UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of Docket # 50-293-LR

Entergy Corporation

Pilgrim Nuclear Power Station

License Renewal Application February 1, 2011

PILGRIM WATCH'S REPLY TO ENTERGY'S AND NRC STAFF'S INITIAL STATEMENT OF POSITION ON PILGRIM WATCH CONTENTION

I. INTRODUCTION

In accordance with the Board's September 21, 2010 Order (Confirming Matters Addressed at September 15, 2010, Telephone Conference), Pilgrim Watch files its rebuttal to Entergy's and NRC Staff's prefiled testimony.

On September 23, 2010, the Board Ordered (Order Confirming Matters Addressed at September 15, 2010, (Telephone Conference), hereinafter "September Order") that the hearing now scheduled for March 9, 2011 will be bifurcated to consider two issues.

According to the September Order (pp. 1, 2),

> [T]he primary and threshold issue [is] "*whether the meteorological modeling in the Pilgrim SAMA analysis is adequate and reasonable to satisfy NEPA, and whether accounting for the meteorological patterns/issues of concern to Pilgrim Watch could,*

on its own, credibly alter the Pilgrim SAMA analysis conclusions on which SAMAs are cost-beneficial to implement (hereinafter referred to as "the meteorological modeling issues").

Then, and only "if the Board decides in favor of Intervenors on the primary and threshold issue..., the hearing will proceed to consideration of whether, and the extent to which, additional issues as set forth below will be heard."

On November 23, a majority of the Board found, we believe improperly, "that the mean consequences values issue was not timely raised and therefore the issue will not be entertained by the Board during the evidentiary hearing on Contention 3." (November 23 Order, pp. 1-2) In October 2006, the Board refused to allow as within scope that Entergy's SAMA analysis multiplied mean consequences by a weighted too-low probability to improperly insure that, no matter how large real economic consequences might be, the consequences supposedly balanced against costs in the SAMA analysis would be trivialized. It is widely recognized that probabilistic modeling can underestimate the deaths, injuries, and economic impact likely from a severe accident. By multiplying high consequence values with low probability numbers, the consequence figures appear far less startling.

Mark Twain put it well, "There are lies, damned lies and statistics." The reason this is so is very simple; take an example. Entergy says that "on-shore" sea breezes occur only 12% of the time. But "in and of itself" this 12% cannot change anything; the MACCS2 code averages all 365 days of the year, and the effect of the 12% simply disappears in the average that the code uses to calculate consequences. Similarly, the way in which the code is used effectively eliminates the ability to determine what the consequences could be if the wind is blowing towards denser population centers such as Metropolitan Boston, Providence, Cape Cod, Brockton rather than offshore.

What Entergy should be required to do to determine consequences is to change the way in it uses the code and determine what the consequences would be if an accident occurred during that 12%, or on a day in which the wind is blowing towards a major metropolitan center or densely populated area. But the issues to which the Board has limited the first phase of the hearing to permit, **prohibits** asking this question. Even if PW showed that an accident during a "sea breeze" or "towards Boston" day could cause significant changes in the area that would be contaminated, that would not meet the Board's unrealistic requirement that PW show that there would be a significant difference with no changes at all in the code or the way in which it intentionally masks and eliminates any meteorological differences.

In addition, even if Entergy ran the right analysis using a variable trajectory model etc., the unchanged downstream portions of the code, particularly the use of probabilities and averaging in the Output File, would insure that there would be no significant change in the final result.

In short, and as PW has said before, this proceeding has been reduced to meaninglessness. PW has been barred from making any showing that Entergy and the NRC have used the MACCS2 code to insure that no source term will ever have any significant effect. The question might well be asked: If Entergy had used the MACCS2 code in the way it has to determine the effect of an accident at Chernobyl the day before the accident occurred, what consequences would the code show? The clear answer is that the code would show that the only consequence would be severely limited damage within a 10 mile radius, and all the children's thyroids, reindeer in Lapland and sheep in Wales would be unaffected. That, of course, is what did not happen.[1]

Bottom line what Entergy did in subsequent studies did not prove anything of importance and that what will occur at this hearing is essentially a waste of time.

I am not a meteorological expert, so at my personal expense I asked Dr. Egan to look at Entergy's Initial Statement and expert testimony and confirm what common sense indicated to me was true. He told me that it is.[2]

Simply stated, all that Entergy's pre-filed testimony showed is that Entergy uses the code in such a way as to insure that meteorological differences won't make any difference in the end result. And that is exactly the point, and why requiring PW to show that they would is a fool's errand.

Pilgrim Watch has shown (in our Pre-Field Testimony January 3, 2011 and below) that the meteorological model used by Entergy is deficient. But neither Pilgrim Watch nor anyone else including Drs. Hanna, O'Kula and Ramsdell, regardless of how much time and money Entergy spent, can prove that "meteorological patterns/issues ... could, on its own, credibly alter the

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[1] Dr. Edward Teller, Father of the H-bomb and far from being an alarmist when it comes to the development of atomic energy, wrote in the May 1965, Issue 2 of *Journal **of** Petroleum Technology:* "In principle, nuclear reactors are dangerous. . .The explosion of a nuclear reactor is not likely to be as violent as an explosion of a chemical plant. But a powerful nuclear reactor which has functioned for some time has radioactivity stored in it greatly in excess of that released from a powerful nuclear bomb. . .A gently seeping nuclear reactor can put its radioactive poison under a stable inversion layer and concentrate it onto a few hundred square miles in a truly deadly fashion [Emphasis added].

SAMA's are restricted to 50 miles and Pilgrim's SAMA does not justify additional mitigation measures, just like all of the other SAMAs that have been performed around the country using this NRC approved methodology.

[2] Pilgrim Watch will file a separate Motion requesting that Dr. Bruce Egan's statement presented here be accepted as a late filed Exhibit; we believe that it assists the Board in making a determination on the merits of the issues and therefore merited the expenditure of my money and his time.

Pilgrim SAMA analysis/issues of concern." Commission and Board Majority decisions guaranteed that this exercise has been a colossal waste of everyone's money and time.

Consequently, the public walks away knowing that justice has not been done, and knowing that citizens have been cheated by this process and prevented from getting mitigation measures we deserve to reduce risk.

II. APPLICABLE LEGAL STANDARDS - NEPA

A. As remanded by the Commission in CLI-10-11, and clarified by the Board, a primary threshold issue is whether the meteorological modeling in the Pilgrim SAMA analysis is adequate and reasonable to satisfy NEPA.

Pilgrim Watch's Pre-Filed Testimony (January 3, 2011) at 16 fully demonstrated that the meteorological modeling in Pilgrim's SAMA analysis is inadequate and not reasonable to satisfy NEPA; and that PW's recommended alternate meteorological modeling does not pose any conflict with NEPA's Rule of Reason. Entergy's arguments (Entergy's Initial Statement of Position, January 3, 2011, pgs.2-5) are without merit.

