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Pilgrim Watch

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Via Express Mail
Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration, Mailstop T-6D 59
U.S. Nuclear regulatory Commission
Washington DC 20555-0001
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Subject: Comments Regarding Scope of the Environmental Review for the Pilgrim Nuclear Power Station's License Renewal Application- Federal Register Notice, April 14, 2006 (72 FR 19554)

On behalf of Pilgrim Watch, I am submitting the following comments on issues that we feel should be included in the review on a site specific basis. These include but are not limited to: security; spent fuel pool accidents; health impact; monitoring; marine impact; low level radioactive (LLRW) waste storage, 2012-2032; buried waste on-site; emergency planning as it relates to the Severe Accident Mitigation Analysis.

These comments have been filed both electronically and by mail. We would be happy to provide additional information. We look forward to and appreciate in advance your confirmation of receipt.

Very truly yours,

Mary Lampert

E-RIDS= ADM-03

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Template=ADM-013

Add=
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I. Security

The 9th Circuit Court of Appeals ruled, June 2, 2006, that likely environmental consequences of a potential terrorist attack on a nuclear facility must be considered in an environmental review under the National Environmental Policy Act (San Luis Obispo Mothers for Peace; Santa Lucia Chapter of the Sierra Club; Peg Pinard V. Nuclear Regulatory Commission; United States of America).

The Court found that the possibility of a terrorist attack on a nuclear facility is neither "remote nor speculative;" the numeric probability of a specific attack is not required in order to assess likely modes of attack, weapons, and vulnerabilities of a facility, and the possible impact of each of these on the physical environment, including the assessment of various releases scenarios; and there is no support for the use of security concerns as an excuse from NEPA's requirements.

Therefore NRC must consider in Pilgrim's environmental review Pilgrim's vulnerabilities, likely modes of attack and weapons used, and the possible impact of these on the physical environment - including the assessment of various release scenarios and mitigation strategies.

PILGRIM SECURITY: TARGETS

Spent Fuel

The cooling water in the spent fuel pool could be lost due to acts of malice or insanity resulting in an uncontrolled fire and release of large amounts of radiation.

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 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 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.*

BWR Mark I & Mark II Reactors like Pilgrim are especially vulnerable: Pilgrim is a GE Mark I BWR. This type of reactor is especially vulnerable to attack because the pool is 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).

Reactor Core A nuclear meltdown, exposing the fuel rods inside the reactor core, can be accomplished by breaching the primary containment wall. A small plane or helicopter loaded with explosives could accomplish the task.

Disabling necessary support Systems Alternatively, a nuclear meltdown or spent fuel pool fire could occur by disabling secondary support, such as cutting off electrical power to a plant/spent fuel pool and disabling the backup generators, clogging or cutting off the main water supply to the plant/spent fuel pool and gaining control to the control room

Some Potential Modes of Attack [1]

MODE OF ATTACK	CHARACTERISTICS	PRESENT DEFENSE
Commando-style by land	• Could involve heavy weapons/sophisticated tactics • Attack requiring substantial planning and resources	Alarms, fences, lightly-armed guards, with offsite backup
Commando-style by water	• Could involve heavy weapons/sophisticated tactics • Could target intake canal • Attack may be planned to coordinate with a land attack	500 yard no entry zone – marked by buoys – simply, "no trespassing" signs Periodic Coast Guard surveillance by boat or plane
Land-vehicle bomb	• Readily obtainable • Highly destructive if detonated at target	Vehicle barriers at entry points to Protected Area
Anti-tank missile	• Readily obtainable • Highly destructive at point of impact	None if missile is launched from offsite
Commercial aircraft	• More difficult to obtain than pre-9/11 • Can destroy larger, softer targets	None
Explosive-laden smaller aircraft	• Readily attainable • Can destroy smaller, harder targets	None
10-kilotonne nuclear weapon	• Difficult to obtain • Assured destruction if detonated at target	None

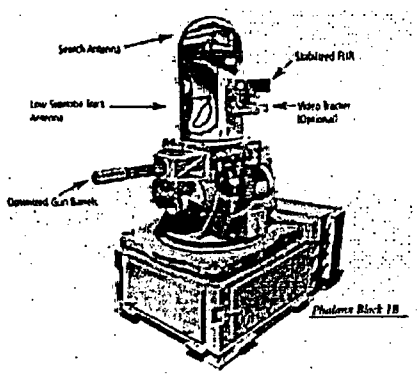
WHAT'S WRONG WITH PILGRIM'S SECURITY?

Air: Since September 11, 2001, a "no- fly" zone was put into effect for a short period, and was then eliminated. Because of the proximity of Boston and other airports, a "no fly" zone can not be large enough to permit effective response by Air Force or National Guard fighter aircraft. Even at the relatively slow speed of 300 miles per hour, a ten-mile "no fly" zone would provide only 2 minutes advance

[1] Gordon Thompson, *Robust Storage of Spent Nuclear Fuel: A Neglected Issue of Homeland Security,* p. E-S 5, December 2002. NOTE: Pilgrim Watch added 2nd row to table, ATTACK BY WATER.

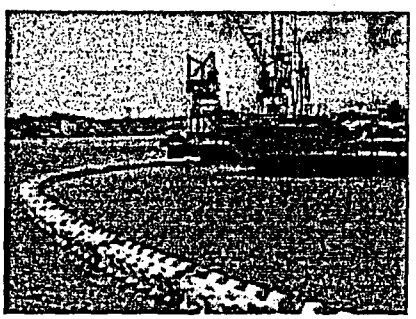
warning. The time for the two interceptor jets on "high alert" to be airborne is ten minutes. Flights between secondary airports do not even screen passengers. Hyannis, for example, is a five minute flight from Pilgrim; Pilgrim is surrounded by secondary airports. A small plane or helicopter loaded with explosives could cause the intended damage to the spent fuel pool, reactor building, control room or other support structures.

A mitigation strategy that the ER must analyze is a combination of on-site missiles and a no-fly zone for a pre-warning. The ER should compare the cost of mitigation versus the cost of the consequences resulting from a severe accident of doing nothing. The Raytheon Phalanx Close-In Weapon System, in particular, is thought to be ideally suited to protect nuclear reactors because it is available 24 hours a day and able to differentiate between a real threat and a passing or lost aircraft. Its' computerized radar system can determine if an aircraft's flight path termination point is at the reactor site. If such a determination is made, operating personnel can verify the approaching threat and destroy it shortly before it strikes the reactor. The system is ideal to use when the reactor is close to an airport or busy traffic lines, like Pilgrim NPS, because of its advanced analysis capabilities. We are not suggesting that it be operated by personnel other than U.S. military.



Sea: There is a 500yard "exclusion zone", marked by buoys or floating "no-trespassing" signs, is not impenetrable, and is not patrolled most of the time. There is no capability of immediate armed response. There is no screen across the in-take canal to block a submerged explosive- simply a boom. Sunbathers, kayakers, photographers have been apprehended on the beach in front of the reactor. The point is that they were there not simply that they were eventually caught.

Mitigation strategies for the ER to analyze are a screen across the mouth of the intake canal (recommended for the Millstones by Homeland Security) and secure the perimeter with water barriers such as those manufactured by Wisprawave and used at U.S. Navy installations. Compare, for example, the cost of the consequences resulting from a successful sea-based attack to the cost of installing a grate across the mouth of the intake canal, a floating sea barrier and additional security.



Land: Outside responders can offer little help. On site security personnel are under-manned, under-trained, under-equipped, under-paid and unsure of what they can do according to the workers, themselves. See: the Project on Government Oversight and "Are These Towers Safe?" *Time Magazine*, June 20, 2005. The Time article has comments by Pilgrim's former security training officer, Kathy Davidson.

Mitigation strategies for the ER to analyze include: federalizing security; increased onsite training of off-site responders with on-site responders in mock attack drills; how long it takes for a sufficient number of offsite responders to mobilize onsite; enforced 40 hour work week for each security worker - not averaging security personnel's total hours; increased security force; increased training; supplied and trained with appropriate weapons; clarifying the appropriate/allowable response permitted of onsite security personnel – when they can shoot. The ER comparison should include comparing the cost of remedying these deficiencies to the cost of consequences from doing nothing.

FEDERAL TESTS OF SECURITY – NOT CREDIBLE/INADEQUATE

On-site security tests are not credible because Wachenhut, the foreign –owned company that provides security for Pilgrim and half the nation's reactors will also test security at these reactors - a conflict of interest. The tests, themselves, are not

adequate because there is to much advance notice; the tests set a low bar to hurdle by using a low passing grade; the tests are performed during operating hours when the number of workers on site are minimal; tests limit the insider role to that of a passive participant; tests require defense against only a small number of attackers; tests to not assess the reactor's ability to defend the spent fuel pool or defend against an attack using aircraft or boats; if a licensee performs poorly there are not enforcement actions; no independent observers or input.

Mitigation strategies for the ER to analyze are self explanatory from the above.

Conclusion – Security

The Environmental review is now required by the 9th Circuit Court's decision to analyze security at Pilgrim. It is now necessary to compare the consequences of an attack - billions of dollars and latent cancers - against the "cost" of measures that would lessen the likelihood of an attacks success.

See: 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.

Dr. Jan Beyea's estimated the consequences following the release of Cesium-137 from Pilgrim's spent-fuel pool. We recognize that these are conservative estimates because: (1) he only considers Cesium-137, other radionuclides would be released; and (2) he only looks at latent cancers and not other radiation-linked diseases, reproductive disorders and birth defects.

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

II. Spent Fuel Pool Accidents

The following summarizes material discussed more fully in two Motions to Intervene in Pilgrim's application: Request for Hearing and Petition To Intervene By Pilgrim Watch, Docket No. 50-293, May 25, 2006, 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, page 50; and 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

Discussion:

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. 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. 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.

Mitigation strategies include: requiring low density pool storage and secured (hardened) dry cask storage. These measures are requested by the Massachusetts Attorney General in his petition to intervene and by the Town of Duxbury at Annual Town Meeting, 2005 and 2004. Other strategies were analyzed by Dr. Gordon Thompson and found not to be effective. Reconfiguring the assemblies in the pool 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. The National Academy of Sciences recommended installing a spray cooling system 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.[2] This is unlikely to be achievable at Pilgrim and 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. Doing nothing, as is the present situation, must be weighed against the consequences.

Consequences: The Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene includes a report on the potential consequences of a spent fuel pool fire at Pilgrim by Jan Beyea, PhD., May 25, 2006.

Table 1. Cost estimates for a release of 10% of spent-fuel pool inventory of radioactive Cesium-137 assuming no change in cancer risk coefficient (billions of dollars)

Category	Pilgrim	Vermont Yankee	Comment
Direct costs[a)]	49	39	
Indirect administrative costs[b)]	49	39	
Loss in property values adjacent to treated areas[c)]	7-74	9-87	
Costs associated with cleanup or demolition of downtown business and commercial districts, heavy industrial areas, or high-rise apartment buildings.[d)]	??	??	Particularly important for Pilgrim, with its proximity to Boston
Total	> 105-171	> 87-165	

a) As estimated from computations with MACCS2 at comparable sites with the parameters given in (Beyea et al. 2004a). Reduction by 1/3rd to account for wind rose effects.
b) Based on Chanin and Murfin. "We believe . . . that it might be reasonable to double the cost estimates provided [here] in order to account for indirect costs." (Chanin and Murfin 1996), p. 6-3. The factor might not be as great in the current case, however, because of economies of scale. We assume that litigation costs offset any economies of scale.
c) Assumes 5% loss in property value for an area surrounding the plume that includes 1 to 10 times as many persons as are in the (0.24 radian) plume extending out to 250 miles (see Appendix I). A similar 5% loss in property value is assumed in the plume from 250-1000 miles. $132,000 in property value assumed per capita (Beyea et al. 2004a). Although not included in this total for the contention phase, loss in property value upon sale by government of remediated property should be included here. MACCS2 assumes no such loss.
d) We have not attempted an estimate for this category in the contention phase.

Beyea, page 9

[2] 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).

Beyea stated that, "releases lower than 10% of the Cesium-137 inventory, even releases too low to justify remediation, could have costs associated with loss in property value in the range of 10 to 100 billion dollars (Beyea, page 8).

Table 2. Cost estimates for a release of ~100% of spent-fuel pool inventory of Cs-137 assuming no increase in cancer risk coefficient (billions of dollars)

Category	Pilgrim	Vermont Yankee	Comment
Direct costs[a)]	163	173	
Indirect administrative costs[b)]	163	173	
Loss in property values adjacent to treated areas[c)]	16-162	17-172	
Costs associated with cleanup or demolition of downtown business and commercial districts, heavy industrial areas, or high-rise apartment buildings.[d)]	??	??	Particularly important for Pilgrim, with its proximity to Boston
Total	> 342-488	> 364-518	

a) As estimated from computations with MACCS2 at comparable sites with the parameters given in (Beyea et al. 2004a). Figures reduced by 1/3rd to account for wind rose effects.
b) Based on Chanin and Murfin. "We believe . . . that it might be reasonable to double the cost estimates provided [here] in order to account for indirect costs." (Chanin and Murfin 1996), p. 6-3. The factor might not be as great in the current case, however, because of economies of scale. We assume that litigation costs offset the economies of scale.
c) Assumes 5% loss in property value for an area including 1 to 10 times as many persons as are in a 0.24 radian plume extending out to 700 miles (see text). A similar 5% loss in property value is assumed in the plume from 700-1000 miles. $132,000 in property value assumed per capita (Beyea et al. 2004a). Although not included in this total for the contention phase, loss in property value upon sale by government of remediated property should be included here. MACCS2 assumes no such loss.
d) We have not attempted an estimate for this category in the contention phase.

Table 3. Estimates for latent cancers following releases from the spent-fuel pools at either Pilgrim or Vermont Yankee (assuming no increase in cancer risk number)

Category	10% release	~100% release
Latent cancers in main plume path from residual contamination[a)]	1300	4000
Latent cancers from deposited resuspension[b)]	1300	4000
Total	2,700	8,000

a) Based on typical numbers for plants analyzed in (Beyea et al. 2004a). Figures reduced by 1/3rd to account for wind rose effects. Cancers in the direct plume are reduced by more than a factor of ten from decontamination and deconstruction.
b) Assumes 10% resuspension and redistribution of deposited Cesium-137 resulting from a) wind removal in the first few weeks, and b) remediation/demolition efforts over successive years. It is possible that even the resuspended Cesium would produce concentrations high enough to justify remediation, with a corresponding reduction in projected cancers. However, clean-up costs would be increased.

Table 4. Cost estimates for a release of 10% of spent-fuel-pool inventory of Cs-137 assuming 3-fold increase in cancer risk coefficient (billions of dollars)

Category	Pilgrim	Vermont Yankee	Comment
Direct costs[a)]	89	79	
Indirect administrative costs[b)]	89	79	
Loss in property values adjacent to treated areas[c)]	> 7-74	> 9-87	
Costs associated with cleanup or demolition of downtown business and commercial districts, heavy industrial areas, or high-rise apartment buildings.[d)]	??	??	Particularly important for Pilgrim, with its proximity to Boston
Total	> 186-253	> 167-245	

a) As estimated from computations with MACCS2 at comparable sites with the parameters given in (Beyea et al. 2004a). An increase in the cancer risk numbers is mathematically equivalent to an increase in release magnitude, which is how the numbers in the Table were computed. Figures reduced by 1/3rd to account for wind rose effects.
b) Based on Chanin and Murfin. "We believe . . . that it might be reasonable to double the cost estimates provided [here] in order to account for indirect costs." (Chanin and Murfin 1996), p. 6-3. The factor might not be as great in the current case, however, because of economies of scale. We assume that litigation costs offset the economies of scale.
c) Assumed to be at least as great as the figures calculated in Table 1, where the cancer risk coefficient was left unchanged. Although not included in this total for the contention phase, loss in property value upon sale by government of remediated property should be included here. MACCS2 assumes no such loss.
d) We have not attempted an estimate for this category in the contention phase.

Table 5. Cost estimates for a release of ~100% of spent-fuel-pool inventory of Cs-137 assuming a three-fold increase in cancer risk coefficient (billions of dollars)

Category	Pilgrim	Vermont Yankee	Comment
Direct costs[a)]	283	353	
Indirect administrative costs[b)]	283	353	
Loss in property values adjacent to treated areas[c)]	16-162	17-172	
Costs associated with cleanup or demolition of downtown business and commercial districts, heavy industrial areas, or high-rise apartment buildings[d)]	??	??	Particularly important for Pilgrim, with its proximity to Boston
Costs due to delays in implementing remediation and deconstruction[d)]	??	???	
Total	> 582-728	> 723-878	

a) As estimated from computations with MACCS2 at comparable sites with the parameters given in (Beyea et al. 2004a). An increase in the cancer risk numbers is mathematically equivalent to an increase in release magnitude, which is how the numbers in the Table were computed. Figures reduced by 1/3rd to account for wind rose effects.
b) Based on Chanin and Murfin. "We believe . . . that it might be reasonable to double the cost estimates provided [here] in order to account for indirect costs." (Chanin and Murfin 1996), p. 6-3. The factor might not be as great in the current case, however, because of economies of scale. We assume that litigation costs offset the economies of scale.
c) Assumed to be at least as great as the figures calculated in Table 2, where the cancer risk coefficient was left unchanged. Although not included in this total for the contention phase, loss in property value upon sale by government of remediated property should be included here. MACCS2 assumes no such loss.
d) We have not attempted an estimate for this category in the contention phase.

Table 6. Estimates for latent cancers following releases from the spent-fuel pools at either Pilgrim or Vermont Yankee (assuming a 3-fold increase in cancer risk number)

Category	10% release	~100% release
Latent cancers in main plume path from residual contamination[a)]	4,000	12,000
Latent cancers from deposited resuspension[b)]	4,000	12,000
Total	8,000	24,000

a) Based on typical numbers for plants analyzed in (Beyea et al. 2004a) multiplied by a factor of 3. Figures reduced by 1/3rd to account for wind rose effects. Cancers in the direct plume are reduced by more than a factor of ten from decontamination and deconstruction.
b) Assumes 10% resuspension and redistribution of deposited Cesium-137 resulting from a) wind removal in the first few weeks, and b) remediation/deconstruction efforts over successive years. It is possible that even the resuspended Cesium would produce concentrations high enough to justify remediation, with a corresponding reduction in projected cancers. However, clean-up costs would be increased.

Beyea notes that the cancer estimates in Table 3 are lower limits, because they only include cancers from Cesium-137. This approximation ignores shorter isotopes in the fresh fuel in the pool, especially Cesium-134 (Benjamin 2003), page 11. Beyea goes on to say that, "Releases from Pilgrim headed initially out to sea will remain tightly concentrated due to turbulence until winds blow the puffs back over land (Zagar et al.), (Angevine et al., 2006). This can lead to hot spots of radioactivity in unexpected locations (Angevine et al. 2004). Beyea, p.11. Therefore dismissing radiation blowing out to sea is inappropriate. Reduction of turbulence on transport from Pilgrim across the water to Boston should also be studied, according to Beyea's analysis. The program CALPUFF (Scire et al. 2000) has the capability to account for reduced turbulence over ocean water and could be used in sensitivity studies to see how important the phenomenon is at Pilgrim.

