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ADJUDICATIONS STAFF

Pilgrim Watch

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Secretary, U.S. Nuclear Regulatory Commission,
Washington, DC 20555-0001
Attn: Rulemakings and Adjudications Staff.
E-mail comments to: SECY@nrc.gov.

RE: Docket No. PRM-51-10 – Pilgrim Watch's Comments in Support Massachusetts Attorney General's Petition for Rulemaking

Pilgrim Watch supports the Massachusetts Attorney General's Petition for Rulemaking, in its entirety. Specifically, we support the Petitioner's requests that the NRC:

1. Revoke 10 CFR 51.53(c)(2) and 51.95(c), and Table B-1 of appendix A to 10 CFR part 51; and revoke 10 CFR 51.23(a) and (b), 51.30(b), 51.53, 51.61, and 51.80(b) to the extent that these regulations state, imply, or assume that the environmental impacts of high-density pool storage are insignificant and therefore need not be considered in any National Environmental Policy Act of 1969 (NEPA) analysis.

The petitioner asserts that the revocation of these regulations that serve to ``codify'' the use of the GEIS by the NRC, is necessary to ensure compliance with NEPA in the Pilgrim and Vermont Yankee license renewal cases. In this regard, the petitioner properly

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demonstrates that new and significant information, provided by the petitioner, shows that spent nuclear fuel stored in high-density fuel storage pools is much more vulnerable to fire than the GEIS concludes.

2. Issue a generic determination that the environmental impacts of high-density pool storage of spent fuel, including the environmental impacts of accidents arising from this storage, are significant.

3. Amend its regulations concerning severe accident mitigation alternatives (SAMAs). The petitioner requests that the body of SAMAs that must be discussed in an environmental impact statement or related supplement or in an environmental assessment, under 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 appendix A to 10 CFR part 51 (Postulated Accidents: Severe Accidents) must include alternatives to avoid or mitigate the impacts of high-density pool fires.

4. Require that any NRC licensing decision that approves high-density pool storage of spent fuel at a nuclear power plant or any other facility must be accompanied by an environmental impact statement that addresses the environmental impacts of high-density pool storage of spent fuel at that nuclear plant or facility, and presents a reasonable array of alternatives for avoiding or mitigating those impacts.

Pilgrim Watch also filed contentions on May 25, 2006 in the license renewal proceedings of the Pilgrim Nuclear Power Station - Contention 4: The Environmental Report Fails To Address Severe Accident Mitigation Alternatives (SAMAs)

Which Would Reduce the Potential for Spent Fuel Pool Water Loss and Fires. We submit that contention; see Attachment A, in order to provide additional material to the NRC to support the Massachusetts Attorney General's Petition for Rulemaking. And we wish to supplement section 4.4.2.f, *The consequences of water loss in the spent fuel pool caused by accident or terrorism could be catastrophic*, of that Contention with a summary of the consequence analysis performed by Dr. Jan Beyea for the Massachusetts Attorney General.

Estimates of Costs and Latent Cancers Following Releases of Cesium-137 from Pilgrim's Spent-Fuel Pool

	10% release C-137	100% release C-137
Cost (billions)	$105-$175 billion	$342-$488 Billion
Latent Cancers	8,000	24,000

Source: The Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene With respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plants Operating License and Petition for Backfit Order Requiring New Design features to Protect Against Spent Fuel Pool Accidents, Docket No. 50-293, May 26, 2006 includes a Report to The Massachusetts Attorney General On The Potential Consequences Of A Spent Fuel Pool Fire At The Pilgrim Or Vermont Yankee Nuclear Plant, Jan Beyea, PhD., May 25, 2006.

The NRC staff argued that admission of both the AGO's and Pilgrim Watch's contentions were precluded by NRC regulations which excuse licensee renewal applicants from addressing the environmental impacts of spent fuel storage in their environmental reports. We disagree with their conclusion; and applaud the AGO for filing this Petition in the alternative. We join the AGO and request that if the Commission accepts this petition for rulemaking, it should withhold any decision to renew the operating licenses for the Pilgrim and

Vermont Yankee nuclear power plants until the requested rulemaking has been completed and until the NRC has completed the NEPA process for consideration of environmental impacts of high-density pool storage of spent fuel at the Pilgrim and Vermont Yankee nuclear plants.

CONCLUSION

We support the Massachusetts Attorney General's conclusions that, the Commission should:

(a) consider new and significant information showing that the NRC's characterization of the environmental impacts of spent fuel storage as insignificant in the License Renewal GEIS is incorrect,
(b) revoke the regulations which codify that incorrect conclusion and excuse consideration of spent fuel storage impacts in NEPA decision-making documents,
(c) issue a generic determination that the environmental impacts of high-density pool storage of spent fuel are significant, and
(d) order that any NRC licensing decision that approves high-density pool storage of spent fuel at a nuclear power plant or any other facility must be accompanied by an EIS that addresses (i) the environmental impacts of high-density pool storage of spent fuel at that nuclear plant and (ii) a reasonable array of alternatives for avoiding or mitigating those impacts.

Submitted by,

Mary Lampert
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ATTACHMENT A

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

In the matter of
Entergy Corporation
Pilgrim Nuclear Power Station
License Renewal Application

Docket # 50-293

May 25, 2006

REQUEST FOR HEARING AND PETITION TO INTERVENE BY PILGRIM WATCH

Contention 4: The Environmental Report Fails To Address Severe Accident Mitigation Alternatives (SAMAs) Which Would Reduce the Potential for Spent Fuel Pool Water Loss and Fires

4.0 Contention

The Environmental Report is inadequate because it fails to address the environmental impacts of the on-site storage of spent fuel assemblies which, already densely packed in the cooling pool, will be increased by fifty percent during the renewal period. A severe accident in the spent fuel pool should have been considered in Applicant's SAMA review just as accidents involving other aspects of the uranium fuel cycle were. In addition, new information shows spent fuel will remain on-site longer than was anticipated and is more vulnerable than previously known to accidental fires and acts of malice and insanity. The ER should address Severe Accident Mitigation Alternatives that would substantially reduce the risks and the consequences associated with on-site spent fuel storage. Petitioners have outlined some of these alternatives.

4.1 The Contention is within the Scope of these proceedings

The contention is within the scope of these proceedings because Severe Accident Mitigation Alternative (SAMA) analyses are within the scope of a license renewal proceeding. Any exemption in the Generic Environmental Impact Statement (GEIS, NUREG 1437) and 10 CFR §51.53 for spent fuel storage covers normal operations only, not severe accidents. A severe accident in the spent fuel pool needs to be considered as part of the SAMA analysis, just as severe accidents in the core of the facility were considered by the Applicant. In addition, Petitioners have brought forth new and significant information that makes consideration of the spent fuel pool necessary under NEPA.

4.1.1 Category 2 issues are within the scope of these proceedings

Under 10 CFR §2.309, a petitioner is required to show that the issue raised in the contention is within the scope of the proceeding. The National Environmental Policy Act (NEPA), 42 USC § 4332, is the "basic charter for protection of the environment." 40 CFR § 1500.1(a). Its fundamental purpose is to "help public officials make decisions that are based on understanding of environmental consequences, and take decisions that protect, restore and enhance the environment." 40 CFR § 1500.1(c). The NRC regulations implementing NEPA for Nuclear Plant license renewals are in 10 CFR § 51(c) "Operating license renewal stage." In its application for license renewal of PNPS, Entergy was required under 10 CFR § 51 to provide an analysis of the impacts on the environment that will result if it is allowed to continue beyond the initial license. The regulation governing licensing renewals requires the Applicant for renewal to submit an Environmental Report. 10 CFR 51.53(c)(1). The NRC then uses the ER to prepare an

Environmental Impact Statement or Environmental Assessment, although the NRC has an independent obligation to "evaluate and be responsible for the reliability" of the information. 10 CFR §51.70. The primary method by which NEPA ensures that its mandate is met is the "action-forcing" requirement for preparation of an EIS. *Robertson v. Methow Valley,* 490 U.S. at 348-49 (1989). The environmental impacts that must be considered in an EIS include those which are "reasonably foreseeable" and have "catastrophic consequences, even if their probability of occurrence is low . . ." 40 CFR §1502.22(b) (1). The fact that the likelihood of an impact may not be easily quantifiable is not an excuse for failing to address it in an EIS. NRC regulations require that "to the extent that there are important qualitative considerations or factors that cannot be quantified, these considerations or factors will be discussed in qualitative terms." 10 CFR§51.71.