Entergy says (at 3) that "there are two tenets of NEPA law that are germane" (Emphasis added) – that NEPA does not require worst-case scenarios and does not require federal agencies to resolve all uncertainties. The Commission understood that additional tenets are important (CLI-10-22[3]). Entergy's omissions lead us to conclude that Entergy does not dispute those

[3] 2010/08/27-Commission Memorandum and Order (CLI-10-22), pgs., 9-10 says, "requirements are "tempered by a practical rule of reason." An environmental impact statement is not intended to be "a research document." If relevant or necessary meteorological data or modeling methodology prove to be unavailable, unreliable, inapplicable, or simply not adaptable for evaluating the SAMA analysis cost-benefit conclusions, there may be no way to assess, through mathematical or precise model-to-model comparisons, how alternate meteorological models would change the SAMA analysis results. Some assessments may necessarily be qualitative, based simply on expert opinion.

additional tenets; that it knows that the meteorological data or modeling methodology recommended by PW for Pilgrim's SAMA is available, reliable, applicable and adaptable for evaluating the SAMA analysis; and that the shortcomings and uncertainties of Pilgrim's analysis were not fully disclosed.

B. Entergy argues that PW argument for a complex variable model boils down to an assertion that there are better methods available for determining the offsite dose consequences and costs in the SAMA analysis. But because it is subject to NEPA's rule of reason, the pertinent question for a SAMA analysis is not whether they are "plainly better" models or whether the analysis can be further refined, but rather whether the selected methodology is reasonable. Entergy says that no purpose would be served to further refine the SAMA analysis unless it looks *genuinely plausible* that inclusion of an additional factor or use of other assumptions or models may change the cost-benefit conclusions for the SAMA candidates evaluated; but it has never checked any additional factors, or other assumptions or models, to see if this is so..

Entergy's argument is seriously flawed on two counts. First PW did not argue that there were "plainly better" methods to determine offsite consequences; instead we correctly stated that Entergy's methods were plainly outdated, inappropriate for Pilgrim's site and significantly flawed. Entergy's choice of methods served to severely underestimate consequences so that offsite costs appeared not to justify mitigations to reduce risk and better protect the health and safety of the public.

Ultimately, NEPA requires the NRC to provide a "reasonable" mitigation alternatives analysis, containing "reasonable" estimates, including, where appropriate, full disclosures of any known shortcomings in available methodology, disclosure of incomplete or unavailable information and significant uncertainties, and a reasoned evaluation of whether and to what extent these or other considerations credibly could or would alter the Pilgrim SAMA analysis conclusions on which SAMAs are cost-beneficial to implement."

Second PW, unlike Entergy, fully understands the rule of reason. We are not asking that Entergy "resolve all uncertainties." Instead we point to the fact that NEPA does not allow, or find reasonable, the applicant's decision to use outdated methodologies and assumptions in their analysis. PW's alternative meteorological modeling methods are available, in use by other federal agencies, industries and parties, and are both reliable and applicable to Pilgrim's SAMA cost benefit analyses. And these are Federal agencies whose purpose, just like SAMAs I supposed to be, is to protect public health and safety.

C. Entergy argues that NEPA does not require analysis of worst-case scenarios. PW understands that NEPA does not require "worst case" but that does not mean that Entergy is permitted to use a "fantasy case." A "fantasy case" is in fact what Entergy used for this important licensing decision.

To bolster its argument, Entergy misinterprets the GEIS to support the absurd claim that reactor accidents can be assumed to be "small." The GEIS says,

> SMALL. The *probability weighted consequences* of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. *See* § 51.53(c)(3)(ii)(L). 10 C.F.R. Part 51, Subpart A, Appendix B, Table B-1, Issue 76 (Emphasis added).

The GEIS says not that accident consequences are small, but only after going through the "probability weighted consequences" that <u>they then appear small</u>.

Again, consider if the pertinent data on Chernobyl had been obtained the <u>day before the accident</u> and put into the MACCS2 code; and, as here, the mean average of meteorological and economic consequences were then multiplied by probability in the MACCS2 Output File (as here), it is inevitable that we would see how little damage the following day's accident at Chernobyl caused.

D. Entergy avoids talking about the other tenets of NEPA that the Commission deemed important in CLI-10-12 and Entergy heretofore had brought forward during these proceedings. Entergy had argued that an environmental impact statement is not intended to be "a research document." We agree with that statement. However, the statement is not applicable to the issue at hand.

The plume modeling that PW presents as appropriate for Pilgrim's SAMA analysis, instead of Entergy's decision to use the straight line Gaussian model, is not a technique that requires research. It is, in fact, an established method that is publically available, routinely used, and appropriate for quantifying atmospheric dispersion of contaminants. Although some effort may be required to adapt it for SAMA analyses, this would be very straightforward and research would not be required. If Entergy had spent its effort and money having Drs Hanna and O'Kula to do this, instead of what they were directed to do, there could have been resolution to the dispute.

Appropriate meteorological data or modeling methodology is available[4]. There is no shortage of appropriate meteorological data for a licensing model application. Alternative modeling methods that would use more extensive meteorological data are also available.

[4] Affidavit of Joseph A. Jones and Dr. Nathan Bixler Concerning Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 25, 2007 prepared for NRC Staff response to Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 29, 2007: Paragraph 18. (NEB), "Material fact number 49 states that no other code exists that performs similar analyses for severe accidents at nuclear power plants. There is at least one other code that is similar to MACCS2, and that code is COSYMA (and) [t]here are other codes for computing

Entergy and their experts chose to use only one year of onsite data. Dr. Hanna demonstrated that meteorological data is also available from nearby airports and, importantly, that processed data on a gridded basis can be obtained from NOAA to augment the onsite meteorological data relied upon for the SAMA analyses that have been provided by Entergy. PW also showed this by including the Thorpe site-specific meteorological study that used available meteorological data from multiple stations. Also there are several publically available meteorological modeling methods that can simulate variable trajectory transport and dispersion phenomena. MM5 is one which is routinely used nationally and internationally. There are other options as well. The present state of art of an appropriate meteorological model would use multi station meteorological measurement data as input to the meteorological model. The numerical computations, based upon numerical weather prediction techniques, would compute wind fields appropriate for modeling dispersion over a much larger geographic area than does Entergy's inappropriate single measurement site.

