December 13, 2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
Entergy Nuclear Generation Company and	)	Docket No. 50-293-LR
Entergy Nuclear Operations, Inc.	)	ASLBP No. 06-848-02-LR
	)	
(Pilgrim Nuclear Power Station)	)	

DECLARATION OF MR. JOSEPH R. LYNCH AND DR. KEVIN R. O'KULA IN SUPPORT OF ENTERGY'S ANSWER OPPOSING PILGRIM WATCH REQUEST FOR HEARING ON A NEW CONTENTION REGARDING INADEQUACY OF ENVIRONMENTAL REPORT, POST-FUKUSHIMA

Mr. Joseph R. Lynch ("JRL") and Dr. Kevin R. O'Kula ("KRO") state as follows under penalties of perjury:

I. INTRODUCTION

A. Entergy Declarants

1. Joseph R. Lynch

1. (JRL) I am the Manager of Licensing for the Pilgrim Nuclear Power Station ("Pilgrim"). My professional and educational experience is summarized in the Curriculum Vitae attached as Exhibit 1 to this Declaration.

2. (JRL) I have over 29 years of nuclear power experience and background in engineering, licensing/regulatory affairs, environmental compliance, complex problem solving, stakeholder communications, project management, cost control, budgeting and employee management. I obtained my Bachelor of Science in Mechanical Engineering (BSME) from the Worcester Polytechnic Institute in Worcester, Massachusetts in 1982, specializing in thermodynamics and fluid dynamics. I have undertaken graduate-level studies in Business Management,

Communications, and Regulatory Compliance. I have also taken numerous internal and external management courses while previously working with the Yankee Atomic Electric Company and the Vermont Yankee Nuclear Power Station.

3. (JRL) In my current position as Pilgrim Licensing Manager, I am responsible for managing the Pilgrim Licensing Group, which supports the operation and regulatory compliance of the Station in accordance with NRC, State and Federal regulations, permits and statutes. I am responsible for the development of all necessary letters, licensing correspondence and regulatory approvals from the NRC, local, state and federal agencies required in support of plant operations. I am familiar with all Pilgrim operational systems, including the operation, and maintenance of the Direct Torus Vent ("DTV"), and the Severe Accident Mitigation Guidelines ("SAMGs"). I am familiar with the Pilgrim License Renewal Application, and the aging management measures that will be required of Pilgrim during its period of extended operation.

2. Dr. Kevin R. O'Kula

4. (KRO) I am an Advisory Engineer with URS Safety Management Solutions ("URS") LLC. My professional and educational experience is summarized in the Curriculum Vitae attached as Exhibit 2 to this Declaration.

5. (KRO) I have over 29 years of experience as a technical professional and manager in the areas of safety analysis methods and guidance development, computer code evaluation and verification, probabilistic safety assessment, deterministic and probabilistic accident and consequence analysis applications for reactor and non-reactor nuclear facilities, source term evaluations in both design basis and severe accident assessments, risk management, reactor materials dosimetry, and shielding. I obtained a Bachelor of Science in Applied and Engineering Physics

from Cornell University in 1975, a Master of Science in Nuclear Engineering from the University of Wisconsin in 1977, and a Ph.D. in Nuclear Engineering from the University of Wisconsin in 1984.

6. (KRO) My education and training in Nuclear Engineering includes understanding of dose pathways through which atmospheric and aqueous releases from highly unlikely severe accidents in nuclear power plants could result in radiological exposures to individuals. I have previous Probabilistic Safety Assessment ("PSA") and severe accident analysis experience in analyzing reactor core phenomena under accident conditions, including scenarios where core degradation and fuel melting are postulated to have occurred. The severe accident analysis work in these efforts has included evaluating the fission products behavior and estimating the subsequent release of radionuclides into the environment.

7. (KRO) I have over 23 years of experience in using the MELCOR Accident Consequence Code System ("MACCS") and the MACCS Version 2 ("MACCS2") Computer Codes, and have taught MACCS2 training courses for the Department of Energy ("DOE") at Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Idaho National Laboratory, the Waste Isolation Pilot Plant (WIPP), and at DOE Safety Analysis Workshops. I was the lead author of a DOE guidance document on the use of MACCS2.[1] Also, I am a member of the State-of-the-Art Reactor Consequence Analysis ("SOARCA") Project Peer Review Committee that provides critical review and comment to Sandia National Laboratories ("Sandia") and the Nuclear Regulatory Commission ("NRC") on the use of integrated modeling of accident progression and offsite consequences using both state-of-the-art computational analysis tools and best

[1] *MACCS2 Computer Code Application Guidance for Documented Safety Analysis*, DOE-EH-4.2.1.3-Final MACCS2 Code Guidance, Final Report, U.S. Department of Energy, Washington, DC (June 2004).

modeling practices in evaluating severe accident sequences, and applying MACCS2 to estimate the subsequent off-site consequences from these accident conditions.

B. Pilgrim Watch's Proposed Late-Filed Contention on Fukushima

8. (JRL, KRO) We have reviewed and are familiar with Pilgrim Watch's late-filed contention concerning alleged new and significant information resulting from the March 11, 2011 accident at Japan's Fukushima Daiichi reactor complex, which was filed on November 18, 2011 in the NRC licensing proceeding for Pilgrim's license renewal.[2] We are also familiar with the Declaration provided by Mr. Arnold Gundersen in support of Pilgrim Watch's new contention.[3]

9. (JRL, KRO) Pilgrim Watch's late-filed contention states:

> Based on new and significant information from Fukushima, the Environmental Report is inadequate post Fukushima Daiichi. Entergy's SAMA analysis ignores new and significant issues raised by Fukushima regarding the probability of both containment failure, and subsequent larger off-site consequences due, in part, to the need for flooding the reactor (vessel, containment, pool) with huge amounts of water in a severe accident, as at Fukushima. "An important limitation of the MACCS2 code is that it does not currently model and analyze aqueous transport and dispersion of radioactive materials through the subsurface water, sediment, soils, and groundwater. As demonstrated by the recent events in Japan, certain accident scenarios can result in large volumes of contaminated water being generated by emergency measures to cool the reactor cores and SFPs, with yet to be determined offsite radiological consequences. To determine the relative risk significance of these types of scenarios, (Pilgrim's) Level 3 PRA must (model and analyze) the aqueous transport and dispersion of radioactive materials[1]." Further, there is no provision within the Severe Accident Mitigation Guidelines (SAMGs) for processing the water post accident. This important technical gap in Entergy's SAMA needs to be addressed before closing this proceeding. As in Japan, enor-

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[2] Pilgrim Watch Request for Hearing on New Contention Regarding Inadequacy of Environmental Report, Post Fukushima (Nov. 18, 2011) ("PW Request").

[3] Declaration of Arnold Gundersen Supporting a Request by Pilgrim Watch for a New Contention Hearing Regarding the Inadequacy of Pilgrim Station's Environmental Report, Post Fukushima (Nov. 17, 2011) ("Gundersen Decl.").

> mous quantities of contaminated water are likely to enter Cape Cod Bay (adding to the radioactive atmospheric fallout on the waters and contamination resulting from aqueous transport and dispersion of radioactive materials through subsurface water, sediments, soils and groundwater) and then flow to other water bodies and shores posing significant offsite consequences and costs, threatening the health of citizens and the ecosystem and damaging the economy.
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> [1] SECY-11,0089, Enclosure 1, pg., 29; http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2011/2011-0089scy.pdf; and Commission Voting Record, Decision Item SECY-11-0089, September 21, 2011, http://www.nrc.gov/reading-rm/doc-collections/commission/cvr/2011/2011-0089vtr.pdf

PW Request at 1-2 & n.1. Pilgrim Watch thus contends that "it plainly is necessary to redo Pilgrim's SAMA analysis to take into account this purported new and significant information." Id. at 3. According to Pilgrim Watch, should a severe accident occur, "enormous quantities of contaminated water are likely to enter into Cape Code Bay and other waters (adding to the radioactive atmospheric fallout on the water and runoff) posing significant offsite consequences and costs." Id.; Gundersen Decl. at ¶¶ 14, 18. Pilgrim Watch asserts that the Pilgrim SAMA analysis is deficient because the MACCS2 code "does not currently model and analyze [such] aqueous transport and dispersion of radioactive materials." PW Request at 3; Gundersen Decl. at ¶ 14. In addition, Pilgrim Watch asserts that the Pilgrim Severe Accident Mitigation Guidelines ("SAMGs") contain no provision for processing contaminated water post accident. PW Request at 3; Gundersen Decl. at ¶¶ 15-16, 25-28.

10. (JRL, KRO) Our Declaration addresses the claims raised by Pilgrim Watch concerning the adequacy of the Pilgrim SAMA analysis in light of Fukushima. In summary, the claims Pilgrim Watch raises in its contention are neither new nor significant and as such would not alter the Pilgrim SAMA analysis results as claimed by Pilgrim Watch. The claims are not new information because the fact that the MACCS2 code models and calculates the consequences from large, atmospheric radiological releases resulting from a severe accident (and not from the aqueous releases into the adjacent Cape Cod Bay focused on by Pilgrim Watch), has

been well known and understood since the predecessor MACCS code was introduced in 1990, and is clearly evident from the MACCS2 User Guide,[4] which Pilgrim Watch has often referenced in this proceeding.

11. (JRL, KRO) Likewise, the claims are not significant for two reasons. First, an accident like the one that occurred at Fukushima is highly unlikely to occur at Pilgrim. Second, even if a severe accident resulted in contaminated water being discharged into Cape Cod Bay (as has occurred at Fukushima with releases into the Pacific Ocean), accounting for such discharges in the Pilgrim SAMA analysis would not materially alter the results of the analysis.

12. (JRL, KRO) An accident like the one that occurred at Fukushima is highly unlikely to occur at Pilgrim for several reasons:

- The Fukushima accident was initiated by a combination of natural phenomena, a magnitude 9.0 earthquake followed by a series of tsunamis with one 46 – 49 feet in height. Such sequential events have a very low likelihood of occurring, particularly at the same severity, at the Pilgrim site.[5]
- In addition, Pilgrim's emergency operating procedures require venting the primary containment long before such venting was attempted at Fukushima. Thus, even assuming an extended station blackout ("SBO") were to occur at Pilgrim, resulting in a

[4] NUREG/CR-6613, Code Manual for MACCS2, Vol. 1, SAND97-0594, User's Guide (May 1998) ("NUREG/CR-6613 Vol. 1").

[5] A severe earthquake measuring 9.0 on the Richter Scale occurred 112 miles off the coast of the Fukushima Daiichi Nuclear Power Station. The earthquake was the largest Japan has ever experienced and subsequently caused a series of seven tsunami waves. The maximum tsunami height impacting the Fukushima Daiichi site was estimated to be 46 to 49 feet (14 to 15 meters). This exceeded the design basis tsunami height of 18.7 feet (5.7 meters) and was above the site grade levels of 32.8 feet (10 meters) at units 1- 4. This combined event sequence then led to all AC power being lost to units 1-4 when a tsunami overwhelmed the site and flooded some of the emergency diesel generators and switchgear rooms, with DC power being lost on units 1 and 2. See INPO 11-005, "Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station," Institute of Nuclear Power Operations (November 2011) ("INPO Report"), a copy of which is provided at Exhibit 3 to this Declaration.

loss of power to operate normal core cooling systems as occurred at Fukushima, Pilgrim operators would have taken venting actions to avoid the buildup of high pressures and accumulation of combustible gases inside containment, which would have facilitated the ability to conduct emergency core cooling functions. The ability to maintain emergency core cooing functions would in turn reduce the likelihood of core damage and hence the potential for contaminated water to escape into the environment.