In a petition for intervention, contentions that seek compliance with NEPA must be based on the applicant's Environmental Report (ER). 10 CFR§2.309(f)(2). Under 10 CFR §51 (c)(3)(ii) the plant is required to provide an ER that contains analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term for those issues identified as Category 2 issues in Appendix B to subpart A of that part. Under 10 CFR §51(c)(ii)(L) "if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." Severe Accidents are listed as a Category 2 issue in a subsection of Appendix B entitled "Postulated

Accidents." Under "Severe Accidents", it states "the probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives." Contentions implicating Category 2 issues ordinarily are deemed to be within the scope of license renewal proceedings. *See Turkey Point, supra* at 11-13. As PNPS did not consider mitigation alternatives for severe accidents in the environmental impact statement of its original licensing, this issue is within the scope of this proceeding.

4.1.2 A Severe Accident involving the spent fuel pool is a Category 2 issue

For issues listed in Appendix B to Subpart A of 10 CFR 51 as Category 1 issues, the Commission resolved the issues generically for all plants and they are not subject to further evaluation in any license renewal proceeding. See 61 Fed. Reg. 28, 467 (1996). The Applicant may assert that since "on-site spent fuel" is listed separately under "Uranium Fuel Cycle and Waste Management" in Appendix B as a Category 1 issue, it does not need to be evaluated for Severe Accident Mitigation Alternatives. However, a proper reading of this Appendix makes it clear that spent fuel pools are not, and should not be, categorically excluded from a SAMA analysis. The rather long section called "Uranium Fuel Cycle and Waste Management" in the Appendix (which includes on-site spent fuel) deals with the issue of off-site radiological impacts of the fuel cycle and waste management during ***normal operations***. It also refers to certain generic issues like the proposed long term waste repository at Yucca Mountain and high level

waste transportation. This section addresses impacts based on normal operating conditions at the plant in a generic way, and designates them Category 1 issues, and outside the scope of relicensing proceedings. The NUREG-1437 6.4.6.7 explains the Category 1 finding for on-site spent fuel storage and concludes "Radiological impacts will be well within regulatory limits; thus radiological impacts of on-site storage meet the standard for a conclusion of small impact." Surely since it contemplates remaining within regulatory limits the Agency refers here to normal operations, not severe accidents. A severe accident is, by definition, outside of regulatory limits.[1]

In contrast, the section titled "Postulated Accidents" is very short. It is divided into only two sections, "Design Basis Accidents", which have been dealt with generically by the NRC and thus are Category 1, and the other dealing with the site specific impacts of Severe Accidents. This section is deceptively short – however in its purpose and function it requires the operator to consider a very broad range of possible accidents and mitigation alternatives to reduce the impacts of those accidents. Applicants for license renewal take the mandate to consider mitigation alternatives seriously – hence Entergy has devoted 176 pages to analyzing various facets of its operations in order to consider ways of reducing the consequences of a severe accident.

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[1] The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. Generally, the U.S. Nuclear Regulatory Commission (NRC) categorizes accidents as "design basis" (i.e., the plant is designed specifically to accommodate these) or "severe" (i.e., those involving multiple failures of equipment or function and, therefore, whose likelihood is generally lower than design-basis accidents but where consequences may be higher), for which plants are analyzed to determine their response. NUREG-1437, 5.2.1 General Characteristics of Accidents.

4.1.3 Applicant has included other accidents involving the Uranium Fuel Cycle in its SAMA analysis demonstrating it agrees that these are within the Scope of these proceedings

Many of the Severe Accidents considered in Entergy's ER involve "The Uranium Fuel Cycle," although again, these were considered Category 1 for the purposes of normal operations in Appendix B. For example in Table E.2-1 of Appendix E of the application "Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation" Applicant considered several mitigation alternatives that could prevent a core melt at the facility, although this obviously encompasses an accident in "The Uranium Fuel Cycle." The idea that the spent fuel pool is somehow outside this analysis, and that even if mitigation alternatives are readily available and cost effective the plant need not consider them, is ridiculous. The spent fuel pool is a structure that is part of the facility and although some aspects of its environmental impacts (off site radiological impacts during normal operations; prospects of long term storage) have been taken off the table, it is still vulnerable to severe accidents and thus within the realm of a proper SAMA analysis. By including other aspects of the Uranium Fuel Cycle in its SAMA analysis, Applicant has demonstrated that it agrees with this reading of Appendix B. The Category 1 topics under "Uranium Fuel Cycle and Waste Management" refer to environmental impacts during ***normal operations*** of the plant and do not exclude a consideration of severe accident mitigation.

4.2 The Issue raised in this Contention is Material to these proceedings

10 CFR 2.309(f)(iv) requires that the Petitioner "Demonstrate that the issue raised in the contention is material to the findings the NRC must make to support the action that is involved in the proceeding." In discussing the materiality requirement, the Atomic Safety and Licensing Board considering the license renewal for Millstone Nuclear Power Station stated "In order to be admissible, the regulations require that all contentions assert an issue of law or fact that is material to the outcome of a licensing proceeding; that is, the subject matter of the contention must impact the grant or denial of a pending license application. Where a contention alleges a deficiency or error in the application, the deficiency or error must have some independent health and safety significance." *Millstone, supra* at 7, and *see Private Fuel Storage, supra* at 179-180. The deficiency highlighted in this contention has enormous independent health and safety significance. By not performing a SAMA analysis on the potential for fires in its spent fuel pools, Applicant is not just failing to provide the NRC with all possible mitigation alternatives, it is also potentially putting the public and the environment at great risk. The Environmental Report's SAMA analysis is deficient and that deficiency could significantly impact health and safety.

4.3 An Adjudicatory Hearing is the only way to properly address Petitioners' concerns

The Licensing Board may determine that many of the issues raised in Petitioners contentions, including spent fuel environmental impacts and security, have been dealt with generically already by the NRC, and any complaints about the treatment of these topics or

enforcement of these rules should be raised by Petitioners as part of a 2.206 petition or by filing a rulemaking petition under 10 CFR § 2.802. *See for example, Turkey Point, supra* at 18, and *In the Matter of Amergen Energy Company, LLC* (License Renewal for Oyster Creek Nuclear Generating Station) ASLBP 06-844-01-LR p. 14, fn 9. (2006). In anticipation of this objection, Petitioners have set forth in Exhibit C a partial list of these and other concerns that have been brought to the NRC's attention by Petitioners and other citizens groups over the last 20 years. Despite these laborious efforts by the public to raise their legitimate safety and environmental concerns, the NRC has granted only one of the dozens of 2.206 petitions submitted.[2] In addition, NRC rules preclude any appeal of a 2.206 decision, and "the hearing rights available through a section 2.206 petition are scarcely equivalent to, and not an adequate substitute for, hearing rights available in a licensing proceeding." *Washington Public Power Supply System* (WPPSS Nuclear Project No. 3), ALAB-747, 18 NRC 1167, 1175-77 (1983). In addition, rulemaking under 10 CFR §2.802 takes a minimum of three years and can take up to nine years.[3] By the time these issues are addressed in a rulemaking proceeding, this re-licensing process will be over and PNPS would be operating without these issues being resolved. Because of barriers (not the least of which is the cost to public interest groups of hiring qualified legal representation and experts) which have barred concerned citizens from effective participation in rulemaking and enforcement in the past, Petitioners assert that license renewal is the proper and appropriate

[2] Submitted by T. Cochran of the NRDC in 1997.

[3] There is no way to predict the length of time before the DBT rulemaking process will be complete. A spokesman for NRC's Region I said, "[I]t takes years for the rulemaking process to be carried out...." Nucleonics Week, July 14, 2005. He noted that NRC review of rulemaking generally takes two and a half years, but could take much longer, and in at least one case, nine years.

time to address safety and environmental issues that are of concern to the public. Linking agency action in license renewals to effective and meaningful reviews of safety and environmental concerns is required by National Environmental Policy Act and by the Atomic Energy Act.

4.4 Basis

Petitioners consider the spent fuel pool subject to a SAMA analysis just as consideration of possible core melt scenarios were. They are all part of the "Category 1 - Uranium Fuel Cycle" for normal operations, but subject to SAMA analysis for events that are outside normal operations. In addition, a SAMA analysis of spent fuel pool fires is necessary because new information shows that (1) spent fuel will remain on site longer than anticipated and (2) the risk of spent fuel pool fires is greater than previously thought. In addition, Petitioners will outline some mitigation alternatives that should have been considered.