A second reasonableness criterion avoided by Entergy is that the modeling method must be reliable. The outputs from such meteorological models that are used to produce inputs for the dispersion models are well accepted and form the basis for the weather predictions provided by the National Weather Service as well as analyses of air pollution impacts of concern to regulatory agencies. These techniques have been proven to be reliable and acceptable for air quality permitting and policy applications in complex terrain and over large distances, by the US EPA and the US Park Service, as well as internationally. PW argued with sufficient

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consequences." In response to whether these other models would be impractical, as claimed by Entergy, NRC's expert, Dr. Bixler, said paragraph 7: (NEB) "(Entergy's) Material fact number 10 states that it is impracticable to use computer codes that accommodate multi-station data… (In contradicting this assertion, Dr. Bixler says) [s]uch multi-station analyses have been and continue to be performed in support of Final Safety Analysis Report (FSAR) documentation for space launches that involve significant quantities of radioactive materials."

particularity that for complex meteorological situations such as for the Pilgrim, these techniques would be *more* reliable than using the straight line Gaussian model. Drs. Hanna and O'Kula's analyses did not prove otherwise, discussed below.

The third reasonableness criterion avoided by Entergy is that the modeling methods should be applicable to SAMA analyses. The methods PW recommended are applicable because with straightforward modifications to incorporate nuclear radiation decay rates, they can produce the fields of concentration values and deposition rates needed for dosage calculations. Entergy's cannot.

The fourth reasonableness criterion avoided by Entergy is that the modeling methodology be adaptable for evaluating SAMA analysis cost benefit conclusions. There is nothing inherent in variable trajectory models that would prohibit the output concentration and deposition fields from being applied to SAMA analyses.

None of the criteria cited would make it unreasonable to apply alternative models to the Pilgrim's SAMA analyses.

Further there is no basis to the argument that there may be no way to assess through mathematical or precise model to model comparisons, how alternative meteorological models would change the SAMA analysis results. Some assessments may necessarily be qualitative, based simply upon expert opinion. But this argument seems to undercut the very value of the mathematical simulation models Entergy used to assess the impacts of nuclear reactor emissions.

Last, the rationale offered that the use of advanced models would be computationally too expensive and/or burdensome to use are not justified by the actual run times shown in our review of MACCS2 output files. With modern computers, using inappropriate models on the basis of differences of alleged computational costs is indefensible.

Invoking the "practical rule of reason "to the present disagreement about the most appropriate modeling methodology for application to the Pilgrim SAMA analyses is blatantly dismissive of the concept that the present methods are inappropriate and outdated, and that there are indeed alternative modeling methods that would be quite reasonable to use.

III. PILGRIM WATCH'S WITNESSES

Pilgrim Watch Memorandum Regarding SAMA Remand Hearing (December 2, 2010) notified the Board that because of Board and Commission decisions in this proceeding limiting the evidence that will be entertained during the evidentiary hearing on Contention 3, at that hearing Pilgrim Watch will not be able to prove that, as required by the September 23 Order, "*the meteorological patterns/issues of concern to Pilgrim Watch could, <u>on its own</u>, credibly alter the Pilgrim SAMA analysis conclusions on which SAMAs are cost-beneficial to implement.*" (Italics the Board's; underlining Pilgrim Watch's) Therefore, not to waste very limited resources, we said we would rely upon evidence already presented. The testimony of Pilgrim Watch's experts and their CV's are on record.

Recognizing that Mary Lampert (representing Pilgrim Watch pro se) is not an expert in meteorology, she went to the added personal expense of asking our meteorological expert, Dr. Bruce Egan to review Entergy's Initial Statement of Position on Pilgrim Watch Contention 3 and Pilgrim Watch's analysis of Entergy's conclusions.

Dr. Egan says in his attached declaration that he reviewed the recent affidavit testimony jointly authored by Drs. Steven R. Hanna and Kevin R. O'Kula and the affidavit by James V.

Ramsdell. Dr. Egan's declaration responds to some of the issues discussed relating to the SAMA analyses methods used for the relicensing of the Pilgrim Nuclear Power Station.

Pilgrim Watch respectfully requests the Board to accept these comments as part of the record. We believe that they will assist the Board and community in evaluating these important public safety issues.

III. FACTUAL ISSUES – PRINCIPLE DISPUTES

A. METEOROLOGICAL MODELING FOR SAMA, EPA AND EMERGENCY PLANNING ANALYSES-FUNCTION & PURPOSES SAME

Pilgrim Watch argued that the straight-line Gaussian plume was not adequate for Pilgrim's site and SAMA analysis; and that other federal agencies agree that complex plume models should be for used in complex environments, such as at Pilgrim's coastal location. Entergy's experts attempt to justify NRC's approval of Applicant's use of simplistic models by drawing a false distinction between the meteorological model/data required in emergency planning and EPA analyses from what is required for SAMAs. Entergy's experts argue that SAMA analyses are not focused on tracking individual plumes, but rather on the mean or expected consequences over a large domain for a set of 19 postulated accident scenarios (obtained from the Pilgrim PSA) for many different weather sequences occurring over a year and a 50-mile radius.

Dr. Egan responds (Egan 2011 Decl.,1) that there is no justification for this attempted distinction. Neither he nor Pilgrim Watch has confused the purposes of emergency planning with the purposes of SAMA analyses. He says that,

> [T]here seems to be a running theme that because the end use of dispersion modeling for SAMA analyses vs. consequence assessments for emergency response planning is different, one can justify using outdated modeling methodologies that ignore technological improvements for SAMAs. My comments will show that I disagree with this perspective.
>
> Emergency response planning should require the running of accurate and competent models for purposes of identifying evacuation routes, locations of decontamination centers, etc., in order to minimize the potential exposure of residents and workers in the event of an actual accident. Emergency responses in an accident requires a real time alert system showing which evacuation routes, how workers should approach the plant and similar information for use in an actual emergency.
>
> SAMA analyses require an assessment of the potential consequences of various postulated accidents that might happen for anticipated meteorological events.
>
> Each of these applications requires that appropriate meteorological data be used. The meteorology at a site does not vary by application and one should apply the best science that is reasonably available for all these applications. There may be tradeoffs if some analysis methods may be substantially more costly than others, but the application of modeling to SAMA analyses does not appear to be one of them. The issue is not cost for the analyses but rather the confidence that one has that the modeling is done reliably with state of the art technologies.

Further, in regard to issues of model capabilities and applications to SAMA and Emergency response needs, Dr. Egan says (Egan 2011 Decl.,3),

> Dr. Hanna and Mr. Ramsdell seem to acknowledge that recent advances in atmospheric sciences, especially in understanding the complexities of dispersion in the planetary boundary layer have resulted in technical improvements to atmospheric transport simulations. These scientific advances as well as in advances in computational methods have resulted in the remarkable improvements made to the meteorological models that are used operationally to predict future weather. Many

> of these advances have been incorporated into the coding of the newer transport and diffusion models used for environmental assessments required for permitting and safety of power plants and industrial sources. I am sure that these experts would also agree that for emergency planning or for use during actual emergencies, it would be beneficial to use dispersion models that utilize better science to simulate phenomena and to predict the dispersion consequences of individual events in a highly reliable and competent manner. (Emphasis added)

Contrary to Entergy's position, the basic purposes of a SAMA analysis, emergency planning, and EPA analysis are the same.