- Further, the Fukushima accident involved core melts at three adjacent reactors at a six-reactor site, whereas Pilgrim is a single reactor plant. The simultaneous nature of the challenges at the Fukushima units complicated the emergency response to those challenges. The Fukushima operators had to attempt to simultaneously cool three reactors, which were vying with each other for available power and cooling water, as well as to protect against radiation and to deal with other complications from the occurrence of problems at the reactors. Such competition for resources and complications would not be present at the single-unit Pilgrim plant.

13. (JRL, KRO) Moreover, even if a severe accident such as that which occurred at Fukushima were to occur at Pilgrim, with contaminated water being discharged into Cape Cod Bay, accounting for such discharges would not materially alter the results of the Pilgrim SAMA analysis for two reasons:

- First, the Pilgrim SAMA analysis considers accident scenarios involving failure to vent and the consequences resulting from subsequent large, atmospheric releases of radionuclides. The potential consequences from atmospheric releases are far greater than potential consequences resulting from the aqueous releases at issue in Pilgrim

Watch's contention. The atmospheric releases have greater, more immediate and direct impact to persons and populated areas, resulting in greater consequences. Thus, if the Pilgrim SAMA analysis were redone to assume that some portion of the radioactive releases was via an aqueous pathway (*e.g.*, discharges into Cape Cod Bay), instead of entirely into the atmosphere, the magnitude of consequences would be reduced. This would thus result in lower offsite population dose risk ("PDR") and lower offsite economic cost risk ("OECR") than what has been quantified for the Pilgrim SAMA analysis.[6]

- Second, the Pilgrim SAMA analysis considers large radiological releases several times larger than the releases that occurred from all three of the damaged Fukushima reactors combined. Thus, Fukushima has revealed no information that would alter the SAMA analysis.

14. (JRL, KRO) At bottom, Pilgrim Watch's contention erroneously asserts that the Pilgrim SAMA analysis must consider an accident like the one that has occurred at Fukushima even though (1) such a scenario is highly unlikely to occur at Pilgrim, and (2) the Pilgrim SAMA analysis already considers postulated containment failure with atmospheric radiological releases much larger than the releases that have occurred at Fukushima – which involved core damage in three reactor units. Thus, consideration of the purportedly new and significant information revealed by Fukushima would not alter the results of Pilgrim's SAMA analysis.

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[6] As discussed further below, the consequences of aqueous releases are lower because liquid pathways (*e.g.*, seafood ingestion and shoreline activities) can be mitigated to ensure little if any dose is incurred, and ocean currents will act to effectively dilute postulated radioactive concentrations to levels below regulatory concern without the need for cost-intensive clean-up measures. In contrast, airborne releases have the potential to reach high populations in the fifty-mile region considered in the SAMA analysis and would transport and deposit radioactivity downwind along the atmospheric plume path of travel, thus requiring active cleanup measures to decontaminate both farmland and non-farmland areas.

II. PILGRIM WATCH'S CONTENTION RAISES NO NEW INFORMATION

15. (KRO) The information that Pilgrim Watch raises in its contention is not new. It is clear from even a cursory review of the documents explaining the use and operation of the MACCS2 code (and its predecessor MACCS) that the code models the atmospheric release, transport, dispersion and deposition of radionuclides following a severe reactor accident, and not aqueous releases. Certainly, Mr. David Chanin, whom Pilgrim Watch previously relied upon as the "author of the code,"[7] clearly recognized this limitation of the MACCS2 code. For example, in his Declaration supporting Pilgrim Watch's opposition to summary disposition of Pilgrim Watch Contention 3 over four years ago, Mr. Chanin stated:

> I, David I. Chanin, was primary developer of the MACCS and MACCS2 computer codes under sponsorship of the U.S. NRC and DOE while working at Sandia National Laboratories 1982-1996. MACCS2 is considered by NRC (and DOE) to be state-of-the-art for assessing potential doses, health effects, and economic consequences which could result from radiological releases to the atmosphere after severe accidents or sabotage.[8]

In addition, earlier this year when supporting Pilgrim Watch's first post-Fukushima contention (concerning recriticalities), and after TEPCO had announced the release of radioactively contaminated water into the Pacific, Mr. Chanin stated

> "Through Sandia National Laboratories, I was an architect and developer of the MACCS2 computer code, and I am familiar with the code. MACCS2 is used by the DOE, NRC staff, and NRC licensees to model the doses, health effects, and economic consequences that result from unintended radiological releases into the atmosphere. NRC and its licensees use the MACCS2 code as part of the Severe Accident Mitigation Alternatives (SAMA) analysis."[9]

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[7] See Pilgrim Watch SAMA Remand Pre-Filed Testimony (Jan. 3, 2011) at 16.

[8] Declaration of David I. Chanin in Support of Pilgrim Watch's Response Opposing Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3 (June 5, 2007) at 1 (emphasis added).

[9] Pilgrim Watch Request for Hearing on Post Fukushima SAMA Contention (May 12, 2011) at 20 (emphasis added).

Thus, the alleged failure of the MACCS2 code to model and analyze the aqueous transport and dispersion of radioactive materials (i.e., discharge of radioactively contaminated water into Cape Code Bay) raised by Pilgrim Watch is not new information.

16. (KRO) In particular, MACCS version 1.5.11.1, the predecessor code to the MACCS2 code, released in February 1990 makes clear in the model description document (NUREG/CR-4691[10]) that the code models the atmospheric release, transport, dispersion and deposition of radionuclides following a severe reactor accident. NUREG/CR-4691 expressly states that the purpose of the MACCS code is to "simulate the impacts of severe accidents at nuclear power plants on the surrounding environment" and makes clear that "[t]he principal phenomena considered in MACCS are atmospheric transport, mitigative actions based on dose projection, dose accumulation by a number of pathways including food and water ingestion, early and latent health effects, and economic costs." NUREG/CR-4691 Vol. 2 at iii (emphasis added). In other words, the MACCS computer code "performs probabilistic calculations of potential off-site consequences of the atmospheric releases of radioactive material in reactor accidents." Id. at xi (emphasis added). As NUREG/CR-4691 explains, "[s]hould such an accidental release occur, the radioactive gases and aerosols in the plume while dispersing in the atmosphere would be transported by the prevailing wind. The environment would be contaminated by radioactive materials deposited from the plume and the population would be exposed to radiation. Estimation of the range and probability of the health effects induced by the radiation exposures not avoided by protective measure actions and the economic costs and losses that would result from the contamination of the environment is the object of a MACCS calculation." Id. at 1-1.

[10] NUREG/CR-4691, MELCOR Accident Consequence Code System (MACCS), SAND86-1562, Vol. 2 (Model Description), Sandia National Laboratories (Feb. 1990) ("NUREG/CR-4691 Vol. 2").

17. (KRO) The MACCS code was updated and replaced by the MACCS2 code in 1997-98, and this is the primary code used to calculate offsite population dose and economic consequences for the Pilgrim SAMA analysis. While MACCS2 "represent[ed] a major enhancement of its predecessor MACCS," the core functions of MACCS2, to model atmospheric radiological releases after a severe accident, and to estimate the consequences of those releases, remained unchanged from MACCS. As explained in the MACCS2 User's Guide, "[t]he principal phenomena considered are atmospheric transport and deposition under time-variant meteorology, short- and long-term mitigative actions and exposure pathways, deterministic and stochastic health effects, and economic costs." NUREG/CR-6613 Vol. 1 at iii (emphasis added). In other words, the "radioactive materials released are modeled as being dispersed in the atmosphere while being transported by the prevailing wind. During transport, whether or not there is precipitation, particulate material can be modeled as being deposited on the ground." Id. at 2-1 (emphasis added). MACCS2 is divided into three primary modules, one of which is ATMOS, which "performs all of the calculations pertaining to atmospheric transport, dispersion, and deposition, as well as the radioactive decay that occurs prior to release and while the radioactive material is in the atmosphere." Id. at 2-2 (emphasis added).

18. (KRO) Thus, the fact that the MACCS2 code models and analyzes the consequences of atmospheric radiological releases is clearly stated in code's user guide and has been well known and understood since MACCS was introduced.

19. (KRO) The MACCS2 code and NRC severe accident consequence analyses model the consequences from atmospheric radiological releases, rather than those from other pathways, because as succinctly stated in the generic environmental impact statement prepared by the NRC to analyze the environmental impacts from license renewal, "[f]or most plants, the air pathway

represents the most likely pathway for significant dose to the public."[11] As discussed in more detail below, the potential consequences from atmospheric releases are far greater than potential consequences resulting from aqueous releases because of their more immediate, and direct impact to persons and populated areas. As such, as demonstrated later in this Declaration, Pilgrim Watch's assertions concerning potential aqueous release pathways are insufficient to materially change the results of the Pilgrim SAMA analysis, which considers the far more significant atmospheric pathway.

20. (KRO) As stated above in paragraph 16, MACCS does consider radiological consequences received through water ingestion. The long-term population dose calculated by the MACCS2 code includes the radiological exposure from groundshine and resuspension, from decontamination work, from the consumption of contaminated food, and from the ingestion of contaminated surface water.[12] Uptake of contaminated surface water in the long-term model includes water ingestion from: (1) deposition of material directly onto freshwater bodies and (2) deposition of material onto land with subsequent wash-off due to rainfall and other precipitation into freshwater bodies.[13] A standard assumption used in MACCS2 applications is that ingestion uptake will be limited to freshwater bodies and wash-off only, with no uptake from oceans or associated seawater bodies, *e.g.*, bays. Specifically, in the MACCS2 model for Pilgrim there are two watershed types in the 50-mile region surrounding the plant: land drained by rivers and the ocean. There are no major lakes. An input parameter to the code is the watershed index, which is provided in the site input data file. Following MACCS2 guidance in the selection of input pa-

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[11] NUREG-1437, Generic Environmental Impact Statement for License Renewal Vol. 1 (May 1996) at 5-12.

[12] NUREG/CR-6613 Vol. 1 at 7-45.

[13] The water ingestion model assumes that the area surrounding the site is divided into two categories, water and land, according to the fraction of the region covered by land. Of the material deposited directly onto water or transferred from land to water, the user specifies the amount that will eventually be consumed by humans.

rameters,[14] the Pilgrim site input data file assigns a non-zero value to account for deposition onto surface freshwaters and for run-off and wash-off from the land (identified as watershed index = 1) and a zero value is used for the Atlantic Ocean and its bays (including Cape Cod Bay)(identified as watershed index = 2).

21. (JRL, KRO) The above described watershed input data used in the MACCS2 code was clearly laid out in Document No. S&SA-170, MACCS2 Input Data, which was provided to Pilgrim Watch on November 15, 2006 as part of Entergy's initial disclosures in this proceeding.[15]

22. (KRO) In summary, the documents explaining and supporting the MACCS and MACCS2 codes are clear that the codes model the atmospheric release and dispersion of radioactive releases following a severe reactor accident. The fact that the codes model atmospheric releases, and not the type of aqueous releases into Cape Cod Bay that Pilgrim Watch claims ought to be considered, was well known and understood, and is therefore not new information.

III. A FUKUSHIMA-TYPE ACCIDENT SCENARIO IS HIGHLY UNLIKELY TO OCCUR AT PILGRIM

23. (JRL, KRO) Pilgrim Watch's contention erroneously asserts that a Fukushima-type accident is likely to occur at Pilgrim, and essentially argues that a Fukushima-type accident and its consequences must be considered in the Pilgrim SAMA analysis. To the contrary, a Fukushima-type accident is highly unlikely to occur at Pilgrim for at least three reasons. First, the natural phenomena initiating sequence of events that occurred at Fukushima (9.0 magnitude

[14] NUREG/CR-4551, SAND86-1309, Vol. 2, Rev. 1, Part 7, Evaluation of Severe Accident Risks: Quantification of Major Input Parameters, MACCS Input, Sandia National Laboratories (Dec. 1990) at Section 2.8; NUREG/CR-6613 Vol. 1 at Section 7.12.