Table 7. Assigning damage cost estimates in billions of dollars based on Table 3 of (Beyea et al. 2004a)

Release magnitude	Pilgrim	Vermont Yankee
3.5 MCi	71[a)]	54[b)]
35 MCi	219[c)]	243[d)]

a) Cost figure for Catawba for a 3.5 MCi release.
b) Cost figure for Lasalle for a 3.5 MCi release.
c) Cost figure for Lasalle for a 35 MCi release reduced by 20%
d) Cost figure for Lasalle for a 35 MCi release reduced by 10%

Extrapolated and interpolated direct damage costs for Pilgrim and Vermont Yankee were computed from the following formulas:

Pilgrim: Damages = 0.66* 35* (release in Mci)$^{0.5}$

Vermont Yankee: Damages = 0.66 * 24 * (release in MCi)$^{0.65}$

The factor of 0.66 comes from wind-rose effects.

Administrative costs are taken equal to direct costs, following the suggestion of (Chanin and Murfin 1996). Property loss estimates are discussed below.

Estimates of losses in property value. It is assumed that an area exists around the "main portion" of plume, where potential property buyers would be concerned about residual risk. (The main portion the plume is defined as the area where remediation or demolition takes place.) Outside the main plume, contamination would still be measurable. Lack of trust in statements by government would translate into loss in property values. All things being equal, persons would wish to live as far away from contaminated areas as possible.

Costs versus benefits of mitigation alternatives – approximately $105-$488 billion versus $71 million

Costs: a spent fuel accident is conservatively estimated to cost from $105 to $488 billion dollars and result in 8,000 – 24,000 latent cancers from exposure to Cesium-137. Exposure to other radionuclides and other resultant diseases, reproductive disorders and birth defects will up the toll.

What will mitigation cost?

Currently casks cost about 1 to 2 million dollars per cask.[3] Pilgrim has approximately 440 tons of fuel on-site which would cost about $71 million dollars to place into dry cask storage. 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. 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-needed basis, to free up space in the pool for newer spent fuel.[4] This, and the application's silence

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

[4] ". . . 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

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. It is up to the NRC assure that the public's interests are protected and the vote of the Town of Duxbury that re-licensing be opposed unless Safer storage of spent radioactive fuel rods is required until all spent rods are moved off site - low density pool storage and hardened dispersed dry cask storage.

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 and by the 9th Circuit Court's decision. In addition, 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.

Also, it is irrelevant whether the 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 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.

We have outlined several possible accident scenarios in our Motion to Intervene that were not addressed by the Applicant's Environmental Report. In addition, some possible mitigation alternatives have been described. Given the catastrophic impact

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there." *What to do with nuclear waste?* Kevin Dennehy, Cape Cod Times, August 15, 2004.

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.

III. Demographics

Demographics – Population- Why it is Important

When Boston Edison was planning to build Pilgrim NPS, they initially considered building on the naval air station in Quincy. That site was discarded because Quincy, and the surrounding communities, was too heavily populated. Instead, Plymouth was chosen.

Population 1970 versus 2012-2032:

Plymouth Population

Pilgrim NPS - Status	Population
Reactor Under Construction, 1970	18,606[5]
Date Proposed License Renewal, 2012	56,132 (3-fold increase)
Date Proposed Renewal End, 2032	62,657

A similar population explosion exists in surrounding communities and counties.[6]

Pilgrim NPS Emergency Planning Zone (EPZ)

Municipality	1970	2030
Plymouth	18,606	62,657
Carver	2,420	13,979
Duxbury	7,636	16,798
Kingston	5,999	13,698
Marshfield	15,223	27,948

Counties: Plymouth & Barnstable[7]

Counties	1970	2030
Plymouth	333,314	551,005
Barnstable	96,656	334,766

Age: By 2030, (1) in (3) people living in this area will be over the age of 55, compared to 1 in 5 now.[8]

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[5] www.mass.gov/dhcd/iprofile/239.pdf.

[6] USGen web www.rootsweb.com; and The Boston Metropolitan Area Planning Council Report on Population and Employment Projections 2010 -2030 http://www.mapc.org/2006_projections.html

[7] Figures for 2030 unavailable from federal or state government sources; figures from Entergy, Appendix E, 2-17; Barnstable and Plymouth counties tourist destinations, increased transient populations

New information exists that needs to be analyzed including, but not limited to: population projections and age distribution for the 10-mile Emergency Planning Zone; 50 mile ingestion zone; and for the 2 zones analyzed by Sandia National Laboratory's Consequence Analysis for a Core Melt At Pilgrim, CRAC-2 Report [9]– 20 mile peak fatal zone and 65 mile zone peak injury zone.

Entergy failed to tell the story in Appendix E, Applicant's Environmental Report Operating License Renewal Stage Pilgrim Nuclear Power Station, 2.6.

Why New Demographic Information is Important

Emergency Planning: There must be "reasonable assurance" that adequate protective measures can be taken in the event of a radiological emergency, including a severe accident that occurs simultaneously with another event – such as a storm or a terrorist attack that complicates planning. This means that the infrastructure required in an emergency can, beyond a reasonable doubt, respond to the emergency needs of projected population during the 2012-2032 time-periods.[10]

NRC needs to analyze in this licensing procedure the projected populations for the years 2012-2032 in the 10-mile Emergency Planning Zone; the 50-mile ingestion zone; and the 20 mile peak 1st year early fatality zone and the 65 mile peak 1st year injury zone, Sandia CRAC-11 Report.

We can not get around this by shrinking the size of the area of impact of an accident to let's say 2 miles around and 5 miles downwind[11]. Because we know in a severe accident that the impact will be greater than 2 miles round[12]; the concept of

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[8] The Boston Metropolitan Area Planning Council Report on Population and Employment Projections 2010 -2030 http://www.mapc.org/2006_projections.html

[9] Calculation of Reactor Accident Consequences U.S. Nuclear Power Plants (CRAC-2), Sandia National Laboratory, 1982

[10] NUREG 1437, Vol. 1, page 5-11 states that as "the population around the plant increases, the potential risk and the increase in risk must be specifically examined."

[11] NEI White Paper, "Range of Protective Actions for Nuclear Power Incidents," July 8, 2004; NUREG-0654 FEMA-REP 1 Rev. 1 Supp.3

[12] Calculation of Reactor Accident Consequences U.S. Nuclear Power Plants (CRAC-2), Sandia National Laboratory, 1982; and Consequences of a spent fuel accident, Safety and

"downwind" is not applicable in coastal communities[13]; the "shadow evacuation" phenomena was established at TMI and Katrina[14]; and new technology means that news will rapidly spread far and wide of a disaster due to the widespread use of cell phones and hand-held computers.

Neither can we get around this by claiming that an accident will be slow breaking or of minimal consequence. A core melt at a Boiling Water Reactor, such as PNPS, could occur in minutes.[15] A spent fuel accident is a credible event; is likely to come without warning; and result in catastrophic consequence.[16]

Nor can we get around the issues by saying that we can simply shelter the population and ignore evacuation. In a severe accident, sheltering would not be effective[17].

Security of Commercial Spent Nuclear Fuel Storage Public Report, National Academy of Sciences, April 2005.

[13] Hourly wind direction archives for southeastern Massachusetts are recorded on http://www.iwindsurf.com/windandwhere.iws?regionID=102&geographicalAreaID=19&snapShotBar=snapshot; and the National Weather Service provides data at least every hour, 24/7.

[14] Shadow Evacuation is a documented phenomenon that those well outside the zone will evacuate: Three Mile Island provided a realistic example. There, the Pennsylvania Governor issued an evacuation advisory (note, it was not an order). It was expected to have precipitated the flight of only 3,400 people (pregnant women and pre-school children within five miles of the plant); instead, a total of 144,000 people (a government figure) evacuated the surrounding region. Katrina provided new information –and that was a hurricane with many days warning

[15] *Estimates of containment performance under severe accident conditions are found in* Chapter 9 of NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," December 1990 and for Boiling Water Reactors, (a)Transient (loss of offsite power) plus failure of core shut down systems (scam). Could lead to core melt in several hours with significant potential for containment failure. More severe consequences if pumps trip does not function; and (b) Small of large LOCAs with failure of ECCS to perform leading to core melt degradation or melt in minutes to hours with significant potential of loss of containment integrity.

[16] "Finding 2A: Spent fuel storage facilities cannot be dismissed as targets for such attacks because it is not possible to predict the behavior and motivations of terrorists, and because of the attractiveness of spent fuel as a terrorist target given the well known public dread of radiation...The committee judges that attacks by knowledgeable terrorists with access to appropriate technical means are possible." 'Safety and Security of Commercial Spent Fuel Storage," National Research Council of the National Academy of Sciences, Public Version, April, 2005, p. 4

[17] NUREG-0654 FEMA-REP 1 Rev. 1 Supp.3- Appendix I states that, "Having people seek shelter if they cannot evacuate before the plume arrives was considered to apply only for a short-term (puff) release of known duration." (P.2); and, "The staff has ... recognized that sheltering people in most structures close to a nuclear plant, where plume concentrations and dose consequences are likely to be highest, will not prevent early adverse health effects during a major radioactive release." (P.3)

The NRC must require the Licensee to demonstrate that the population in the rapidly growing Southeastern Massachusetts could safely evacuate in the event of a severe nuclear accident during the extended twenty year operation before granting a license extension to 2032.

NRC must analyze the impact on planning of the increased elderly population projected to be living in this area - such as impact on the transportation dependent and nursing home populations.

In this proceeding the above mentioned new information must be considered, although it was not presented in Entergy's filing. It includes new population data and its effect upon emergency planning; and the further impact of the new means of rapid communication, new evidence from Katrina's evacuation, and terrorism as a credible event.

Health Impact: Projected age distributions will affect the expected health impact to the population from radiation exposure – both routine and above routine. This must be analyzed – the licensee's filing failed to do so.

By 2030, (1) in (3) people will be over the age of 55, compared to 1 in 5 now.

We know from new research that radiation affects the most vulnerable – the young[18] and the old.[19] This makes intuitive sense – for example, the older we get, the more vulnerable we become and this is borne out by research.[20]

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[18] National Academies of Science, Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2, 2005, National Academies Press

[19] George Kneale and Alice Stewart, "Factors Affecting Recognition of Cancer Risk of Nuclear Workers" Occupational and Environmental Medicine 52 (1995):515-23; Steve Wing et al.," Mortality among Workers at Oak Ridge National Laboratory," Journal of American Medical Association 265 np, 11 (20 March 1991): 1437-38.

[20] We note that the A-bomb studies concluded that radiation affects the young and healthy more than the old, since they found more cancer in the young. But this would make radiation unlike almost any other cause of death. The A-Bomb Survivor Study was begun in 1950, five years after the bombing; many of the sick, weak, young children and elderly died off from the devastating lifestyle consequences of the bomb. The survivors were actually a selected healthy survivor population; the survivors are not a representative population.

What Entergy's Filing Said and Did Not Say

What Entergy Provided

All or parts of 15 counties and the cities of Boston, Massachusetts and Providence, Rhode Island, are located within 50 miles of PNPS. (2-16).

Table 2-2

Estimated Populations and Annual Growth rates in Plymouth and Barnstable Counties[21]

	Plymouth County		Barnstable County	
Year	Population	Percent Annual Growth	Population	Percent Annual Growth
1980	405,437		147,925	
1990	435,276	0.7	186,605	2.6
2000	472,822	0.9	222,230	1.9
2010	496,053	0.5	257,844	1.6
2020	517,644	0.4	299,035	1.6
2030	551,005	0.6	334,766	1.2
2040	579,529	0.5	368,720	1.0

Note that the impact is minimized by providing simply an annual rate of growth.

Population in Attachment E Severe Accident Mitigation Alternatives Analysis

E.1.5.2.1 Projected Total Population by Spatial Element – Appendix E: E.1-61

The total population within a 50-mile radius of PNPS was estimated by Entergy for the year 2032 by combining total resident population projections with transient population data from Massachusetts and Rhode Island. Table E. 1-13 shows the estimated population distribution.

[21] Applicant's Environmental Report Operating License Renewal State Pilgrim Nuclear Power Station, 2.6 Regional Demography

Table E. 1-13
Estimated Population Distribution within a 50-mile radius

Sector	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Mile	50-Mile Total
N	0	0	0	0	80474	80474
NNE	3	0	0	0	0	3
NE	3	0	0	0	0	3
ENE	3	0	33121	0	0	33124
E	5	0	33121	23185	0	56311
ESE	23	0	49682	92740	0	142445
SE	950	9936	115925	23185	0	149996
SSE	13289	69555	82803	0	0	165647
S	23695	99364	132485	84383	43397	383324
SSW	23695	49762	23696	23185	21699	142037
SW	23695	71088	277374	349491	114546	836194
WSW	23695	71088	277374	349491	183037	904685
W	22818	71088	277374	388324	286370	1045974
WNW	16494	71088	118481	303450	390150	899663
NW	11269	71088	195075	1529212	405561	2212205
NNW	5599	35544	43350	31295	321894	437682
Total	**165236**	**619601**	**1659861**	**3197941**	**1847128**	**7489767**

Note: We understand that the projections on impact (doses to the public and cost estimates) are based on the key hole

What New Information Entergy Failed to Provide

Overview[22]: The region is expected to add 465,000 people by 2030. The region will be aging with a dramatic spike in the over 55 population. The largest population increases are expected in urban center such as Boston and Cambridge and in a half-dozen suburban towns, such as Plymouth and Weymouth with very large housing developments on the horizon. (MAPC Metro Future projections brief #1)

According to the report the area south of Boston is expected to grow faster in population and jobs than any other section of Greater Boston through the year 2030. Jobs are important because they factor into projecting the transient population.

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[22] Population Projections: Primary Source: The Boston Metropolitan Area Planning Council Report on Population and Employment Projections 2010 -2030
http://www.mapc.org/2006_projections.html

Communities south of Boston will grow 13%. Plymouth is expected to add the most, about 10,000 residents – a population jump over 20%.

The population is expanding because there is more open land and large projects are planned in Plymouth and on the Weymouth Navel Air Station land ---located just off Route 3, the evacuation route for Duxbury and Marshfield.

By 2030, 1 in 3 people will be over the age of 55, compared to 1 in 5 now. That has an impact on health (increased susceptibility to harm from radiation exposure, routine and above routine) and transportation (increasing the number of transportation dependent).

According to the report, all projections are based on current trends and are projected to continue to 2030, the time frame under consideration. The methodology used by MAPC is described in the report.

Regional Total –Metropolitan Area Planning Council –January 31, 2006

2000	2010	2020	2030	% increase
4,309,456	4,526,777	4,671,253	4,775,562	10.8%

Population Total by Municipality, January 31, 2006 (MAPC Report)
Pilgrim NPS Emergency Planning Zone (EPZ)

Municipality	2000	2010	2020	2030	% increase by 2030
Plymouth	51,701	56,132	59,724	62,657	21.2%
Carver	11,163	12,298	13,221	13,979	25.2%
Duxbury	14,248	15,284	16,121	16,798	17.9%
Kingston	11,780	12,561	13,191	13,698	16.3%
Marshfield	24,324	25,805	26,995	27,948	14.9%

Population Total by Municipality, January 31, 2006 (MAPC Report)
Municipalities Located Along Routes to Pilgrim's EPZ Reception Centers

Municipality	2000	2010	2020	2030	% increase by 2030
Middleboro	19,941	21,243	22,128	22,832	
Taunton	55,975	58,695	60,708	62,284	
Plymton	2,637	2,839	3,002	3,135	
Halifax	7,501	8,059	8511	8,878	
Bridgewater	25,184	27,334	28,827	30,037	
Pembroke	16,927	18,575	19,334	19,939	17.8%
Hanover	13,164	13,791	14,290	14,682	11.5%
Rockland	17,670	18,811	20,827	21,213	
Abington	14,605	15,744	15,704	16,082	
Whitman	13,882	14,342	14,703	14,976	
Norwell	9,766	10,223	10,587	10,873	11.3%
Hanover	13,164	13,791	14,290	14,682	
Hingham	19,882	24,692	25,228	25,636	28.9%
Weymouth	53,987	57,017	62,735	63,610	17.8%
Braintree	33,829	34,889	34,948	35,296	4.3%

Example: The route for Duxbury and Marshfield to their Reception Center, Braintree High School, requires passing through the towns of Pembroke, Hanover, Norwell, Hingham, Weymouth and Braintree. The populations in the towns that feed on to Route 3 can be expected to evacuate also – the shadow evacuation. Route 3 was completed in 1963. It was designed to carry 76,000 cars daily but now handles about 140,000 on the stretch approaching the Braintree split – en route to Braintree High School. A widening project would add a third lane from Weymouth to Duxbury, if ever begun and completed 2012-2032; however with population projections from 2010 forward – the area really will not be better off. (Patriot Ledger March 7, 2005).

Plymouth – Pine Hills: The largest housing development in New England, build- out includes 2,877 homes on 3,060 acres. The distance from PNPS to Pine Hills is < 3 1/2 miles from PNPS. The current Pine Hills household size is 1.95 people per building. Based on these numbers, the build-out population will be 5, 850. As of 01/01/06, 967 homes have been built, over 5 years. Therefore, the Town of Plymouth (Lee Hartman, Town of Plymouth) expects the Pine Hills to be substantially completed within the next 10 to 15 years with a total population of 5,850, not including transients. We contend that this fact alone says clearly that there will be a sizeable town within a town, adjacent to Pilgrim NPS; and it speaks against re-licensing Pilgrim NPS.

IV. Emergency Planning

Summary: The Applicant discusses evacuation delay times and speeds and by making false assumptions manages to concoct unrealistic short delay times and fast evacuation speeds. At public meetings on re-licensing Duxbury, Plymouth Selectmen and numerous residents have stated unequivocally that timely and effective evacuation is not possible now, and will not be in the future. In contrast, the applicant appears to start with a conclusion that emergency planning will provide reasonable assurance and then works backwards to support that conclusion. We know that evacuation is not the only protective action; sheltering is not discussed, along with other important planning issues – such as reception centers, medical facilities, tests. The ER is responsible for evaluating the applicants Severe Accident Mitigation Analysis. Whether or not emergency plans and response infrastructure can provide reasonable assurance 2012-32 clearly is part of such an analysis; hence a site specific analysis of emergency planning capability is thereby required. Both the NRC staff and Commission are looking to upgrade planning for a severe accident and that fact alone speaks to the need for the ER to take a hard look at all aspects of planning, here. Last the 9th Circuit Court's decision that terrorism must be considered including its possible impact on the physical environment means all aspects of emergency planning specifically at Pilgrim must be part of the ER.

What the Applicant Says

Emergency Response Data

The assumptions in the models used by the applicant and the input data put into those models do not provide credible conclusions regarding emergency response outcomes in a severe accident. Nor is there reasonable assurance that the assumptions used by FEMA in this area have any credibility.[23] The MACCS2 emergency planning model requires the user to input the time when notification is given to emergency response officials to initiate protective actions for the

[23] . The Senate Homeland Security and Governmental Affairs Committee issued [April 27, 2006] an 800-plus-page report, "Hurricane Katrina: A Nation Still Unprepared." Sen. Susan Collins, R-Maine, Chair of the Committee summarized the report in a written statement that, "We have concluded that FEMA is in shambles and beyond repair, and that it should be abolished."

surrounding population; the time at which evacuation begins after notification is received; and the effective evacuation speed. However, the model assumes that the population is out of danger once crossing the 10-mile boundary. This will not be true in a severe accident such as a core melt and/or a spent fuel pool accident that leads to a zirconium fire. *Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report*, National Academy of Sciences, 3 (April, 2005).