SAMA Analyses: The basic purpose of the SAMA Analysis, in concept at least, is to protect public health and safety in a postulated *beyond design basis accident* by weighing the cost of added measures to reduce risk against their cost. Protection of public safety is the primary goal, albeit with a price tag affixed.

Emergency Response Planning: (Entergy A17) Entergy and their experts confuse emergency planning done in preparation for an accident with trying to determine the actual damages in the event of an accident. The basic purpose of emergency response planning is to have plans in place ahead of time to protect public health and safety in *beyond design basis accidents* by adding measures (plans, equipment, personnel) to reduce risk (10 CFR 50.47); the basic purpose of a SAMA is to protect the public health and safety by reducing the effects of an accident. Both SAMA analyses and emergency planning require the use of appropriate meteorological dispersion modeling and data to properly characterize where plumes are likely to go in a severe accident and the probable deposition within those areas.

For example, 10 CFR 50.47 requires certain steps in emergency planning such as a requirement to provide adequate emergency facilities and equipment to support the emergency response. In order to provide reasonable assurance that adequate emergency facilities, equipment and personnel (such as available hospitals, reception centers, host facilities, transportation providers, traffic management personnel and equipment, alternate food supply) are provided, it is necessary to properly model site-specific meteorological and population data. For example, absent an understanding of local meteorology, Reception Centers required to monitor and decontaminate the population may be located within an area likely to be impacted. The wind blows the same irrespective of the end use of that data - SAMA or emergency response planning. Emergency planning and SAMA analyses are only as good as the data and models that they are based upon. In both cases if an inappropriate model and data for the specific site are used public health and safety will be placed at unnecessary risk and reasonable assurance not provided.

EPA Analyses: The purpose of EPA Clean Air Act is to protect public health and safety from dangerous exposure to released pollutants. O'Kula explains that "Generally speaking, the required EPA modeling focuses on evaluating worst-case scenarios." Generally speaking is an important qualification so that EPA's modeling is not always focused on evaluating so-called worst-case scenarios.

O'Kula continues saying that, "Codes such as AERMOD and CALPUFF were developed by EPA to provide estimates of maximum ambient air concentrations resulting from stationary sources." But a reactor is a stationary source, and therefore EPA's models fit the bill for a SAMA analysis that seeks to provide estimates of contaminant concentrations from a reactor. It makes no difference if EPA's end-game, to set standards or assure compliance, and NRC's end-game, to weigh mitigation against offsite costs are not the same. The tool or means to reach the end, evaluate pollutant transport and deposition, are the same. It makes no sense for Entergy and NRC to draw the distinction that EPA, DOE and other agencies use complex models that are readily available and tested and NRC still uses yesterday's simplistic tool.

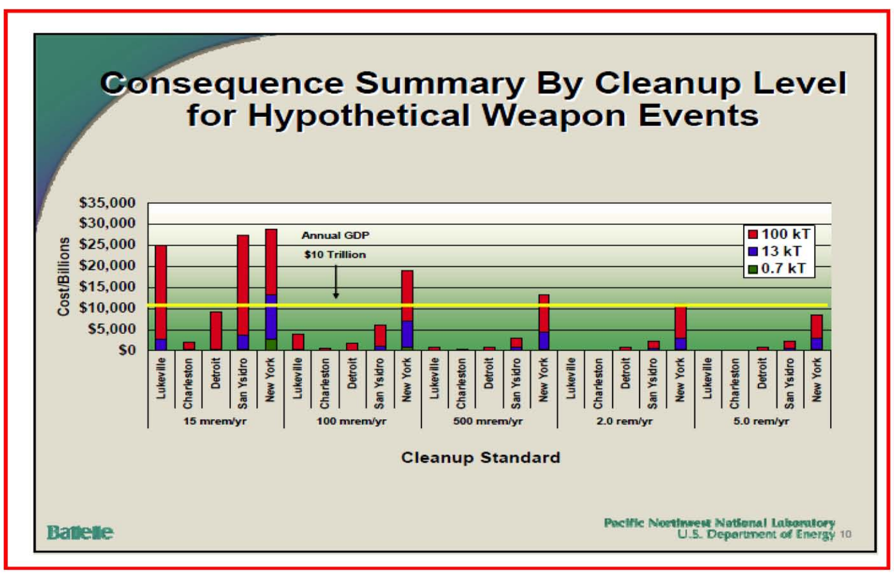
Dr. Egan (2001 Decl., 3) concludes that,

> From a computational point of view, the key difference between the modeling needs of SAMA analyses and applications to emergency response is the fact that, as constructed, the SAMA analyses focus on evaluating only long term average consequences. The short term averages are not needed. For emergency response, the short term predictions are essential. However, the difference between these needs from an air quality modeling computational standpoint essentially reduces to the averaging of the results and how the data is manipulated in post processors. The core elements of the RASCAL model described by Mr. Ramsdell are used to calculate 1 hour values that could be averaged to produce the long term averages needed for a SAMA. With today's computers, the computer time in unlikely to be an issue. We think such advances could improve the reliability and credibility of ATMOS because improvements to the model made to the 1-hour predictions would improve the reliability of the annual average values. (Emphasis added)
>
> An argument is made by Dr. O'Kula that improvements to predicting the annual averages are not necessary, because at the PNPS, one would have to show substantial changes to the projected population doses and the economic consequences to have a another SAMA be cost effective. I note that this is a site specific comment and would not necessarily be applicable to other power plants. At another site, the differences might be much smaller and improvements to the modeling code could change the identification of cost effective SAMAs. The selection of SAMAs should not depend upon the selection of the dispersion model utilized. Improved simulations of transport and dispersion for all time scales would be beneficial to the industry as it would reduce the uncertainty that decision makers have to address.

> The comments that the US EPA 's requirements to address National Ambient Air Quality Standards (NAAQS) with short term averaging times (one hour, 3 hour, 24 hour averages) is the reason that EPA uses more advanced models are not correct. The averaging times for the National Ambient Air Quality Standards (NAAQS) range for one hour to annual averages. The EPA has guidance for selecting the most appropriate dispersion model for use in different applications (40 CFR Part 51 Appendix W. Guideline ion Air quality models). The criteria are based on a combination of appropriate recent science and model validation. With these criteria, there is no issue of different dispersion modeling techniques for modeling short term averages versus long term averages. Three criteria pollutants have annual average standards: SO2, NO2, and particulate matter. <u>The same models used for estimating short averaging time impacts are used for the annual averages.</u> The modeling requirements for demonstrating compliance with the NAAQS for Nitrogen Dioxide are an example. The initial standard set for NO_2 was for annual average concentrations. On the basis of revised findings of health effects, EPA in 2010, set a new standard with a one hour averaging time. <u>The dispersion modeling methods recommended for compliance demonstrations for both the annual averages and the one hourly values did not change.</u> The choice of model does not depend upon the averaging time over which meteorological variations occur. (Emphasis added)