[15] For its initial disclosures, Entergy provided to Pilgrim Watch (and the NRC Staff) a compact disc containing PDF versions of the documents to be disclosed, including Document No. S&SA-170 Revs. 0 and 1 (e.g., Bates Nos. PILLR00020494-PILLR00020908).

earthquake, and subsequent massive tsunami) is highly unlikely to occur at Pilgrim. Second, Pilgrim's plant procedures for venting primary containment during a severe accident differ significantly from those at Fukushima. As a result of these procedural differences, Pilgrim would have vented its primary containment long before that operation was attempted at Fukushima. Thus, if challenged by a scenario involving extended station blackout compromising normal core cooling functions, earlier venting of the containment would have made it more likely that (1) the reactor core would have remained covered by water, lessening the likelihood of any core damage occurring; or (2) had the core become uncovered, water could have been injected into the core sooner to lessen core damage. Third, the fact that Fukushima involved simultaneous challenges to adjacent and interconnected reactor units and, ultimately, core damage and multiple hydrogen explosions complicated the ability of the Fukushima operators to control the event. Such complications and the multiple source terms, decay heat loads, and hydrogen explosions for the plant operators to respond to would not be present at Pilgrim during an accident because Pilgrim is a single unit site.

A. The Fukushima Initiating Events are Unlikely to Occur at Pilgrim

24. (JRL, KRO) The Fukushima incident was initiated by a combination of natural phenomena, a magnitude 9.0 earthquake followed by a series of tsunamis with one 46-49 feet in height, sequential events that have a very low likelihood of occurring, particularly at the same severity, at the Pilgrim site. Particularly with an event such as Fukushima that was caused by sequential, but interrelated natural phenomena (earthquake and ensuing tsunami), later leading to loss of offsite power to plant systems (station blackout), and loss of capability of power restoration due to the level of devastation, it is important not to extrapolate from one location to another when evaluating the outcome. The fact that Fukushima experienced these beyond design basis

events does not mean that a beyond design basis event of the same or another type at Pilgrim is more likely than previously thought. The Fukushima initiating events were very region- and location-specific, and the tectonic forces and topological/geological characteristics are far different between northeast coastal Japan and the coast of Massachusetts.

25. (JRL) Specifically, the following facts about the Pilgrim site reflect that a tsunami or other site flooding natural events, such as those giving rise to the core melt events at Fukushima, are not applicable to Pilgrim:

- *A tsunami at Pilgrim Station is not a probable event. This is based on the known geological features in the area. There are no major subduction zones in the Atlantic Ocean; except for where it borders the Caribbean Sea. As a result, there has been a low frequency of tsunamis compared to the experience in the Pacific Ocean.* ***(Evaluation of Tsunami Sources with the Potential to Impact U.S. Atlantic and Gulf Coast. USGS, August 2008).***
- *The most famous Atlantic tsunami is the 1755 Lisbon tsunami that was generated by an earthquake on a fault offshore of Portugal. Geologists today estimate that the Lisbon earthquake approached magnitude 9 on the Richter scale, with an epicenter in the Atlantic Ocean about 200 km (120 mi) west-southwest of Cape St. Vincent. Although massive destruction of Lisbon occurred, the effects on North America were unremarkable.* ***(Evaluation of Tsunami Sources with the Potential to Impact U.S. Atlantic and Gulf Coast. USGS, August 2008).***
- *The most noteworthy North American tsunami was the result of the 1929 Grand Banks earthquake near Newfoundland, Canada. The maximum tsunami run-up from this event was 6-21 feet, concentrated on the coast of Newfoundland. Wave heights near Plymouth were not noted to be affected. The U.S. tide gauge diagrams following the 1929 earthquake for Eastport (Maine), Portland (Maine), Boston (Massachusetts), and Key West (Florida) indicated no effect from the tsunami.* ***(Evaluation of Tsunami Sources with the Potential to Impact U.S. Atlantic and Gulf Coast. USGS, August 2008).***

- *Pilgrim Station is designed to withstand a flood level of 18.3 feet above mean low water (mlw) that could result from a combination of storm surge and astronomical high tide. The unlikely combination of these two events is estimated to occur once every four thousand years.* ***Pilgrim Station FSAR Section 2.4.4.***

- *Laboratory model testing conducted for the Pilgrim site has shown that the plant would survive a storm surge of 19.5 feet above mlw. These tests included simulating open ocean wave heights up to 31 feet. During the model testing, no wetting of the reactor building occurred.* ***Pilgrim Station FSAR Section 2.4.4.***

- *Pilgrim station is also designed to withstand a Category 3 hurricane (maximum wind speed of 131 mph). The storm surge caused by a hurricane of that magnitude is surpassed by the design nor'easter discussed above. Pilgrim's location on the north side of Cape Cod protects it from the full storm surge of any storm travelling up from the south.* ***Pilgrim Station FSAR Section 2.4.4.***

- *The highest astronomical tide ever recorded in the area was 10.3 feet above mlw on Feb. 24, 1723. The highest storm surge (in conjunction with the high astronomical tide) recorded at Pilgrim station since original construction was 14.5 feet above mlw which occurred on February 7, 1978 (known as the "Blizzard of '78"). Pilgrim survived that event with no storm related damage to any safety systems including the emergency diesel generators ("EDGs").* ***Pilgrim Station FSAR Section 2.4.4.***

- *Pilgrim Station has three sources of offsite power, and three diesel generators ("DGs") at the site. Any one of these sources can supply sufficient power to run the systems necessary to bring the reactor from an operating state to a cold condition.* ***Pilgrim Station FSAR Section 8.1.***

- *Two of the diesel generators, the emergency diesel generators ("EDGs"), were part of the original design of the station. They are each rated at 2600KW and can power the AC powered emergency core cooling pumps and the primary containment cooling systems. These EDGs are located on the north side of the site on the 23' elevation (above sea level) between Cape Cod Bay and the reactor building. As described in question # 4, the elevation of the EDG building was selected based on worst case his-*

toric weather related conditions that have occurred at the Pilgrim site. Both EDGs are tested monthly. ***Pilgrim Station Procedure 8.9.1.***

- *In the late 1980's, Pilgrim added a third diesel generator, which is located on the south side of the site. It was specifically designed in response to NRC rulemaking on station blackout issues to enhance Pilgrim's capability to endure a loss of offsite power and a postulated failure of the two EDGs described above. At the location where it is sited, the reactor and turbine buildings would protect the station blackout diesel generator ("SBO DG") from any storm surge. The SBO DG is a 2000KW generator that can be started from the main control room and can power selected emergency core and containment cooling systems. The SBO DG is tested quarterly.* ***Pilgrim Station Procedure 8.9.16.1.***
- *In the event of a station blackout, operators would follow pre-established procedures to start and load the SBO DG. In parallel, operating procedures specify the minimization of battery load through the shedding of non-essential DC powered components.* ***Pilgrim Station Procedure 5.3.31.***
- *All emergency power sources at Pilgrim are air cooled and do not rely on an external cooling water source.* ***Pilgrim Station FSAR Section 8.1.***

26. (JRL) In short, because of the factors discussed above, an accident like the one that occurred at Fukushima is highly unlikely to occur at the Pilgrim site.

B. Pilgrim's Venting Procedures Differ from Fukushima

27. (JRL) Although preliminary, the Government of Japan has prepared a comprehensive report[16] that summarizes known facts concerning the accident. My review of the Fukushima Report's discussion of the procedures for venting the Fukushima primary containments indicates

[16] Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety – The Accident at TEPCO's Fukushima Nuclear Power Stations, Nuclear Emergency Response Headquarters, Government of Japan (June 2011) ("Fukushima Report") (attached as Exhibit 4 to the Declaration of Joseph R. Lynch, Lori Ann Potts and Dr. Kevin R. O'Kula in Support of Entergy's Answer Opposing Pilgrim Watch Request For Hearing on A New Contention Regarding Inadequacy of Environmental Report, Post-Fukushima (June 27, 2011) ("Lynch/Potts/O'Kula Decl.")).

that Pilgrim's procedures for venting containment differ significantly from those at Fukushima. The Fukushima Report's description of how those procedures were carried out at Fukushima also varies significantly from how Pilgrim's procedures would be carried out under similar circumstances. Entergy has previously provided testimony on the differences between Fukushima's and Pilgrim's venting procedures based on information contained in the Fukushima Report, Lynch/Potts/O'Kula Decl. ¶¶ 26-33, which will not be repeated here.

28. (JRL) The Institute of Nuclear Power Operations ("INPO") has also prepared the INPO Report, which provides a narrative overview and timeline for the earthquake, tsunami, and subsequent nuclear accident at Fukushima, to provide an accurate and consolidated source of information regarding the sequence of events during the accident. INPO Report at 1.

29. (JRL) With respect to venting of the Fukushima containments, the INPO Report states:

> The TEPCO severe accident procedures provide guidance for venting containment. The guidance directs venting when containment pressure reaches the maximum operating pressure if core damage has not occurred. If core damage has occurred, venting the containment will result in a radioactive release, so containment is not vented until pressure approaches twice the maximum operating pressure.

INPO Report at 10. In addition, the INPO Report states:

> The severe accident procedures specify that the chief of the Emergency Response Center (site superintendent) shall determine if containment venting should be performed. The site superintendent may solicit input and advice from station management when making this decision. Although government permission is not specifically required before containment is vented, government concurrence is desired.

Id. The INPO Report's discussion of the venting procedures in place at Fukushima and their implementation during the accident is consistent with the information in the Fukushima Report describing the venting procedures and their implementation during the accident.

30. (JRL) Based on the stated summary of venting procedures applicable at Fukushima and the events that actually occurred, the procedures governing venting of the Fukushima reactors differ significantly from those at Pilgrim in two key respects.

31. (JRL) First, the Pilgrim procedures require Entergy to vent the primary containment using the direct torus vent ("DTV") long before the Fukushima operators attempted that same operation. Pilgrim Emergency Operating Procedures detail the steps that are required to control containment pressure well before the time at which Fukushima's procedures called for venting (i.e., when containment pressure approaches the maximum operating limit if no core damage, or twice the maximum operating limit if core damage has occurred). Further, there are multiple pathways available to reduce containment pressure to desired levels. See Lynch/Potts/O'Kula Decl. ¶¶ 28-33. (JRL) Second, Pilgrim's procedures provide the Control Room Shift Manager with the authority and direction to utilize the DTV before reaching a level that could challenge the primary containment. Authorization from someone outside the plant is not needed. Id.

33. (JRL) Had containments at Fukushima been vented earlier, reactor pressures would likely have been low enough to allow emergency core cooling before core damage occurred. At Fukushima, alternative cooling sources were available, but reactor pressure was too high, thus water could not be injected into the cores. For example, the INPO Report states that, subsequent to the core melt in Fukushima Unit 1, "[c]ore cooling was eventually established when reactor pressure lowered sufficiently and a fire engine was used to inject fresh water, followed by seawater." INPO Report at 9. "[L]ittle to no injection was achieved until after the [Unit 1] containment was vented successfully". Id. at 11.

34. (JRL) In summary, Pilgrim's operating procedures for venting containment differ markedly from those at Fukushima, and it is clear that, under its procedures, Pilgrim would vent its containment long before such venting was attempted at Fukushima. By venting containment and maintaining reactor pressures low enough to allow emergency core cooling, operators can inject water into the core and prevent core damage.

