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PRM-50-85

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RULEMAKINGS AND  
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September 10, 2007

**PILGRIM WATCH COMMENT IN SUPPORT OF DOCKET NO. PRM-50-85:  
PETITION FOR RULEMAKING REGARDING LOCATION HOST SCHOOLS**

Pilgrim Watch supports the petition for rulemaking filed by Eric Epstein, TMI Alert, Inc.

NRC should require that host Schools, as well as well Reception Centers, are located well outside the expected plume exposure pathway where exposure is expected to be harmful— > 20 miles from the reactor. The purpose of a relocation center is to provide a “safe haven;” and this means that they must be located outside the likely-to-be impacted geographic area where harmful levels of exposure can reasonably be expected to occur as a result of an accident requiring protective actions. Studies show that harmful exposures from an accident requiring evacuation are likely to be in areas beyond 10-miles. Further we know from the National Academies of Sciences BEIR VII that radiation is harmful at lower doses than NRC currently assumes in its consequence models; therefore the determination of what is a “safe” distance must be redefined and then extended.

**1. Emergency Planning Zone (EPZ) 10-Miles – However Impact Much Wider**

A. Why was a 10-mile emergency planning zone established in the first place? It was established for “political/economic reasons” not scientific/public health reasons.

Emergency planning only became a requirement after the TMI accident in 1979. By that date reactors were built and some were located in close proximity to major population centers. The EPZ size was chosen to exclude those larger population centers in planning; and more generally to make locating reactors there seem “acceptable.”

Looking at NRC's list of operating reactors and the population in 1980 where they are located makes the point. Indian Point is 24 miles NW of New York City. Its population in 1980 was 7,071,639. NYC had the densest population in the country. Limerick is 21 miles NW of Philadelphia - the 4<sup>th</sup> largest urban place in 1980. Its population in 1980 was 1,688,210.

B. There is nothing magic about 10-miles.

1) Core Melt Consequence Estimates: For example, back in 1982 the Sandia National Laboratory conservatively calculated reactor accident consequences for US Nuclear Plants - those calculations extended well beyond 10-miles. For example, a core melt at Pilgrim NPS, calculated by the federal government, would result in a 20 mile peak 1<sup>st</sup> year fatal radius; a 65 mile peak 1<sup>st</sup> year injury radius; and 23,000 peak cancer deaths.<sup>1</sup> One would think that the EPZ's would have been readjusted –extended- but that was not the case. Most certainly it makes no sense for Relocation Centers to be closer than the calculated peak 1<sup>st</sup> year fatal radius. Especially in light of the fact that these estimates are conservative because 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 order;
- assumed aggressive medical treatment for all victims of acute radiation exposure in developing numbers for early fatalities;

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<sup>1</sup> Calculation of Reactor Accident Consequences U.S. Nuclear Power Plants (CRAC-2), Sandia National Laboratory, 1982. “Peak” refers to the highest calculated values – it does not mean worst case scenario. This is due to uncertainties in the meteorological modeling acknowledged by Sandia. The model only considered one year's worth of data and does not model for precipitation beyond a 30-mile radius. This is significant because the highest consequences are predicted to occur when a radioactive plume encounters rain over densely populated area. Peak Early Fatalities are deaths that result within the first year. Peak Early Injuries are radiation-induced injuries occurring in the first year that require hospitalization of other medical attention – such as sterility, thyroid nodules, vomiting and cataracts. Peak Cancer Deaths are predicted to occur over a lifetime. However, this is not the case with leukemia which is assumed to have occurred within the first 30 years following the accident.

- 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 the linear dose response and that risks are greater than 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%

2) Spent Fuel Pool Consequence Accidents: Spent Fuel Pool accidents can occur either by human error, equipment malfunctioning or from acts of malice. A core melt can cascade into a spent fuel pool accident because pools are active systems and require systems to function. Spent fuel has no where to go offsite anytime soon so therefore the probability of an accident involving spent fuel must be considered more seriously. Spent fuel disasters resulting from acts of malice must be considered in planning – including locating relocation centers – recognizing that their consequence will be far greater due to the huge amount of radioactivity stored now.