4.4.1 Storage of spent fuel should be addressed in the Application's SAMA analysis because new information indicates that it is likely to remain on-site longer than was originally anticipated.

In 1982, the Nuclear Waste Policy Act (NWPA, 42 USC§ 10101) was passed whose principal purpose was to establish a scheme for siting and licensing a permanent repository for spent reactor fuel and other high level radioactive waste (HLW). For interim storage of HLW, the NWPA authorized the Commission to take necessary actions to "encourage and expedite the effective use of available storage, and necessary additional storage, at the site of each civilian nuclear power reactor," to the extent these activities are consistent with "the

protection of the public health and safety, and the environment." 42 USC § 10152.

The license renewal application does not address Severe Accident Mitigation Alternatives for storage of spent fuel assemblies during the renewal period even though the spent fuel pool will be at maximum capacity by 2012 and there are no prospects for off-site storage in the foreseeable future. The ER contains only one vague sentence relating to the storage of spent fuel generated during the 20 year renewal period, and no acknowledgment of its environmental impacts.[4] This treatment is consistent with the NRC's long-standing policy of separating reactor licensing decisions from high level radioactive waste storage concerns. The rationale for this seemingly bizarre separation of issues is grounded in the agency's Waste Confidence Ruling in 10 CFR §51.23, 49 FR 34694, Aug. 31, 1984, as amended at 55 FR 38474, Sept. 18, 1990, which reflects the Agency's confidence back in 1984 that a long term repository would be in place in the near future to accept high level radioactive waste from power stations. This ruling states that until then nuclear facilities can safely store their waste on-site for a period of 30 years after cessation of operations (whether that be at the end of the license or its renewal period). Although 10 CFR §51.23(c) also says "This section does not alter any requirements to consider the environmental impacts of spent fuel storage during the term of a reactor operating license or a license for an ISFSI in a licensing proceeding," the Commission also deals with the impacts during operations generically. NUREG – 1437, The Generic Environmental Impact Statement (GEIS) for License Renewal

[4] "The spent fuel assemblies are then stored for a period of time in the spent fuel pool in the reactor building and may later be transferred to dry storage, if needed, at an onsite interim spent fuel storage installation provided necessary regulatory approvals are obtained." PNPS Application ER, section 3.2.3, p.3-4.

of Nuclear Plants (1996) and 10 CFR §51 Appendix B to Subpart A states: "The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on-site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available." However, the NRC's NEPA regulations create an exception to this rule where there is "new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 CFR § 51.53(c)(iv). In other words, if there is new information relevant to this finding, the Environmental Report submitted with the application for license renewal must address these impacts.

In the years since the Waste Confidence Ruling and the GEIS were promulgated the nation's plan for permanent high level radioactive waste storage at Yucca Mountain has run into one obstacle after another, and confidence in the "Waste Confidence Rulemaking" has been shaken. In his pre-filed testimony before the Public Service Board of Vermont, on January 17, 2006, Dr. Gordon Thompson described why "there is near-universal agreement that the repository will not open in 2010, and great uncertainty about when it might open thereafter."[5] And when it does actually open, it would not have enough capacity to accept all of the waste generated by Pilgrim and the forty other nuclear plants that have approval to operate for another 20 years. The Yucca Mountain repository will fill to capacity shortly after it opens.[6] Further, there is no guarantee where Pilgrim

[5] In the Matter of the Petition of Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc., for a Certificate of Public Good, under 30 V.S.A. 248, to Construct a Dry-Fuel-Storage Facility at the Vermont Yankee Nuclear Power Station.

[6] Yucca Mountain is being designed to hold 77,000 tons of waste. By the time Pilgrim's license expires, 2012, there will be about 60,000 tons of waste waiting in

would stand on the federally-established shipping schedule if and when a federal repository opens and there is no requirement for Pilgrim to send its waste. Licensees can trade or sell their place on the shipping schedule.

Dr. Thompson also discussed the other unlikely off-site prospects for management of spent fuel. The only other off-site options currently proposed for managing high level radioactive waste from nuclear plants are re-processing and interim off-site storage in Skull Valley, Utah. Prospects for reprocessing nuclear fuel are at least 50-60 years in the future, according to the Nuclear Energy Institute.[7] Storage of high level radioactive waste at the Skull Valley Goshute Indian Reservation in Utah has run into obstacles as well, as acknowledged by Entergy Executive Vice President Curt L. Hebert Jr. And opposition to the proposed interim fuel storage continues.[8] In

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more than 30 states. 40 reactors have already been approved to operate an additional 20 years, generating tons of waste. President Bush's energy plan calls for building new reactors and each power plant generates about 2,000 more tons a year. Yucca is designed to process 3000 tons per year. If nuclear plants generate 2,000 tons a year, the best that they can do at Yucca is catch up by 1,000 tons a year. With the backlog that means it would take roughly 60 years to get the new waste to Yucca. However, shortly after Yucca opened, it would be filled to capacity. *In Bush Seeks to Jump-Start Nuclear Power, Proposed Test of New Waste-Reprocessing Methods, Aims to Ease Concerns Over Storage*, John J. Fialka, The Wall Street Journal, January 26, 2006; Page A4.

[7] Nuclear Energy Initiative Holds Uncertainties, Bush Plan Could Cut Dependence on Oil but Relies on Unproven Technologies, Guy Gugliotta, Washington Post ,Sunday, February 19, 2006; A09. In response to a claim that the Bush Administration's proposed reprocessing system may be ready by 2025, Steven Kraft, senior director of used fuel management for the Nuclear Energy Institute, an industry policy group, voiced doubts: "This is a matter of developing future technologies, and those technologies are 50 to 60 years away." *In Bush Seeks to Jump-Start Nuclear Power, Id.* at A4.

[8] Louisiana-based Entergy Corp. sent a letter to Sen. Orrin Hatch and the Utah congressional delegation indicating that it would "hold in abeyance" future investments for construction of the PFS site. "We recognize the political obstacles to finding solutions to management of spent fuel from nuclear plants and believe the Utah facility is probably not the best solution to be pursued at this time," wrote

addition, any off-site solution to highly radioactive spent fuel storage also includes the transportation of that waste to the site. The transportation of .high level radioactive waste, despite the generic high confidence written into the NRC's regulations, will also entail overcoming substantial technical, political, and legal challenges.[9]

Entergy Executive Vice President Curt L. Hebert Jr. *Nuclear waste storage: Four companies hold a 68% interest in the project*, Robert Gehrke, The Salt Lake Tribune, 12/21/2005.

"Politicians, four-wheelers, green activists, business and even the top leaders of The Church of Jesus Christ of Latter-day Saints - they all told the U.S. Bureau of Land Management what they think about plans to transport reactor waste to the Skull Valley desert." *Cause unites N-dump foes,* Judy Fahys, Salt lake Tribune, May 9,2006.

"The House Energy and Water Development Subcommittee earmarked $30 million Thursday for interim nuclear-waste storage, and with the money came a promise from the subcommittee's chairman that he was not trying to force nuclear waste on any community. The chairman and the Energy Department have insisted they are not looking to put nuclear waste at the Private Fuel Storage site on the Skull Valley Goshute Indian reservation in Tooele County. But any talk of an interim site keeps the PFS idea alive. 'We're skeptical the $30 million for interim storage won't target Skull Valley,' said Vanessa Pierce, program director at the Healthy Environment Alliance of Utah. "With its NRC license, right now PFS is the only game in town. And that's why we're counting on Sen. Bennett to cut this money when it gets to his committee in the Senate." "I would not put this in a community that is not willing to accept it," Hobson said. Hobson told Rep. Rob Bishop, R-Utah, during an earlier floor debate that he was not looking to put the waste into a private site. "There's no doubt Utah is an unwilling community," said Bishop's chief of staff, Scott Parker. "The department still needs permission from Congress to move along with an interim plan before the money could actually be spent on the effort. Sen. Bob Bennett, R-Utah, sits on the Senate Appropriations Committee. *House panel allocates $$ for nuclear storage: Chairman says he's not forcing it on a community,* Suzanne Struglinsky, Deseret Morning News, May 13, 2006.