Pilgrim Watch is concerned that Entergy's and NRC's focus on drawing a false distinction between the purposes of SAMA, EPA and emergency planning is really about something else. The apparent stated purpose for a SAMA analysis is to minimize the true offsite economic consequences to protect public health and safety in the event of a severe accident. The unstated purpose is public relations - reduce public opposition to relicensing old reactors and licensing new ones. Like other reactors seeking license extension, Pilgrim now is located in an increasingly urbanized area where the cost of a severe accident realistically and honestly would be huge. Likewise, potential locations for new reactors will be near populated areas because of the constraints posed by transmission capability. Therefore, to counter public opposition, it is in the interest of NRC and industry to artificially minimize consequences by using an outdated consequence code (MACCS2), an unrealistically low source term, averaged meteorology, a simplistic meteorological model (Straight-line Gaussian plume model), and mean values to average consequences multiplied by a low estimated probability, and ignore real cleanup costs in attempt to show that there is no risk to the public that the accident will occur or cause any real damage.

PW's Exhibit 8, a report by Pacific Northwest National laboratory, shows the consequences of a dirty bomb in both densely populated urban areas and an isolated rural area (Lukeville). It makes our point. We know that in reality much more deposition would result from a reactor accident than a dirty bomb, magnifying consequences and costs. Entergy's SAMA analysis is the equivalent of "Duck and Cover;" Pilgrim Watch is simply pointing out that "the Emperor has no clothes."



B. CONSERVATISM- ENTERGY'S SAMA ANALYSIS & SUBSEQUENT ANALYSES WERE NOT CONSERVATIVE

1. Entergy's experts cited two reports (Lewellen and Molenkamp[5]) that, Entergy claimed, showed that the straight-line Gaussian model was conservative in 2007. [Entergy, Motion for Summary Disposition, 12]. Entergy's Initial Statement of Position simply refers to Molenkamp's study. (Entergy, pg 8, A.57, A.58). These reports do not show anything, as NRC well knows, because the studies were performed in locations not comparable to Pilgrim's site. It is an apples and oranges comparison, as the NRC has admitted.

Neither of these studies supports Entergy's contention that the Gaussian plume model produces "conservative" estimates for the PNPS site. The fundamental flaw in Entergy's contention is that a comparison made in the high desert land in Idaho (Lewellen Study) or in Kansas or Oklahoma (Molenkamp study) tells little or nothing about what a comparison made in Plymouth, Massachusetts would show. PNPS' site is characterized by its coastal location, varying terrain, "forested hills interspersed with urban areas" (Appendix E, 2.1). In contrast, the Lewellen and Molenkamp studies were performed in areas that are not in the least comparable to the PNPS site. As a predictor of what might happen at PNPS, Entergy's reports are not "conservative;" they are simply meaningless. Whether the Gaussian plume model is "conservative" relative to the Pilgrim site cannot be determined without running both ATMOS (the Gaussian plume) and an alternative model (e.g. MM5 and CALPUFF) with PNPS site specific data. Entergy avoided doing this.

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[5] WSMS refers to the results from a test that released a tracer conducted in 1981 at the Idaho National lab (INL is located in high desert land, eastern Idaho), Lewellen, 1985, NUREG/CR-4159; Molenkamp et al (2004) compared several codes for recorded data in the Midwest, NUREG/CR-6853]

NRC has admitted that the Molenkamp study site in central Oklahoma and Kansas did not have "topography that would interact with the large-scale flow producing local modification of wind speed and direction" and that it did not have "changes in surface properties that could affect local flow, such as a coastal site with a land-sea breeze" [NUREG/CR 6853, 3]. The Molenkamp sites are "relatively smooth and (have) has minimal effect on the wind field and the surface is fairly uniform and therefore produces relatively little thermal forcing." The NUREG also says that it "would have preferred a site with greater topological and diurnal homogeneity" (NUREG/CR-6853, Oct. 2004, at xi and 2) such as PNPS; and readily admitted that "it would be best if MACCS2 and RASCAL/RATCHET results could be compared with measurements over the long distances and types of terrain of interest to the NRC." The only reason that "the less desirable comparison with a state-of-the art code was chosen to provide input into the decision on the adequacy of MACCS2 ATD was that such measurements do not exist." (Ibid at 2)

Dr. Egan agrees. He said that, (Egan Decl. 2011,7)

> The model comparison study (Molenkamp et al, (2004) referenced by Drs. Hanna and O'Kula in their Reponses to questions 57 and 58 shows only model to model comparisons. The model to model setting and meteorological data used was over simple, flat terrain where, as Dr. Hanna discusses, one expects that models with dispersion rates based upon the Prairie Grass experiment data would produce similar results. Therefore a comparison of model predictions made in the relatively flat area of the "Southern Great Plains (SGP) site in Oklahoma and Kansas" cannot be used to state how model comparisons would fare at a coastal area like Plymouth, MA. The Molenkamp study text itself asserts that "the topography of Oklahoma and Kansas is relatively smooth and has minimal effect on the wind field, and the surface is fairly uniform and therefore produces relatively little local thermal forcing." Sea and land breezes are driven by thermal forcing.

> In the section of this report about the selection of the study site, they state that they were not able to find a site that met one of their criteria: "a site with changes in surface properties that could affect the local flow such as a coastal site with a land-sea breeze."

Whether ATMOS is "conservative" or "comparable" relative to the Pilgrim site cannot be determined without running both ATMOS and an alternative model (e.g. MM5 and CALPUFF) with PNPS site specific data.

2. Entergy's two supplemental sensitivity studies, by ENERCON and WSMS (O'Kula), also were performed in 2007 (their conclusions are referred to in Entergy's Initial Statement) and similarly fail to support Entergy's contention. Dr. O'Kula's WSMS report says it performed "a series of sensitivity studies to evaluate the effects of changes in the input parameters challenged by PW on the results of the SAMA analysis" [Entergy Material Facts, 15-18]. But even though WSMS may have made "wide ranging changes" to such inputs as wind speed and direction, WSMS still used the same flawed inputs to the same flawed MACCS2 code, and used the fundamentally flawed straight-line Gaussian plume equation in which "released material is assumed to travel downwind in a straight line." [NUREG/CR-6853 (October 2004), 3] No matter how many "scenarios" WSMS may have studied using a "downwind in a straight line" assumption, they cannot (as PW's evidence has shown) provide a valid comparison to variable trajectory "scenarios" that WSMS never studied. The same holds true for Enercon; adding on to Entergy's base figure (assuming its limitations) it simply input additional limited economic data into the fundamentally flawed MACCS2 code. The same holds true for Dr. Hanna's report. He, likewise, cannot provide a valid comparison to variable trajectory "scenarios" that he never studied.