In addition, the model does not consider those who cannot evacuate and must shelter. Protective actions involve both evacuation and sheltering. Under some circumstances evacuation will not be possible for all or a portion of the affected population. The elderly often require transportation assistance because they are infirm, cannot drive themselves or have only one car per household that may not be available in an emergency.

The applicant's evacuation time input data is from, *Pilgrim Station Evacuation Time Estimates and Traffic Management Plan Update, Revision 5,* (November 1998). However later data is available. KLD prepared a later report for Entergy, *Pilgrim Nuclear Power Station Development of Evacuation Time Estimates, KLD TR-382, Revision 6,* (October 2004). The newer KLD study relies on newer census data and newer roadway geometric data. The most recent data available should be used as source material to get the most accurate estimates.[24]

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[24] The 2004 KLD Report compares the 1998 previous ETE Study to the 2004 Current ETE Study, Table 1-1. ETE Study Comparisons, p 1-9. Significant differences include, for example:

Topic	1998 ETE Study	2004 ETE Study
Resident Population	1990 Census	2000 Census, extrapolated to 2005
Employee Population	Growth in state employment between 1990 and 1996 used to project 1997 employment Estimated employees for each town that lived in EPZ, number walk to work, number work at home	Growth in state employment between 1990-2000 to extrapolate to 2005. Employment journey to work data (State 2001 data files) identified portion of employees who commute into EPZ relative to total number. In addition data surveys were sent to major employers.
Transient Population		More detailed analysis day-trippers carried out
Roadway Geometric Data	Road capacities based 1994 HCM	Road capacities based on 2000HCM

Many of the assumptions and study estimates in the applicant's source, *Pilgrim Station Evacuation Time Estimates and Traffic Management Plan Update, Revision 5,* (November 1998) are faulty. For example, voluntary evacuation from within the EPZ was estimated to be 50% within a 2-5 mile ring around the reactor, excluding the "key-hole;" and 25% in the annular ring between the 5-mile boundary of the circle and the 10-mile EPZ boundary.[25] Shadow evacuation was not considered.[26] Special Events, such as the July 4th celebration, were not considered. Evacuation time estimates for the EPZ was performed for, "Off-season mid-week, mid-day in good weather; and summer mid-week, mid-day, good weather." Using the above false assumptions, the study describes unrealistically low evacuation time estimates. Clearly there is no guarantee that an accident will not occur on holidays, during the commuter rush hour, on summer week-ends, or in bad weather. Emergency planning and a severe accident analysis should assume the worst case scenario.

Evacuation Delay time

The Environmental Report states "The elapsed time between siren alert and the beginning of the evacuation is 40 minutes. A sensitivity case that assumes 2 hours for evacuees to begin evacuation was considered in this study to evaluate consequence sensitivities due to uncertainties in delay time." Application ER Appendix E.1.5.2.7, p. E-1-64. In other words, the assumption is that the longest likely delay before residents begin to evacuate is 2 hours. This assumption is incorrect for the simple reason that notice of the evacuation could take longer than 2

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[25] The Town of Duxbury at Annual Meeting, 2006, recognized that many more citizens would be at risk than those within 2/5 miles and they would voluntarily evacuate, along with those outside the 10-miles; hence the Town Meeting voted to oppose the 2/5 miles planning policy.

[26] Three Mile Island provides the best, and perhaps only, realistic example. There, the Pennsylvania Governor issued an evacuation advisory (note, it was not an order). It was expected to have precipitated the flight of only 3,400 people (pregnant women and pre-school children within five miles of the plant); instead, a total of 144,000 people (a government figure) evacuated the surrounding region. Donald J. Zeigler, Ph.D. found the same in a telephone survey of households near Shoreham and later in households near Indian Point. *Evacuation Behavior In Response To Nuclear Power Plant Accidents*, by Donald Zeigler and James Johnson, Jr., The Professional Geographer (May, 1984).

hours to reach people. The sirens that are in place cannot be heard by residents inside some buildings and houses, when the windows are closed, when air conditioners are on, in bad weather, or if the dwellings are set back from a main road. They also cannot be heard inside vehicles. Citizens have complained to Entergy about the inadequacies of the early warning sirens. It is more likely that notification will result from word-of-mouth, adding to delay. If, for example, the accident occurs at 1:00AM, it would be more than 5-6 hours before the community had awakened and word spread.

The peak population in the EPZ approximates 100,000 who are spread over approximately 150 square miles and engaged in a variety of activities. Hence it must be anticipated that some time will elapse between transmission and receipt of information advising people of the accident. The amount of elapsed time will vary from one individual to the next depending where that person is (at home, at the beach, sailing or in motor boats, fishing, out-of-home entertainment center); what the person is doing (working, shopping at a regional mall); time of day, families may be united in the evenings, but dispersed in the day; week-day versus week-end and holidays. Some may be outside the EPZ at the time the emergency is declared. These people may be commuters, shoppers who reside within the EPZ and who will return to join the other household members upon notification of an emergency. Use of a 2 hour delay time in the sensitivity case is overly optimistic.

Evacuation Speed

The Environmental Report states "The worst case for Pilgrim is during the winter, under adverse weather conditions, since snow removal can add up to an hour and a half to evacuation time. The radius of the Emergency Planning Zone is 10 miles. Assuming that the net movement of the entire population is 10 miles, the time required for evacuation ranges from 3 hours 35 minutes to 6 hours 30 minutes, and the average speed in clear weather to 1.54 miles/hour under adverse weather conditions. The average evacuation speed is 2.17 miles/hour, or 0.97 meter/second." And "A sensitivity case that assumes a lower evacuation speed of 0.69 meter/second was considered in this study to evaluate consequence uncertainties in evacuation speed." Application ER, E.1.5.2.7.

However, to arrive at this number, the applicant falsely assumes that in a severe accident harmful levels of radiation (and thus evacuation) will not extend beyond 10 miles. The Sandia National Laboratory CRAC-2 core melt consequence analysis for Pilgrim conservatively stated that the 1st year peak fatal radius was 20 miles and the 1st year peak injury radius was 65 miles. *Calculation of Reactor Accident Consequences, U.S. Nuclear Power Plants (CRAC-2),* Sandia National Laboratory (1982). The National Academy of Sciences has stated that a spent fuel pool accident that led to zirconium cladding fires "... would create thermal plumes that could potentially transport radioactive aerosols hundreds of miles downwind under appropriate atmospheric conditions" The Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report, National Academy of Sciences, April 2005, p.50. Therefore, in a severe accident, evacuations will have to go well beyond 10 miles to protect public health and safety.

The assumption that snow removal can add up to an hour and a half to evacuation time is also optimistic. It assumes that workers will be available to plow and does not account for the likely event that they will evacuate with their families. And although July 4th holiday traffic could easily slow evacuations more than an hour and one-half, KLD did not analyze "special events" in their traffic estimates. Summer week-end traffic was also ignored despite the fact that Pilgrim is located in a popular summer resort area due to the many beaches, forests and historic sites. The route to and from Cape Cod passes almost directly past the nuclear plant such that traffic getting to and departing from the Cape travels over the same routes that are designated in a nuclear evacuation.

Shadow evacuation is ignored. Studies of human behavior following Three Mile Island (TMI) were described in a study published in *Evacuation Behavior In Response To Nuclear Power Plant Accidents,* Donald Ziegler and James Johnson, Jr., The Professional Geographer, (May, 1984). At TMI a limited evacuation advisory of pregnant women and pre-school children within 5 miles of the reactor was recommended by the Governor; that number would have resulted in 3,400 evacuees. Instead up to 200,000 people actually evacuated, approximately 39% within 15 miles of the reactor. The "shadow" evacuation is not expected to diminish until approximately 25 miles out from the reactor. The study found that in addition to the high rate of voluntary evacuation, those evacuees tended to travel greater distances

than observed in other kinds of disasters. The TMI study evidenced that the median distance traveled by evacuees was 85 miles. Professor Zeigler issued a later report for Long Island in December 2001. He reported on a telephone survey asking what the response would be if an accident occurred at Shoreham Station. He concluded if emergency planners assume that only those people who are told to evacuate will actually evacuate, they will expect 2,700 families to be on the road; instead, they will have 289,000 families from all over Long Island.

Extrapolating from these studies and looking at population projections in towns outside the Pilgrim EPZ, but along the major evacuation routes, makes it obvious that the roads upstream will be filled by panicked residents once word of the accident gets out. This could result in those near the core being trapped and their departure very significantly delayed.[27]

What the applicant does not say

The applicant asserts that even in a serve accident current emergency plans will minimize consequences – perhaps "minimize" but they do not say to what extent. The point is that plans must provide "reasonable assurance" and that was not demonstrated by the applicant and must be investigated in the ER.

Goal/Assumptions Underlying Emergency Planning, False

1. Current Goal Emergency Plans -Prevent Lethal Doses not Prevent Cancer, Disease, Genetic Damage

NRC requires emergency planning only for those within the "plume exposure" pathway – 10 mile radius. The choice of this radius was based in part on NRC's analysis indicating that in a severe accident, dose rates high enough to cause early

[27] For example, the route for Duxbury and Marshfield to Braintree High School Reception Center requires passing through the towns of Pembroke, Hanover, Norwell, Hingham, Weymouth and Braintree. The populations in the towns that feed onto Route 3 can be expected to evacuate also – the shadow evacuation. Route 3 was completed in 1963. It was designed to carry 76,000 cars daily but now handles about 140,000 on the stretch en route to Braintree High School. A widening project would add a third lane from Weymouth to Duxbury, if ever begun and completed 2012-2032; however with population projections from 2010 forward – the area really will not be better off. (Patriot Ledger March 7, 2005).

fatalities from acute radiation syndrome would be confined to about 10 miles. However dose rates outside this region, though on average not high enough to cause early fatalities could be high enough to cause significant risk of cancer unless effective measures were taken. NRC's emergency planning was not designed to limit such exposures in the event of "worst core melt consequences" for which the protection goal is that "immediate life threatening doses would generally not occur outside that zone[28]."

The public, on the other hand, views "reasonable assurance" differently – that is protected from harm, not simply immediate death, protected from all the other health effects from radiation exposure. Who believes that the general public would support nuclear power if this were commonly known?

2. NRC and the applicant narrow the area of response in a severe accident to an absurdly small area –impact much wider.

This serves to provide false assurance that emergency planning works in a now overly congested area but it does not pass the sniff test.

> NUREG 0654, Supp. 3, "The guidance in this document...emphasizes that the preferred initial action to protect the public from a severe reactor accident is to evacuate immediately about 2 miles in all directions from the plant and about 5 miles downwind from the plant, unless conditions make evacuation dangerous. Persons in the remainder of the plume exposure pathway emergency planning zone (EPZ) should be directed to go indoors and listen to the Emergency Alert Stations while the situation is further assessed."

The Town of Duxbury recognized the absurdity of this guidance and voted against the policy at Annual Town Meeting, 2006. Duxbury recognized that:

- Sandia National Laboratory, Calculation of Reactor Accident Consequences U.S. Nuclear Power Plants (CRAC-2), set the peak 1st year fatal radius for Pilgrim at 20 miles and the peak injury radius at 65 miles.[29]

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[28] NRC, Criteria for preparation and Evaluation of radiological Emergency Response Plans and Preparedness in Support of Nuclear Plants, NUREG-0654, 1980, p.12.

[29] These estimates are conservative. The federal study, CRAC II: used census data from 1970;assumed entire 10-mile EPZ would be evacuated within at most six hours after issuance

- The National Academy of Sciences, Safety and Security of Commercial Spent Nuclear Fuel Storage, Public Report, April 2005 stated,

> Such (zirconium cladding) fires would create thermal plumes that could potentially transport radioactive aerosols hundreds of miles downwind under appropriate atmospheric conditions." NAS, p.50

- The "shadow evacuation" is well-established and folks well outside the 10-mile EPZ, not to mention the 2-mile ring/5 mile downwind section, will evacuate; and they will hear about the accident rapidly due to cell phones and today's capability of rapid communication.

3. "Key Hole" Theory of Plume Dispersion – ignores variability wind in coastal communities – see Section VI

Pilgrim is located on the coast and the wind is highly variable due to the Sea Breeze Effect, terrain, buildings, and variation in precipitation/fog patches.[30] Therefore planning must be for the entire radius – not simply for those inside one imaginary "relatively narrow plume."

3. Plans Assume Slow Breaking Accident – Post 9/11 not realistic

Emergency planning should be designed to account for the full spectrum of potential consequences, including the so-called "fast-breaking" release scenarios in which radioactive releases would begin within 30 minutes after an attack. This is one of the major conclusions of the report conducted for the government of New York by James

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order; assumed aggressive medical treatment for all victims of acute radiation exposure in developing numbers for early fatalities; used a now obsolete correlation between radiation dose and cancer risk that underestimated the risk by a factor of 4 relative to current models; and current models need to be recalculated again based on the National Academy's BEIR VII Report (June 2005) that reconfirmed that there is no safe level of radiation, risks are greater that previously thought and health risks other than cancer must be considered –such as heart disease and birth defects; sampled only 100 weather sequences out of over eight thousand (an entire year's worth), a method that underestimates the peak value over the course of a year by 30%

[30] Dr. J.D. Spengler, Dr. G.J. Keeler, Final Project Report: Feasibility of Exposure Assessment For the Pilgrim Nuclear Power Plant –Prepared for The Massachusetts Department of Public Health, May 12, 1988; and research by Dr. Bruce Eagan for the Massachusetts Department of Public Health

Lee Witt Associates. Certain terrorist attack scenarios could be capable of causing such rapid releases. [31]

4. Hazard Assessment – equipment to monitor and track the plume – Inadequate – see, Section VI

Managing an event – making the proper emergency call - requires first grappling with what has happened. Plans assume and regulations require [50.47 (b)(9)], that data regarding the status of plant conditions, radiological release and weather are reliable, accurate and timely – they are not at Pilgrim NPS.

The state is dependent on the licensee's reports and accuracy of the licensee's equipment. As described in Section VI, radiation monitors and weather equipment is not computer linked to the state and local authorities from all points that radiation is released from Pilgrim and from appropriate off-site locations. Local communities are dependent on the state's interpretation of the licensee's accident reports of what is happening and how it may affect the population. The state sends a team to take samples and sends those samples back to state labs for analysis. However that takes time – too much time.

The ER must recognize that planning is hopeless without upgrading the reactor's monitors, as described in Section VI and computer link those monitors to the state and local authorities. A similar recommendation was made by James Witt in his analysis of Indian Point.

5. Plans/IPs Fail to Adequately Address Notification of Public – a timely emergency response will not occur, thereby increasing public harm

Rapid notification of emergency responders and the public is central to planning. Emergency Responders must have communication equipment that is interoperable – not the case throughout the EPZ. Public notification: At present notification systems are inadequate in that they essentially rely on one system - sirens. Sirens can not be heard in all parts of the EPZ towns and can not be heard inside if the windows are down - they are simply an outdoor warning system. Sirens can and have failed.

[31] James Lee Witt Associates, *Review of Emergency Preparedness of Areas Adjacent to Indian Point and Millstone*, March 2002, Executive Summary, page X.

Pilgrim's sirens have been unreliable. They failed 12 times from January 2000 to January 2004. The latest siren failure came after a brand-new siren system was installed.

What is needed? Outdoors: sirens in sufficient number with an audible, but simple, voice message and battery back-up. Indoors: rapid dialing systems that have the capability to notify workers and every household and business within the EPZ in less than 15 minutes. Systems are on the market today that can do the job. Roads: Reader boards –more installed on major highways and portable reader boards provided to EPZ communities. Low frequency dedicated radio capability. Busses/Vans for transportation dependent – radio equipment on board so that they can be notified.

5. Potassium Iodide (KI)

KI has been offered to communities within the 10-mile Emergency Planning Zone. The applicant opposed its distribution. The state basically cooperated with the applicant. For example: MDPH provided little public education; stalled KI pre-distribution to Cape Cod despite state legislation that authorized distribution and town requests for KI; refused to stockpile Reception Centers – with the incredible excuse that it would encourage too many people to go to the Reception Centers; and wrote to HHS opposing the Bioterrorism Act, 2002, a federal provision to stockpile KI out to 20 miles. We ask the ER to analyze the consequences of MA's ineffective KI pre-distribution program in a severe accident.

Factor into the analysis, for example, the following:

- The American Thyroid Association recommends that: Potassium iodide should be made available to populations living within 200 miles of a nuclear power plant and should be "pre-distributed" to households within 50 miles of a plant. Massachusetts Medical Society advised that KI be provided to all Massachusetts residents.

- U.S. Nuclear Regulatory Commission, NUREG/CR 1433 showed that for children, the following dangers may occur from the inhalation of nuclear materials after a

massive core-melt atmospheric accident (like Chernobyl). Also note that the estimates are conservative in that they do not take into account the vast quantities of iodine now stored in spent fuel pools from recently unloaded reactor cores that would be released in a worst case accident scenario.

Approximate Dangers of a Core-Melt Atmospheric Accident for Children

Distance in Miles	Mean Thyroid Dose (rem) for Exposed Children Outdoors*	Probability of Thyroid Damage to Exposed Children Located Outdoors if not Protected by Stable Iodine (like KI)
1	26,000	100%
5	11,600	100%
10	6,400	100%
25	2,200	80%
50	760	26%
100	200	7%
150	72	2%
200	32	1%

- Chernobyl: NRC's NUREG-1623 points out that radioactive iodide can travel hundreds of miles on the winds. An increase in cancer caused by Chernobyl..."was detected in Belarus, Russia and Ukraine. Notably, this increase, seen in areas more that 150 miles from the site, continues to this day and primarily affects children who were 0-14 years old at the time of the accident...the vast majority of the thyroid cancers were diagnosed among those living more than 31 miles from the site. The 2001 figures were 11,000 thyroid cancers at 31 miles.

6. Transportation dependent

Transportation dependent are not considered by the applicant in their time estimates. There will be a larger number of transportation dependent 2012-2032 because of the increased projected EPZ population projected of over age 55 and the increasing trend of dual income and single parent households resulting in increased numbers of "latch-key" children. The ER must analyze the size of the transportation dependent population; where the providers are coming from; whether the number

of providers meets the need; the response time; and whether the actual response time has been tested by sending busses to EPZ assigned locations. If drivers do not show up are the National Guard under contract and trained to do the job?

7. Reception Center – location and capacity

Reception Centers are required to monitor, decontaminate, assess medical needs and provide transportation to hospitals if required, and reunite families. NUREG-0654, J-12 states that Reception Centers must monitor 100% of the population within 12 hours.