[9] Obstacles and the bases of legal opposition have been outlined to the US Congress by the State of Nevada. Testimony points to a variety of transportation issues: more than 123 million citizens reside within one-half mile of proposed transportation routes, some if not many will raise objection; DOE prefers shipment by rail, yet many sites do not have rail access and rail access to Yucca is not available; terrosism risks associated with rail transport; DOE has never done an evaluation of the nuclear criticality risk of spent fuel casks getting struck by state-of-the art-armor piercing weapon; few casks even exist today. *Testimony before the U.S. House of Representatives, Committee on Transportation and Infrastructure, Subcommittees on Railroads and Transportation and Hazardous Materials,* by Kenny C. Guinn, Governeor of the State of Nevada, Congresswoman Shelley Berkley (D-NV), Marvin Resnikoff, Robert J. Halstead, Professor James David Ballard, (April 25, 2002).

In light of these developments, the NRC's policy of continuing to have confidence that the waste issue will easily be dealt with in the future, and therefore separating decisions regarding generation of waste from decisions about where and how it will be stored, needs to be re-evaluated. The likelihood that all of the high level radioactive waste at Pilgrim will be moved off-site before the year 2062 (renewal period plus 30 years) is dwindling. On-site storage is going to be a reality for generations. States and local communities recognize this and accordingly some[10] have already enacted legislation to enable them to tax licensees for the privilege of storing dry casks on-site and other communities, including Pilgrim's host community, Plymouth, Massachusetts, have filed similar legislation. According to a recent statement in the Boston Globe, the spent-fuel issue does concern the Pilgrim plant operator. "We will run out of space in 2012," Tarantino said. "This was never intended to be a repository for any length of time."[11] These communities recognize that although they did not bargain to be nuclear waste storage sites, in reality they have become so and they should be justly compensated. Licensees also are aware that on-site storage is a reality. Consequently, suits have been

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Questions remain over the safety of nuclear casks in the event of a sustained, hot fire, a review panel of the US National Academy of Sciences has concluded. An NAS report released in Washington DC found there are "no fundamental technical barriers" to safe transportation, but that a number of "serious challenges" remain. Assuming no new plants are built, disposing of fuel from the US's 112 operating plants will require a two-decade-long programme of daily shipments, and more planning needs to be done for managing this massive operation, the report says. The report assessed the adequacy of planning for every kind of accident scenario, but not the potential for deliberate acts such as terrorist attacks. To evaluate that aspect, it says, would require creation of a new committee with full access to classified materials. But since the Sept. 11, 2001, terrorist attacks, the biggest concern has been terrorist attacks -- and about that danger, the report is silent because its investigators were unable to obtain adequate information from the U.S. Nuclear Regulatory Commission.

[10] Examples include Maine, Minnesota, Vermont

[11] Pilgrim spokesman David Tarantino to the Boston Globe. *Decision Looms Over Pilgrim*, Carolyn Y. Johnson, Boston Globe (April 16, 2006).

brought against DOE by licensees, including Entergy, to compensate them for having to store waste longer than anticipated. *DOE Breached Contract, Says Court Agency Can Be Sued for Failure To Begin Taking Used Nuclear Fuel*, Nuclear Energy Insight, October 2000; *Large utility makes deal on nuke waste. Government to pay company to keep on-site storage*, Sun Washington Bureau, Suzanne Struglinski, August 11, 2004.

Entergy is aware that this fuel is likely to remain on-site for far longer and in far higher quantities than was originally planned and designed for, and is ultimately responsible for the safety of spent nuclear fuel stored at the plant. Therefore the Environmental Report should address the likely impacts of on-site storage for the foreseeable future. Mitigation strategies that could prevent severe accidents or reduce their consequences should be considered.

Entergy's application does not address the environmental issue of the storage of existing waste in its ER, and does not describe its plans for the excess capacity of spent fuel that will be generated during an additional 20 years of operations. The original license for Pilgrim allowed the storage of 880 spent fuel assemblies in its cooling pool. In 1994, the plant's then owner, Boston Edison, Inc., applied for and was granted permission to re-rack the fuel in order to accommodate 3,859 assemblies, the amount that would be generated through the end of the current license in 2012. NUREG 1437 § 6.4.6.2 states that the amount of additional waste generated during license renewal will be a function of each plant's refueling schedule but that the total accumulated volume of spent fuel after an additional 20 years of operation of a plant would be roughly 50% more than at the end of 40 years of operation (DOE/RW-006). Using this calculation,

Pilgrim will presumably have generated a total of 5,785 spent fuel assemblies by the end of its renewal period, 2032.

In 10 CFR §51.53 (c)(2) "Post Construction Environmental Reports" says that the Environmental Report must contain a description of the proposed action including plans to modify the facility or its procedures in accordance with 54.21. However, in its Environmental Report Appendix E 3.2.3, Entergy dismisses the issue of additional storage with one vaguely worded sentence: "The spent fuel assemblies are then stored for a period of time in the spent fuel pool in the reactor building and may later be transferred to dry storage, if needed, at an onsite interim spent fuel storage installation provided necessary regulatory approvals are obtained." Whereas some other plants have applied to increase the capacity of their spent fuel storage on-site prior to applying for license renewal,[12] Entergy appears to be waiting until the capacity at Pilgrim runs out before taking this step, confident that they can obtain permission to generate an additional 20 years of waste before formally addressing the issue of what to do with it. While this approach might have made sense when there was confidence in the Waste Confidence Rule, today it makes more sense and is more protective of the environment to assess the impacts of on-site spent fuel storage ***before*** permission is given to generate more waste. To do otherwise would risk prejudging the findings on subsequent storage.

[12] Independent Spent Fuel Storage Locations on site at reactors that have completed the license renewal process include: Calvert Cliffs; Oconee; Hatch; Peach Bottom; McGuire; Robinson; Dresden; Arkansas; Point Beach. Independent Spent Fuel Storage Locations on site at reactors whose license renewal is under review includes: Palisades; Oyster Creek; Vermont Yankee as of Match 2003. NRC website spent fuel-storage-locations.

4.4.2 New information shows that the risk of an accidental spent fuel fire at a reactor like Pilgrim is greater than previously thought

The NRC has never performed an EIS that addresses the potential for, and impacts of, the onset of exothermic oxidation reactions in a spent fuel pool. NUREG 1437 § 6.4.6 simply states "Inadvertent criticality and acute occupational exposure are remote risks of dense-racking (DOE/RW-0220)." Yet, in a report published in October 2000 and issued in January 2001, the NRC Staff has conceded that if the water in any densely packed spent nuclear fuel pool is lost, even a year and longer after discharge, the fuel will heat up to the point where its zircoloy cladding will melt and then catch fire.[13] The resulting fire will not be able to be extinguished and has the potential of significantly contaminating hundreds of miles downwind. *Spent Fuel Heatup Following Loss of Water During Storage*, Allen Benjamen et al. (Sandia National Laboratory, NUREG/CR-0649, SAND77-1371, 1979), fig.14.

4.4.2. a The risk of fire is increased because the spent fuel is densely packed

U.S. nuclear power plant operators have dealt with the lack of an off-site destination for their accumulating spent fuel by packing as many fuel assemblies as possible into their storage pools until capacity is met or exceeded. The original design density of spent fuel in the

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[13]A technical study of spent fuel accident risk, performed for the NRC by Sandia Lab, clearly stated that a catastrophic meltdown in the spent fuel pool of a nuclear power plant could cause fatal, radiation-induced cancer in thousands of people as far as 500 miles from the site. NUREG-1738 *Technical Study of Spent Fuel Accident Risk at Decommissioning Nuclear Power Plants* (2001).

pools associated with BWRs had the fuel assemblies spaced out in a loose square array. The standard spacing for new dense-pack racks today is 23 cm - barely above the 21.4 cm spacing in reactor cores. *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, Fran N. von Hippel, Science and Global Security, 11: 16 (2003). This "dense-packed" fuel is kept sub-critical by enclosing each fuel assembly in a metal box whose walls contain neutron-absorbing boron. *Id.* These boron-containing partitions would block the horizontal circulation of cooling air if the pool water were lost, greatly reducing the benefits of mixing recently-discharged with older, cooler fuel. During a partial uncovering of the fuel, the openings at the bottoms of the spent-fuel racks would be covered in water, completely blocking air from circulating up through the fuel assemblies. The portions above the water would be cooled primarily by steam produced by the decay heat in the below-surface portions of the fuel rods in the assemblies and by blackbody radiation. *Id. at 17.* In the absence of any cooling, a freshly-discharged core generating decay heat at a rate of 100 kWt/tU would heat up adiabatically within an hour to about 600°C, where the zircaloy cladding would be expected to rupture under the internal pressure from helium and fission product gases, and then to about 900°C where the cladding would begin to burn in air. *Id.* The cooling mechanisms in a drained dense-packed spent-fuel pool would be so feeble that they would only slightly reduce the heatup rate of such hot fuel.