3. Entergy and Dr. Hanna forget is that it is not possible to be conservative simultaneously in both the near and far field. For example, Dr. Hanna comments (A70) that, "More importantly for the SAMA analysis, use of the slightly lower wind speed at Pilgrim is conservative because, as discussed in A28 above, concentrations are always approximately inversely proportional to wind speed (that is, if wind speed increases by about 10%, concentrations decrease by about 10%). This ignores the fact that if the wind is strong, the effluent will be carried to a greater distance and in a shorter period of time. Therefore consequences in the far-field will increase due to latent health effects (resulting from lower dose exposure) and cleanup costs will be extended over a larger area. "Conservative" does not mean simply focusing on severe radiation sickness in the very near-field, Entergy's focus, while ignoring latent health effects and cleanup costs in the far-field.

4. NRC Staff's own expert, Dr. Bixler,[6] a Principle Member of the Technical Staff in Sandia National Laboratories, generally agreed with Dr. Egan and admitted that the Gaussian plume model results are "conservative" is correct only if the word "conservative" is defined narrowly:

> 8. (NEB) Material fact number 12 states that the MACCS2 Gaussian plume model results are in good agreement with, and generally more conservative than those obtained by more sophisticated models. *If* the word conservative implies that calculated plumes with the MACCS2 code are generally more focused and more concentrated than would be the case if the calculations had been performed with more sophisticated models, then the statement is accurate. However, a more focused,

[6] Affidavit of Joseph A. Jones and Dr. Nathan Bixler Concerning Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 25, 2007 prepared for NRC Staff response to Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 29, 2007

> more concentrated plume does not always correspond to a smaller number of person rem, *depending on the trajectory of the plume* compared with population centers. (Emphasis added)

In short, NRC Staff's expert is in full accordance with PW's argument that whether a Gaussian model is conservative depends entirely on "*the trajectory of the plume compared with population centers;"* and PW submitted significant evidence that the straight-line Gaussian plume could not, and did not, predict site-specific atmospheric dispersion for Pilgrim's coastal region, or accurately predict what population centers the likely variable plume would affect.

5. Entergy argued that its SAMA analysis was conservative because "coastal breezes are appropriately accounted for in the Pilgrim SAMA analysis." (See Entergy Dir. at A73-A81). Not so. Here, again, Dr. Bixler agrees with PW and Dr Egan, and says that "*the effect of sea breeze is not taken into account"* in Entergy's studies.

> 10. (NEB) Material Fact number 19 states that the effect of sea breeze is taken into account in the Pilgrim site meteorological data. *Although the wind speed and direction of a sea breeze may be included in the actual PNPS meteorological data, the effect of sea breeze is not taken into account.* The effect that is not taken into account is that the *complex flow pattern under sea breeze conditions differs substantially from the straight-line pattern used in the MACCS2 analyses*." (Emphasis added)

Dr. Bixler's statements may be "Inconvenient Truth[s]" but we are not swayed by NRC Staff's qualification that, although Dr. Bixler, a Principle Member of the Technical Staff in Sandia National Laboratories, was earlier put forward as a fully qualified expert to address these issues in testimony Concerning Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 25, 2007, he somehow is not qualified to speak to these issues today.

6. Finally if Pilgrim Watch is allowed to make an Offer of Proof at the March 2011 Hearing, we will demonstrate the plethora of significant ways in which the SAMA analysis was not conservative. For example we will focus on probabilistic modeling, the amount of radioactive release (small size of accident modeled, spent fuel pool releases ignored), use of an outdated MACCS2 computational code), and the severe minimization of cleanup costs, health costs, and other costs.

C. ENTERGY'S SUBSEQUENT ANALYSES DID NOT RESOLVE THE DISPUTE WHETHER ACCOUNTING FOR METEROLOGICAL PATTERNS/ISSUES OF CONCERN TO PW COULD CREDIBLY ALTER THE SAMA ANALYSIS

Entergy's subsequent analyses presented in their Initial Statement did not resolve the dispute whether accounting for meteorological patterns/issues of concern to Pilgrim Watch could credibly alter the SAMA analysis.

As mentioned in the introduction. it is not possible for either Pilgrim Watch, or anyone else, (including Entergy) to show that meteorology, *in and of itself*, would result in a significantly different SAMA analysis

Moreover, the effect a variable plume would have on even a proper SAMA analysis cannot be determined without running a site-appropriate variable plume model to determine exactly where and how large the affected area might be, and, more importantly, how a major radiological accident could affect that area and what, using an updated computer modeling code with proper inputs and statistical computations chosen to not water down consequences, the true resulting costs and damage might be. Entergy's experts failed to do this. PW has been barred from doing so.

Entergy's testimony and supporting exhibits do not show that Pilgrim's SAMA analysis is adequate and reasonable to satisfy NEPA requirements. The basic dispute is not resolved because Entergy did not use a variable model such as CALPUFF in its subsequent studies.

Entergy (at 2) repeats Dr. O'Kula's conclusion that "the population dose risk (PDR) and the off-site economic cost risk (OECR) would need to increase by more than a factor of two before the next severe accident mitigation alternative (SAMA) would become cost beneficial (and) subsequent analyses to "incorporate" Pilgrim Watch's objections to the initial SAMA did not increase by more than a factor of two (2) offsite consequences."

Dr. O'Kula's analysis proved nothing because he used the <u>same models and assumptions</u> that Entergy used in its initial SAMA analysis. Repeating the same mistake over and over with different numbers does not provide proof. The "factor of two" claim would be very different if the proper consequence code, assumptions and source and weather inputs had been used.

Dr. Hanna used CALMET, not CALPUFF. CALMET is not the same as CALPUFF or other variable trajectory models, recommended by PW as appropriate for Pilgrim's SAMA analysis. Dr. Egan explained that in order to show the difference between using a straight-line Gaussian model and a variable model, it was necessary to run both models and compare. Dr. Egan (Egan 2011 Decl.) explained that it was possible and reasonable to do so. Entergy and NRC have the resources to do so, but have chosen not to use them, probably because they fear the likely result.