C. Unlike Fukushima, Pilgrim is a Single Reactor Unit Site

35. (JRL, KRO) Another difference between Pilgrim and Fukushima is the fact that Pilgrim is a single unit reactor, whereas the Fukushima accident involved core damage in three operating reactors (out of six total units) at the site. This difference is important because the earthquake, tsunami, and blackout simultaneously challenged the six Fukushima reactor units, leading to core damage in three units, which complicated the emergency response actions. The Fukushima operators had to contend with and attempt to simultaneously maintain cooling in three reactor units, which were vying with each other for available power and cooling water, as well as to protect against radiation levels and to deal with other post-accident complications arising from problems at the three reactors.

36. (JRL, KRO) For example, the hydrogen explosion that occurred at Unit 1 "significantly altered the response to the event and contributed to complications in stabilizing the units." INPO Report at 9. Prior to the Unit 1 hydrogen explosion, workers were laying temporary cables from recently arrived mobile generators to the Unit 2 standby liquid control pumps. Id. at 23. "Operators were only moments away from energizing the Unit 2 standby liquid control system when . . . an explosion occurred in the Unit 1 reactor building. Debris struck and damaged the cable and the power supply vehicle, and the generator stopped." Id. at 24. The standby liquid control system provides an alternate water injection source to cool the reactor core. Although

not sufficient on its own to maintain adequate core cooling, had it been energized and operable, the standby liquid control system would have added more water to the Unit 2 reactor core that would have likely delayed uncovery of the core and provided operators more time to prevent core damage.

37. (JRL, KRO) A topical report issued by the Massachusetts Institute of Technology[17] ("MIT") also notes that, "[d]ue to [the Fukushima] site's compact layout, problems at one unit created negative safety-related situations at adjacent units." MIT Report at 10. The report provides another example of the complications caused by ongoing accidents at the interconnected Fukushima units as follows:

> For example, the hydrogen explosion at Unit 3 disabled some fire pumps used for seawater injection at Unit 2. Also, it has been suggested that the fire/explosion at Unit 4 was caused by leakage of hydrogen released from Unit 3 through shared duct-work with Unit 4. Units 5 and 6, which are far from Units 1-4, were unaffected by the hydrogen explosions at Units 1 and 3.

Id.

38. (JRL, KRO) Thus, it is clear that the difficulties the Fukushima operators faced in attempting to control ongoing accidents at three reactors located on the compact Fukushima six-unit site complicated their accident management efforts, complications that would not be present at Pilgrim because it is a single unit site.

D. Pilgrim Watch Does Not Challenge the Equipment Failure Probability Assumptions Relied on in the Pilgrim SAMA Analysis

39. (KRO) Apart from the differences between the Pilgrim plant and the Fukushima plant described above, it is important to note that neither Pilgrim Watch nor Mr. Gundersen challenges the initiating event or equipment failure probability assumptions relied on in the Pilgrim

[17] J. Buongiorno *et al.*, "Technical Lessons Learned from the Fukushima-Daiichi Accident and Possible Corrective Actions for the Nuclear Industry: An Initial Evaluation," Massachusetts Institute of Technology, MIT-NSP-TR-025 Rev. 1 (July 26, 2011) ("MIT Report"). The MIT Report is attached as Exhibit 4 to this Declaration.

SAMA analysis. The Pilgrim SAMA analysis considers plant conditions that lead to multiple system failures, and require successful mitigation to prevent core damage, that were identified using a structured, systematic process for identifying initiating events and related component failure probabilities that account for plant-specific features. Neither Pilgrim Watch nor Mr. Gundersen challenges these probability assumptions, or otherwise make any attempt to relate the Fukushima accident (and its initiating events and equipment/system failures) to the Pilgrim plant. For example, neither Pilgrim Watch nor Mr. Gundersen identifies any change in a component failure probability that has revealed itself at Fukushima.

IV. CONSIDERATION OF PILGRIM WATCH'S CLAIMS WILL NOT MATERIALLY ALTER THE PILGRIM SAMA ANALYSIS

40. (KRO) I have previously submitted testimony in response to Pilgrim Watch's claims in this proceeding regarding the hypothetical atmospheric releases and radiological consequences analyzed in the Pilgrim SAMA analysis.[18] Among other things, my testimony has shown that the purported new and significant information revealed by Fukushima will not result in any material change to the results of the Pilgrim SAMA analysis. In other words, consideration of the Fukushima-related claims that Pilgrim Watch has raised will not result in any SAMA becoming potentially cost beneficial. The same is true with respect to the contention Pilgrim Watch raises here. The reasons are: (1) the radiological consequences from the atmospheric releases assumed in the Pilgrim SAMA analysis are greater than the consequences that may result from the aqueous releases asserted by Pilgrim Watch; and (2) the Pilgrim SAMA analysis considers radioactive releases far larger than those that have occurred from all three Fukushima units

[18] See Declaration of Kevin R. O'Kula (May 16, 2007) ("O'Kula Decl."); Testimony of Dr. Kevin R. O'Kula and Dr. Steven R. Hanna on Meteorological Matters Pertaining to Pilgrim Watch Contention 3 (Jan. 3, 2011) ("Entergy Contention 3 Testimony"); Declaration of Dr. Thomas L. Sowdon and Dr. Kevin R. O'Kula in Support of Entergy's Answer Opposing Pilgrim Watch Request for Hearing on Post-Fukushima SAMA Contention (June 6, 2011) ("Sowdon/O'Kula Decl."); Lynch/Potts/O'Kula Decl..

combined. Thus, Pilgrim Watch has raised no issue that would result in the identification of any additional potentially cost beneficial SAMAs.

A. Atmospheric Radiological Releases Result in Greater Consequences than the Aqueous Releases Alleged by Pilgrim Watch

41. (KRO) One way to analyze the issues raised by Pilgrim Watch is to qualitatively compare the consequences that would result from atmospheric releases to those that would result from aqueous releases, and how those consequences would be considered in the Pilgrim SAMA analysis. With respect to the Pilgrim SAMA analysis, consequences from the large, atmospheric releases assumed in the Pilgrim SAMA analysis are far greater than those that Pilgrim Watch asserts must be considered based on events at Fukushima, i.e., contaminated water releases into Cape Cod Bay. Accordingly, consideration of Pilgrim Watch's concerns would not result in population dose risk ("PDR") and off-site economic cost risk ("OECR") greater than those calculated for the radiological releases already assumed in the Pilgrim SAMA analysis, and therefore would not result in any different outcome in the SAMA analysis.

42. (KRO) As explained in the Declaration addressing Pilgrim Watch's claims concerning the direct torus vent (Lynch/Potts/O'Kula Decl. at ¶¶ 63-69), the Pilgrim SAMA analysis uses the MACCS2 code to determine the offsite consequences from postulated severe accidents and the resultant large, atmospheric radioactive releases. The Pilgrim SAMA analysis postulates a range of energetic severe accident release events with sufficient energy to breach the reactor fission product barriers (e.g., breach the reactor vessel or the containment structure) or lead to their bypass. Some of the 19 accident scenarios (later identified in this Declaration as leading to atmospheric source terms called collapsed accident progression bins, or "CAPBs") modeled in the Pilgrim SAMA analysis assume that substantial portions of the Pilgrim reactor core inventory are released into the atmosphere. These include five scenarios that result in 25% or more of both

the iodine and cesium inventories being released into the atmosphere, two of which involve failure to vent and early failure of the containment. Lynch/Potts/O'Kula Decl. at ¶¶ 53, 67-68 & Table 2. These releases are far greater than those estimated to have occurred at Fukushima. Id. at ¶¶ 67-68 & Table 2. An additional major conservatism in the Pilgrim SAMA analysis is that lower volatility, but high-risk, radionuclide groups are assumed to be released as part of the airborne source terms, whereas these have not been released in detectable quantities from Fukushima. This includes strontium (Sr), ruthenium (Ru), lanthanum (La), cerium (Ce), and barium (Ba). Id. at ¶ 68. These atmospheric releases have direct, immediate impact to the population and areas in the path of the atmospheric plume. The costs of these population exposures and economic-related costs are considered in the Pilgrim SAMA analysis.

43. (KRO) As discussed in NUREG-1437, "contaminated reactor water" can impact "surface water bodies used for drinking water, aquatic food, and recreation." NUREG-1437 at Section 5.3.3.4.1. Relative to the airborne releases considered in the Pilgrim SAMA analysis, waterborne releases to the Atlantic Ocean would be slower-acting (because persons are not immediately impacted by an aqueous radioactive release) and can be mitigated (e.g., interdiction of fish, shellfish and other marine foodstuffs until radiological concentrations are below concern) before impacting persons. In addition, similar to current conditions in the Pacific Ocean,[19] radioactivity concentrations in the Cape Cod Bay and adjoining Atlantic Ocean regions would be expected to show concentrations below regulatory levels on a time scale consistent with the 13.9-day mean residence time.[20] This mean residence time would equate to a 9.65-day half-life[21] for

[19] As discussed, infra, the French IRSN has reported that offshore radioactivity concentrations due to aqueous releases from Fukushima decreased significantly over time such that, since approximately the beginning of July 2011, concentrations have decreased below the point of being detectable by the measuring equipment used for monitoring such concentrations.

[20] As set forth at pages 2-28 and 2-29 of Supplement 29 to the GEIS, NUREG-1437, the mean residence time is the average time that a contaminant will spend within a body of water before being removed by tidal exchange, ocean

any radionuclide released into the Bay. Thus, after ten half-lives (96.5 days) the concentration of an aqueous release of contaminated water would be less than 0.1% of the original concentration.

44. (KRO) In contrast, the airborne source terms modeled in the Pilgrim SAMA analysis have immediate impact to persons who are directly exposed to the radioactive plume before any mitigation occurs. Further, airborne releases deposited on land are modeled to persist over time. Long-term exposures from airborne releases are through land contamination and therefore groundshine[22] from deposited radioactivity, food and water ingestion, and resuspension of radioactivity that was initially deposited on the land.

45. (KRO) As explained in my testimony on Pilgrim Watch Contention 3, a large portion of the population dose risk ("PDR") and off-site economic cost risk ("OECR") (the key risk values of interest for determining potentially cost-beneficial SAMAs) result from longer term exposures to radionuclides to populations 10-50 miles away from the Pilgrim plant. For example, the results of the Pilgrim SAMA analysis show that about 94% of the OECR (most of which occurs in the long-term phase of the SAMA analysis) occurs in the 10 to 50 mile range, and 79% of the OECR occurs in the 20 to 50 mile range. Entergy Contention 3 Testimony at A43. Because the OECR is calculated on a per person basis, higher economic costs will occur in grid elements where the ground contamination levels and the population levels are high. Similarly, over 95% of the PDR occurs in the 10 to 50 mile range, and 83% occurs in the 20 to 50 mile

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circulation and wind-induced motion. NUREG-1437, Supplement 29, Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Pilgrim License Renewal, Vol. 1 (July 2007) ("NUREG-1437 Supp. 29")at § 2.2.5.1, Water Body Characteristics.

[21] The half-life of a contaminant is the time required to reduce the concentration by a factor of two, and is the product of the mean residence time and the natural log (2), or the mean residence time x 1.44.

[22] Radionuclides deposited on land surfaces emit gamma radiation, *e.g.*, Cs-137, such that a person could incur radiological exposure to this radiation (referred to as "groundshine") by being on or near those surfaces.

range. Id. Again, the PDR is driven by the inhalation of radionuclides and groundshine exposure during the long-term phase (7 days to ~30 years after plume passage).