In 2001, the NRC staff summarized the conclusions of its most recent analysis of the potential consequences of a loss-of-coolant accident in a spent fuel pool as follows:

> "(I)t was not feasible, without numerous constraints, to establish a generic decay heat level (and therefore a decay time) beyond which a zirconium fire is physically impossible. Heat removal is very sensitive to . . . factors such as fuel assembly geometry and SFP (spent fuel pool) rack configuration . . . (which) are **plant specific** and . . . subject to unpredictable changes after an earthquake or cask drop that drains the pool. Therefore, since a non-negligible decay heat source lasts many years and since configurations ensuring sufficient air flow for cooling cannot be assured, the possibility of reaching the zirconium ignition temperature **cannot be precluded on a generic basis**." *Id. at 18.* (emphasis added)

4.4.2.b The cooling water in the spent fuel pool could be lost due to an accident

The cooling water in a spent-fuel pool could be lost in an accident or by a malicious act which results in drainage of the pool or boil off of the water in the pool. Possible causes of drainage include any damage to the structural integrity of the pool that drains the water at a rate that exceeds water makeup capability. *Nuclear Waste Disposal Crisis*, David Lochbaum, PennWell Books, PennWell Publishing Company, Tulsa, Oklahoma (1996) p.111. Events producing this failure mode include, for example, heavy loads dropping into the pool or onto its wall. David Lochbaum discusses (12) fuel handling events in his 1996 book. *Id.* Two of these occurred at Pilgrim. In January 1974, while transferring an irradiated fuel assembly from the spent fuel pool to the channel inspection facility at Pilgrim. The fuel assembly became detached from the main grapple and fell approximately 20 feet to the bottom of the pool. In December 1979, a new fuel assembly was dropped at Pilgrim while it was being transferred to its storage

location in the pool. *Id.* at 167-169. And the Massachusetts DPU reported that on June 26, 1991, during the process of removing a fuel bundle from the [Pilgrim] reactor to the spent fuel pool, the refueling bridge grapple opened unexpectedly and a fuel bundle was dropped. MA. D.P.U. 92-1A-B.

There have been several instances where such accidents have caused rapid water loss. One occurred in 1994 at Edwin Hatch, Baxley Georgia (BWR). On Dec 1994 a core shroud head dropped into Unit I spent fuel pool from one foot above the water surface. The bolt which was 17 feet long and 3 inches in diameter, weighing 365 pounds, glanced off the side wall and fell to the bottom of the pool without hitting the storage racks or fuel assemblies. The bolt tore a 3 inch gash in the 3/16 of an inch thick stainless steel liner. Approximately 2,000 gallons of water was lost. The spent fuel pool water level dropped nearly two inches in 23 minutes. *Id.* at 112. The Hatch incident occurred less than a year after a screwdriver dropped into a spent fuel pool at a foreign reactor had similar results. On January 31, 1994, workers at Tricastin Until I in France were removing the control rod cluster guide tube from a spent fuel assembly. A 15 foot long screw driver weighing 44 pounds fell into the spent fuel pool and punctured the stainless steel liner. The level in the spent fuel pool dropped nearly four inches. *Id.* at 112.

In addition to the above scenarios, fuel pool cooling systems could malfunction bringing about accelerated water loss in the pool. Events producing this failure mode include a fuel pool cooling system pipe break and the failure of the system's heat removal function. Another scenario causing drainage would be a failure of inflatable and mechanical seals that allows water to leak from the pool into adjacent areas such as the containment, the shipping cask pit, and the fuel

transfer tube. All spent fuel pools are connected via fuel-transfer canals or tubes to the cavity holding the reactor vessel. These can be partially drained through failure of the interconnected piping systems, moveable gates, or seals designed to close the space between the pressure vessel and its surrounding reactor cavity. A 1997 NRC Report (NUREG-1275) described two incidents of accidental drainage: Once the water level is below the top of the fuel, the gamma radiation would climb to 10,000 rems/hr at the edge of the pool and 100's of rems/hr in regions of the spent fuel pool out of direct sight of the fuel - because of the scattering of gamma rays by air and the building. Even at the lower radiation level, lethal doses would be incurred within an hour. Given such dose rates NRC staff assumed that further ad hoc interventions would not be possible. *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants*, NUREG-1275, p. A1A-1 (1997).

Despite the fact that accidents like the ones described above can be easily envisioned and have in fact happened at Pilgrim and other plants, and could have caused a catastrophic loss of coolant water in the spent fuel pool, the ER does not include a SAMA analysis to look at mitigation alternatives that might reduce the likelihood or the impacts of these scenarios.

4.4.2. c The cooling water could be lost due to acts of malice or insanity

New information shows that spent fuel pools are structurally vulnerable to destructive acts of malice or insanity, and sabotage-induced pool fires. In a report issued in April 2005, entitled "Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report" (hereinafter "NAS Safety Report") the National Academy of Sciences

addressed the hazards of stored spent power- reactor fuel. The report concluded that reactor pools are especially attractive terrorist targets because of their large inventory of radionuclides and consequent capability of immense destruction; they are particularly vulnerable to terrorist attack because they are less well protected structurally than reactor cores, and they typically contain inventories of medium and long-lived radionuclides that are several times greater than those in individual reactor cores. *Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report*, National Academy of Sciences, p.36 (April 2005). A loss-of-pool-coolant event resulting from damage or collapse of the pool could have severe consequences. Severe damage of the pool wall could potentially result from several types of terrorist attacks, including attacks with large civilian aircraft, high-energy weapons, or attacks with explosive charges. *Id.* at 49.

A crash into the spent fuel pool by an aircraft would raise concerns of both puncture (see below) and fire. To study the potential for fire, researchers at the Sandia National Laboratory, using water to simulate kerosene, crashed loaded airplane wings into runways. They concluded that at speeds above 60 m/s (135 mph), approximately "50% of the liquid is so finely atomized that it evaporates before reaching the ground. If this were fuel, a fireball would certainly have been the result, and in the high-temperature environment of the fireball a substantially larger fraction of the mass would have evaporated." *Reducing the Hazards from Stored Spent Power-Reactor Fuel, supra* at 14. The blast that would result from such a fuel-air explosion might not destroy the pool but could easily collapse the building above, making access difficult and dropping debris into the pool. A small explosive laden plane could cause this catastrophic series of events.

Pilgrim's spent-fuel pool is located above ground level. Hence it could drain completely it could drain completely if either its bottom or sides were punctured. Concerns that the turbine shaft of a crashing high-speed fighter jet or an act of war might penetrate the wall of a spent-fuel storage pool and cause a loss of coolant led Germany in the 1970s to require that such pools be sited with their associated reactors inside thick-walled containment buildings. When Germany decided to establish large away-from-reactor spent-fuel storage facilities, it rejected large spent-fuel storage pools and decided instead on dry storage in thick-walled cast-iron casks cooled on the outside by convectively circulating air. The casks are stored inside reinforced-concrete buildings that provide some protection from missiles. *Id.* at 15. A terrorist attack with a shaped-charge anti-tank missile could also puncture a pool. *Id.* at 16. The National Academy of Sciences reported to Congress last year that "successful terrorist attacks on spent fuel pools, though difficult, are possible." *NAS Safety and Security Report, supra* at 3. This report found that "[i]f an attack leads to a propagating zirconium cladding fire, it could result in the release of large amounts of radioactive material." Id. The long-term contamination consequences of such a fire could be "worse than those from the Chernobyl accident." *Id. at 45.*

4.4.2. d BWR Mark I & Mark II Reactors like Pilgrim are especially vulnerable

Pilgrim is distinguished by its obsolete Mark 1 containment design, which has
been criticized since 1972. Concerns that the Mark I containment design will respond inadequately to deal with a large loss-of-coolant

accident were first raised in a September 20, 1972 memorandum by Dr. S. H. Hanauer on behalf of the Atomic Energy Commission. IMO Boston Edison Co. (Pilgrim Nuclear Generating Station), Docket No. 50-293, 1987 NRC LEXIS 37 (1987). Beyond the questionable safety of the Mark I containment design, another specific design feature which justifies plant specific SAMA review of PNPS is its elevated spent fuel pool. GE Mark I (like Pilgrim) and Mark II Boiling Water Reactors are especially vulnerable to attack because they are located at the top of the reactor building, outside primary containment. "The spent fuel pool, (in GE Mark I BWR reactors) is located in the reactor building well above ground level. Most designs [including Pilgrim] have thin steel superstructures. The superstructures and pools were not, however, specifically designed to resist terrorist attack." *Id. at 41.* "The vulnerability of a spent fuel pool to terrorist attack depends in part on its location with respect to ground level as well as its construction. Pools are potentially susceptible to attacks from above or the sides depending on their elevation ....." *Id. at* 43. Prior to the National Academy Report, independent scientists from our leading universities came to the same conclusion. *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Edwin Lyman, Allison MacFarlane, Gordon Thompson, Science & Global Security, Vol. 11, No.1, (2003).