However, Pilgrim's Reception Centers have a capacity only for 20%. NRC, the State and the applicant justify this violation of regulation based on an outdated "Krimm's Memorandum," named after a FEMA official who pulled 20% out of a hat based on response to a hurricane. You can't base policy on hurricanes. People react very differently to a nuclear disaster than to a hurricane warning. Public warning for a hurricane is ample –TV & Radio Storm Watch reports give ample warning, often days in advance; in contrast, the time of official notice of a nuclear attack/accident can be very short –less than 30 minutes.

This policy leaves 80% without an opportunity to be monitored and decontaminated risking their health. If 80% are not monitored and decontaminated they will not only put at unnecessary risk their physical and psychological health; they will contaminate populations in other areas with dirty vehicles. Also, it is likely many more than 20% will go to the Reception Center and it will be overwhelmed so none will be served.

Institutionalized populations may not go to the Reception Centers at all. School children, the most vulnerable population, may simply be sent to the "Host School," facilities that do not have monitors or decontamination capability. Residents at Nursing Homes, Group Homes and detainees in jail are not brought to the Reception Centers. They will be brought to other locations – locations without monitors and decontamination equipment. The most vulnerable populations are "skimmed" – perhaps this is because collectively their number exceeds 20%.

The ER must take this into consideration and factor in what the consequences will be in a severe accident if 80% of the population continues not to be provided for.

8. Special Areas – Unique Geographic Location makes evacuation impossible

Some areas that are likely-to-be exposed can not evacuate in a timely manner in certain weather conditions – they are trapped. Gurnet and Saquish, part of Plymouth, can not evacuate in exceptionally high tides or snow storms. In a low tide, boats can not get in to evacuate either. Cape Cod is another example of a trapped population.

The ER must analyze the consequence of providing no "reasonable assurance" to segments of our population in a severe accident under certain weather conditions and scenarios.

9. Sheltering

The guidance in Appendix 1 to NUREG-0654, Supplement 3 states,

> Having people seek shelter if they cannot evacuate before the plume arrives was considered to apply only for a short-term (puff) release of known duration. P.2
>
> In addition, studies have shown that except for very limited conditions, evacuation in a plume is still more effective in reducing health risks that prolonged sheltering near the plant. P.2-3
>
> The staff has considered these uncertainties and has recognized that sheltering people in most structures close to a nuclear plant, where plume concentrations and dose consequences are likely to be highest, will not prevent early adverse health effects during a major radioactive release. Accordingly the staff has concluded that it is better to evacuate promptly near the plant for a serious reactor accident as a precautionary measure rather than to wait for additional information that may become available after a release occurs. P.3

How does the ER reconcile the facts that: (1) sheltering is not effective in a severe accident, in other than a short-term puff release; (2) a timely evacuation of all likely-to-be-affected populations realistically is not possible in likely-to-be affected

areas in a severe accident due to increased population and limited infrastructure – roadways and emergency personnel; (3) increased number of transportation dependent 2012-2032 due to an increase in the number of elderly and latch-key children; and (4) none of the EPZ Town Shelters were designed and properly equipped for fallout and none, excepting Duxbury's, even are stockpiled with KI and N95 face masks?

10. Protecting Worker Safety

Currently protective gear is not provided for EPZ emergency responders (except in the Town of Duxbury that purchased their own) even in a general emergency described in the Emergency Calendar as "...the most serious type of emergency." However Police, Fire and DPW workers are outside on duty at this time. Worse protective gear is not provided for those who volunteer for lifesaving missions that is to go outside after their dosimeter has exceeded the recommended "safe" level. Lacking protective gear not only is bad for the workers health but decreases the number who will show up to perform the job. How will the ER analyze this?

The REWMDS, the center to decontaminate emergency workers, is in the peak fatal zone, directly across the street from the 10 mile EPZ demarcation line in Carver. The ER must analyze how workers can be effectively monitored and decontaminated in a likely-to-be contaminated area.

11. Injured and Contaminated – Medical Facilities

50.47 (b) (12) requires that arrangements are made to treat the contaminated and injured. However, the plan does not acknowledge that some accident scenarios will result in large numbers of injured and contaminated individuals.

Hospitals listed to serve those within the 10-mile EPZ of Pilgrim, for example, cannot handle monitoring and decontaminating large numbers of people. Also, some hospitals listed to serve the EPZ are too close to the reactor site to be of use – Cape Cod and Falmouth.

The Commonwealth of Massachusetts has stated that they intend to set up mobile decontamination tents. Has the ER ascertained that MDPH has an adequate supply of monitors, decontamination equipment, KI and trained personnel? Because of the

possibility that there may be multiple attacks, as occurred in 9/11, Massachusetts can not rely on moving needed equipment from other reactor sites.

Medical Facility 2003-2004	Location
Brockton Hospital	Brockton
Cape Cod Hospital	Hyannis
Charlton Memorial Hospital	Fall River
Good Samaritan Hospital	Brockton
Falmouth Hospital	Falmouth
Metro West Medical Center	Framingham
Morton Hospital	Taunton
Quincy Hospital	Quincy
St Luke's Hospital	New Bedford
Sturdy Medical Center	Attleboro
Tobey Hospital	Wareham

12. Training

Emergency responders, including school teachers, are required to have training – 50.47 (a), (b). The ER must analyze what percent actually have received training; decide if it is sufficient that they have only been offered training, but not taken it; whether there is, or should be, a fixed percent of each category of responder (Fire, Police, DPW, Harbor/Beach personnel, teachers, nursing/group home workers, bus drivers etc) that must receive training in each calendar year for the local plan to be in compliance?

13. Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) Biennial Emergency Simulation Exercises

Biennial Emergency Response Exercises are conducted by the Department of Homeland Security/Federal Emergency Management Agency to assess the level of State and local preparedness in responding to a radiological emergency in the 10-mile Emergency Planning Zone (EPZ). However this is the agency that was described by the Senate Chair of Homeland Security as "...being in shambles and beyond repair, and that it should be abolished." It is doubtful that the ER can with a

straight face place credence in FEMA's past assessments to allow confidence that emergency planning can provide "reasonable assurance" from 2012-2032?

The ER must recognize that the results of previous exercises tell nothing about the adequacy of planning. For example: exercises have not been realistic, none have provided no-notice or occurred during non-duty hours or been based upon a scenario involving a fast breaking release of radiation that results in the contamination of a significant portion of the 10-mile emergency planning zone and the 50-mile ingestion pathway zone. Exercises have not covered a variety of conditions: inclement weather; different seasons; holidays; grid lock on primary transportation routes; terrorism scenarios; and scenarios that assess stress on limited emergency resources and personnel – such as testing a scenario involving multiple attacks in the region i.e. attacks on electrical transmission lines or a regional electrical blackout. Exercises have never been based upon a scenario in which significant self-evacuation, or "shadow evacuation," occurs beyond the 10-mile radius and as far away as 50 miles; despite the fact that academic research and the experience at Three Mile Island demonstrate there will be significant shadow evacuation outside of the 10-mile zone. Exercises have not taken into consideration a large number of people, who have been injured and contaminated, requiring treatment and decontamination. Exercise have not assessed how long it takes various emergency officials to travel to state and local emergency operations centers; and what happens if EOCs are transferred during the accident out of the community to a more distant location. With these shortcomings, and the above list are simply highlights, how can the ER find planning adequate now to provide confidence that it will provide reasonable assurance from 2012-2032?

V. Human Health

ER Must Assess Impact and Mitigation on a Site Specific Basis

Overview: The preceding Section II focused on spent fuel pool accident consequences and the new information presented by Jan Beyea for the Massachusetts Attorney General's Motion to Intervene and Backfit. However there is new and significant information supporting our contention that twenty additional years of "normal" operations will be harmful to public health. Pilgrim releases radiation as part of its standard operations. Radiation-linked diseases are documented in communities around Pilgrim. This fact and projected demographic data indicate that this population will be at an increased risk. The National Academy of Sciences (NAS) latest report on low-dose radiation risk, *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (June, 2005) concluded that no amount of radiation is safe. The documented radionuclide releases from Pilgrim in the past have long half-lives and bio-accumulate in the environment. We submit that if the Applicant disputes a causal link between the radiation released by Pilgrim and the cancers seen in its neighboring towns, the current systems in place to monitor releases are inadequate and must be improved. We further submit that if the NRC or State disputes elevated radiation-linked diseases rates or a causal connection that they have not taken into account the unreliability of Pilgrim's monitoring data and reports.

<u>Mitigation ER must consider if Pilgrim is allowed to continue operations:</u>

- Reduction of allowable radioactive emissions into our air and water so that the biological impact is no greater than that allowed from the releases from a chemical plant licensed today and allowable dose reduced to be in synch with current scientific knowledge on the effects of low-dose radiation on health, National Academy of Sciences' Biological Effects of Ionizing Radiation, BEIR VII report.
- Verification of releases by combination radiation and weather monitors – computer linked to state and local authorities – at all points where radiation is released from Pilgrim and at appropriate off-site locations in the seven most impacted towns and on Cape Cod.

Demographics: The Population Directly Abutting Pilgrim is Increasing Substantially and the Population is Older and thus More Susceptible to Radiation Damage

Changing demographics in communities impacted by Pilgrim are such that the dose effect on the population will be far greater than originally anticipated when the plant was licensed – a larger/denser population and older population..

When Pilgrim was licensed and built in 1972, its location was in an area that was remote and undeveloped. The population around the plant has changed drastically in the last 30 years, and this aging plant is now located in the fastest growing region in Massachusetts. In Pilgrim's backyard, Pine Hills, the largest housing development in New England, is under construction. The build-out includes 2,877 homes on 3,060 acres, and Pine Hills, Inc. is actively trying to acquire more land to build in this area. The distance from Pilgrim to Pine Hills is < 3 ½ miles. The current Pine Hills household size is 1.95 people per building. Based on these numbers, there will soon be 5, 850 people living just a few miles from this nuclear plant.[32]

The region is expected to add 465,000 people by 2030 and this group will be aging with a dramatic spike in the over 55 population. The largest population increases are expected in urban centers such as Boston and Cambridge and in a half-dozen suburban towns, such as Plymouth and Weymouth which have very large housing developments on the horizon. *The Boston Metropolitan Area Planning Council Report on Population and Employment Projections 2010 -2030*, http://www.mapc.org/2006 projections.html. The methodology used by MAPC is described in the report. (see Exhibit F-1). According to the report the area south of Boston is expected to grow faster in population and jobs than any other section of Greater Boston through the year 2030. Communities south of Boston will grow 13% and Plymouth is expected to add the most, about 10,000 residents – a population jump of over 20%. By 2030, 1 in 3 people will be over the age of 55, compared to 1 in 5 now. This is relevant to any analysis of health impacts, as studies have shown an increased sensitivity to low levels of ionizing radiation in older populations. *Greater Sensitivity to Ionizing*

[32] This number does not include transients either visiting or working at Pine Hills.

Radiation At Older Age: follow-up of workers at Oak Ridge National Laboratory through 1990. Richardson, D.B. and Wing, S. Int. J. Epidemiol., 1999, 28:428-436; *The Hanford Data: Issues of Age at Exposure and Dose.* Stewart, A.M., Kneale, G.W., PSR Quarterly Vol. 3, No.3 (Sept. 1993) 3:101-111; and *Leukaemia near nuclear power plant in Massachusetts*, Richard Clapp, Sidney Cobb, C K Chan, Bailus Walker, 924 , Lancet, 1987.

Radioactive Emissions from Pilgrim

When an EIS is prepared, NEPA requires the NRC to "disclose the significant health, socioeconomic and cumulative consequences of the environmental impact of a proposed action." The CEQ defines cumulative impacts as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." *Baltimore Gas and Electric Co. v. Natural Resources Defense Council*, 462 U.S. 87, 106-7 (1983), citing Council on Environmental Quality ("CEQ") regulations at 40 CFR §§1508.7 and 1508.8.

In its Final Environmental Impact Statement, the 1972 owners of Pilgrim stated in the Summary of Environmental Impacts and Effects, Section 5-c. that, "The effluents from the facility, if operated as described by the Applicant and in accordance with the technical specifications and rules and regulations of the Commission, will not endanger the public health or the natural environs of the station." *Final Environmental Impact Statement, Pilgrim Nuclear Power Station*, Boston Edison Company, Docket 50-293, 5-c, p. iii, US Atomic Energy Commission Division of Radiological and Environmental Protection, (May 1972). In its current Application, Appendix E, Applicant states "Very low levels of radioactivity may be released in plant effluents if they meet the limits specified in NRC's regulations. These releases are closely monitored and evaluated for compliance with the NRC restrictions in accordance with the PNPS Offsite Dose Calculation Manual." ER Appendix E.3.2.3.1. Essentially the same was stated regarding solid and gaseous releases. Therefore the assumption is that there will be no danger to public health from routine releases

since they will be monitored and will not exceed federal limits.[33] However, despite this confidence written into the Application, we bring forward new and significant information that demonstrates that there has ***already*** been documented radiation linked disease in the communities near PNPS. In addition, a recent report was published by the National Academy of Sciences that demonstrates that ***there is no safe dose of radiation for humans.***

Radiation-Linked Diseases in Communities near Pilgrim

There is new information since Pilgrim began operations in 1972 that shows increases in radiation-linked diseases in the communities around Pilgrim. The increases were in part attributed to operating with defective fuel; operating without the off-gas treatment system in the first years; poor management and practices culminating in the releases in June 1982 that coincided with weather conditions that held the releases over the area. *Southeastern Massachusetts Health Study 1978-1986,* Morris, Martha and Knorr, Robert, Commonwealth of Massachusetts Executive office of Human Services, Department of Public Health, 1990 and *Meteorological Analysis of Radiation Releases For the Coastal Areas of The State of Massachusetts For June 3rd to June 20th, 1982,* William T. Land.

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[33] "The NRC, in 10CFR 20.1301 (Reference 8) limits the levels of radiation to unrestricted areas resulting from the possession or use of radioactive materials such that they limit any individual to a dose of: less than or equal to 100 mrem per year to the total body. In addition to this dose limit, the NRC has established design objectives for nuclear plant licensees. Conformance to these guidelines ensures that nuclear power reactor effluents are maintained as far below the legal limits as is reasonably achievable. The NRC, in 10CFR 50 Appendix I (Reference 9) establishes design objectives for the dose to a member of the general public from radioactive material in liquid effluents released to unrestricted areas to be limited to: * less than or equal to 3 mrem per year to the total body; and, * less than or equal to 10 mrem per year to any organ. The air dose due to release of noble gases in gaseous effluents is restricted to:* less than or equal to 10 mrad per year for gamma radiation; and, * less than or equal to 20 mrad per year for beta radiation.The dose to a member of the general public from iodine-131, tritium, and all particulate radionuclides with half-lives greater than 8 days in gaseous effluents is limited to:* less than or equal to 15 mrem per year to any organ. The EPA, in 40CFR190.10 Subpart B (Reference 10), sets forth the environmental standards for the uranium fuel cycle. During normal operation, the annual dose to any member of the public from the entire uranium fuel cycle shall be limited to:* less than or equal to 25 mrem per year to the total body; * less than or equal to 75 mrem per year to the thyroid; and, * less than or equal to 25 mrem per year to any other organ." *Pilgrim Nuclear Power Station Radiological Environmental Monitoring Program Report,* p.20 (2004).

The cancers found in the communities around the power station initially were studied by Dr. Sidney Cobb and Dr. Richard Clapp and their results were published in a peer reviewed journal in 1987. They included elevated rates of Myelogenous Leukemia – a type of cancer most likely to be triggered by exposure to radiation.[34] This led to a case- control study carried out by the Massachusetts Department of Public Health that showed a four fold increase in adult Leukemia between 1978 and 1983. The report stated "a dose-response relationship was observed in that the relative risk of leukemia increased as the potential for exposure to plant emissions also increased."[35]

Denial: Response to MDPH's Southeastern Massachusetts Health Study: The Southeastern Massachusetts Health Study was conducted, peer -reviewed, and made public during the Dukakis Administration. However, there was a complete about face in November 1990 when Governor Weld took office that has continued through successive Massachusetts Republican Administrations. December 1990, Governor Weld sent his Executive Secretary to accompany Pilgrim's Vice President, Ralph Bird, and Pilgrim's Health Physicist, Tom Sowden, to visit Massachusetts' Interim Commissioner of Public Health, David Mulligan. At that meeting Pilgrim presented their "wish list" and obviously they had the Governor's blessing. Pilgrim, the implicated industry, would be allowed to appoint a second peer review panel to re-review the Southeastern Massachusetts Health Study; and, until the industry's peer review panel decided whether the study was credible all the study's recommendations would be put on hold. The second peer review panel could find nothing wrong with the study's methodology. The re-review panel stated clearly in their report, Review of the Southeastern Massachusetts Health Study by Hoffman,

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[34]An epidemiological analysis of five towns around Pilgrim shows a 60 percent increase in leukemia rate, excluding leukemias not caused by radiation exposure. - Dr. Sidney Cobb, et.al., Lancet, 1987. The rate of myelogenous leukemia (the type most likely to be triggered by exposure to radiation) among males in the 5 towns around the Pilgrim reactor was found to be 2 1/2 times greater than the statewide average. *Leukemia in Five Massachusetts Coastal Towns,* Dr. Sydney Cobb, et al., Abstract for the American Epidemiologic Society, March 18, 1987; and *Leukemia near Massachusetts Nuclear Power Plant*, letter, Clapp, R.W., Cobb, S, Chan, C.K., Walker, B., Lancet 1987; 2:1324-5.

[35]Adults living and working within ten miles of the Pilgrim reactor had a fourfold increased risk of contracting leukemia between the years of 1978 and 1983 when compared with people living more than 20 miles away, according to a 1990 study by the Massachusetts Department of Public Health. *Southeastern Massachusetts Health Study 1978-1986*, Morris, M.S., Knorr, R.S., Massachusetts Department of Health, Southeastern Massachusetts Health Study, Oct., 1990. Archives of Environmental Health, Vol. 51, p266, 1996, July-Aug. #4.

Lyon, Masse, Pastides, Sandler, Trichopoulos, submitted to the Commissioner of Public Health, October 1992 in the Executive Summary that, "The [original SMHS] study team adhered to generally accepted epidemiologic principles..." and "the findings of the SMHS cannot be readily dismissed on the basis of methodology errors or proven biases..." But somehow they just couldn't believe it - given Pilgrim's emissions. However for emissions data, the re-review committee relied on data collected and provided by Pilgrim - not surprisingly it indicated that Pilgrim hardly emitted any radiation – and one offsite monitor located in South Boston, well outside the EPZ and outside the geographic area likely to pick up routine emissions.

The story gets worse. Massachusetts Department of Public Health allowed Pilgrim, the implicated industry, to provide all the sound bites, press releases and public announcements about the re-reviews' findings and refused to let their employees, who conducted the original study, speak to the press. [36]No subsequent studies have been performed. MDPH has chosen to protect the industry's health over the public's health. Once again, we see political science used to re-write real science on behalf of industry. At the May 17, 2006 NRC Public Environmental Scoping Meeting, an NRC official stated that they had visited MDPH and were told by MDPH's Suzanne Condon and the department that there were no negative impacts from PNPS's operations. Our message to you is that MDPH's statements are politically-driven and have little to no resemblance to fact.