46. (KRO) In contrast, the releases of contaminated water into Cape Cod Bay that Pilgrim Watch asserts must be considered in the Pilgrim SAMA analysis would not result in PDR and OECR consequences remotely approaching those assumed in the SAMA analysis. Releases of contaminated water into Cape Cod Bay will not result in immediate, direct exposures to people, and therefore would not result in corresponding costs to be considered in the SAMA analysis. Similarly, contaminated water released into Cape Cod Bay will not result in PDR and OECR consequences anywhere near as large as those that will occur in the heavily populated areas 10-50 miles from the Pilgrim plant in the long-term phase of the SAMA analysis. In other words, for example, there will be comparatively very minimal PDR consequences because (1) there will be minimal dose incurred as a result of inhalation (the release is not airborne) or shoreline exposure (limited number of persons near or on Cape Cod Bay compared to those on land); and (2) there will be minimal water and food ingestion doses (saltwater is not potable, and marine foodstuff consumption will be interdicted by State and Federal agencies until water concentration levels are deemed safe).

47. (KRO) The surface water exposure pathways susceptible in the event of a liquid discharge to coastal waters are both direct exposure and indirect exposure. Specifically, they include submersion in the water (swimming), undertaking activities near the shoreline (fishing and boating), or ingestion of fish or shellfish. Exposure would tend to be over time frames that range from days to weeks, if unmitigated. However, these same pathways are amenable to interdiction (*e.g.*, temporary control and prevention of shoreline recreational use and temporary bans on fish and shellfish consumption). Thus, uptake by humans and long-term effects would be small. In

time, the action of currents and dilution provided through tidal exchange and ocean would dilute any highly unlikely liquid release in a timeframe characterized by a 9.65-day half-life (discussed in paragraph 43). This situation is in contrast to the timeframe and magnitude of the human-intensive, costly activities that are accounted for in the SAMA analysis modeling of airborne releases.

48. (KRO) To put this in context, the source term from CAPB-15 has been shown to dominate both the PDR and OECR of the overall costs. If the total amount of Cs-137 estimated from this atmospheric source term is released instead to Cape Cod Bay, the concentration over the total volume of Cape Cod Bay (assuming an average depth of 100 feet) would diminish on a timescale associated with a half-life of 9.65 days. After 18.8 weeks (4 – 5 months), the concentration of Cs-137 would decrease to below the EPA regulatory limit of 3 pCi/liter. Thus, although some costs could be conservatively estimated to account for temporary lost maritime business and limits on shoreline use, these would be considerably smaller that the costs accounted for in the SAMA analysis for CAPB-15, which models an atmospheric release. These economic costs from an atmospheric release are incurred due to the effects of the airborne plume and meteorological conditions at the time of the postulated accident, and would be imposed by the deposition pattern from the airborne plume as it traveled through the 50-mile SAMA region (on the order of minutes to hours), and thereby leading to radiological exposures over a timeframe of days to years. The magnitude of the costs associated with an atmospheric release would be controlled by the ability or inability to cost-effectively decontaminate property, lands, housing, and business assets, mostly due to sources of radioactivity on surfaces, such as Cs-137, that would persist unless actively removed by human intervention. These costs are highest in the more distant, high-population areas in the fifty-mile region.

49. (KRO) In the Pilgrim SAMA analysis, the averted public exposure costs (APE) attributable to the PDR contributes about 32% of the total benefit. The averted off-site economic costs (AOC) attributable to the OECR contribute about 54% of the total benefit. Thus, 86% of the overall SAMA benefit is attributable to the PDR and OECR.[23] The SAMA results show that for the next potentially cost-beneficial SAMA, SAMA 8, the approximate cost of implementing the SAMA (>$5,000,000) is more than twice the benefit ($2,410,000), or the cost avoided, from implementing the SAMA. What this means in terms of the net effect to the SAMA analysis is that for the next SAMA to be determined potentially cost beneficial (i) the OECR and PDR would each need to increase by a factor of 2.2; or (ii) the OECR would need to increase by nearly a factor of 3 (2.98) if the PDR stays constant; and (iii) the PDR would need to increase by a factor of 4.3 if the OECR stays constant.

50. (KRO) Modeling the consequences that would result from aqueous releases of the type that have occurred at Fukushima would not materially alter the results of the Pilgrim SAMA analysis (by causing additional SAMAs to become potentially cost-beneficial) because, for the reasons discussed above, the OECR and PDR for aqueous releases would be much less than the OECR and PDR for the large, atmospheric releases assumed in the Pilgrim SAMA analysis. For example, if instead of conducting a SAMA analysis that models all radionuclides being released into the atmosphere (as is currently the case in the Pilgrim SAMA analysis), one were to model the same quantity of radioactive release with some portion of that radioactivity released directed into the water, the results would not identify any additional potentially cost beneficial SAMAs for at least the following reasons:

[23] The remaining 14% of the SAMA benefit is a combination of on-sites costs, the averted occupational exposure, and the averted on-site costs, including on-site decontamination and replacement power. The overall results of the SAMA analysis are documented in Appendix G of NUREG-1437, Supplement 29.

- First, any radionuclides that are released via the aqueous pathway would actually decrease the PDR for the reasons discussed above. The aqueous releases would result in little, if any, direct exposures to people, and therefore would result in limited PDR corresponding costs to be considered in the SAMA analysis.

- Second, costs associated with contamination cleanup (part of the OECR calculation) would be greater from atmospheric releases deposited onto land, than releases into the water. In the case of the latter, the Atlantic Ocean will dilute the concentration of radionuclides in relatively short order (as has occurred in the Pacific off the coast of Fukushima, see discussion infra).

- Third, greater consequences will result if more radioactivity is airborne and thus reaches population centers, such as Boston and Providence. This is true for both PDR (population dose exposure) and OECR (offsite economic activity) costs, as was noted in Table 3 in ENT000001, and summarized in paragraph 45 (above).

51. (KRO) Indeed, I have previously addressed a claim raised by Pilgrim Watch regarding the consideration of ongoing, low-level radioactive releases at Fukushima and their potential impact the Pilgrim SAMA analysis. In response to Pilgrim Watch's claims regarding alleged recriticalities and ongoing radioactive releases occurring at Fukushima, I testified:

> Any ongoing radioactive releases from Fukushima due to post-scram recriticalities, as well as any other ongoing low-level releases of radioactivity from Fukushima, would therefore contrast sharply with the releases assumed in the Pilgrim SAMA analysis. These ongoing releases would include any airborne releases due to evaporation and resuspension of radioactivity from the facilities at Fukushima, releases resulting from the occurrence of any alleged recriticalities, and any aquatic releases from leaks stemming from the recovery efforts. These radioactive releases and any other ongoing releases would be very small compared to the large airborne releases due to energetic phenomena considered in the Pilgrim SAMA analysis. For example, a long, but relatively small, release of radioactive iodine could occur over weeks and be observed as elevated concentrations in sub-

> drains and other liquid pathways or elevated airborne levels, but the actual dose received by the public from this type and level of release would be greatly exceeded by the much larger, short-term release of longer-lived, more dose-dominant radionuclides (*e.g.*, Cs-137, Sr-90, and Pu-238 among others) that are associated with elevated, severe accident releases to the atmosphere assumed in the Pilgrim SAMA analysis.

Sowdon/O'Kula Decl. at ¶ 31 (emphasis added).

52. (KRO) In summary, Pilgrim Watch has made no showing that any of the concerns it seeks to litigate in this proceeding would materially alter the SAMA analysis. Pilgrim Watch nowhere shows how any of its aqueous radioactive release concerns would result in a sufficient increase in PDR, OECR, or both to identify any additional potentially cost beneficial SAMAs.

B. The Pilgrim SAMA Analysis Considers Radiological Releases Larger Than Those That Have Occurred at Fukushima

53. (KRO) Another way to analyze Pilgrim Watch's aqueous release claims to determine whether they materially change the results of the Pilgrim SAMA analysis is to compare the overall radioactive release estimates from the three Fukushima damaged reactors to the hypothetical releases postulated in the Pilgrim SAMA analysis. I have previously provided testimony demonstrating that the large atmospheric radioactive releases considered in the Pilgrim SAMA analysis are far larger than the atmospheric releases that occurred at Fukushima. As discussed in the Sowdon /O'Kula Declaration, comparison of the radiological releases assumed in the single-unit Pilgrim SAMA analysis shows that the Pilgrim SAMA analysis accounts for severe accident releases greater than the reported releases from all of the Fukushima units combined. Sowdon/O'Kula Decl. at ¶ 41. As explained in the Lynch/Potts/O'Kula Declaration, subsequent to the development of the comparisons in the Sowdon/O'Kula Declaration, the Japanese authorities increased their estimate of the radioactive release from Fukushima by about 22% above the estimates used in the Sowdon/O'Kula Declaration. This increase had no effect on the conclusions

drawn from the comparisons made in Table 5 of the Sowdon/O'Kula Declaration. As noted there, "even if Fukushima radionuclide release estimates were to double, CAPB-15 (which contributes over 80% of the PDR and OECR to the Pilgrim SAMA analysis) would still bound the estimated I-131 releases from all of the Fukushima facilities by about a factor of two (1.78) and the estimated Cs-137 releases [from all of the Fukushima facilities] by about a factor of three (2.66)." Sowdon/O'Kula Declaration at 24 n.16. Thus, the radionuclide releases assumed in the Pilgrim SAMA analysis far exceed actual releases at Fukushima. Lynch/Potts/O'Kula Decl. at ¶ 66 & n.8.

54. (KRO) In addition, also in the Lynch/Potts/O'Kula Declaration, I explained that the fraction of the Fukushima units' core inventories released into the environment, based on measurements and computer model-backed calculations reported to date by the Japanese government, is less than the core inventory release fraction considered in multiple Pilgrim SAMA-basis CAPBs. Lynch/Potts/O'Kula Decl. at ¶¶ 67-68.

55. (KRO) To further refine this point, the atmospheric and liquid radiological release estimates from Fukushima can be compared to the atmospheric release estimates used in the Pilgrim SAMA analysis. For consistent comparisons across estimates here, the radiological content is provided in mega-curies (MCi).

56. (KRO) First, to recap, in June 2011 the Nuclear & Industrial Safety Agency ("NISA"), the regulating agency in Japan, estimated the atmospheric radiological release from all three Fukushima reactors as 7.7×10^{17} becquerels ("Bq"), or 770 peta-bequerels ("PBq"),[24] which can be converted to 20.81 MCi.[25] In Table 1 below, the iodine-equivalent airborne release

[24] 1 PBq = 10^{15} Bq.

[25] 1 MCi = 37 PBq.

in MCi for each of the Pilgrim SAMA CAPBs is shown, as well as the ratio of that release to the NISA estimate for the combined airborne releases from the damaged Fukushima reactors.

Table 1. Atmospheric Radionuclide Release Estimates From the Pilgrim SAMA Analysis Compared to Total Estimates from Fukushima Daiichi (Iodine-131 Equivalent)[26]

CAPB Source Term to the Atmospheric Environment	I-131 Equivalent (MCi)	Ratio of Pilgrim CAPB to NISA Estimate for Fukushima (20.81 MCi)
CAPB-1	0.00001	0.000003
CAPB-2	0.01	0.0007
CAPB-3	0.02	0.0007
CAPB-4	9.3	0.45
CAPB-5	13.6	0.65
CAPB-6	8.1	0.39
CAPB-7	10.8	0.52
CAPB-8	85.6	4.11
CAPB-9	22.2	1.07
CAPB-10	78.7	3.78
CAPB-11	45.3	2.18
CAPB-12	0.014	0.0007
CAPB-13	2.0	0.09
CAPB-14	8.4	0.40
CAPB-15	83.4	4.01
CAPB-16	11.9	0.57
CAPB-17	105.7	5.08
CAPB-18	21.2	1.02
CAPB-19	118.1	5.68

[26] In Table 1, the term "I-131 Equivalent" is used to compare airborne release of different radionuclides using the radiological effect from I-131 based on the methodology from the International Nuclear and Radiological Event Scale (INES) of the International Atomic Energy Agency (IAEA) (IAEA INES The International Nuclear and Radiological Event Scale, User's Manual, International Atomic Energy Agency and OECD/Nuclear Energy Agency, Vienna, Austria (2009)). The INES scale assumes the inhalation of the airborne concentration of the radionuclide in question along with the effective dose to adults from ground deposition of radionuclides, integrated over fifty (50) years, including consideration of resuspension, weathering, and ground roughness, and compares the resulting dose to that from I-131. The estimates of the radiological releases from Fukushima have been reported in terms of I-131 and Cs-137, which are the dominant radionuclides, with the overall release reported in I-131 equivalent activity, in Becquerels (Bq) or Curies (Ci), by multiplying the estimated Cs-137 release by a factor of 40 to account for its higher radiological hazard, and adding this number to the estimated I-131 release. Table 1 uses the same methodology to compare the airborne releases from the Pilgrim SAMA analysis 19 CAPBs to the NISA I-131 equivalent estimate to show that the postulated releases assumed in the Pilgrim's analysis are considerably higher than the airborne releases estimated from Fukushima. The weighting factor of 40 for Cs-137 is appropriate for airborne releases because the equivalence assumes radiological dose effect through inhalation and groundshine. Ingestion doses are not included because interdiction levels are assumed to prevent any significant dose to individuals affected by the accident.