Petitioners and others have outlined their concerns about the special vulnerability of BWR Mark I and Mark II Reactors in a petition to the NRC under 10 CFR § 2.206 entitled "Petition to the U.S. Nuclear Regulatory Agency Requesting Emergency Enforcement Actions To Address Structural Vulnerabilities of Boiling Water Reactors With Mark I and Mark II Containments and Their Irradiated Fuel Pools."

(submitted August, 2004).[14] However, questions regarding the general operational safety of the Mark I design and the increased vulnerability of Pilgrim's elevated and poorly-protected spent fuel pool justify site-specific SAMA review.

4.4.2. e The NRC has demonstrated that it considers terrorist attacks on nuclear plants are foreseeable threats that must be addressed

Shortly after September 11, 2001 the NRC re-evaluated security threats against nuclear plants to determine potential "Design Basis Threats" (DBTs). The DBTs describe generically the security threats against which plant owners must design protections systems. Currently the NRC is proposing to amend its regulations that govern DBT requirements under 10 CFR §73. The proposed rule (RIN 3150-AH60) would revise the DBT requirements for radiological sabotage and theft or diversion of Strategic Nuclear Material. These new requirements make generically applicable the security requirements previously imposed on existing licensees by the NRC's April 29, 2003 DBT orders. However one of the major criticisms of the proposed rulemaking is that they do not include defenses from threats to spent fuel pools from the air, despite the recent NAS report that demonstrated that spent fuel pools are extremely vulnerable to this type of attack. [15]

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[14]The NRC denied the Petition despite the fact that the Petitioner's contentions were supported in large part by the National Academy's study.

[15] *2.206 Petition to Address Structural Vulnerabilities o Mark I and I BWRs and their Irradiated Fuel* (submitted August 2004) and Supplemental (Filed in April 2005) referring to NAS Report, *Safety and Security of Commercial Spent Nuclear Fuel Storage,* National Academy of Sciences, April 2005.

In the NAS Safety Report, the committee found that because vulnerability is plant specific, a plant-by-plant vulnerability analyses should be performed. "Finding 3 D: The potential vulnerabilities of spent fuel pools to terrorist attacks are plant-design specific. Therefore specific vulnerabilities can only be understood by examining the characteristics of spent fuel storage at each plant." *NAS Safety and Security Report, supra* at 6 and 58. In addition, more than four years after September 11, 2001, the NAS expressed concern over NRC's slow pace: "...the Nuclear Regulatory Commission's analyses of spent fuel storage vulnerabilities have not yet been completed and actions to reduce vulnerabilities ...have not yet been taken. Moreover, some important additional analyses remain to be done. The slow pace in completing this work is of concern given the enormous consequences as described elsewhere in this report." *Id.* at 75.

The possibility of a terrorist attack on Pilgrim goes well beyond mere speculation. The 9/11 Commission has documented the fact that nuclear facilities had been among the original targets of the al Qaeda terrorists. "Indeed, KSM [Khalid Sheikh Mohammed] describes a grandiose original plan: a total of ten aircraft to be hijacked, nine of which would crash into targets on both coasts-they included those eventually hit on September 11 plus CIA and FBI headquarters, nuclear power plants, and the tallest buildings in California and the state of Washington." *The 9/11 Commission Report*, National Commission on Terrorist Attacks Upon the United States, p.154 (July 22, 2004).

4.4.2. f The Pilgrim spent fuel pool is particularly vulnerable to attack from the air

Pilgrim is located less than 40 miles from Logan International Airport in Boston, one of the country's busiest airports and the origin of two of the hijacked airplanes on September 11, 2001. As discussed

above, the BWR Mark I reactors are particularly vulnerable to attacks on their fuel pools because these are located in the reactor building well above ground level and usually have thin steel superstructures. The superstructures and pools were not designed to resist terrorist attack, and are vulnerable to attack by large civilian aircraft. *NAS Safety and Security Report, supra* at 41 and 49. As stated earlier, the densely packed spent fuel pools are at much higher risk of a catastrophic fire than previously thought, even with a partial drop in the water level of the pool.

General aviation pilots are not screened before takeoff and the contents of general aviation planes are not screened at any point. General aviation includes more than 200,000 privately owned planes, which are located in every state at more than 19,000 airports. For example the following airports are within 10 nautical miles of Pilgrim: Double A, Carver; Jordan Hospital, Plymouth; Plymouth Municipal Airport, Plymouth; Russell Mill Pond, Plymouth; Sampson Pond, Carver; Wayne West, Carver, West Pond, Plymouth. Over 550 of these airports also provide commercial service. In the last five years, the GAO reported about 70 aircraft stolen from general aviation airports, indicating a weakness that could be exploited by terrorists. Neither the reactor building, control room nor spent fuel pool at Pilgrim are designed to withstand aircraft impacts or explosive forces. A large plane – or a light aircraft packed with high explosive – could do extensive enough damage to the pools to drain cooling water, causing the high-level waste to ignite and release lethal radioactive cesium over thousands of square miles.[16]

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[16] The most common light aircraft in the U.S. is the Cessna Skyhawk. It can travel 687 miles, can carry 675 pounds, evade radar and deliver up to 1,000 pounds of high explosive. Hence these general aviation aircraft, with a suicidal terrorist and hundreds of pounds of explosives can be used as a poor person's Cruise missile. The FBI has reportedly been concerned about a scenario involving two light planes

Despite the increased risk of terrorism, the increased risk of fire in densely packed spent fuel pools, being located in the fastest growing region of New England, its location near one of the busiest and expanding airports in the nation, and the fact that the design of the Pilgrim spent fuel pool is the most vulnerable to attack, Entergy has not addressed the issue of Severe Accident Mitigation Alternatives for an attack on its spent fuel pool.

In its response to the citizen's 2.206 petition regarding plant vulnerability, the NRC listed current measures that have been put in place to deal with the increased risks after September 11.

> "Nuclear plants incorporate structural features to protect against severe external events such as tornadoes, hurricanes, fires and floods. These structural features, supported by the deployment of effective and visible physical protection measures, provide a deterrent to terrorist activities. With respect to potential terrorist attacks by air, Federal efforts have increased substantially since September 11, 2001. Those efforts include enhanced airline passenger and
> baggage screening, strengthened cockpit doors, and the Federal Air Marshals program, among others. Federal law enforcement and intelligence agencies have increased efforts to identify and mitigate potential aircraft-related threats before they can be carried out. In more than one case, the Department of Defense and Federal Aviation Administration (FAA) have acted to protect airspace above nuclear power plants in response to threats which were later determined
> to be non-credible. These and other government-wide efforts have improved protection against air attacks on all industrial facilities, both nuclear and non-nuclear. Nonetheless, nuclear plant licensees have well established emergency procedures and

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striking a nuclear plant – one after another. Military protection could not save PNPS. The two interceptor jets at Otis Airbase require a 10 minute mobilization time – likely to arrive and intercept too late. NRC's own study from 1982 stated an aircraft impact could "obliterate the reactor's primary core containment," release massive amounts of radiation, and kill thousands of people without any chance of evacuation. Control rooms, cooling pools filled with spent fuel rods, and other vital targets are even more vulnerable than the reactor itself. *Homeland Security: Nuke Plants are Suicide Hijacker Targets*, Stan Goff, Special Forces Veteran, (November 13, 2003).

severe accident management guidelines that provide a means to help mitigate the potential consequences of terrorist attacks should they occur."[17]

These measures are inadequate on their face. Recent reports have demonstrated that airline security measures cannot keep even journalists from bringing banned items (including explosives) on board commercial airlines, much less deal with threats from organized and determined terrorists. The "no-fly" zone around Pilgrim seems to be shrinking yearly. Lower flight paths into and away from Logan International Airport were recently approved, allowing commercial airlines to fly directly over Plymouth and neighboring communities at lower altitudes. Private planes can be seen sight-seeing and performing aerial tricks in close proximity to the plant. The "well established emergency procedures and severe accident management guidelines" provide no real protection for Massachusetts citizens in the event of an attack on Pilgrim. The emergency preparedness has been dealt with primarily by shrinking the evacuation area to a more manageable size (see NUREG-0654, Supp 3) and the SAMA analysis presented by Entergy does not include accidental fires much less breaches to the spent fuel pool caused by an external attack.