The National Academy of Sciences<sup>2</sup>

“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.”  
NAS, p.4

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<sup>2</sup> Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report, National Academy of Sciences, April 2005

“Terrorists view nuclear power plant facilities as desirable targets because of the large inventories of radionuclides they contain. The committee believes that knowledgeable terrorists might choose to attack spent fuel pools because: (1) at U.S. commercial nuclear power plants, these pools are less well protected structurally than reactor cores; (2) they typically contain inventories of medium – and long-lived radionuclides that are several times greater than those in individual reactor cores.” NAS, p.36

“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, for instance: (1) Attacks with large civilian aircraft; (2) Attacks with high-energy weapon; Attacks with explosive charges.” NAS, p.49

“Finding 3B –... a terrorist attack that partially or completely drained a spent fuel pool could lead to a propagating zirconium cladding fire and the release of large quantities of radioactive materials to the environment. Details are provided in the committee’s classified report.” NAS, p.6

“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 excess cancer estimates ...to between 2,000 and 6,000 cancer deaths” p.45

The likely consequences of a spent fuel pool accident are severe. A consequence analysis of a spent fuel pool fire at Pilgrim Station was done in May 2006 for the Massachusetts Attorney General. It provides a good example.

Estimates of Costs and Latent Cancers Following Releases of Cesium-137 from Pilgrim's Spent-Fuel Pool<sup>3</sup>

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

Further plume models must consider a spent fuel pool fire and how a fire will affect the spread of contamination. Therefore it is again obvious that Relocation Centers must be located > 20 miles from the reactor site.

**2. NRC relies on outdated and inappropriate plume distribution models to justify emergency planning regulation and guidance in general and to the placement of Relocation Centers, the specific topic under review.**

Hazard assessment (a cornerstone in emergency planning) is currently improperly based by the NRC and FEMA on a simplistic and inappropriate plume distribution model – a steady-state, straight line Gaussian plume model. The straight-line Gaussian model was designed for flat terrain and will provide inaccurate estimates of concentrations if the terrain is actually more complex as is the case at most reactors -e.g., reactors located in a river valley, along the coast, in hilly terrain. For those reactors a variable trajectory model should be used. When used the real distance and directions that a plume may travel will be shown to be beyond what is currently assumed and hence the Relocation Centers should be located at a further distance.

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<sup>3</sup> 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.

Meteorological studies continue to be ignored. For example: many reactors are located on a coastline and are subject to the sea breeze effect. At Pilgrim, for example, in the summer months the differential temperature between the land and water draws the sea breeze inland on warm days beyond the 10-mile EPZ boundary line. Likewise releases from Pilgrim, for example, headed out to sea will remain tightly concentrated due to reduced turbulence over water until the winds blow the puffs back over land.<sup>4</sup> This can lead to hot spots of radioactivity in unexpected places. Dismissing radioactivity blowing out to sea is inappropriate. The program CALPUFF has the capability to account for reduced turbulence over ocean water and should be used.<sup>5</sup> Reduced turbulence over the ocean has implications for transport to Boston, towns in between but well outside the 10-mile EPZ, and to communities on Cape Cod, 20-25 miles from the reactor – a fact currently ignored.

Therefore placing Relocation Centers at reactors subject to these meteorological conditions close to the current EPZ would make no public health sense; and not having Relocation Centers for the population outside the current 10-miles EPZ makes no sense, either.

**3. NUREG-0654, J-12 states that,** “Each organization shall describe the means for registering and monitoring of evacuees at relocation centers in host areas. The personnel and equipment available should be capable of monitoring within a 12 hour period all residents and transients in the plume exposure EPZ arriving at relocation centers.”[Emphasis added]

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<sup>4</sup> Zager M, Tjernstrom M, Angevine W. 2004. New England coastal boundary layer modeling. In: AMS 16<sup>th</sup> Symposium on boundary Layers and Turbulence, August 2004, Portland, Maine. Angevine WM. Tjernstrom M, Senff CJ, White AB. 2004. Coastal Boundary layer Transport of urban pollution in New England In: 16<sup>th</sup> Symposium of boundary layers and turbulence PortLand, Maine, 13<sup>th</sup> Symposium on Turbulence and diffusion, August 2004, Portland, Maine. Angevine WM. Tjernstrom M, Zager M. 2006. Modeling of the Coastal Boundary Layer and Pollutant Transport in New England. J. of Appl Meteorol & Climatol 45: 137-154.

<sup>5</sup> Scire JS, Strimaitis DG, Yamatino RJ. 2000 A User’s Guide for the CALPUFF Dispersion Model (Version 5). Concord MA: Earth Tech, Inc.