57. (KRO) Table-1 shows CAPB-8, -9, -10, -11, -15, -17, -18, and -19 are each larger than the total release from all three damaged reactors at Fukushima using the larger NISA estimate. In particular, CAPB-15, a source term that contributes over 80% of the population dose risk ("PDR") exposure and off-site economic cost risk ("OECR") in the Pilgrim SAMA analysis, is a factor of four larger than the total release from all three of reactors damaged by the earthquake, tsunami, and station blackout events of March 11, 2011 at Fukushima. Thus, with respect to atmospheric releases (which as previously discussed are of greater consequence and impact than aqueous releases), it is clear that the Pilgrim single-unit SAMA analysis considers releases far larger than those that have occurred for the three Fukushima reactors.

58. (KRO) Some estimates are available as to how much radioactivity was released into the Pacific Ocean from Fukushima. According to data provided in the INPO report, on April 2, 2011 very high concentrations of radioactivity were identified in the harbor of the station. The source was water accumulating in the turbine building, flowing through a trench, and leaking into the harbor. INPO Report at 38. The total magnitude of this release was estimated at 0.13 MCi. Id.[27]

59. (KRO) Quantities and concentrations of radioactivity in subsequent liquid releases have been smaller. According to information provided by the World Nuclear Association,[28] on April 4-10, 2011 and with government approval, TEPCO released to the sea approximately 10,400 cubic meters (m^3) of slightly contaminated water – a total of about 0.000004 MCi (or 4 curies) of radioactivity – in order to free up storage space for more highly contaminated water.

60. (KRO) Overall estimates of radioactive releases to the Pacific Ocean have been provided, and a review of those estimates indicates a significant range in the estimates. In Sep-

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[27] (JRL) It is important to note that based on the description of the Fukushima leak event provided in the INPO report, the Pilgrim plant does not have any comparable leak pathways into Cape Cod Bay.

[28] See http://www.world-nuclear.org/info/fukushima_accident_inf129.html.

tember 2011, researchers at the Japan Atomic Energy Agency ("JAEA"), Kyoto University and other institutes estimated that about 0.41 MCi of radioactivity (I-131 and Cs-137) had been released into the sea from late March through April, including substantial airborne fallout. Another study, by the French Institute for Radiological Protection & Nuclear Safety ("IRSN"), has estimated the aqueous release for Cs-137 alone as 0.73 MCi (27 PBq).[29] While there is a significant range in these estimates, the sources are in agreement that the large bulk of the releases occurred in the late March, early April time frame. Notably, the IRSN report (which has reported the largest estimate of aqueous releases) indicates that, since July 11, 2011, the radioactive concentrations of water measured at sea are mostly below the limits of detection of the measurement equipment used for monitoring.

61. (KRO) The World Nuclear Association states that concentrations of radioactivity measured in ocean water outside of plant structures since the known radioactive releases in April 2011 have been below regulatory levels since April 2011. This information is consistent with that presented by the French IRSN report which, as noted, indicates that since July 11, 2011, the radioactive concentrations of water measured at sea are mostly below the limits of detection of the instruments used for monitoring.

62. (KRO) A way to compare the radiological releases hypothesized in the Pilgrim SAMA analysis to the estimates provided by these organizations is to compare just the Cs-137 releases postulated in the Pilgrim SAMA analysis with the CS-137 estimated releases reported for Fukushima. By adding the largest Cs-137 aqueous release estimate (0.73 MCi from France's

[29] A rough English translation of the IRSN study can be found at http://www.simplyinfo.org/?p=3818.

IRSN) and the largest estimate of airborne Cs-137 release estimate (0.41 MCi from Japan's NISA)[30] from the three Fukushima reactors, the resulting sum is 1.14 MCi of Cs-137 alone.[31]

63. (KRO) Table 2 below compares the Cs-137 atmospheric release estimate hypothesized in each of the Pilgrim SAMA CAPBs to the combined IRSN and NISA Cs-137 Fukushima release estimates. As shown in Table 2 below, this release estimate from Fukushima's three reactor units is still less than five of the Pilgrim SAMA analysis CAPB source terms to the atmospheric environment from hypothetical, highly unlikely severe accidents. Specifically, the combined Cs-137 release estimates from the IRSN (aqueous) and NISA (atmospheric) of 1.14 MCi is less than the Cs-137 releases postulated for CAPB-8, -10, 15, -17, and -19. Comparing the important PDR- and OECR-dominant CAPB-15 with the three-reactor Fukushima release, the Cs-137 release postulated for CAPB-15 is a factor of 1.5 greater than the Cs-137 released from the three damaged Fukushima reactors.

[30] The airborne cesium release estimate was obtained from NISA data and converted into MCi. The NISA data is available at http://www.tepco.co.jp/en/nu/fukushima-np/index-e.html under the PDF presentation entitled "The Great East Japan Earthquake and Current Status of Nuclear Power Station" (Dec. 7, 2011) at slide 11.

[31] It should be noted that this combined airborne and aqueous estimate of 1.14 MCi of Cs-137 is conservative because it likely reflects some double counting of airborne Cs-137 releases. The French ISRN estimates are based on measurements of radioactivity observed in the seawater and not on measurements or estimates of actual releases into the seawater. The Cs-137 measured and estimated in the French IRSN study would therefore likely include atmospheric releases of Cs-137 that fell out over the ocean, or on land and was subsequently washed into the ocean.

Table 2. Pilgrim CAPBs and Cs-137 release Compared to Fukushima (Using the liquid release estimate from IRSN + NISA atmospheric release estimate)

CAPB Source Term	Cs-137 Released in CAPB (MCi)	Ratio of Pilgrim CAPB Cs-137 Release to Combined Liquid Release (IRSN) + Airborne Release (NISA) = 1.14 MCi
CAPB-1	0.000001	0.000001
CAPB-2	0.00030	0.0003
CAPB-3	0.00032	0.0003
CAPB-4	0.169	0.15
CAPB-5	0.237	0.21
CAPB-6	0.149	0.13
CAPB-7	0.189	0.17
CAPB-8	1.750	1.54
CAPB-9	0.455	0.40
CAPB-10	1.602	1.41
CAPB-11	0.907	0.80
CAPB-12	0.0003	0.0002
CAPB-13	0.039	0.03
CAPB-14	0.172	0.15
CAPB-15	1.724	1.51
CAPB-16	0.210	0.18
CAPB-17	2.168	1.90
CAPB-18	0.402	0.35
CAPB-19	2.426	2.13

64. (KRO) In summary, the Pilgrim SAMA analysis considers releases far larger than those that have occurred at Fukushima's three reactors, whether comparing total iodine-equivalent releases to the atmosphere, or comparing total cesium releases to the atmosphere and by leakage into the ocean. In both cases, the fact that the Pilgrim SAMA analysis assumes all releases are atmospheric is more conservative because atmospheric releases will cause far greater and more immediate and direct impact to populated areas compared to aqueous releases. This means that further consideration of Pilgrim Watch's claims will not materially alter the results of the Pilgrim SAMA analysis. Fukushima has revealed no information suggesting that the Pilgrim

SAMA analysis underestimates the consequences (PDR and OECR) that would result from a severe accident. Because the Pilgrim SAMA analysis considers radiological releases, and hence consequences, that are far larger than those that have occurred from Fukushima's three reactors, Pilgrim Watch's claims will not result in the identification of any new potentially cost beneficial SAMAs.

V. Pilgrim Watch's and Mr. Gundersen's Remaining Claims are Immaterial or Meritless

65. (JRL, KRO) In light of the information discussed above, the remaining claims and unsupported assertions made by Pilgrim Watch and Mr. Gundersen are immaterial or meritless.

66. (JRL, KRO) Mr. Gundersen erroneously asserts, with no support, that, in light of Fukushima, it is "reasonable to assume that the entire Cape Cod Bay would be unusable by the public for its intended function after a severe accident at Pilgrim Station." Gundersen Decl. at ¶ 33. This is hardly the case. As previously discussed, an accident like that at Fukushima is highly unlikely to occur at Pilgrim for a number of reasons, including the facts that (1) the natural external phenomena initiating events that occurred at Fukushima are highly unlikely to occur at Pilgrim; (2) Pilgrim's plant procedures for venting primary containment during a severe accident differ significantly from those at Fukushima; and (3) Fukushima involved simultaneous challenges to six reactors on a compact site and, ultimately, core damage to three reactors, which complicated the ability of Fukushima operators to manage the accident. In addition, according to the World Nuclear Association, concentrations of radioactivity measured in ocean water have been below regulatory levels since April 2011, and the French IRSN study shows that, since July 11, 2011, the radioactive concentrations of water measured at sea were mostly below the limits of detection of instruments used for monitoring. Similarly, as discussed above for Pilgrim, even assuming a large radioactive release directly into the ocean, much larger than the aqueous re-

leases at Fukushima, the concentration of Cs-137 would decrease to below EPA regulatory limits within months.

67. (JRL, KRO) Pilgrim Watch's and Mr. Gundersen's assertions that the Pilgrim SAMGs fail to provide for the processing of contaminated water that would (allegedly) result from a severe accident at Pilgrim, and thus that water would have to be released into Cape Cod Bay (see e.g., PW Request at 1-3; Gundersen Decl. at ¶¶ 25-26, 28) would not materially alter the results of the SAMA analysis. As previously discussed, because of the site and operational differences at Pilgrim (*e.g.*, the unlikelihood of the earthquake and tsunami, different venting procedures, and single-unit site), Pilgrim is not likely to face a Fukushima-type accident scenario requiring Pilgrim to treat contaminated water. Thus, Pilgrim Watch's concern about lack of a SAMG to address contaminated water is irrelevant. But even were Pilgrim faced with such a scenario, as previously explained, Pilgrim Watch's concerns regarding contaminated water will not materially change the Pilgrim SAMA analysis results. The Pilgrim SAMA analysis considers radioactive releases far greater than those which have occurred for three reactor accidents at Fukushima. Furthermore, the release of contaminated water will not have nearly the impact of the large, atmospheric releases assumed in the Pilgrim SAMA analysis.

68. (JRL, KRO) Mr. Gundersen also asserts that the "Price Anderson insurance limits will be exceeded to pay compensation for damages, much of which is due to marine dependent industry losses." Gundersen Decl. at ¶ 38. Whether or not this assertion has any merit, it is irrelevant for purposes of the Pilgrim SAMA analysis. As previously demonstrated, a Fukushima-type accident is highly unlikely to occur at Pilgrim, thus the consequences of any such accident would be weighted very low in the SAMA analysis and would not result in the identification of any potentially cost beneficial SAMAs.