NUREG-1437 5.3.3.1 states, "Although the threat of sabotage events cannot be accurately quantified, the commission believes that acts of sabotage are not reasonably expected. Nonetheless, if such events were to occur, the commission would expect that resultant core damage and radiological releases would be no worse than those expected from internally initiated events." This easy dismissal of the potentially serious and *different* effects from an act of sabotage

[17] *Of The Matter of Boiling water Reactors of Mark I and Mark II Designs*, J. E. Dyer, Director, DD-05-04.

ignores the fact that an attack from outside the plant would cause an immediate breach in the containment of the pool itself. Because of this fact a release of radioactive material could happen sooner than it would from an internally initiated event. In addition, an internally initiated event would likely result from a series of escalating situations which might trigger operator responses. An act of sabotage from the outside would give no such warning.

4.4.2. f The consequences of water loss in the spent fuel pool caused by accident or terrorism could be catastrophic

The National Academy of Sciences Report described what would happen if a terrorist attack on the spent fuel pool leads to a zirconium cladding fire. The Academy stated that, "Such (zirconium cladding) fires would create thermal plumes that could potentially transport radioactive aerosols hundreds of miles downwind under appropriate atmospheric conditions." *NAS Safety and Security Report, supra* at 50. The excess cancer estimates from such an accident would be between 2,000 and 6,000 cancer deaths. *Id. at* 45. The damage which can be done by a large release of fission products was demonstrated in the Chernobyl accident.[18] The result from an accident in the spent fuel

[18] More than 100,000 residents from 187 settlements were permanently evacuated because of contamination by Cs-137. Strict radiation-dose control measures were imposed in areas contaminated to levels greater than 15 Ci/km-2 of CS-137. The total area of this radiation-control zone is huge – equal to half of New Jersey. *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States,* Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Edwin Lyman, Allison MacFarlane, Gordon Thompson, Science & Global Security, Vol. 11, No.1, pages 7-10 (2003).

pool and release of radioactive material at Pilgrim could potentially be much more severe.[19]

Given the extreme consequences of such an event, any foreseeable possibility of such a fire needs to be considered and its impacts addressed. And as described below, mitigation alternatives are available to decrease the likelihood of fire in these pools.

4.4.3 There are mitigation alternatives that would decrease the likelihood of a fire in the Pilgrim Spent Fuel Pool

For the purposes of raising an admissible contention a thorough examination of mitigation alternatives should not be required, since that would in effect be requiring the petitioner to prove the contention itself, rather than just demonstrate a deficiency in the Applicant's ER. The Commission has consistently ruled that in deciding whether the NRC's admissibility standard is satisfied, the substantive merits of a contention may not be reached. *Sierra Club v. NRC*, 862 F.2d at 228, citing *Texas Utilities Electric Co.* (Comanche Peak Steam Electric Station, Unit 1), ALAB-868, 25 NRC 912, 931 (1987). Despite this,

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[19] Inventories of Cs-137 in PNPS fuel pool: PNPS' pool contains a much larger inventory of Cs than the 2 MegaCuries (MCi) that were released from the core of Chernobyl. PNPS' spent fuel pool currently has somewhat over 400 metric tons, and is licensed to hold over 600 metric tons. 400 tons of spent reactor fuel would contain 35 mega-curies (MCi) of Cs-137. If 10-100% of the Cs-137 in a spent fuel pool i.e. 3.5-35 MCi were released by a spent fuel fire to the atmosphere in a plume distributed vertically uniformly through the atmosphere's lower "mixing layer" and dispersed downwind in a "wedge model" approximation under median conditions (mixing layer thickness of 1 km, wedge opening angle of 6 degrees, wind speed of 5 m/sec, and deposition velocity of 1cm/sec) then 37,000-150,000 km-2 would be contaminated above 15 Ci/km-2, 6,000-50,000 km-2 would be contaminated to greater than 100 Ci/km-2 and 180-6,000 km-2 to a level greater than 1000 Ci/km-2. Although a number of isotopes are of concern, we focus on Cs-137. It has a half-life of 30-years, is relatively volatile and, along with its short lived decay product, barium-137 (2.55 minute half-life), accounts for about one half of the fission product activity in 10-year old spent fuel. It is a potent land contaminant because 95% of its decays are to an excited state of BA -137, which de-excites by emitting a penetrating (0.66-MeV) gamma ray. *Id.* at 7.

Petitioners submit the work of Dr. Gordon Thompson, who has provided a detailed analysis of mitigation alternatives and their approximate costs. Some of these alternatives, including reconfiguring the spent fuel pool and installation of automated spray cooling systems, would yield a slight reduction in the risk of spent fuel pool fires but would not provide an adequate or a long term solution. However, the most important change that Entergy can make to reduce the risk of this kind of severe accident would be to immediately implement a strategy of using low density pool storage for only the most recently unloaded fuel assemblies with the rest being transferred to safely secured dry casks at the earliest date possible.

4.4.3. a Reconfiguring the Spent Fuel Pool

To reduce spent fuel pool vulnerability, the National Academy of Sciences recommended that the fuel pool be rearranged (checker-boarding) so that the recently unloaded, very hot fuel is dispersed in the pool among the older and cooler fuel. *NAS Safety and Security Report, supra* Finding 3C. Shifting the fuel around will yield a small reduction in risk; however it will do no good if there is partial drainage of water or if debris blocks air flow in a drained pool. Dr. Gordon Thompson recommends the pools contain 5-year fuel only and open-frame racks.

4.4.3. b Spray Cooling System

Despite the fact that NRC Chair Nils Diaz and some industry spokespersons, including David Tarantino at Pilgrim, stated April 2005 that fire hoses could be effectively used to extinguish a spent fuel fire, it is unlikely that the resulting high radiation fields would allow human access with hoses. Following an event at the Connecticut Yankee

nuclear plant on August 21, 1984, the NRC issued Bulletin 84-03 requiring licensees of operating nuclear plants to among other things calculate the radiation doses in the vicinity of the spent fuel pools should the water level drop. Workers would receive a lethal dose of radiation in 40 to 85 seconds if exposed to the levels that would be present in the area.[20]

The development of a redundant and diverse response system to mitigate loss-of-pool-coolant events is critical. To this end, the National Academy of Sciences recommended also that a spray cooling system be installed and specified that the system must be capable of operation even when the pool is drained (which would result in high radiation fields and limit worker access to the pool) and the pool or overlying building, including equipment attached to the roof or walls, are severely damaged." *NAS Safety and Security Report, supra* at 6 and 57.[21]

4.4.3. c Limiting the frequency of offloads of full reactor cores

An additional precaution to reduce the vulnerability of spent fuel pools would be to limit the frequency of offloads of full reactor cores

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[20] By letter dated November 29, 1984, the licensee of the Connecticut Yankee and Millstone nuclear plants provided the NRC with its response to Bulletin 84-03. The licensee informed the NRC that the calculated radiation dose rate near the edge of a drained spent fuel pool was 40,000 Rem/hr. The dose rate for Millstone Unit 3 was 19,000 Rem/hr. These calculations are representative of the replies received by the NRC from other plant owners. Workers would receive a lethal dose of radiation in 40 to 85 seconds if exposed to such high levels. Twenty years have passed since those calculations and the tons of additional spent fuel have only increased the potential radiation hazards. Given the 25 Rem emergency worker dose limit articulated by the NRC in Information Notice No. 84-40, workers could only visit the area of the spent fuel pool railing for 2-5 seconds, scarcely enough time to position a fire hose and lash it in place.