V. ENTERGY'S EXPERT'S EVIDENCE DID NOT RESOLVE THE DISPUTE WHETHER ACCOUNTING FOR METEROLOGICAL PATTERNS/ISSUES OF CONCERN TO PW COULD CREDIBLY ALTER THE SAMA ANALYSIS

Entergy claims that the testimony of Dr. O'Kula and Dr. Hanna and other supporting exhibits demonstrate that the Pilgrim SAMA analysis is adequate and reasonable. In particular, Entergy says that:

1. The Gaussian Plume Segment model used in the ATMOS module of MACCS2 is adequate and reasonable for performing SAMA analyses. (See Entergy Dir., A.33, A. 48-A50)
2. MACCS2 compares favorably with more complex models. (See Entergy Dir., A.51-A.60)
3. The meteorological data inputs used for the Pilgrim SAMA analysis are both temporally and spatially representative. (See Entergy Dir., A.61-A.72)
4. Coastal Breezes are appropriately accounted for in the Pilgrim SAMA analysis. (See Entergy Dir.,A.73-A.81)
5. "Hot spots" as claimed by Pilgrim Watch are both technically incorrect and immaterial. (See Entergy Dir., A.82-A.89)
6. The CALMET Wind Trajectory Analysis shows that any short-term differences in observed winds across the SAMA domain have negligible effect on the annual frequencies of trajectory directions and on the Pilgrim SAMA consequences. (See Entergy Dir., A.92-A.105)
7. Terrain is conservatively treated for purposes of the Pilgrim SAMA Analysis. (See Entergy Dir., A.106-A,114)
8. Pilgrim Watch's other Contention 3 issues are without merit. (See Entergy Dir., A.115-A.118.)

We disagree. As shown by the following review of these points, the actual facts to not support Entergy's positions.

1. Entergy: The Gaussian Plume Segment model used in the ATMOS module of MACCS2 is adequate and reasonable for performing SAMA analyses. See Entergy Dir. at A33 and A48-A50. We disagree.

a. Entergy (Dir. at A33, A48) says that the Gaussian Plume Segment Model in ATMOS, unlike a standard straight-line Gaussian plume model updates key meteorological variables, other than wind direction, on an hourly basis." [Emphasis added) The key point is that Gaussian plume segment model does not vary wind direction so that the plume is assumed to travel in a straight-line. At Pilgrim's coastal location the winds are variable – they change direction – and this is not captured in Entergy's plume segment model. Models that account for variability, such as CALPUFF are readily available.

b. Dr. Egan's concerns about the plume segment model documentation on which Entergy and Drs. Hanna and O'Kula rely were expressed as follows: (Egan 2011 Decl., 2)

> The responses by Drs Hanna and O'Kula to questions 14 and 33 describe how the ATMOS module within the MACCS2 model simulates transport and dispersion with a "plume segment" algorithm. Their description states that the plume segment model is more than the straight-line Gaussian plume model in that it is "able to account for hour to hour changes in atmospheric stabilities, wind speed, and precipitation during plume travel. Noticeably **absent are hourly changes in wind direction**, a key concern for the PNPS site. It is a straight-line Gaussian model. The associated reference to the plume segment model refers to a section of NRC Regulatory Guide 1.111 entitled "Plume Element Models". The reference to this section is misleading as it has only one equation that is for a "puff" model. No equations are provided for the plume segment model. Reference to the plume segment model is in a following single paragraph that states that the plume segment model uses **spatial and temporal** (emphasis added) variations of wind direction,

wind speed and atmospheric stability to define the transport and diffusion of each element. The next and final paragraph in Regulatory Guide 1.111 essentially states what we have being advocating: "The effectiveness of the meteorological input data in defining atmospheric transport and diffusion conditions is dependent on the representativeness of these data and the complexity of the topography in the site region; therefore a detailed discussion of the applicability of the model and input data should be provided." The plume segment model as has been applied to the PNPS uses temporal but not spatial variations of meteorological conditions. Spatial variations would require the use of simultaneous meteorological data. My understanding is that the application at PNPS did not use multiple station data in this context.

c. The description of the ATMOS model equations in Jow et al[7] (1990) reveals that the transport and diffusions algorithms for a plume segment model are much more complicated than those of the steady state, straight line single plume Gaussian model and the Lagrangian puff model. To conserve or account for mass changes, each plume segment would need to have its virtual source emission location and strength, the segment locations, and the segment, lengths, widths, heights, and contaminant concentrations adjusted at each time step in a manner that assures that mass conservation is maintained within each segment and assure that the distortions to the plume dimensions necessary for each time step do not result in any increases of concentration values. With a steady state Gaussian plume model or with the Gaussian puff model these adjustments would not be necessary. <u>It is not clear from the model descriptions how all these adjustments are made. The lack of documentation therefore calls for a disclosure of computer test results that confirm that the plume segment model conserves mass within each</u>

[7] N Jow, J.L. Sprung, J.A. Rollstin, L.T. Ritchie, D.I. Chanin, "MELCOR Accident Consequence Code System (MACCS), Volume II, Model Description" **...**
http://www.osti.gov/bridge/servlets/purl/10117751-AvVwCk/webviewable/ -

segment and within the plume as whole. A simple set of model runs with a single sequence of time varying meteorological conditions could be used as long as the wind speed, stability, and deposition rates were tested independently for both constant and time varying inputs.

d. Single Year Data: Entergy, at 8, explains that they take a "full year of hourly conditions." PW disputes that one year of data is sufficient. We base our disagreement on the following:

- Revised Chapter 4, *Meteorological Monitoring*, of Guide DOE/EH-0173T (Exhibit 13) says that the joint-frequency distribution and choices of meteorological conditions for the accident analyses should be based on a minimum of 5 years of hourly-averaged data acquired by a meteorological program that meets the objectives and principles of ANSI/ANS-3.11-2000 and EPA-454/R-99-005.
- Spengler and Keeler Report, Page 22, (Exhibit 1) says that, "Seasonal wind distributions can vary greatly from one year to the next."
- NRC's own document, NRC Regulatory Guide 1.194, 2003, *"The NRC staff considers 5 years of hourly observations to be representative of long-term trends at most sites,"* although "with sufficient justification [not presented by Entergy here] of its representativeness, the minimum meteorological data set is one complete year (including all four seasons) of hourly observations."
- Dr. Edwin Lyman, Declaration of Edwin S. Lyman, PHD, Regarding the Mechanics of Computing Mean Consequences in SAMA Analyses (November 22, 2010, pg., 6) said in his Affidavit that, " It is questionable whether a single year's worth of weather data

provides a sufficiently conservative data set for the purposes of SAMA analysis. Some MACCS2 analyses utilize data sets spanning multiple years, which must be averaged in order to be input into the MACCS2 code."

- Dr. Egan (Egan 2011 Decl.,8) commented that EPA generally requires 5 years on data even for annual averages.

e. Entergy's focus on long term averages means, even if more data were used, the relevance of the impact of individual potential accidents would still be entirely lost.

Entergy, at 8, concludes that, "the details of a particular plume's trajectory do not have a material impact on the statistical expected value, or mean, of the overall SAMA analysis because the unique behavior in a wind trajectory for a specific plume will tend to be compensated by the trajectories of other plumes." (Entergy Dir. at A17, A52) The tracking of individual plumes is not required for computing a long-term annual consequence summed over a broad area." (Entergy Dir. at A.48)

The problem with this approach is that taking a mean average of the weather out over 50 miles, means that the site specific effects are totally masked or washed out. The SAMA analysis is required to be a site specific analysis performed for a major licensing decision.