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

Executed in Accord with 10 C.F.R. § 2.304(d)
Joseph R. Lynch
Manager, Licensing
Pilgrim Nuclear Power Station
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Plymouth, MA 02360
Phone: 508-830-8403
E-mail: jlynch4@entergy.com

Executed in Accord with 10 C.F.R. § 2.304(d)
Kevin O'Kula,
Advisory Engineer
URS Safety Management Solutions LLC
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EXHIBIT 1

600 Rocky Hill Road
Plymouth, MA 02360

(508) 830-8403 (Work)
(508) 728-1421 (Cell)
E-mail: jlynch4@entergy.com

Joseph R. Lynch Jr.

Objective

Senior Manager/Regulatory Affairs with 29 years of nuclear power experience and background in engineering, licensing/regulatory affairs, environmental compliance, creative problem solving, stakeholder communications, complex project management, cost control, budgeting and employee management. Strong strategic thinker and team builder.

Areas of Expertise

- Regulatory Affairs/Licensing
- Project Management
- Design and Systems Engineering
- Environmental Health & Safety
- Compliance
- Oral and Written Communications

Education

Worcester Polytechnic Institute – Worcester, Massachusetts
Bachelor of Science in Mechanical Engineering (BSME)
Specialized in Thermo/Fluids/Nuclear

Graduate Studies in Business Management, Communications and Regulatory Compliance

Numerous Internal and External Management Courses – Yankee Atomic Electric Company; Vermont Yankee Nuclear Power Corporation

Professional experience

2007-Present Entergy Nuclear Operations

Licensing Manager

Manages the Pilgrim Nuclear Power Station Licensing Group supporting the operation and regulatory compliance of the station in accordance with NRC, State and Federal regulations, permits and statutes.

Development of all necessary letters, licensing correspondence and regulatory approvals from NRC, local, state and federal agencies required in support of plant operations.

- Responsible for communicating with regulators, governmental representatives and media on plant status, regulatory issues and emergent events.
- Management of a $ 6-8 million dollar annual department budget.

2006-2007 Environmental Resources Management (ERM)

Senior Nuclear Consultant

Directs ERM's national nuclear team, and leads, coordinates, or supports nearly all of the nuclear-related work on behalf of ERM nationally.

Responsible for the oversight of all technical and policy-related activities of the nuclear staff experts within ERM. Maintains a close awareness of current and emergent regulatory issues within the nuclear sector, developing trends, and industry initiatives. Recent projects include;

- Support of Groundwater Program development at several nuclear power plants in accordance with EPRI/NEI Guidance Documents and plant specific attributes.
- Regulatory affairs, licensing and permitting responsibility for nuclear client.
- Environmental, Health & Safety (EHS)/Due Diligence Assessments for several nuclear clients supporting Merger & Acquisition (M&A) efforts.

2003-2006 Yankee Atomic Electric Company

Director, Regulatory Affairs, Licensing and Site Closure

Directed and managed the Site Closure Project activities for the clean-up and decommissioning of the Yankee Nuclear Power Station in strict compliance with NRC, State and Federal regulations, permits and statutes.

Development of strategies to obtain all necessary permitting, licensing and regulatory approvals from NRC, local, state and federal agencies required to remediate all environmental hazards from the site in support of unrestricted re-use of the property.

- Responsible for communicating with community members, regulators, governmental representatives and media on project status, key company decisions and emergent issues.
- Authored the Site Closure Project Plan (SCPP), an industry first, comprehensive plan that integrated stakeholder input, corporate goals and regulatory compliance by working with local, state and federal stakeholders to solicit input and acceptance.
- Extensive outreach to stakeholders via written and verbal communication including site personnel, executive management, community advisory boards, local/state government leaders, town meetings, community and media events.
- Control and management of a $ 6-8 million dollar annual project budget.

2000-2003 Connecticut Yankee Nuclear Power Company

Decommissioning Oversight Manager

Directed and coordinated oversight of the construction and plant demolition activities at the Connecticut Yankee Nuclear Power Station in accordance with applicable regulatory standards.

Position responsibilities included, but were not limited to the following;

- Implemented department activities in accordance with established and newly developed station programs, policies and procedures.
- Assured a safety conscious work environment, including implementation of the Standards of Conduct and the Site Corrective Action Program.
- Communicated site performance to stakeholders including site personnel, executive management, Independent Assessment groups, community members, regulators, governmental representatives and the media.
- Assured decommissioning activities did not affect safe storage of spent nuclear fuel.
- Assisted site executive management in establishing and implementing strategic plans.

1997-2000 Vermont Yankee Nuclear Power Corporation

Department Manager – Design Engineering

Responsible for management of plant design modifications, thermal/hydraulic design analyses and plant support functional areas for a twenty (20) engineer staff, including consultants, contractors and administrative support. Control and oversight of a $ 3-4 million dollar annual budget.

Position responsibilities included;

- Interface with U.S. Nuclear Regulatory Commission (USNRC) through Senior Resident and /or Region I Project Manager.
- Reviewed and approved all departmental design work products.
- Preparation, review and approval of Bases for Maintaining Operation (BMO).
- Preparation and maintenance of plant Design Basis Documentation (DBD).
- Preparation, review and approval of 10CFR50.59 Safety Evaluations.
- Employee performance appraisals, bonus/compensation determination and goal setting.
- Qualified adjunct instructor for providing training to engineering staff.
- Maintained the Department budget by tracking expenditures on capital and O&M Projects, contractor costs and employee salaries/benefits.
- Identified and developed Continuous Process Improvements (CPI) initiatives with plant management, supervision, and staff to improve overall performance of engineering work products.

1982-1997 Yankee Atomic Electric Company

Manager – Design Engineering Fluid Systems (1995-1997)

Supervised the Design Engineering Fluid Systems staff supporting the Vermont Yankee Nuclear Power Station.

- Responsible for the review and approval of design change packages, calculations and analyses, 10CFR50.59 Safety Evaluations, Operability Determinations, Bases for Maintaining Operability, Design Basis Documents (DBD) and Department assigned commitments/corrective actions.

- Responsible for oversight of the VY MOV, and Safety Classification Programs.
- Responsible for planning and scheduling of all assigned work, outage preparation/implementation activities, project budget accountability and direction of contractor staff.

Motor-Operated Valve (MOV) Program Manager (1994-1995)

Directed Connecticut Yankee's efforts for planning and implementation of the Generic Letter 89-10 MOV Program testing and overhaul activities through the 1995 Refueling Outage (RFO).

- Coordinated the completion of all documentation in support of NRC inspection and closure of the GL 89-10 imposed requirements for safety-related MOVs.

Lead Systems Engineer (1992-1994)

Project Manager for the Millstone Unit 1 Hardened Wetwell Vent System design and implementation.

- Instrumental in engineering and development of all design change documents.
- Responsible for the management of all work projects for Northeast Utilities, within the Systems Engineering discipline.

Senior Project Engineer (1990-1992)

Served as Project Manager for the Yankee Nuclear Power Station (YNPS) high-pressure turbine retrofit and Main Condenser replacement projects.

- Provided project management, engineering and scheduling oversight.
- Worked extensively on condition assessment, performance monitoring and replacement justification for the YNPS Main Condenser.
- Negotiated the Contracts for acquisition of the HP Turbine and Main Condenser.

Systems/Senior Systems Engineer (1982-1990)

Designed, specified, and analyzed nuclear power plant fluid/air systems and equipment at the Yankee Nuclear Power Station.

- Provided technical assistance and installation supervision on primary and secondary plant equipment and systems.
- Designed/installed the Safe Shutdown System (Appendix R requirement for remote shutdown of YNPS), Emergency Diesel Generator (EDG) and Safety Injection Building ventilation upgrades, EDG replacement and commercial grade dedication of the EDGs.
- Shift outage coordinator for the 1990 summer Refueling Outage at YNPS.
- Worked closely with the plant staff in planning, prioritizing and craft labor oversight/support.

EXHIBIT 2

KEVIN R. O'KULA

Advisory Engineer

URS Safety Management Solutions LLC

2131 South Centennial Avenue
Aiken, South Carolina 29803-7680
Telephone: 803.502.9620 – Email: kevin.okula@wsms.com

KEY AREAS:

- **Computer Model Verification and Validation**
- **Accident and Consequence Analysis for Design Basis Accident Support**
- **Regulatory Standard & Guidance Development**
- **New Reactor Design Accident Analysis and PRA Support**
- **Severe Accident and Quantitative Risk Analysis**
- **Level 2/3 Probabilistic Risk Assessment**
- **MACCS2 Code Applications**
- **Level 3 PRA Standard Development**

Professional Summary:

Dr. O'Kula has over 29 years of experience as a manager and technical professional in the areas of accident and consequence analysis, source term evaluation, commercial and production reactor probabilistic risk assessment (PRA) and severe accident analysis, safety software quality assurance (SQA), safety analysis standard and guidance development, computer code evaluation and verification, risk management, hydrogen safety, reactor materials dosimetry, shielding, and tritium safety applications. He is a member of the American Nuclear Society (ANS) Standard working group ANS 58.25 on Level 3 Probabilistic Safety Assessment, and is a member of the Peer Review Committee for the Nuclear Regulatory Commission's (NRC's) State-of-the-Art Reactor Consequence Analysis (SOARCA) Program. Kevin was part of the Department of Energy (DOE) team writing DOE G 414.1-4, *Safety Software Guide*. He coordinated technical support for the DOE Office of Environment, Safety, and Health (EH) in addressing Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2002-1 on Software Quality Assurance (SQA), and was a consultant to DOE/EH-31 Office of Quality Assurance for disposition of SQA issues. Dr. O'Kula was a member of the Partner, Assess, Innovate, and Sustain (PAIS) Safety Case team for the Sellafield Site in the United Kingdom in the early 2009 period. The PAIS team identified and began implementation of improvement opportunities in nuclear safety and related areas. Recommendations were documented in comprehensive reports to the Site's Nuclear Management Partners consortium in March 2009.

He is, or has supported, Atomic Safety Licensing Board (ASLB) relicensing issue resolution for several commercial plants including Indian Point, Prairie Island, and Pilgrim Nuclear Power Station, on severe accident mitigation alternatives (SAMA) analysis. He was also part of the accident analysis and PRA/severe accident teams supporting the Design Certification Document for the U.S. Advanced Pressure Water Reactor (US-APWR) a joint effort with URS Washington Division and Mitsubishi Heavy Industries (MHI). He has provided similar support for an alternative reactor technology, the Pebble Bed Modular Reactor (PBMR).

Kevin is coordinating WSMS support to the Quantitative Risk Analysis (QRA) for evaluation of hydrogen events in a waste vitrification plant design, including fault tree and human factors areas. He is also a contributor to the DOE response on the use of risk assessment methodologies as part of the DNFSB Recommendation 2009-1 implementation action for Risk Assessment. He led work in reviewing EIS food pathway consequence analysis performed on assumed accident conditions from the Mixed Oxide Fuel Fabrication Facility (MFFF), sited at the Savannah River Site. This project compared and evaluated the impacts calculated from three computer models, including MACCS2, GENII, and UFOTRI.
He is past chair of the American Nuclear Society (ANS) Nuclear Installations Safety Division (NISD), and the Energy Facility Contractors Group (EFCOG) Accident Analysis Subgroup. He is a member of the Nuclear Hydrogen Production Technical Group under the ANS's Environmental Sciences Division, and is chair for the EFOCG Hydrogen Safety Interest Group. He was the Technical Program Chair for two ANS embedded topical meetings on Operating Nuclear Facility Safety (Washington, D.C., 2004) and the Safety and Technology of Nuclear Hydrogen Production, Control and Management (Boston, MA, 2007).