Evidence of radiation-linked disease continued. In a statement before the Southeastern Massachusetts Health Study Review Committee [June 26, 1992] Dr. Richard W. Clapp, the founder and former director of the Massachusetts Cancer Registry and Professor of Environmental Health at Boston University School of Public Health, presented a graphical assessment of the pattern of leukemia and thyroid cancer in the towns closest to Pilgrim during the period 1982-1989. *Analysis of 1974-1989 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer*, Dr. Richard Clapp, DSc, MPH (2006), *personal communication*.

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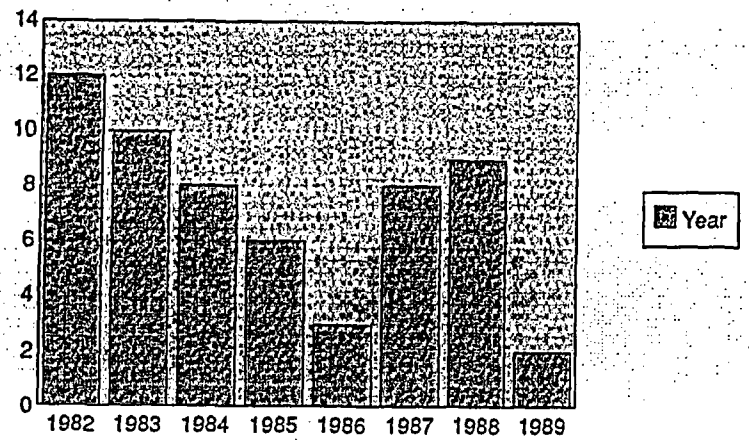
[36] Pilgrim Watch has a complete record of reports, comments, press releases, correspondence with re-review panel regarding the re-review. Note that, the 27 page Executive Summary of the SMHS Review, dated December 1, 1992 was authored by Boston Edison, the implicated industry, although it appears to be written by the review panel and was distributed to so imply. We also have analyses of the SMHS by companys hired by Boston Edison . Their reports are obviously suspect. An example of science for hire: ERI, Charles Poole, Plausibility of the Results from the Southeastern Massachusetts Health Study, January 18, 1991.

Leukemia (minus CLL) in Plymouth Area

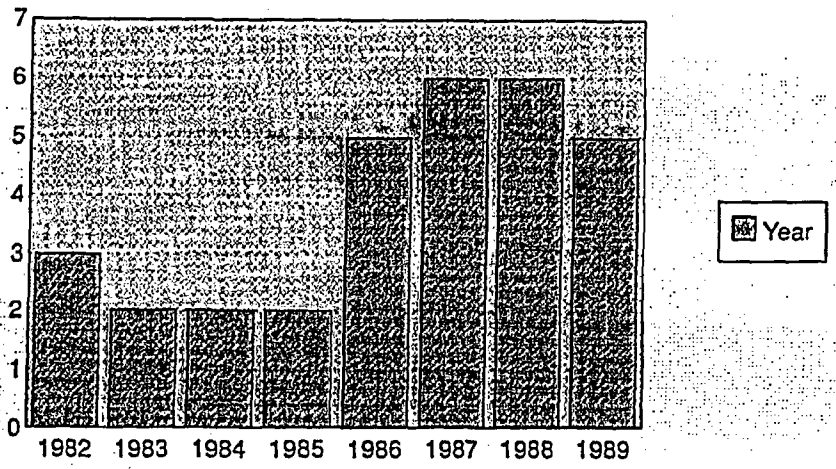
1982-1989



as of 6/25/92

Thyroid Cancer in Plymouth Area

1982-1989



as of 6/25/92

The incidence of leukemia peaked in 1982 and subsequently declined until 1986. Then there was a second, smaller peak in 1987 and 1988 while declined in 1989. The number of cases exceeded the number expected in 1982-85 and 1987-88. The second graph depicts the pattern of thyroid cancer in the same set of towns. It shows a peak in the years 1987-1988. These patterns of cancer incidence are

consistent with the predicted health effects of the radiation released in the early 1980s.

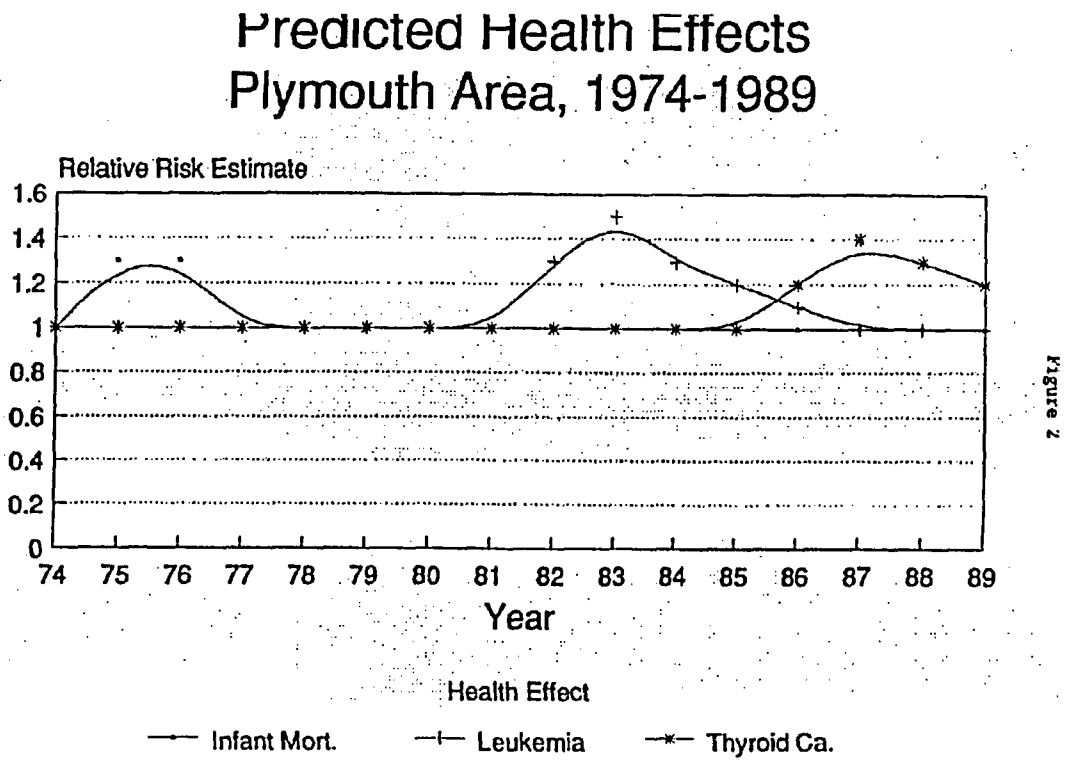


Figure 2

The graph shows the predicted health effects. A statistically significant increase in childhood leukemia was noted in communities near Pilgrim, too. Although Massachusetts Department of Public Health recommended a state sponsored case controlled childhood leukemia study, it was not done.

The Massachusetts Cancer Registry also shows, for the years 1998-2002, a continuing increase of leukemia and thyroid cancer in the towns around PNPS. Specifically, there were 83 cases of leukemia reported to the Massachusetts Cancer Registry (MCR), where 72.9 would have been expected based on statewide rates. This results in a Standardized Incidence Ratio (SIR) of 114 (95% conf. int. = 91-143). In addition, there was excess thyroid cancer in these same towns for the same time period. The thyroid cancer SIR was 122 (95% conf. int. = 96-155). In other words, leukemia was 14% elevated over the statewide rate and thyroid cancer was 22% elevated. Neither of these calculations were statistically significantly elevated by the usual convention ($P<.05$), but there were more cases than expected nevertheless. This means there is a continuing excess of these two radiation-related

cancers in the population, as there was in the 1980s. *Analysis of 1998-2002 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer,* Dr. Richard Clapp, 2006, *personal communication.*

Prostate cancer and multiple myeloma, both radiation-linked diseases, are also elevated and statistically significant for the years 1998-2002 in the seven towns most likely to be impacted near Pilgrim (Carver, Duxbury, Kingston, Marshfield, Pembroke, Plymouth, and Plympton). *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006).* Occupational Radiation Studies, Chapter 8,, National Academies Press, 2006.Specifically, data from the Massachusetts Cancer Registry indicates 613 cases of prostate cancer vs. 513.5 expected, SIR=119 (95% C.I.=110-129); multiple myeloma: 47 cases vs. 31.7 expected, SIR=148 (95% C.I.=108-198). *Analysis of 1998-2002 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer*, Dr. Richard Clapp, 2006, *personal communication.*

BEIR VII: Health Effects of Low Level Ionizing Radiation

The National Academies Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, the National Research Council, published *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* in 2005. Drawing upon new data in both epidemiologic and experimental research, they concluded that no amount of radiation is safe. There is a linear no threshold response to radiation, and exposure to low levels of radiation is approximately three-times more dangerous than previously thought. *BEIR VII: Health Risks from Exposure to Low Levels of Ionizing Radiation*, Report in Brief, June 2005. Therefore it is not surprising that radiation-linked disease rates are higher than expected in communities exposed to Pilgrim's past releases.

A summary of cancer deaths estimated at NRC's permissible dose release is provided in the BEIR VII Report. The report shows the number of cancer cases and deaths expected to result in 100,000 persons (with an age distribution similar to that of the entire U.S. population) exposed to 100mSv per year over a 70 year lifetime. On average, assuming a sex and age distribution similar to that of the entire U.S. population, the BEIR VII lifetime risk model predicts approximately one individual in 100 persons would be expected to develop cancer (solid cancer or leukemia) and

approximately one in 175 would be expected to die from cancer from a the permissible dose of 100 mSv. Lower doses would produce proportionately lower risks. For example one in 1000 would develop cancer from an exposure to 10 mSv.

This new report validates concerns raised by us and helps explain the radiation-linked disease observed near Pilgrim NPS. When the standards were set by the NRC for permissible release of off-site radiation, low levels of radiation were considered harmless. However, the BEIR VII report now reveals that any exposure is potentially dangerous. Therefore it is not surprising that radiation-linked disease rates are higher than expected in communities exposed to Pilgrim's past radiological releases.

This new information is particularly relevant to the issue of re-licensing Pilgrim because twenty additional years of exposure will harm an already damaged population. Both BEIR VII and previous nuclear worker studies show that the health effects of radiation are cumulative. *Effects of Radiation and Chemical Exposures on Cancer Mortality Among Rocketdyne Workers: A Review of Three Cohort Studies.* Morgenstern, H and Ritz, B., Journal: *Occupational Medicine: State of the Art Reviews*, Vol. 16, No. 2, April-June 2001, pages 219-238. And as shown previously, there is a growing and aging population in the area immediately surrounding the plant. This population has already been harmed by the effects of radiation from Pilgrim and as a result is more susceptible to even permissible levels of off-site radiation. An additional twenty years of operations would put a group that is already damaged at further risk.

Bio-Accumulation of Radionuclides in the Environment from 1972-2032

The effects of radiation exposure are cumulative. Some types of nuclear power plant emissions stay radioactive for a long time and, because they can enter biological food chains, those materials can accumulate in the environment and adversely affect public health. "If radioactive emissions persist for years, decades or even centuries within the environment, then even modest reductions in annual discharges may not be sufficient to prevent an environmental build up of those materials over time." *Estimates of Environmental Accumulations of radioactivity Resulting from Routine Operation of New England Nuclear Power Plants (1973-84),* Dr. Richard W. England,, Mr. Eric Mitchell, p.4, A Report of the Nuclear Emission Research Project, Whittemore School of Business and Economics, University of New Hampshire, Durham, N.H.,

August 1987.

It is known for example that the following radionuclides have been released from Pilgrim into neighboring communities: plutonium 239 (half life 24,400 years); neptunium 236 or 237 (half life ranging from 120,000 years -2.1 million years); cesium 137 (half life 30.2 years); strontium 90 (half life 28.5 years); tritium (half life 12.3 years), and xenon (half life 9.17 hours). Xenon transforms after its emission into cesium 135, which persists almost indefinitely in the environment. Examples of previous releases have been reported in the Annual Radiological Environmental Monitoring Program Reports [REMP].[37] These releases include substances that will remain active in the local environment for the foreseeable future and should be taken into account when actual on-going doses to the public are evaluated.

Pilgrim has operated, and most likely will continue to operate, with defective fuel

Pilgrim began operations in 1972 with defective fuel. The Massachusetts Department of Public Health's Southeastern Massachusetts Health Study 1978-1986 stated, "Pilgrim, which began operations in 1972, had a history of emissions during the 1970s that were above currently acceptable EPA guidelines as a result of a fuel rod problem." *Southeastern Massachusetts Health Study 1978-1986*, Morris M.S., Knorr R.S., Executive Summary, Massachusetts Department of Health (October, 1990).

In the March 2005 and April 2006 Pilgrim SALP (Systematic Assessment of License Performance, performed by the NRC) Reports, NRC Resident Inspector, William Raymond, stated that Pilgrim operated in 2004 and 2005 with defective radioactive fuel – that is, fuel with perforated cladding. We do not have information one way or another whether defective fuel was used in other previous years. Fuel cladding provides the first barrier to prevent radiation from getting out and harming workers

[37] For example, in June 1982, Pilgrim blew its filters and released contaminated resin material off site into surrounding communities. The licensee's own Radiological Environmental Monitoring Program Report for 1982 showed for example: Cesium -137, (1,000,000) times higher than expected in milk tested at the indicator sampling farm 12 miles west of the reactor and no elevation at the control station, 22 miles away; Cesium-137 again (1,000,000) higher in vegetation samples from indicator farms .7 miles and 1.5 miles from the reactor. Plutonium 239/240: Radiological Environmental Reports(REMP) 1998, Plutonium found in indictor samples and Duxbury Beach; REMP 1999, Plutonium found Duxbury Beach; REMP 2000, Plutonium in indicator samples and Duxbury Beach, later excused by stating contamination must have resulted from a dirty beaker; REMP 2001 Plutonium Duxbury Beach; REMP 2003 forward stopped testing for Plutonium on Duxbury Beach.

and the public. Degraded fuel is an on going issue for the industry. NRC Commissioner Merrifield has admitted nearly 1/3 reactors now have failed fuel, and the trend is increasing, not decreasing. *Briefing on Nuclear Fuel Performance,* Transcript, p.4, (February 24, 2005), http://www.nrc.gov.

Use of degraded fuel will increase exposure to both the public and workers. For example, according to the NRC, "a plant operating with 0.125 percent pin-hole fuel cladding defects showed a general five-fold increase in whole-body radiation exposure rates in some areas of the plant when compared to a sister plant with high-integrity fuel (<0.01 percent leaks). Around certain plant systems the degraded fuel may elevate radiation exposure rates even more." United States Nuclear Regulatory Commission, Information Notice No. 87-39, *Control Of Hot Particle Contamination At Nuclear plants*, (August 21, 1987).

Monitoring Radioactive Emissions

We would like to submit that if Applicant, NRC or current MDPH spokespersons dispute a causal link between the radiation released by Pilgrim and the cancers seen in its neighboring towns, the current systems in place to monitor releases are inadequate and must be improved if re-licensing is to be considered. The Comments to the Southeastern Massachusetts Leukemia Study made by Dr. Richard Clapp illustrate this point:

> I would like to reiterate a point that Drs. Knorr and Morris [Massachusetts Department of Public Health epidemiologists, authors of the Southeastern Massachusetts Health Study] made to you in one of their memoranda, e.g., that the emissions data provided by the utility are not reliable. I have had numerous discussions with individuals in the Department of Public health as well as colleagues who previously worked in a job monitoring worker exposure to Pilgrim contractors in the mid-1970's. From these discussions, I am convinced that the actual emissions were considerably worse than what has appeared in public documents and has been available to researchers to date. In particular, there were transuranic isotopes[38]released that should

[38] The transuranic isotope referred to was Neptunium. Neptunium releases were reported orally to Dr. Clapp by Stuart Shalat, who worked for the contractor doing the re-fueling in the 1980s.

never have been emitted to the general environment." Richard C. Clapp, MPH,Sc,D., Statement before the Southeastern Massachusetts health Study Review Committee, (June 26, 1992)

In the years since that statement was made, the quality of the environmental monitoring by Pilgrim has, if anything, decreased. (See following section, VI). The public can not be required to prove a causal link between the radiation released and the statistically significant increase in cancers if there is no effective monitoring system in place to measure those releases nor can the Applicant claim that a causal link does not exist.

As stated previously, the system in place to monitor off-site radiological releases at Pilgrim is inadequate. Although there are documented increases in radiation-linked cancers in the communities around the plant, this aging plant does not use monitors which would allow state or federal authorities to confidently measure radiation releases. Some of the deficiencies of the monitoring system currently used by Pilgrim are described in the following section, as well as needed improvements that need to be made to the Pilgrim environmental monitoring program.

Conclusion:

We have presented new and significant information showing that the off-site radiological consequences of another twenty years of operations by Pilgrim are likely to be greater than previously thought.

Epidemiological studies of cancer rates in the communities around Pilgrim show an increase of radiation-linked disease that can be attributed to past operations of the plant.

The demographics of the population immediately surrounding the plant, including its age and geographical distribution, make this population more susceptible to more radiation-linked damage than was contemplated when the plant was licensed.

If Pilgrim is allowed to continue operations this should only be allowed under the following conditions so that public health would be better protected.

- Reduction of allowable radioactive emissions into our air and water so that the biological impact is no greater than that allowed from the releases from a chemical plant licensed today and limits that are in synch with BEIR VII.
- Verification of releases by radiation and weather monitors – computer linked to state and local authorities – at all points where radiation is released from Pilgrim and at appropriate off-site locations - appropriate sites chosen by meteorological analyses.

VI. Monitoring

Summary: The ER must analyze the accuracy and reliability of Pilgrim's monitoring and reporting in order to accurately assess what impact Pilgrim actually has had on the environment and is likely to have in the future.

We contend that in order to have any reasonable assurance that public health and safety will be protected 2012-2032, the following changes in the monitoring program must occur.

1. Environmental monitoring program must be changed as follows:

   - Control stations actually placed outside the area of Pilgrim's influence - outside Emergency Planning Zone [EPZ] communities;
   - Number and type of samples expanded;
   - Split samples provided to an in independent source;
   - analysis and reports performed by an independent laboratory, not one owned by the applicant;
   - Monitoring wells installed to test for groundwater contamination and migration placed onsite, especially along the edge of Cape Cod Bay.

2. Monitoring air emissions modified to include:

   - Off-site releases - upgrade equipment by installing combination weather/ radiation detection and measurement devices, fix-mounted to provide real-time measurements, placed in appropriate locations as determined by a site-specific meteorological study;
   - On-site monitors upgraded.

3. Multidimensional plume dispersion models, Class B Models; and multiple meteorological towers placed in the seven surrounding towns [Carver, Duxbury, Kingston, Pembroke, Plymouth, and Plympton] and on Cape Cod according to site specific meteorological analysis performed, for example, for the Commonwealth by Dr. J.D. Spengler and Dr. Bruce Eagan.

