A, Appendix B. Thus, the failures in the 1989 SAMDA analysis are also inherently site specific failures that can only be remedied by site-specific reanalysis.

26. (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 two areas – 1) additional SAMA candidates analyzed for BWRs; 2) economic consequences from accident scenarios 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.

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 21, 2012.

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

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Nebraska Public Power District. 2008. Cooper Nuclear Station, License Renewal Application, Appendix E: Applicant's Environmental Report, Attachment E: Severe Accident Mitigation Alternatives Analysis, September.

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Attachment A: 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