Dr. O'Kula was PRA group manager for K Reactor at the time of restart in the early 1990s. He led a successful effort demonstrating Savannah River Site (SRS) K-Reactor siting compliance to 10 CFR 100, and tritium facility compliance with SEN-35-91. He was the project leader for independent Verification and Validation (V&V) of urban dispersion software for the Defense Threat Reduction Agency (DTRA) and is the current V&V project manager for the evaluation of several chemical/biological software tools for the U.S. Army Test and Evaluation Command (ATEC) and Chemical-Biological Program (Dugway Proving Ground (Utah) and Edgewood Chemical/Biological Center in Maryland.

Education:

Ph.D., Nuclear Engineering, University of Wisconsin, 1984
M.S., Nuclear Engineering, University of Wisconsin, 1977
B.S., Applied and Engineering Physics, Cornell University, 1975

Training:

Conduct of Operations (CONOPS), 1994
Harvard School of Public Health, Atmospheric Science and Radioactivity Releases, 1995
Consequence Assessment, (Savannah River Site, 1995)
U.S. DOE Risk Assessment Workshop (Augusta, GA, 1996)
MELCOR Accident Computer Code System (MACCS) 2 Computer Code, 1997, 2005
MCNPX Training Class (ANS Meeting, 1999)

Clearance:

Active DOE "Q"

Professional Experience:

Washington Safety Management Solutions **1997 to Present**
Advisory Engineer and Senior Fellow Advisor

Dr. O'Kula is a member of the State-of-the-Art Reactor Consequence Analysis (SOARCA) Project Peer Review Committee that provides recommendations on applying MACCS2 in the context of accident phenomena and subsequent off-site consequences in the context of severe reactor accidents. This activity

supports the efforts of Sandia National Laboratories (SNL) and the Nuclear Regulatory Commission (NRC) to provide more realistic assessment of severe accidents.

Dr. O'Kula is also part of the Level 3 PRA Standard working group charged with developing an ANSI/ANS standard for Level 3 PRA analysis. He participated in a team that conducted an SQA gap analysis on the bioassay code [Integrated Modules for Bioassay Analysis (IMBA)] based on DOE G 414.1-4 requirements. He identified safety analysis codes that were designated as DOE "toolbox" codes, and oversaw production of the first documents (QA criteria and application plan, code guidance reports, and gap analysis) for six accident analysis codes designated for the DOE Safety Software Toolbox. He provided support to DOE/EH-31 (now DOE/HSS) for addressing SQA issues for safety analysis software. He was a contributor to DOE G 414.1-4, *Safety Software Guide* on SQA practices, procedures, and programs.

Kevin has provided technical input for work packages on several recent commercial projects. In the first, he teamed with Entergy on MACCS2 code applications issues in the Severe Accident Mitigation Alternatives (SAMA) analysis area for the Pilgrim Nuclear Power Station. In the second, he was part of tritium environmental release analysis team that supported evaluation of tritium control and management areas for the Braidwood plant. A third effort developed an initial SAMDA document for the Mitsubishi Heavy Industries (MHI) US-APWR (1610 MW_e evolutionary PWR), as well as complete a control room habitability study for postulated toxic chemical gas releases.

Kevin was part of a Washington Group team that developed a Design Control Document (DCD) for the MHI US-APWR using input information from MHI. He was Chapter lead on Chapter 15 (Transient and Accident Analysis), and later transitioned to severe accident evaluation and documentation support to Chapter 19 (PRA and Severe Accidents). He currently is the Chapter 19 lead for PRA and Severe Accident for COLA development for the Pebble Bed Modular Reactor (PBMR).
Dr. O'Kula developed the outline, coordinated contributors, and assembled the first draft of the DOE *Accident Analysis Guidebook*, a reference guide for hazard, accident, and risk analysis of nuclear and chemical facilities operated in the DOE Complex. He is also the primary author and coordinator for the *Accident Analysis Application Guide* for the Oak Ridge contractor. Dr. O'Kula also developed a one-day course and exam for the guide, which he later presented to the Oak Ridge, Paducah, and Portsmouth staff. Dr. O'Kula also led an independent V&V review for the DTRA of the U.K.-developed Urban Dispersion Model (UDM) software for predicting chemical and biological plume dispersion in city environments, and is leading projects to verify and validate chemical/biological simulation suite software applications for the Dugway Proving Ground (Utah), and the Edgewood Chemical Biological Center (ECBC) in Maryland.

Managing Member, Consequence Analysis

Dr. O'Kula was responsible for the consequence analysis associated with accident analysis sections of Documented Safety Analysis (DSA) reports and other safety basis documents for SRS, Oak Ridge, and other DOE nuclear facilities. He also developed the methodology and identified appropriate computer models for this purpose. Additionally, Dr. O'Kula developed training to enhance consistency and standardize analyses in the consequence analysis area. He was project manager for environmental assessment support to SRS on a transportation safety analysis using the RADTRAN code.
Dr. O'Kula coordinated development of a DOE Accident Analysis Guidebook involving over 10 sites and organizations. He also led the effort to produce Computer Model Recommendations for source term (fire, spill, and explosion), in-facility transport, and dispersion/consequence (radiological and chemical) areas.

Westinghouse Savannah River Company **1989 to 1997**
Group Manager

Dr. O'Kula managed consequence analyses associated with accident analysis sections of DSA reports and other safety basis documents. He also developed the associated methodologies and identified appropriate computer models. He was a member of the management team supporting Criticality Safety Evaluation preparation assisting Safe Sites of Colorado and the dispositioning of final criticality safety issues for the decommissioning and decontamination of nuclear facilities at the Rocky Flats Environmental Technology Site.

In a teaming arrangement with Science Applications International Corporation, Kevin initiated discussions that led to development of an emergency management enhancement tool to risk inform likely source terms. Applied this approach to a Savannah River nuclear facility (K Reactor), and was part of the team to provide this methodology for use on the British Advanced Gas-Cooled Reactors (AGRs) (for the United Kingdom's Nuclear Installation Inspectorate). Model was knowledge-based, and required development of an Accident Progression Event Tree (APET) for the facility in question.

Dr. O'Kula managed the completion of the SRS K Reactor PRA program. He was the lead for development of the K Reactor Source Term Predictor Model and assisted with the core technology lay-up program to preserve competencies in reactor safety. He coordinated a 25-person group responsible for K Reactor probabilistic and deterministic dose analyses, and led the examination of reduced power cases at project termination. He developed risk and dose management applications to cost-effectively prioritize facility modifications.

Kevin interfaced with DOE Independent and Senior Review teams to finalize study acceptance, and transitioned the risk assessment team to risk management functions for nuclear and waste processing facilities. In addition, he successfully prepared a 10 CFR 100 Siting white paper to resolve issues raised by the DNFSB, and teamed with DOE/HQ legal support to document resolutions. He led the development of a position paper demonstrating SRS Replacement Tritium Facility compliance with DOE Safety Policy (SEN-35-91).

Staff Engineer

Dr. O'Kula led an analytical team quantifying the tritium source term during a Loss of River Water design basis accident. He evaluated airborne tritium levels with multi-cell CONTAIN model, interfaced with a multidisciplinary team to resolve Operational Readiness Review concerns, developed an SRS-specific methodology for applying MACCS as a tool for Level 3 PRA Applications, and applied CONTAIN code for K Reactor source term analysis.

E.I. du Pont de Nemours & Company **1982 to 1989**
Principal Engineer, Research Engineer

Dr. O'Kula performed risk analysis duties for the Savannah River Laboratory (SRL) Risk Analysis Group, after earlier conducting research activities for the Reactor Materials and Reactor Physics Groups. He performed initial planning for offsite irradiation of test specimens to evaluate remaining reactor lifetime for Savannah River reactor components.

Westinghouse Electric Corporation **1975**
Summer Student, Reactor Licensing
Monroeville, PA

American Electric Power Corporation **1973 to 1974**
Co-op Student, Reactor Physics and Reactor Licensing
New York, NY

Long Island Lighting Company **1972**
Summer Intern
Riverhead, NY

Partial List of Publications (2000-2010):

K. R. O'Kula, D. C. Thoman, J. Lowrie, and A. Keller, *Perspectives on DOE Consequence Inputs for Accident Analysis Applications*, American Nuclear Society 2008 Winter Meeting and Nuclear Technology Expo, November 9-13, 2008 (Reno, NV).

K. R. O'Kula, F. J. Mogolesko, K-J Hong, and P. A. Gaukler, *Severe Accident Mitigation Alternative Analysis Insights Using the MACCS2 Code*, American Nuclear Society 2008 Probabilistic Safety Assessment (PSA) Topical Meeting, September 7-11, 2008 (Knoxville, TN).

K. R. O'Kula and D. C. Thoman, *Modeling Atmospheric Releases of Tritium from Nuclear Installations*, American Nuclear Society Embedded Topical Meeting on the Safety and Technology of Nuclear Hydrogen Production, Control and Management, June 24-28, 2007 (Boston, MA).

K. R. O'Kula and D. C. Thoman, *Analytical Evaluation of Surface Roughness Length at a Large DOE Site (U)*, American Nuclear Society Winter Meeting, November 12-16, 2006 (Albuquerque, NM).

K. R. O'Kula and D. Sparkman, *Safety Software Guide Perspectives for the Design of New Nuclear Facilities (U),* Winter Meeting of the American Nuclear Society, November 13 – 17, 2005 (Washington, D.C.).

K. R. O'Kula and R. Lagdon, *Progress in Addressing DNFSB Recommendation 2002-1 Issues: Improving Accident Analysis Software Applications*, Fifteenth Annual Energy Facility Contractors Group Safety Analysis Workshop, April 30 – May 5, 2005, Los Alamos, NM (2005).

K. R. O'Kula and Tony Eng, *A "Toolbox" Equivalent Process for Safety Analysis Software*, Fourteenth Annual Energy Facility Contractors Group Safety Analysis Workshop, May 1-6, 2004, Pleasanton, CA (2004).

K. R. O'Kula, D. C. Thoman, J. A. Spear, R. L. Geddes, *Assessing Consequences Due to Hypothetical Accident Releases from New Plutonium Facilities (U)*, American Nuclear Society Embedded Topical Meeting on Operating Nuclear Facility Safety, November 14 – 18, 2004 (Washington, D.C.).

K. O'Kula and J. Hansen, *Implementation of Methodology for Final Hazard Categorization of a DOE Nuclear Facility (U)*, Annual Meeting of the American Nuclear Society, June 13-17, 2004, (Pittsburgh, PA).

K. R. O'Kula and Tony Eng, *A "Toolbox" Equivalent Process for Safety Analysis Software*, Fourteenth Annual Energy Facility Contractors Group Safety Analysis Workshop, May 1-6, 2004, Pleasanton, CA (2004).

K. R. O'Kula, et al., *Evaluation of Current Computer Models Applied in the DOE Complex for SAR Analysis of Radiological Dispersion & Consequences*, WSRC-TR-96-0126, Westinghouse Savannah River Company (2003).

K. R. O'Kula, et al., *Evaluation of Current Computer Models Applied in the DOE Complex for SAR Analysis of Radiological Dispersion & Consequences*, WSRC-TR-96-0126, Rev. 3, Westinghouse Savannah River Company (2002).

K. R. O'Kula, *A DOE Computer Code Toolbox: Issues and Opportunities*, Eleventh Annual EFCOG Workshop, also 2001 Annual Meeting of the American Nuclear Society, Milwaukee, WI (2001).

Publications (1988-1999):

Dr. O'Kula authored or co-authored more than 20 publications between 1988 and 1999. Details are available upon request.

Professional Societies and Standards Committees

- American Nuclear Society
- Health Physics Society
- Level 3 ANS PRA Standard Committee 58.25