Airborne Monitoring Systems

On-site Monitors; Sage System; Thermoluminescent Dosimeters [TLDs] High School Monitors

A. On-Site Monitors, deficiencies [39]

1. Radiation Monitoring Systems

Radiation detectors are located at exit points from the plant to measure gaseous radioactive effluents. These detectors monitor the gross gamma radiation of gaseous effluents as they pass by. These readings are monitored and recorded in the control room, and when the radiation level approaches release limits, either the effluents can be diverted to another system for further processing, or the power level of the reactor can be reduced in order to reduce the amounts of radioactivity produced. The **radiation detectors are sensitive only to the total amount of radiation impinging on them, they don't differentiate between one isotope and another**, since there are substantial assumptions regarding short half-lives of isotopes entering the systems. One fundamental limitation to measuring gamma radiation levels exiting the plant ventilation systems is that a small perturbation in the total amount of radiation detected, since the decay rate is so much lower compared to short half-life isotopes. **In this way, a leak of long half-life isotope could go undetected by a radiation detector.** The use of chemical and gamma spectrographic analysis is designed to augment the stack radiation monitoring program.

2. Chemical and gamma spectroscopic analysis techniques used to estimate release rates of individual nuclides

Periodic sampling and analysis techniques are employed to determine the relative abundance of various isotopes that are being released. This is very important since the biological action and possible impact is quite different for different isotopes. The way this is carried out is that radioactive effluent is sampled by systems that employ filters and charcoal to draw air through them. After a given period of time, the

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[39] Ellen B. Cargill, R.T., PhD, Survey of Documents Concerning the Operation of Pilgrim Nuclear Power Station, Preliminary Draft, provided to Petitioners by Author.

contents of the filters and charcoal are analyzed by measuring the radioactive decay rate as a function of disintegration energy. Since isotopes decay by emitting radiation of characteristic energies, the amount of a given isotope present in the sample can be estimated by the magnitude of the number of disintegrations at characteristic energies. The uncertainties associated with this method are that in general isotopes emit a spectrum of radiation frequencies, and in a case where there are a large number of unknown isotopes present in the sample, the energy peaks can overlap for different species and **it may not be possible to assay many isotopes with any accuracy.** Another problem that can occur is that the **efficiency of the charcoal absorber is strongly a function of relative humidity,** so in cases of high humidity, the amount of a given isotope present in the charcoal may not at all reflect the concentrations in the sampled effluent. Detectors used to perform these measurements have non-uniform responses to different energy peaks, and calibration of these sensitive instruments should be conducted frequently. Finally, the raw measurements from these instruments are entered into equations to estimate actual release rates, so the associated uncertainties may be quite high.

3. The Direct Torus Vent System (DTVS) was installed because it was recognized that there was something like a 90% probability of that containment failing. In order to protect the Mark I containment from a total rupture it was determined necessary to vent any high pressure buildup. The DTVS does not have a filter; therefore unfiltered material will be vented into the neighborhoods. The DTVS provides reason to add additional monitoring to better assess what was released after its use.

B. Existing Off-Site Monitors, Deficiencies - Sage, TLD's, High Schools

Off-site monitors to measure airborne emission of radionuclides from Pilgrim include: the Sage System consisting of 14 real-time monitors installed on the edge of Pilgrim's property; thermoluminescent docimeters (TLD's) placed in locations 0 to >15 km from Pilgrim; real-time monitors placed in a few schools for the sole purpose of educating students.

1. Sage System [Computerized "Ring" Monitors] – Deficiencies
   - The Sage System does not provide any significant protection to the citizens of Southeastern Massachusetts. The "NRC Draft Report For Comment On Findings On Issues Of Offsite Emergency preparedness For the Pilgrim Nuclear Power Station [NUREG-1438], issued May 1991, expressly noted that MDPH

installed this system, "even though fixed offsite monitors are no longer endorsed by the NRC..."[page 2-159].

- Under the agreement with Boston Edison Company [BECO], the previous licensee, the monitors were installed less than a quarter of a mile from the plant. Yet, the NRC has found that monitors closer than 1000 meters [about 2/3 of a mile] would provably provide inaccurate readings in the event of an accident.
- The agreement included 22 potential monitoring sites, but only 14 have been installed. Again this is contrary to NRC research on real time monitoring, which concluded that using as few as 14 monitors would grossly underestimate the radiation from narrow emission plumes.
- The monitors are only in a small quadrant behind the plant. Therefore, there is no effective monitoring in the directions of Scituate, Marshfield, Duxbury, Kingston, or much of Plymouth [including the Gurnet, Saquish neck at the end of Duxbury r Beach.
- There are no monitors on Cape Cod. The Cape is across open water -- nothing to break up a plume.
- The placement of the Sage monitors effectively ignores the results of wind analysis done by the Harvard School of Public health, under the direction of Dr. J.D. Spengler and Dr. G.J. Keeler, May 12, 1988 that described the variability of coastal winds and that the sea breeze effect brought winds inland > 10 miles. Also a true ring of monitors is feasible. At Seabrook NPS, the Citizens Monitoring Network is installing monitors on buoys at sea.
- The Sage monitors do not measure high and low let alpha and beta radiation.
- The Sage System also seems subject to the critical deficiencies outlined by Alfred Schmidt in his attached comments to EPA, March 31, 1992. For example, he states "Many of the off-site air sampling systems are ...deficient because they are housed in virtually closed metal shelters which seriously restrict the flow of particle laden air to the collection filters." Schmidt's report is attached at the end of the Monitoring Exhibit.
- The Sage System lacks software to make sense out of the computer data arriving at Massachusetts Department of Public Health [MDPH]. The data has not been systematically graphed, charted or reported to the public.

2. TLD's - Thermoluminescent dosimeters placed in offsite locations ranging from 1 km (.6 miles) to > 15 km (9.3 miles) to measure gamma radiation levels. These devices are passive in as much as they must be in place for a period of time [3 months] and then brought back to the laboratory to determine the amount of radiation the device received at that location for that period of time.

Pilgrim Radiological Monitoring Program Report, 2004
Off-site TLDs – location and number

Zone	Distance	Number
1	0-3 km (0- 1.8 miles)	45
2	3-8 km (1.8 -4.9 miles)	21
3	8-15 km(4.9 – 9.3 miles)	10
4	> 15 km (9.3 miles)	7

Deficiencies TLD's

- TLD's provide only an average figure, and increases of potential significance can be masked by lower than average readings during other parts of the month. Biological impact occurs on a daily basis.
- TLD's can only read to a maximum threshold, that is, like a film badge they can only read so high.
- TLD's do not read high or low let alpha and beta.
- Dr. Hoffman, at Penn State, did an analysis of TLD's and concluded they provided poor sensitivity to Zenon 133. He said it took about 85 hours at maximum concentration before anything showed up and that even then the amount was underestimated by a factor of around 20.

3. High School Monitoring Project - This system consists of radiological and meteorological monitoring systems at each of seven high schools [3 in Plymouth; 1 each in Carver, Kingston, Duxbury and Marshfield]. These on-line monitoring stations are connected by modem to each other and to MDPH.

Deficiencies:

- This program was initiated by the Governor's Council on Radiation Protection solely as a teaching device for the students, not as a monitoring device to protect public health and safety. They recognized that this important job could not be left to a changing collection of teachers, students or janitors, working part-time and not trained technicians.
- It is overly optimistic to assume that the schools are all coincidentally placed in the most favorable locations in regard to population density and meteorological conditions.
- The High School monitors, like the Sage, have poor sensitivity to low energy gamma and beta. To be protective of public health they should measure gamma, beta and alpha radiation, at both the high and low energy levels. For example Iodine-125 is at the 60 KeV and most iodine's are less than 100 KeV.
- Calibration and testing of equipment is not adequately and consistently performed.

Environmental Monitoring

PILGRIM NUCLEAR POWER STATION Radiological Environmental Monitoring Program Reports (REMP).

The Radiological Environmental Monitoring Program reports can not be relied upon to produce accurate data. The Applicant collects the samples to determine Pilgrim's radiological impact on the general public. The "control stations" are too close to the reactor; in actuality, they are indicator stations. Fewer sample media and numbers now are taken than before; fewer are required. Since July 2002, the Applicant's own laboratory analyzes the samples for radioactivity. Reports for the NRC and public are prepared by the Applicant, Entergy. Finally high deposition of radiation found is attributed by Entergy to sources other than Pilgrim.

A. Sampling –obtained by applicant; control stations located too close to Pilgrim

Sampling and Analysis: The **environmental** sampling media collected in the vicinity of PNPS and at distant locations included air particulate filters, charcoal cartridges, seawater, shellfish, Irish moss, American lobster, fishes, sediment, milk, cranberries, vegetation, and animal forage." [40]

The sampling locations are divided into two classes, indicator and control. Indicator locations are those that are expected to show effects from Pilgrim operations. The REMP states that while the indicator locations are typically within a few kilometers of the plant, the control stations should be located so as to be outside the influence of Pilgrim Station. However, many control stations are too close to Pilgrim - within sight of the reactor and within the official Emergency Planning Zone Communities, [10 miles or 16 kilometers]. In reality they are indicator stations. If radiation is above expected in a sample collected from a "control station" it is attributed to weapons fallout, not Pilgrim. Also the location of the "control stations" ignores the fact that radioactive particulates released to the air from the stack, will be carried by the wind some distance and deposited some distance from the reactor site –in the control locations.

Locations of control stations- Pilgrim NPS:[41]

Description	**Distance/Location**
Surface Water	
Powder Point Control	13 km NNW (8.07 miles)
Irish Moss	
Brant Rock Control	18 km NNW (11.2 miles)

[40] Ibid

[41] Entergy, Terrestrial and Aquatic Sampling Locations, Pilgrim Nuclear Power Station, Radiological Monitoring Program, Report No. 32, January 1 through December 31, 1999, Figure 2.2-5, page 64

Shellfish	
Duxbury Bay Control	13 km NNW (8.07 miles)
Powder Point Control	13 km NNW (8.07 miles)
Green Harbor Control	16 km NNW (9.9 miles)
Lobster	
Duxbury Bay Control	11 km NNW (6.8 miles)
Fishes	
Jones River Control	13 km WNW (8.07 miles)
Sediment	
Duxbury Bay Control	14 km NNW (8.7 miles)
Green Harbor Control	18 km NNW (11.2 miles)

Less is sampled now than before

Milk, a key indicator, is no longer sampled. Prior to 2000, milk samples were obtained from an indicator station, Plymouth County Farm, and from a control station located in Whitman. Plymouth County Farm stopped milking cows and since that time Entergy has claimed that they could not identify any additional milk animals within 5 kilometers [3.1 miles] of Pilgrim. Petitioners contend that milk samples > 5 kilometers could be indicator stations. Additionally there are farms nearby. Plimouth Plantation is about 3 and ½ miles from Pilgrim and has a farm with lactating cows and goats. The oldest operating dairy farm in the Northeast is located in Duxbury. Entergy's claim that Plimoth Plantation can not provide sufficient milk has not been proven. Exactly how much is required, at minimum, for each test? We request thid information to verify with independent laboratories.

Other sampling media have also been discontinued.

In regard to terrestrial sampling, routine collection and analysis of soil samples was discontinued; instead they claim that if air sampling showed an early indication of any potential deposition of radioactivity, follow-up soil sampling could be performed on an as-needed basis. However, this assumes that the air monitoring is reliable and accurate.

In the area of marine sampling, the following changes were made.

- A sample of the surface layer of sediment is collected, as opposed to specialized depth-incremental sampling to 30 cm and subdividing cores into 2 cm increments.
- Standard LLD levels of about 150 to 180 pCikg were established for sediment, as opposed to the specialized LLDs of 50 pCi/kg.
- Specialized analysis of sediment for plutonium isotopes was removed.
- Sampling of Irish moss, shellfish, and fish was rescheduled to a semiannual period, as opposed to a specialized quarterly sampling interval.
- Analysis of only the edible portions of shellfish (mussels and clams), as opposed to specialized additional analysis of the shell portions.
- Standard LLD levels of 130 to 260 pCVkg were established for edible portions of shellfish, as opposed to specialized LLDs of 5 pCVkg.

Petitioners contend that what was discontinued has resulted in the loss of important data that is required, "to assess the impact of Pilgrim Station on the environment and on the general public." And what was discontinued appears to be connected to elevations of radioisotopes in the environment found in previous years. For example:

Plutonium on Duxbury Beach:

Plutonium historically have been found in Duxbury Bay sediment samples[42]; Entergy has attributed the Plutonium to either weapons testing, cross-contamination from their lab's glassware or simply lost the sample.

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42 REMP Report, **1998:** Sediment Radioactivity Analyses, Plutonium 239/240 was detected in four of the indicator station samples, as well as in the control station samples; REMP Report, **1999:** 2.17 Sediment Radioactivity Analyses Pu-239/240 in the samples collected from the control locations; REMP Report, **2000:** Plutonium-238 detected in 2 of 4 indicator samples , and both control samples; REMP Report, **2001:** Follow-up investigations conducted by the analytical laboratory that performed the 2000 analyses concluded that the results were invalid due to cross-contamination from laboratory glassware. This laboratory also analyzes samples for Department of Energy clean- up projects. Due to the expense of the specialized glassware, it is re-used. Plutonium in indicator samples; REMP Report, **2002:** Although records indicate that the samples were collected and delivered to the analytical laboratory in June, analyses were not performed and the samples could not be located... Two of the samples from the control location in Duxbury were to be analyzed for plutonium; REMP, 2003

It seems far more likely that the plutonium is from Pilgrim which is visible from Duxbury - rather than from a Chinese bomb launched thousands of miles away. It would be coincidental if the beaker used to test the sample at Entergy's own lab just happened to be improperly cleaned and just happened to be contaminated with Plutonium. It seems coincidental that the next years' plutonium sample happened to get lost. This is one reason Petitioners believe that the Applicant should not be responsible for its own environmental testing – the samples should be sent to an independent lab.

B. Monitoring Wells for groundwater contamination: There are no monitoring wells to test for radioactive contaminated water flowing off-site. The water on-site is not used for drinking; therefore the facility is not required by regulation to have monitoring wells.

However radioactive waste is buried on site and leaks from buried pipes and tanks and from other components can leak into the ground and migrate, as occurred at Braidwood and other sites discussed in Pilgrim Watch's Motion to Intervene. Absent monitoring wells, there is no reasonable assurance that radioactive material will not, or has not, migrated into Cape Cod Bay, Duxbury Bay, Kingston Bay and/or Plymouth Bay. Pilgrim's original Environmental Impact Statement makes it is clear that wells must be placed along the shoreline of Cape Cod Bay;

> Surface topography is such that drainage from the Station is seaward and surface water will not leave the property otherwise. Subsurface water follows the surface topography, resulting in overall movement of water toward the Bay.[43]

Also they should be placed at any other appropriate on-site locations [such as property along and off the Access Road] to protect workers, inadvertent intruders and prevent buried radionuclides from being uncovered and airborne and affecting the neighborhood.

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[43] Boston Edison Company, Pilgrim Nuclear Power Station Docket No. 50-293, May 1972, United States Atomic Energy Commission Division of Radiological and Environmental Protection, page.11

C. Analysis of Samples - self analysis: Beginning in July 2002 Pilgrim began to use Entergy's J.A. Fitzpatrick Environmental Laboratory for analysis of environmental samples. Petitioners contend, and are prepared to demonstrate to the ASLB, that results can vary considerably depending on who analyzes the data and reports the findings. A clear conflict of interest is present when the applicant's own company both analyzes the data and reports the results.

D. Attributing elevated readings to other causes: If radioactivity is discovered that could be attributed to Pilgrim, the response is to attribute the contamination to other sources and/or request NRC to change the monitoring requirements.

Example, Milk: Milk historically showed elevated levels of contamination. However as mentioned above milk is no longer tested, although lactating animals are available in the area at Plimoth Plantation approximately less than 5 miles away and at a dairy farm in Duxbury, within the Emergency Planning Zone.

Previously milk was tested in farms near Pilgrim and at a control station in Whitman, 22 miles away. The Radiological Environmental Monitoring Program Report (REMP) for 1980 noted that, at the farms around Pilgrim, "the measured average concentration of both Cesium-137 and Sr-90 were respectively 10,000 and 1,000,000 times in excess of the concentrations expected to be present..." and went on to say that this "is unquestionably due to atmosphere testing." The effort to blame the increase on "atmosphere fallout" ignores a critical fact – no similar increase was experienced at the control station in Whitman.

The 1982 REMP report stated that the highest mean value occurred at the Kings Residence, located < 5 miles from Pilgrim, in late June 1982. There were concentrations greater than 1,000,000 times in excess of the concentration expected. The report, written by Tom Sowden [who continues to work in this area at PNPS] stated,

> It is not uncommon to find marked increase of Cs-137 associated with the cow's pregnancy, and this was most likely the cause. [44]

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[44] REMP 1982, p. 3-69.

However the large animal expert at Tufts Veterinarian School was of a different opinion. He stated that,

> Cows normally do not lactate during pregnancy. And, an animal can not produce Cs-137 on their own. It (Cs-137) must be introduced into the cows system from an environmental source. The cow would have to ingest it in some way."

Meteorological Monitoring

Recommendation:
Multidimensional plume dispersion models, Class B Models; and multiple meteorological towers placed in the seven surrounding towns impacted by the sea breeze effect that were identified by Dr. J.D. Spengler[45] [Carver, Duxbury, Kingston, Pembroke, Plymouth, Plympton] and towers located appropriately on Cape Cod in consideration of the site specific meteorological analysis of Cape Cod performed for the Commonwealth by Dr. Bruce Eagan.

Rationale:
Realistic modeling assumptions and meteorological data are the key to forecasting and implementing appropriate and effective emergency response plans and assessing damage afterwards.

Pilgrim Currently Uses Class A Models and Onsite Meteorological Tower

Currently, Pilgrim uses Class A plume transport models and relies on weather information from their onsite meteorological tower. Neither provides accurate data.

The Class A plume models used incorrectly assumes a steady-state, straight-line plume transport; although actual wind and weather conditions are variable and complex affected by sea and lake breezes, terrain, location/clustering of buildings, and variable precipitation.

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[45] Dr. J.D. Spengler and Dr. G.J. Keeler, Feasibility of Exposure Assessment for The Pilgrim Nuclear Power Plant, May 12, 1988

Pilgrim should use complex Class B models now and from 2012-2032 if the license is extended.

The on-site Met Tower only tells us what the wind direction is on site but not what happens to the plume as it travels offsite. Therefore Pilgrim should use data from multiple weather stations now and from 2012-2032, if the license is extended.

NRC and EPA Guidance Support Multidimensional Modeling and Multiple Weather Stations

Federal Guidance dating back to the 1970's supports the need for Class B models and multiple meteorological towers properly placed throughout this area.

1) Since the 1970s, the NRC has historically documented all of these advanced modeling technique concepts and potential need for multiple meteorological towers especially in coastal site regions. [46]
2) In January 1983 NRC Guidance suggested that changes in on-site meteorological monitoring systems would be warranted if they have not provided a reliable indication of monitoring conditions that are representative within the 10-mile plume exposure EPZ.[47]

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[46] Excerpts from NRC Regulatory Guide 1.23 (Safety Guide 23) Onsite Meteorological Programs, 1972 "The number of locations on a site at which meteorological measurements are necessary will depend largely on the complexity of the terrain in the vicinity of the site. For example, the study of a hill-valley complex, or a site near a large body of water would require a larger number of measuring points to determine airflow patterns and spatial variations of atmospheric stability." ....Section 7. "Special Considerations" states that "at some sites, due to complex flow patterns in non-uniform terrain, additional wind and temperature instrumentation and more comprehensive programs may be necessary. Also, measurements of precipitation and/or solar radiation may be desirable at some locations. Occasionally the unique diffusion characteristics of a particular site may warrant use of special meteorological instrumentation and/or studies. Proposed studies of this nature should be described in the application for a construction permit."