Children are the most vulnerable population to radiation exposure, as explained in BEIR VII. NRC should require that pre-school and school children shall be automatically monitored for contamination when evacuated. Instead, emergency plans now state that the children will be transferred to a “host facility” under the pretense of a “precautionary transfer. Host facilities are not equipped with radiation monitors and decontamination capability. Only if it is “determined” by the state that they could be contaminated en route will they be redirected to the Reception Center for monitoring first. There are two problems with this plan. First the direction of the plume is based on the inappropriate steady state, straight- line plume model discussed above and the wind data is taken from monitors on the reactor. Those weather instruments tell what direction the wind is blowing on site but not what happens to it when it travels offsite. Second, the pre-school and school children typically equal or exceed the total population planned for in the Reception Centers which is 20% of the population, one in five. Therefore the Reception Centers have inadequate resources to deal with the children and the actual number of evacuees that actually will arrive in a timely manner. For example, the Reception Center for Duxbury and Marshfield is planed to handle 5,696 – a number that equals 20% of the combined resident and transient population [20% of 28,482 = 5,696.4]. However Duxbury and Marshfield’s school population = 5,654. There are only 4 portal monitors at the Reception Center. How can four portal monitors and the rest of the decontamination equipment and resources that are on hand there service both the school children and the more than 20% of the population that realistically are likely to show up - in a timely manner. Why is 80% of the population left out of these plans? Perhaps this is the real reason why pre-school and school children are sent to Host Schools - skimmed.

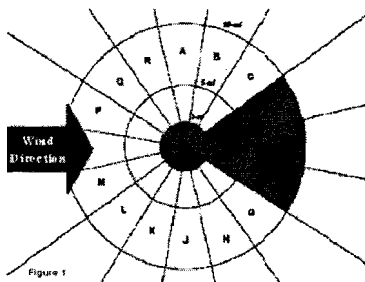
Therefore, NRC should require that Host Schools either have their own monitors and decontamination capability or be located adjacent to the Reception Center so that children automatically will be monitored, if evacuated. And obviously there is no justification for Reception Centers planning only for 20% of the population. Last, there is little sense to monitor and decontaminate citizens in a likely-to-be-contaminated area. Host Schools and Reception Centers must be located > 20 miles from a reactor.

#### 4. Conclusion

Initially a few reactors were located near major cities – making a timely evacuation impossible for those residents; planning too complex; and stockpiling resources to service that number of people exorbitant for the licensee. The solution was “make believe” - require planning only for accidents of minimal consequence and establish a 10 mile EPZ and allow, for example, Host Schools to be located just outside the EPZ.

NRC has minimized the consequences of an accident further now that reactors that were originally located in sparsely populated areas are now in areas that have become densely populated. This makes scarce resources look adequate and justifies allowing the operation of reactors in densely populated areas. The rationale relies on a couple of false myths.

First, planning assumes that radiation will move in a relatively narrow “plume” with a size and shape determined by their straight line model; therefore not everyone within 10 miles of a reactor would have to evacuate. Instead only those in the direction of the narrow radiation plume in the shaded area in the graph below - those in supposedly potentially affected sub-areas of the Emergency Planning Zone - would have to take actions as directed. It is assumed further that only those within a 2 mile ring would have to evacuate; that 50% within the circular portion of the region (2-5 mile ring) would “voluntarily” choose to evacuate; and 35% in annular ring between the circle and the EPZ boundary would “voluntarily” choose to evacuate. The following graph illustrates the model.





However that is not what will happen. Wind is variable; the resident population knows that. Rapid communication - cell phones, computers etc – means that the word of a general emergency will spread quickly. It is absurd to think that those in the supposed up-wind direction will stay put while those downwind are directed to evacuate. Shadow evacuation is a well established phenomenon. Because planning is not based on reality, plans and emergency resources are inadequate and more severe consequences will result.

Second planning is further reduced by another false assumption - that a severe accident is only a minor off-site release, diluting rapidly as distance increases from the site. We appreciate that reactors are not required to estimate for “worst case” but neither should they be allowed to estimate simply for the “best case,” as is the case today.

Therefore by minimizing a severe accident, NRC allows plans to assume only a small portion of the EPZ need to be planned for and that Reception Centers and Host facilities can be located relatively close to the EPZ. Although this may look good on paper, appear to meet the needs of the population, it is not what will happen in reality – public health and safety are placed at an increased and unnecessary risk.

Lessons learned from Katrina: Brownie really did not do, “a heck of a job.” Without significant updates in NRC’s and FEMA’s emergency planning assumptions, guidance and regulations, we know that NRC will make Brownie look good if anything happens at our nation’s nuclear reactors.

Prepared by,  
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The following organizations support the Petition filed by TMI Alert and the Comments of Pilgrim Watch.



The Alliance for Nuclear Responsibility is a California based organization and is additionally concerned about seismic impacts as they relate to emergency planning. The NRC has refused to consider an earthquake that would cause a radioactive release at a California nuclear power plant or storage facility that also resulted in damage to aging road and bridge infrastructure thereby placing our population and our children at risk. This is also true for an act of terrorism or malice. In light of recent earthquakes in Japan and Peru and the tragic events of 9/11/01, the NRC should reconsider its short-sighted refusal to address simultaneous catastrophic events in its emergency planning requirements.

Sincerely

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Thank-you,

Mary Lampert

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