[21] If water is lost from a spent fuel pool recently discharged fuel can ignite in a period as short as 1-2 hours. The actual period depends on the time since the reactor shutdown for refueling. There is at present no pre-engineered means of spraying water into a drained pool to keep the fuel temperature below the ignition point. Human access with hoses could be precluded by fire or high radiation fields generated as part of the attack, or by other disabling mechanisms such as chemical weapons. Sophisticated attackers might attack the reactor and the pool, using the radiation field from the damaged reactor to preclude access to the pool. Once ignition had occurred, spraying water into the pool would feed the fire through the exothermic steam-zirconium reaction. A massive and probably impractical flow of water would be needed to overcome the effect. (Dr. Gordon Thompson).

into the spent fuel pools, requiring longer shut downs of the reactor before any fuel is offloaded, and providing enhanced security when such offloads must be made. *NAS Safety and Security Report, supra* at 59.

4.4.3. d Safer Storage Solutions

The best way to reduce the risk to the public is for the NRC to require low-density pool storage for recently unloaded fuel and secured dry casks for the rest. Petitioners suggest that there are multiple advantages to storing spent fuel in dry casks or low density pools – alternatives that Entergy has not considered at all in its SAMA analysis in its Environmental Report. Among these advantages are: dry cask storage avoids tight packing of thousands of assemblies in the pool, where loss of coolant water/exposure to air would cause them to ignite within a few hours due to the reaction between water, air and immense heat; dry cask storage makes a consequential core accident less likely because the casks are not stored in the reactor building; dry storage is by its nature less dense and therefore minimizes the chance of an accident with thousands of assemblies;[22] there is no risk for dry casks in case of a power outage since waste assemblies cooled by passive air convection; and dry storage has no risk of mechanical breakdowns or problems resulting from human error. The NRC admits dry storage has fewer failure modes and the NRC has approved a range of dry storage designs. Dry storage is in use extensively in the US – at decommissioned plants and at over a dozen operating plants. In fact, no other reactors are building new pools. Low-density pool storage was once a common practice at

[22] There are generally only 2 dozen assemblies in each dry cask, compared to Pilgrim's pool that has 2,278 today and will have 3,859 by 2012. An accident would result in the release of 10 times more high-level radioactivity than released in Chernobyl – contaminating an area (3) times Massachusetts.

nuclear plants and poses a lower level of hazard than high-density pool storage. The National Academy of Sciences has also recommended dry cask storage as the best way to reduce the vulnerability of spent fuel pools.

Once the fuel is in casks, the casks must be secured to reduce their vulnerability to attack. In order to protect the dry casks once they are filled on-site, Dr. Gordon Thompson has outlined two possible schemes for securing them from attack. These are outlined in Exhibit E.

The casks can be multi-purpose, suitable for both storage and shipment. Spent fuel assemblies will have to be put into casks eventually for transport to a permanent repository so the cost of transfer to dry casks will be incurred in the future regardless. Entergy should be required to place the spent fuel in casks now rather than wait until space in its cooling pool completely runs out, because the increased security these casks would provide and the reduction in dense packing in the spent fuel pool would reduce the risk of a severe accident in the pool, and would reduce the consequences of such an accident.

4.4.3. e Costs versus benefits of mitigation alternatives

Although Petitioners do not have the ability to carry out a full cost/benefit analysis of transferring the spent fuel at Pilgrim to dry casks – among other things we do not have access to the MACCS2 inputs used – a rough look at the costs and benefits reveals that this move makes economic sense. Currently casks cost about 1 to 2 million dollars per cask.[23] Pilgrim has approximately 440 tons of fuel

[23] A BWR fuel assembly contains about 200 kg of uranium. The capital expense to transfer to traditional ISFSI about $120 per kilo uranium/ to transfer to hardened

on-site which would cost about $71 million dollars to place into dry cask storage. A 1997 study done for the NRC estimated that the median consequences of a spent fuel pool fire at a pressurized water reactor (PWR) that released 8-80 MCi of cesium-137. The consequences included: 54,000-14,000 extra cancer deaths, 2000-7000 km squared of agricultural land condemned, and economic costs due to evacuation of $117-566 billion.[24] In addition, the licensee will incur the costs of moving the fuel out of the pool as it fills anyway, and will ultimately need to put the fuel in dry casks for transfer to a long term repository when one becomes available. As discussed in this contention, the probability of a spent fuel fire increases yearly with the increase in spent fuel densely packed in the pool, and with the risk of ever more sophisticated acts of terrorism increasing. A rough cost/benefit look at moving spent fuel into secured dry cask storage shows that this mitigation makes economic sense. Although in its ER, Entergy has made vague statements about transferring spent fuel assemblies to dry cask storage in the future, it has not outlined how and when this will happen. In a statement to Cape Cod Times, Pilgrim spokesman David Tarantino has stated that Entergy plans to move assemblies out of the spent fuel pools to dry casks only on an as-

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dispersed ISFSI $240 per kilo – Dr. Gordon Thompson, personal communication. Also MIT July 2, 2002 forum-Presentation by Allison MacFarlane.

[24] " . . . shifting fuel to dry cask storage about 5 years after discharge from a reactor, would cost $3.5 -7 billion for dry storage of the approximately 35,000 tons of older spent fuel that would otherwise be stored in U.S. pools in 2010. . . .For comparison, the property losses from the deposition downwind of the cesium-137 released by a spent fuel pool fire would likely be hundreds of billions of dollars. The removal of the older spent fuel to dry storage would therefore be justified by a traditional cost- benefit analysis if the likelihood of a spent fuel fire in the U.S. during the next 30 years were judged to be greater than about a percent." *Reducing the Hazards from Stored Spent Power Reactor, supra* at 3.
Also, *Estimation of Attributable Costs from Plutonium Dispersal Accidents*, D.I Chanin and W.B. Murfin, Sandia National Laboratory, SAND96-095,1996.

needed basis, to free up space in the pool for newer spent fuel.[25] This, and the application's silence on the issue of future spent fuel storage, make clear that Entergy has no intention of reconfiguring its pool to low density storage in the future. It also makes it unlikely that the plant will take the initiative to store spent fuel in secured dry cask storage as soon as possible.

4.5 Conclusion

A plant-specific assessment of the vulnerability of the spent fuel pool to fires caused by accident or acts of malice is mandated by the NEPA requirement to consider all of the environmental impacts of the re-licensing. In addition, the NRC Regulations (10 CFR 51.53(c) (ii) (L)) call for consideration of severe accident mitigation alternatives on a plant specific basis if the plant has not already done so. The spent fuel pool, although a Category 1 issue for the purposes of normal operations, should have been included in the Category 2 SAMA analysis of severe accidents in the Applicant's Environmental Report. There is also new information since the Generic Environmental Impact Statement was prepared that demonstrates the spent fuel is likely to remain on-site longer than anticipated, and is more vulnerable to fires than had been known.

As described in Contention 3, it is irrelevant whether Applicant would have decided on mitigation or not. It is the analysis, or "hard look" that is required by NEPA. "While NEPA does not require agencies to select particular options, it is intended to 'foster both informed

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[25] ". . . and keeping the fuel submerged in cooling waters is just as safe as keeping they in dry casks, Tarantino said. "The plant may have to consider moving spent fuel to dry casks eventually," Tarantino said, "but not the waste that's already there." *What to do with nuclear waste?* Kevin Dennehy, Cape Cod Times, August 15, 2004.

decision-making and informed public participation, and thus to ensure the agency does not act upon incomplete information, only to regret its decision after it is too late to correct' (*citing Louisiana Energy Services* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 88 (1998))." . . . "if 'further analysis' is called for, that in itself is a valid and meaningful remedy under NEPA." *Duke Energy Corp.*, *supra* at13.

The Petitioners have outlined several possible accident scenarios that were not addressed by the Applicant's Environmental Report. In addition, some possible mitigation alternatives have been described. Given the catastrophic impact to human health and the environment if the spent fuel pool experiences loss of water due to accident or terrorist attack, and the benefit that could be achieved at a relatively reasonable cost to the plant operator, mitigation of the existing vulnerability should at least be considered before the license is renewed.

From: "Mary Lampert" <mary.lampert@comcast.net>
To: "SECY" <SECY@nrc.gov>
Date: Wed, Dec 20, 2006 11:05 AM
Subject: RE: Docket No. PRM-51-10 – Pilgrim Watch's Comments in Support Massachusetts Attorney General's Petition f or Rulemaking

RE: Docket No. PRM-51-10 – Pilgrim Watch's Comments in Support Massachusetts Attorney General's Petition for RulemakingPlease indicate receipt by return email.

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From: "Mary Lampert" <mary.lampert@comcast.net>

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Priority:	Standard
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Concealed Subject:	No
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