[47] NUREG-0737, Supplement 1 "Clarification of TMI Action Plan Requirements," January 1983 Regulatory Guide 1.97- Application to Emergency Response Facilities; 6.1 Requirements, b. Control Room, ".....Provide reliable indication of the meteorological variables (wind direction, wind speed, and atmospheric stability) specified in Regulatory Guide 1.97 (Rev. 2) for site meteorology. No changes in existing meteorological monitoring systems are necessary if they have historically provided reliable indication of these variables that are representative of meteorological conditions in the vicinity (up to about 10 miles) of the plant site. Information on meteorological conditions for the region in which the site is located shall be available via

3) EPA's latest Guideline on Air Quality Models (Federal Register November 9, 2005) state in Section 7.2.8 *Inhomogeneous Local Winds* that,

> In many parts of the United States, the ground is neither flat nor is the ground cover (or land use) uniform. These geographical variations can generate local winds and circulations, and modify the prevailing ambient winds and circulations. Geographic effects are most apparent when the ambient winds are light or calm. In general these geographically induced wind circulation effects are named after the source location of the winds, e.g., lake and sea breezes, and mountain and valley winds. In very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characterization of the winds is a balance of various forces, *such that the assumptions of steady-state straight-line transport both in time and space are inappropriate (italics added).*

EPA goes on to say that

> In the special cases described, refined variable trajectory air quality models can be applied on a case-by-case basis for air quality estimates for such complex non-steady-state meteorological conditions.

This EPA Guideline also references an EPA 2000 report, Meteorological Monitoring Guidance for Regulatory Model Applications, EPA-454/R-99-005, February 2000. Section 3.4 of this guidance for Coastal Locations, discusses the need for multiple inland meteorological monitoring sites, with the monitored parameters dictated by the data input needs of particular air quality models.

EPA concludes that a report prepared for NRC provides a detailed discussion of considerations for conducting meteorological measurement programs at coastal sites.[48]

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communication with the National Weather Service. These requirements supersede the clarification of NUREG-0737, Item III.A.2.2."

[48] Raynor, G.S.P. Michael, and S. SethuRaman, 1979, Recommendations for Meteorological Measurement Programs and Atmospheric Diffusion Prediction Methods for Use at Coastal Nuclear Reactor Sites. NUREG/CR-0936. U.S. Nuclear Regulatory Commission, Washington, DC.

Site Specific Meteorological Studies around Pilgrim NPS Commissioned by the Commonwealth of Massachusetts Support Multidimensional Analysis

Site Specific met studies specifically stated that Pilgrim's on-site meteorological monitoring systems do not provide reliable indication of monitoring conditions that are representative within the 10-mile plume exposure EPZ. A summary of (2) studies is below – the full reports are attached.

Dr. J.D. Spengler and Dr. G.J. Keeler, Feasibility of Exposure Assessment for The Pilgrim Nuclear Power Plant, May 12, 1988

Summary

1. The sea breeze phenomena are observed at the Pilgrim site.

A sea breeze is a localized wind that blows from the sea to the land. It is caused by the temperature difference when the sea surface is colder than the adjacent land. Therefore, it usually occurs on relatively calm, sunny, spring and summer days. Depending on topography, intensity of solar heating and pressure gradients, a sea breeze front can penetrate inland from 1(.5 miles) to 15 km (9 miles). It can occur throughout the year but it occurs most frequently during the spring and summer months. On average Pilgrim experiences about 45 sea breeze days during these two seasons.

Typically onshore component commences about 10:00 AM and can persist to about 4 PM. The wind direction changes during the day veering from the north around through the southeast quadrant by late afternoon. The intensity of the sea breeze can be measured by the wind speed and distance of inland penetration. The intensity of the sea breeze circulation depends upon solar radiation (which is influenced by cloud cover), sea water temperature, and strength of the gradient wind flow. The intensity and effective inland penetration of the sea breeze front in the near environment of the Pilgrim site are not well characterized.

2. Coast line orientation and topography strongly influence wind patterns (the frequency, direction, and strength of onshore winds).Predominantly in the summer and spring, a sea breeze onshore component is observed along the Massachusetts coast. The dominant sea breeze components are east and east- southeast for Boston-Logan, easterly for Plymouth, northeast and east-northeast f or the Canal site, and east and east-southeast for the Pilgrim plant. This finding suggests that the wind speed and direction at one coastal site would not be used as a surrogate for other coastal sites.

3. The meteorological sites available provide limited ability to fully characterize or model the sea breeze circulation in the vicinity of the Pilgrim I Nuclear Power Plant.

Physical modeling of coastal sea breeze circulation patterns is limited by both the number of meteorological sites in the vicinity of the Pilgrim Plant and the number of parameters monitored.

William T. Land, Meteorological Analysis of Radiation Releases For the Coastal Areas of the State of Massachusetts for June 3rd to June 20th 1982

A listing of probable causes resulting in radiation concentration within the microclimate would include (in order of importance):

1. ONSHORE WINDS: Winds from the east and north moving radiation back toward the land away from the coast.

2. WIDESPREAD RAINFALL; Rain which could keep radiation in the lower stratosphere and washout radiation into the ecosystems, food chair and water supplies.

3. COOL DESCENDING AIR; Air which would prohibit radiation from lifting into high altitude winds which would in turn carry the contaminants at the 18,000 foot level safely out to sea.

4. AIR POLLUTION: Pollution which would give added nuclei for radiation to adhere to thereby increasing its ability to stay at lower stratospheric levels.

5. FOG: Fog which would give additional hydroscopic nuclei for both pollution and radiation to coalesce upon.

6. AIR STAGNATION: Stagnation with little or no wind, haze and temperature inversions which in turn have the ability to trap radiation close to the surface.

Conclusion

In light of NRC and EPA's Guidance about the use of refined variable trajectory modeling techniques to provide for more realistic, accurate modeling predictions and site specific meteorological studies demonstrating the complexity of weather at this site. Pilgrim should update to Class B models and multiple weather stations.

A straight –line Gaussian model is not applicable here and the applicant should not rely on weather input data simply from that obtained onsite. By relying on the steady-state, straight –line Gaussian model to construct a "key hole" planners are likely to make the wrong call - send citizens into a plume; tell folks to stay put when should evacuate; or tell them to evacuate when should shelter. Class B models must be required if a license extension is granted for 2012-2032. Computerized combination weather-radiation monitors are readily available and also must be required.

Monitoring Attachment

05/18/92 14:02 ☎ CRIT & STAND DIV

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March 31, 1992

Mr. William K. Reilly, Administrator,
U.S. Environmental Protection Agency,
401 M Street, S.W.,
Washington, D.C. 20460

Re: Rulemaking Pursuant to the Rescission of Subpart I of 40 CFR 61 Relating to Commercial Nuclear Power Reactors Licensed by the Nuclear Regulatory Commission

Dear Mr. Reilly,

The purpose of this letter is to provide you with information about some serious deficiencies in the U.S. Nuclear Regulatory Commission's program for limiting emissions from commercial nuclear power reactors, and to ask that there be continued oversight of this program by the U.S. Environmental Protection Agency until these deficiencies are corrected.

My qualifications for writing on this subject include the fact that I am a registered professional engineer; have been working on nuclear air monitoring problems for over 30 years; have written a comprehensive paper on effective stack monitoring that was published in the Proceedings of the 1988 DOE/NRC Nuclear Air Cleaning Conference(1); have lectured on this subject; and currently am a member of the Working Group to update ANSI Standard N13.1 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities".

The deficiencies that I am referring to are not in the NRC's regulations but in its lack of performance requirements and testing requirements to make certain that its regulations are being met. Thus there are no NRC performance requirements or testing requirements for either the stack emission monitoring systems or the offsite air monitoring instruments at commercial nuclear power plants.

The importance of the stack monitoring systems can be judged from the fact that they are relied on to detect any radioactive emissions which get past the nuclear air cleaning equipment, and to alert the plant operators in time to take corrective action. If they do not work properly there can be a sizeable amount of radioactive discharge, leading to expensive cleanup problems, liability lawsuits, and increased public distrust of the U.S. nuclear power program.

An example of such a monitoring system failure occurred at the Muehleberg Nuclear Power Station in Switzerland in 1986(2) when the stack monitoring system, which was similar to those at many U.S. nuclear power plants, failed to detect a sizeable emission of radioactive particles which had gotten past the plant's air cleaning system. Investigation afterwards showed that radioactive particles had entered the isokinetic stack sampling probes and then deposited in the sample transport tubing, so that none reached the sampling filter and radiation detector.

A similar failure occurred at the DOE's Waste Isolation Pilot Plant in New Mexico in about 1987 when a multiple nozzle isokinetic sampling probe, similar

to those at many U.S. nuclear power plants, plugged with salt dust after only one day's service and had to be replaced with a new style probe that was designed to have very low particle deposition losses(3).

Why there have not been more stack monitoring system failures at U.S. nuclear power plants can be explained by the fact that normally the sampling probes operate in extremely clean air. It is only when the high efficiency filters and charcoal beds fail, and monitoring is important, that the deficiencies show up.

The emission measurement deficiencies at nuclear power plants that concern me most are as follows:

1. There are no performance requirements for the stack monitoring systems in terms of emission measurement accuracy and the largest particles that must be detected.
2. There are no testing or certification requirements for the stack monitoring systems.
3. There are no professional or educational requirements for the people who design and install these stack monitoring systems, in spite of the technical difficulties in making them work properly, and their importance to public health and safety.
4. Many nuclear stack monitoring probes are not in compliance with EPA Method 1 (40 CFR 60, Appendix A) which specifies the minimum permissible distances from flow disturbances.
5. Calculations based on the DEPO 1.03 computer program(4) show that the small diameter transport lines and long tubing runs, which are typical of many nuclear stack monitoring systems, will selectively remove most of the larger airborne particles that are sampled and prevent them from being measured.
6. Many of the off-site air sampling instruments for nuclear power stations are equally deficient because they are housed in closed metal shelters which seriously restrict the flow of particle laden air to the collection filters.
7. Most significantly, there appears to be no recognition by anyone at the NRC that these deficiencies exist, and there appears to be no plan to do anything about them.

In view of the situation that I have described in this letter, and its importance to public health and safety, I hope that everyone concerned will understand the need for oversight of the NRC's emission measurement program by the U.S. EPA until these deficiencies are corrected.

Very truly yours,

SCHMIDT INSTRUMENT CO.

Alfred C. Schmidt

Alfred C. Schmidt, MS, PE
Consultant

(For the list of references please turn to the next page.)

VII. Marine Impact

Methods to Assess Impact: Marine impact can not be assessed at present because definite numbers have not been set on what constitutes "significant impact." A yardstick has to be firmly established for each species (plant and animal) with appropriate federal, state and independent partners and rationales provided to the public.

For example:

There appear to be many methods used to determine impact, each with drawbacks. It must be determined before going forward with the re-licensing process what methods provide the most reliable estimates of impact, with a detailed rationale; a requirement that these methods are followed by the licensee unless better methods are established and independently approved.

We understand that no policy statement regarding losses on a square mile basis has been issued by any state or federal agency. NRC must in its review process determine what percent loss is a significant detriment to any population [figure depending on population], with a detailed rationale.

Intake Effects

Entrainment: Winter Flounder – methods used by Entergy to determine impact

1. Equivalent adult method: "researchers conducting this work have assumed an otter trawl efficiency of 50%, but the actual efficiency may be much lower (or higher), which would alter the number of fish in the study area per square mile and the apparent impact. Second, entrainment sampling results are quite variable. Third, it is difficult to determine the accuracy, and therefore, the applicability, of the survival matrix used in estimating equivalent adults."

Whether or not these levels of impact are a "significant" detriment to the population, and will result in slowing the return to much higher population densities, is currently unknown and a policy statement regarding losses on a square mile basis has not been issued by any of the state or federal agencies. EPA Region 1 has stated in the

past that population impacts of 5% or greater are typically of concern. However, to DEP's Gerry Szal's knowledge, the geographic bounds of this particular population have not been agreed upon by state or federal agencies.

2. 2nd method - estimate the percentage of the total larval population passing in front of the facility that is entrained

3. The third method used by the facility to evaluate impact was the RAMAS (Risk Analysis Management Alternative System; Ferson, 1993) winter flounder model. It was used from 1999-2001 to further evaluate the effects of the facility on the Cape Cod Bay winter flounder population. Results suggested that stock reductions from 2.3 to 5.2% might occur as the direct result of entrainment at the facility.

It should be determined and agreed upon by NRC, appropriate state agencies and independent analysts what method or methods actually provide accurate information needed to assess impact.

Impingement: Because impinged fish from the intake screens are shunted back into the intake, there is a concern that these fish, weakened from impingement, will simply be re-impinged. Permitting and resource agencies should consider requiring an assessment of re-impingement rates to select species of concern. These studies should also assess the need to re-locate the discharge point for impinged fish in order to minimize re-impingement.

Discharge Effects

Thermal Discharge: Discharge temperature is now averaged over an hour; instantaneous measurement should be required.

Thermal backwash: In summary, during a thermal backwash, about 155,000 gpm of heated water (>105°F) is sent into the intake embayment for a period of about 1.5-2 hrs. Studies to evaluate potential impacts of the thermal backwash have not been performed to the knowledge of DEP's Gerry Szal.

Winter Flounder & Rainbow Smelt

Winter Flounder: DEP's Gerry Szal recommended that resource agencies, in concert with the permitting agencies, should consider further evaluation of the intake effects

to winter flounder. If effects are found to be substantial, these agencies should determine what steps need to be taken to reduce the impacts of the facility on the winter flounder population.

Rainbow Smelt: "Brad Chase, DMF (pers. comm. to G. Szal, August 29, 2005) estimates that there has been a sharp decline in the rainbow smelt population in the Jones River since the time when the Lawton, et al. (1990), studies were conducted. Unfortunately, without a quantitative evaluation of the rainbow smelt population size in the Jones River, Mr. Chase felt it was not possible to assess the potential impact of Pilgrim's impingement events on the Jones River smelt population." Until studies performed by the state and the Jones River Watershed Association, we should not finalize a re-licensing decision.

Mitigation

Evaluation of the effectiveness of various mitigation strategies needs to be performed with stakeholder input.

Stocking: We understand that Entergy has contracted with a Cape Cod company to provide substitute stock into Cape Cod Bay. However, we understand that these are a different genetic grouping and that they do not breed with the native stocks. If this is the case, then this method does not solve the problem. An analysis of this issue is required.

Wet Land refurbishment or other unrelated environmental measure: These measures are all well and good but do not address the issue at hand.

See following attachment, Marine Attachment Pilgrim Nuclear Power Station: review of intake and discharge effects to finfish - Technical Memorandum For The Record, Gerald M. Szal [Department Environmental Protection, MA.], August 30, 2005.

Attachment – Marine

Technical Memorandum For The Record

By: Gerald M. Szal

Subject: Pilgrim Nuclear Power Station: review of intake and discharge effects to finfish

Date: August 30, 2005

Potential impacts to aquatic life from the operation of the Pilgrim Nuclear Power Station are divided into two categories: those from the intake of cooling water, and those from the discharge of heated effluent. Intake effects are further divided into two categories: those from impingement on intake screens at the entry of the intake bay; and those from entrainment of fish eggs and larvae through the facility. Discharge effects discussed include those from the cooling water discharge and those from the heated backwash used to control biofouling in the intake bays.

Intake Effects

Impingement

Effects to winter flounder:

Impingement effects to this species are typically small at the Pilgrim facility. An estimated total of slightly over 2,000 winter flounder were impinged in year 2004. Most, if not all, of these were young of the year. This is the second highest impingement rate in the past 25 years of monitoring, but does not appear to represent a significant impact to the population.

Effects to other finfish species:

The following fish species were considered those suffering the greatest numerical losses due to impingement over the last 11 years of monitoring at Pilgrim (Environmental Protection Group 2005):

Table 1

Year	Atlantic silverside	Atlantic menhaden	blueback herring	grubby	rainbow smelt	alewife
1994	36,498	58	269	1,094	9,464	123
1995	13,085	1,560	1,244	648	2,191	39,884
1996	16,615	2,168	2,462	1,347	3,728	216
1997	6,303	1,329	424	405	1,978	317
1998	6,773	1,423	134	335	1,656	158
1999	8,577	42,686	550	628	875	610
2000	25,665	34,354	5,919	1,105	13	2,443
2001	4,987	3,599	229	517	879	1,618
2002	4,430	53,304	943	1,087	335	334
2003	23,149	119,041	1,968	237	532	438
2004	13,107	10,431	2,046	2,257	1,092	145

Of particular interest are the **rainbow smelt.** These fish are an anadromous species and smelt impinged at Pilgrim most probably come from the Jones River population. Although there are two other rainbow smelt runs (Town Brook and Eel River) in the Plymouth/Kinston/Duxbury Bay area they are apparently quite small in comparison to that from the Jones River (based on pers. comm., Brad Chase, MA Division of Marine Fisheries [DMF] to Gerald Szal, DEP). Rainbow smelt are not known to reproduce elsewhere in streams entering Cape Cod Bay or in streams elsewhere on Cape Cod.

During the late 1970s, there were a number of rainbow smelt impingement events at the Pilgrim facility. In 1978 an estimated 6,200 rainbow smelt died during a three-week period in December from impingement episodes at the facility. At the time, a group of state, federal, university and facility personnel met regularly to address potential impacts from the facility. Concern was expressed by these biologists that impingement events from Pilgrim could be significantly affecting the Jones River smelt population. This prompted DMF to conduct an intensive, three-year (1978-1981) study (see Lawton, et al., 1990) to develop an estimate of the adult rainbow smelt population size in the Jones River so that an assessment of the plant's effects could be evaluated.

Results of the Lawton, et al., study state that, based on an estimate of egg production, an unbiased sex ratio, and age-specific fecundity, rainbow smelt spawning stock abundance was estimated to be 4,180,000 adults in 1981. The 6,200-fish loss due to impingement was projected to have reduced the Jones River spawning population by less than one percent, and was not considered to have a significant, negative effect on that population.

Based on a recent interview with personnel at the Division of Marine Fisheries, there have been no recent quantitative estimates of the adult rainbow smelt population in the Jones River. However, judging from visual information on both egg density and adult movement, Brad Chase, DMF (pers. comm. to G. Szal, August 29, 2005) estimates that there has been a sharp decline in the rainbow smelt population in the Jones River since the time when the Lawton, et al. (1990), studies were conducted. Unfortunately, without a quantitative evaluation of the rainbow smelt population size in the Jones River, Mr. Chase felt it was not possible to assess the potential impact of Pilgrim's impingement events on the Jones River smelt population.

Entrainment

Effects to winter flounder:

Entrained organisms at power plants are typically subjected to a number of stresses including mechanical stress, stress from pressure drop and stress from rapid heating (delta temperature effects). Winter flounder are the primary species of concern at many facilities along coastal Massachusetts due to their intrinsic economic value and recent population decreases. The Pilgrim Nuclear facility employs several methods of evaluating the impact of the intake on the local winter flounder population adjacent to the facility. The first is the **"equivalent adult" method** in which the estimated number of eggs and larvae entrained (and assumed killed) by the facility are theoretically "grown up" into adults of different age categories based on literature reports on percent survival from one life stage to the next in wild populations. The number of equivalent adults of a particular adult age (e.g., 3-year olds) can be compared with the number of actual adults, of many year classes, found per square mile in areas adjacent to the facility to form an index of impact.

Density of adult winter flounder was assessed primarily in Plymouth/Kingston/Duxbury Bay (PKDB) and adjacent waters, as these areas were thought to be the primary spawning ground that produced the larvae and eggs entrained by the facility. Researchers conducted sampling in this area using a commercial "otter trawl", a device used to capture bottom fish. The number of equivalent adults cropped by the facility divided by the mean number of flounder found per square mile of PKDB and adjacent areas was used to provide a rough idea of the effect of the facility's impacts due to entrainment of winter flounder.

There are a number of difficulties to be overcome if one is to use this approach. First there are issues encountered in sampling both the adult population in the field as well as the egg and larval population entrained. For example, researchers conducting this work have assumed an otter trawl efficiency of 50%, but the actual efficiency may be much lower (or higher), which would alter the number of fish in the study area per square mile and the apparent impact. Second, entrainment sampling results, in addition, are quite variable. Third, it is difficult to determine the accuracy, and therefore, the applicability, of the survival matrix used in estimating equivalent adults.

Three age-specific survival matrices were provided by Entergy Nuclear (Environmental Protection Group 2005). One matrix uses un-staged larval information (i.e., all larvae are considered to be the same age); the other two use survival data from one stage to the next for four different larval life stages. Because staged larval survival data should provide a greater degree of accuracy, un-staged information was not used for this review. Of the two remaining matrices, that provided by Gibson (1993) was chosen to evaluate winter flounder issues in Mt. Hope Bay as it was also used in analyses conducted for the Brayton Point facility in Mt. Hope Bay.

A fourth difficulty in estimating impact is choosing a particular adult age class for equivalent adults entrained. The author assumed (see below) that the number of Age-4 equivalent adults entrained is proper for comparison to the estimate of the number of adults per square mile, all ages, found in the study area. Many winter flounder are fully mature at Age-3, but some are not (pers. comm. Robert Lawton, MADMF to Gerald Szal, MADEP). Age-4 was used because almost all winter flounder

in the Cape-Cod Bay area are mature at Age-4 (pers. comm. R. Lawton to G. Szal). A more accurate estimate of impact could be prepared if a matrix of length-age-survival data were available for the field population.

The following table provides estimates of entrainment impacts at the Pilgrim Nuclear Power Plant facility in Plymouth, MA, on the local winter flounder population. Estimates are based on data in Environmental Protection Group (2005).

Table 2

Year	No. Adult Winter Flounder in study area[1]	No. Adult Winter Flounder per square mile[2]	Estimate age-3 adults entrained[3]	Estimate age-4 adults entrained[4]	Square miles age-4 adults lost to entrainment[5]
1995	212,989	2,063	9,703	5,919	2.9
1996	316,986	3,070	15,401	50,851	3.1
1997	313,959	3,041	47,091	28,726	9.4
1998	264,812	2,565	77,394	47,210	18.4
1999	176,271	1,707	2,383	1,454	0.9
2000	464,176	4,496	4,521	2,758	0.6
2001	400,812	3,882	33,626	20,512	5.3
2002	476,263	4,613	19,703	12,019	2.6
2003	262,604	2,544	2,951	1,800	0.7
2004	157,532	1,526	50,851	31,019	20.3

Footnotes:

1. Adults were those fish that were $\geq$ 280 mm in total length.
2. The size of the study area changed over the course of the evaluations. According to J. Scheffer (Pilgrim) all estimates in this column are corrected to the same study area size. They have been based on the area swept by the otter trawl used to capture winter flounder and a trawl efficiency of 50%. The current (2004) size of the study area is about 103 square miles.

The equivalent adult method of estimating how many adult of age 3-years would have resulted from the eggs and larvae entrained by the facility, based on literature growth and survival data, was used to obtain these figures. Age-3 adult data were taken directly from Pilgrim Report No. 65; literature data used

Effects to other finfish species:

Several species, besides winter flounder, suffer substantial entrainment losses at the Pilgrim facility. These are cunner, mackerel, menhaden and atlantic herring. Numbers of equivalent adults (of different ages) estimated by the facility to have been lost due to entrainment effects on eggs and larvae are listed below:

Table 3: Estimates of the equivalent numbers of adult fish (at age in years in parentheses)entrained by Pilgrim from 1994-2004. Estimates are based on data in Environmental Protection Group (2005); (note: Atlantic herring figures are for entrainment/impingement combined andcould not be separated due to the manner in which they were reported).

Year	Cunner (1)	Mackerel (3)	Menhaden (2)	Atlantic herring (3)
1994	174,726	830	732	10,774
1995	525,573	6,245	2,452	25, 518
1996	313,002	3,526	1,781	6,096
1997	465,986	942	10,531	16,091
1998	1,542,473	1,824	7,564	2,697
1999	332,601	60	4,072	7,518
2000	319,247	1,216	178	8,120
2001	473,361	311	349	2,701
2002	101,668	482	1,382	2,425
2003	82,467	514	1,187	699
2004	188,107	304	50	3,169

Screenwash and Fish-Return System:

Intake screen wash: The cooling water intake bay at Pilgrim has a number of fine-mesh screens within it that are used to keep fish (but not most fish larvae and eggs) from being brought into the facility. Fish impinged upon these screens can suffer negative acute or chronic effects. At Pilgrim, impinged fish are knocked off the screens by a salt-water spray system. Under normal operation, screens are rotated

only once per 8-hour shift. At the end of the shift, the screens are rotated, and the spray system is operated to dislodge fish from the screens. These fish are shunted to a holding tank where they are counted and further shunted to the intake embayment about 100yds upstream of the intake. If the number of fish during one of these 8-hour periods exceeds 160 fish (rate of 20 fish/hour) an "impingement event" is declared. During such an event, the screens are put into constant rotation, and the event is monitored (i.e., fish are counted) until the event is over. The event is reported as soon as possible after it begins and information on species involved, life stages and numbers of fish is related to the permitting authorities and the Massachusetts Division of Marine Fisheries.

Impinged fish are released into the intake embayment, about 100 yards upstream of the intake bay. To the author's knowledge no studies have been done to evaluate re-impingement rates. Although large-scale impingement events (>100,000 fish) have taken place at the facility, most of these have been with young-of-the year.

The pressure-wash spray system has two sets of nozzles. The first to come in contact with impinged fish is a low-pressure wash (20 pounds per square inch [psi] or less) which is used to remove most fish from the intake screens. The second is a high-pressure wash (80-100 psi) which removes any remaining fish and/or debris. Water for the spray wash is drawn from the saltwater service system and is de-chlorinated prior to use. Reasons for chlorinating this system are explained below.

There are five salt service water pumps at Pilgrim, each with a capacity of 2,500 gallons per minute. The salt service water system has two purposes. It is used to supply cooling water to a number of components within the plant, but is also used for emergency cooling. Typically, four pumps are kept running and the other is kept in reserve. Because the salt water service system must constantly be available for emergency cooling, chlorine alone is used to prevent biofouling within the system. Thermal backwashing (see below), a method used to control biofouling in the intake bays, is not allowed by the Federal Nuclear Regulatory Commission within this system because the water in the salt water service system must constantly be kept cool. The target concentration for chlorine within this system is 0.25 mg/L but the system concentration may reach 1.0 mg/L. Water for this system is taken from the intake bay; chlorinated water from this system is released through the 010 discharge

into the primary discharge canal (discharge number 001). Because the 001 discharge is so large (310,000 gpm), the chlorine concentration (after mixing) in the discharge canal due to the 010 release should not reach levels that are above water quality standards.

Discharge Effects

Cooling water discharge:

The Pilgrim Nuclear facility's discharge is located in an open-coastal environment and is well situated for rapid mixing of its heated discharge. Effects of the heated discharge on finfish, benthos and Irish Moss were studied for more than twenty years. Primary impacts include at least two well-documented events of gas-bubble disease in finfish in the 1970s. Since that time, to the author's knowledge, no other major events appear to have taken place. In addition, due to effects on Irish Moss, the facility reimbursed one harvester for losses. Effects of the discharge on the benthic community appear to be primarily limited to scouring. Judging from diver-assisted studies conducted in the late 1990s, it appears that no more than 1-2 acres of the benthic community were negatively affected by the plant's discharge.

Thermal backwash:

About four to five times a year, for a period of about 1.5 to 2 hours, heated water from the downstream end of the steam condensers is re-routed back through the system and out through the intake embayment. This is done to control macro-fouling, primarily from mussels. To accomplish this, the facility shuts down one of the two intake pumps and pushes hot water back through half the system. During this period (about 34-45 minutes) the water within the half of the system receiving the backwash is typically heated to between 105°F and 110°F, but may reach as high as 120°F. The second half of the system is treated in the same manner. Because the facility has to reduce load during these times, which is expensive, the duration and number of backwashes per year is kept to a minimum.

In summary, during a thermal backwash, about 155,000 gpm of heated water (>105°F) is sent into the intake embayment for a period of about 1.5-2 hrs. Studies to evaluate potential impacts of the thermal backwash have not been performed to the knowledge of the author.

Recommendations to minimize impacts from Pilgrim:

1. Resource agencies, in concert with the permitting agencies, should consider further evaluation of the intake effects to winter flounder. If effects are found to be substantial, these agencies should determine what steps need to be taken to reduce the impacts of the facility on the winter flounder population.

2. Because impinged fish from the intake screens are shunted back into the intake, there is a concern that these fish, weakened from impingement, will simply be re-impinged. Permitting and resource agencies should consider requiring an assessment of re-impingement rates to select species of concern. These studies should also assess the need to re-locate the discharge point for impinged fish in order to minimize re-impingement.

Literature Cited

Gibson, M.R. 1993. Population dynamics of winter flounder in Mt. Hope Bay in relation to operations at the Brayton Point electric plant. Rhode Island Division Fish and Wildlife, West Kingston, R.I.

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Lawton, R., P. Brady, C. Sheehan, S. Correia and M. Borgatti. 1990. Final report on spawning sea-run rainbow smelt (*Osmertus mordax)* in the Jones River and impact assessment of Pilgrim Station on the population, 1979-1981. Dept. Fisheries, Wildlife and Environ. Law Enforcement, MA Division of Marine Fisheries, 18 route 6A, Sandwich, MA 02563.

VIII. Low Level Radioactive Waste (LLRW)

Summary: The environmental impacts of so-called "low level" radioactive waste storage, 2012-2032, should be analyzed in a site specific SEIS. Because: there is no guarantee that off site options will exist after June, 2008; Pilgrim's coastal location is not suitable for waste storage - a salt corrosive environment; increased intensity and frequency of storms predicted for the future; topography is such that contaminants that have leaked will migrate/flow towards and perhaps into Cape Cod Bay; the threat of terrorism. All of these factors could work together to increase the probability that stored nuclear wastes could contaminate the environment and endanger public health and safety.

The Licensee's filing discusses Low Level Radioactive Waste in Appendix E, Applicant's Environmental Report Operating Renewal Stage Pilgrim Nuclear Power Station, section, 3.23. The discussion covers a brief overview of what they do with waste now. The application makes one mention of low level radioactive waste which does not bear on the subject- Applicant's Environmental Report 6.4.2 "land required to dispose of spent nuclear fuel and low-level radioactive wastes generated as a result of plant operations." What is not discussed, but needs to be analyzed, is what Entergy plans to do with LLRW from 2012-2032.

LLRW should be looked at on a site specific basis because of new and significant information since Pilgrim's initial license, 1972.

- Pilgrim had off site options in1972 and reasonably expected them to continue. Not so, now. Barnwell S.C. announced that it will close to Massachusetts generators June 20, 2008.
- Massachusetts is not a member of any compact; in order to join Massachusetts would have to agree to be a host community; Massachusetts indicated clearly in the mid 1990's that it would not be a host community.
- Texas may open, no guarantees, and if it does open there is no assurance that non-Texas Compact members will be able to send their waste there and if allowed whether fees would be prohibitive. The Massachusetts Department of Public Health Radiation Control stated, "As a result of the above, on July 1, 2008 Massachusetts generators will have no treatment option other than

decay on site unless Texas opens a new LLRW site for Class B and C wastes. Texas has not decided yet whether non Texas compact members may use their site."

- Terrorism or acts of malice were not considered a threat in 1972. Not so, post 9/11 - nuclear facilities/materials are known to be attractive targets.
- Pilgrim is located on Cape Cod Bay and the property slopes towards the Bay so that any leaking contaminants from waste storage facilities will flow towards and eventually into the Bay. There are no monitoring wells lining the shoreline.
- The undisputed recognition of global warming is new and brings with it increased severity of coastal storms, erosion, and increased sea levels. Hence this must be factored into on-site waste storage options.
- PNPS is located on the coast – a salt corrosive environment on concrete and waste packaging must be analyzed.

Storage of LLRW is important for our community's health and safety because there is nothing low level about the waste. Waste is characterized "high" or "low" depending on where it comes from, how it is generated, not according to its' toxicity and longevity. Our community's health has been compromised by radiation exposure – discussed above.

We deserve to know what the LLRW storage plans are before the application is decided; so that the re-licensing decision does not prejudge any LLRW storage decision.

Data: 2003 MASSACHUSETTS LOW - LEVEL RADIOACTIVE WASTE SURVEY REPORT, Massachusetts Department of Health Radiation Control Program, October 2005

LLRW Pilgrim Shipped Out and Stored On-Site[49]

TABLE 1	
...TRANSFERRED MORE THAN 100.0	
CUBIC FEET OF LLRW IN 2003	
FACILITY NAME	VOLUME IN CUBIC FEET
1. Entergy Nuclear Generating Company	59,089.0

TABLE 2	
... TRANSFERRED MORE THAN 1.000 CURIE OF LLRW IN 2003	
FACILITY NAME	ACTIVITY IN CURIES
2. Entergy Nuclear Generating Company	1,210.000

[49] 2003 MASSACHUSETTS LOW - LEVEL RADIOACTIVE WASTE SURVEY REPORT, Massachusetts Department of Health Radiation Control Program, October 2005

Table 3	
... STORED MORE THAN 100.0 CUBIC FEET OF LLRW IN 2003	
Facility Name	Waste Volume in Cubic Feet In Storage
1. Entergy Nuclear Generating Company	4,178.3

TABLE 4	
...STORED 1.000 CURIE OR MORE OF LLRW IN 2003	
Facility Name	Activity in Curies
1. Entergy Nuclear Generating Co.	4,620.000

Planned Leakage - "Acceptable" Risk

Waste containers and forms will not last as long as some waste remains hazardous. Therefore, we want to know what Entergy's plans are for storing LLRW; monitoring the releases; and what are the "acceptable" public radiation exposures and health risks.

IX. Buried Waste On-Site

The Aging Management Program does not include an analysis of the potential contamination from buried waste on site. We understand that until 1981 so-called low-level radioactive waste was allowed to be buried at reactor sites. We asked the NRC if Pilgrim buried waste on site up until that date and were informed by Cliff Anderson that they did not. However, there have been persistent rumors that waste indeed had been buried on site and we request that this be investigated.

Cliff Anderson, Branch Chief, USNRC, Region I, May 31, 2006 sent to us the following email.

> The licensee for the Pilgrim station did not conduct any burials of radioactive material prior to 1981 in accordance with the former NRC regulation 10 CFR 20.304, which governed such burials at that time. Notwithstanding, the Pilgrim station did conduct an "alternate disposal" under 10 CFR 20.302 (now cited as 10 CFR 20.2002). That disposal option was requested per 10 CFR 20.302 in a letter, dated January 15, 1993, from Boston Edison Company, and consisted of onsite disposal (i.e., burial) of soil that contained residual contamination from several events. (The events are described in licensee event reports (LERs) 77-29, 82-19 and 88-26.) The licensed material covered by the request included 79,000 cubic feet of excavated construction soil that contained a total radionuclide inventory of 0.636 millicuries of cobalt-60 and Cesium-137. The NRC staff approved the request by letter dated May 4, 1993, with the provision that the NRC Safety Evaluation (SE), enclosed with the May 4, 1993 letter, be permanently incorporated in the Offsite Dose Calculation Manual.
>
> The NRC SE concluded the maximum dose from the disposal area would be less than 0.1 millirem/year during the year of disposal; and that doses during subsequent years through the time of site decommissioning would be less than 0.01 mrem/year. The total dose was well within the staff's guideline of 1 millirem per year, and is a small fraction of the 300 millirem received annually by a member of the public from natural background sources of radioactivity.

The location of the LLRW and the burial method are described in the NRC SE enclosed with the May 4, 1993 letter. The NRC found the disposal location acceptable because of its distance from wetlands and Cape Cod Bay, and because any surface runoff would be entirely within the Pilgrim owner controlled area. We are forwarding the NRC SE to you by regular mail (USPS). The results of NRC inspection of this area were described in NRC Integrated Inspection Report 1999-01, which also will be forwarded by USPS mail.

The onsite spill and burial information is maintained in the licensee's 10 CFR50.75(g) file in accordance with regulatory requirements. Such residual contamination is acceptable per the rule and, as noted above, the public dose consequences are negligible in comparison with the dose from natural background radiation.

Pilgrim Watch has not received the NRC SE or the NRC Integrated Inspection Report 1999-01. These documents should be reviewed by the ER and made public. Regarding the material buried referred to by Cliff Anderson we assume that when permission was granted to bury the waste that it was assumed that decommissioning would occur in 2012 and the contamination would be cleaned up; so-called "low-level" waste was indeed low level in its health impact; and the Radiological Environmental Monitoring Program would detect off site contamination at levels of concern. However these assumptions are no longer tenable if the application is approved.

Cliff Anderson ignored the burial onsite of contaminated materials from the 1987-1990 repairs for which we believe there is no official record; these burials are well known. Those burials must be responsibly dealt with - monitored and remediated, not continue to be ignored for an additional 30 years.

Decommissioning, if the application is approved, will not begin until 2032 or later. We assume that the licensee and NRC determined that burying waste on site would not harm the environment based on a definite time frame – a 40 year license. What would happen after 60 years was not considered nor analyzed. It needs to be to provide reasonable assurance that public health and safety will not be negatively

impacted. For example erosion of the top soil will be affected by the passage of time, increasing frequency and severity of coastal storms; and the topography of the site that slants down into Cape Cod Bay. Migration of contaminants underground is currently not monitored. Migration of contaminants from so-called low level waste has happened at other sites - for example, at Barnwell SC, TVA, Hanford and Starmet. Hence there is no reason to believe that the same could not happen here.