In Entergy's affidavits, Drs. Hanna and O'Kula repeatedly say that SAMA objectives can be met with a model that only produces long term average concentration and deposition of radionuclides. The technology used to obtain these long term averages requires addressing the impact of every hour in the year, but the only numbers that Entergy, Dr. Hanna, or Dr. O'Kula use are the annual averages of all these computations. Lost is valuable information about the statistical ranges of individual predicted events. For example, the 90th or 95th percentiles of the predictions are not available so help interpret the statistical significance of the annual averages. These numbers can be easily produced by post-processing the dispersion model outputs. By limiting the modeling to only 1 year of meteorological data (note that EPA generally requires 5 years of data even for annual averages.), we also have no measure of year to variability of the key number driving the SAMA alternatives.

Because of the focus on long term averages, the relevance of the impact of a potential accident at any particular time or under any particular meteorological conditions is entirely lost.

Dr. Egan agrees. He summarized the problem in his concluding statements:

> As is pointed out in many times in these affidavits, the SAMA objectives can be met with a model that only produces long term average concentration and deposition of radio nuclides. Yet the technology used to obtain these long term averages requires addressing the impact of every hour in the year. The only numbers that matter to the results are the annual averages of all these computations. Lost is valuable information about the statistical ranges of individual predicted events. For example, the 90th or 95th percentiles of the predictions are not available to help interpret the statistical significance of the annual averages. Because of the focus on long term averages, the relevance of the impact of individual potential accidents is entirely lost. These numbers can be easily produced by post processing the dispersion model outputs. By limiting the modeling to only 1 year of meteorological data (we note that EPA generally requires 5 years of data even for annual averages.), one does not have any measure of year to variability of the single annual average which determines the SAMA alternatives.
>
> It is not clear why Entergy relies upon the use of a single year of meteorological data when DOE's own guidance Revised Chapter 4, Meteorological Monitoring, of Guide DOE/EH-0173T calls for retaining meteorological data for a five year period and states that assessments of the frequency distributions for routine accidents should be based on 5 or more years of data. (Egan 2011 Decl., 8)

2. Entergy: MACCS2 compares favorably with more complex models. See Entergy Dir. at A51-A60. We disagree.

a. MACCS2 Code does not compare favorably with more complex models – such as SAND 96-0957.

Entergy justifies the use of the MACCS2 code based on "tradition" – a tradition, unhampered by progress, of using code going back decades. Entergy claims that "MACCS2 based results have been accepted by NRC" (A.51) The NRC may have accepted them, but David Chanin, who wrote the code's FORTRAN and SAND96-0957, disagrees that MACCS2 is the correct computational tool to use for reactor licensing decisions.

> I have spent much time thinking of a way to —jigger the inputs so that the cost model of MACCS2 could be used in a sensible way. As the person who coded it into MACCS and then refined it for MACCS2, and also the person who wrote SAND96-0957, I think what you are attempting is impossible. The economic cost model in MACCS2 was included (at request of sponsors) only for historical reasons to allow comparison of its cost estimates to those of previous studies. It is my firm belief that the MACCS2 cost model is so seriously flawed that even with reevaluation and modification of all its input parameters, its cost results should not be used unless for replicating prior studies." When I was involved with the MACCS2 project (from 1991-1996, and also later in 2000-2001) the NRC had no interest in implementing the cost model of SAND96-0957 into MACCS2. I could have done it without a lot of work, but they weren't interested. (Exhibit 4, August 23, 2006)

Mr. Chanin explained also (Exhibit 00004,"The Development of MACCS2: Lessons Learned," [written for:] *EFCOG Safety Analysis Annual Workshop Proceedings*, Santa Fe, NM, April 29–May 5, 2005) that the MACCS2 code was not held to the QA requirements of NQA-a (American Society of Mechanical Engineering, QA Program Requirements for

Nuclear Facilities, 1994). Rather it was developed using following the less rigorous QA guidelines of ANSI/ANS 10.4. [American Nuclear Standards Institute and American Nuclear Society, *Guidelines for the Verification and Validation of Scientific and Engineering Codes for the Nuclear Industry*, ANSI/ANS 10.4, La Grange Park, IL (1987).

What this means is that all steps of the code development have **not** been documented and tested, and hand calculations have not verified the code's implementation of major transport and exposure pathways for a subset of the radionuclide library.

Mr.Chanin says further that, "If errors are later found in authorization basis calculations, an Unreviewed Safety Question (USQ) could be raised, and continued operation of the facility would then require a demonstration that the facility's safety basis was adequate." (Emphasis added) Mr. Chanin concludes the paper saying that,

> [T]he QA distinctions between an NQA-1 "licensing code" and a "research code" like MACCS2 have been emphasized in light of the fact that MACCS2 calculations are being used to support the Severe Accident Mitigation Alternatives (SAMA) analyses required for the license renewal of commercial nuclear power plants. It seems to me that the code's QA shortcomings and the lack of input justifications are again being ignored.

Mr. Chanin's statements regarding the MACCS2 code make no exception for the ATMOS module that is central to meteorological issues. The Exhibit may be an "Inconvenient Truth" but it is undeniably relevant and within scope.

b. MACCS2 ATMOS Module Does Not Compare Favorably With More Complex Models Designed for Complex Sites, Such As Pilgrim's

(1) There is no basis for Entergy's statement that, at Pilgrim's complex site, the straight-line Gaussian plume model is comparable to variable trajectory models such as AERMOD & CALPUFF. Whether the Gaussian plume model is "comparable" relative to the Pilgrim site cannot be determined without running both ATMOS (the Gaussian plume) and an alternative model (e.g. MM5 and CALPUFF) with PNPS site specific data. (Egan, Teleconference Call, May 4, 2010)

(2) (Egan 2011 Decl.,5) Entergy's experts incorrectly claim that ATMOS, AERMOD and CALPUFF are likely to produce similar results. Dr. Egan disagrees. He says that,

> The statements by Drs. O'Kula and Hanna in response to Question 60 that the three models (ATMOS, AERMOD and CALPUFF) are likely to produce similar results is because the topography of the region modeled were simple, flat terrain, the only setting that the ATMOS model is designed for. I would expect significant differences would be modeled in other topographic settings such as in complex terrain and in coastal settings where terrain elevations, surface parameters and rainfall precipitation rates vary with location. The differences would be even larger if a risk measure such as the 95 percentile values were examined rather than only annual average calculations.

(3) Comparative Studies: Entergy again puts forward the Molenkamp et al. report[8] comparison of the results from the Gaussian plume model used in ATMOS and results from "more complex" models in an effort to show that the results from the straight-line Gaussian model compare favorably with more complex models. Not so.(See Egan 2011 Decl., 7)

[8] Molenkamp et al (2004) compared several codes for recorded data in the Midwest, NUREG/CR-6853

The fundamental flaw in Entergy's contention is that a comparison made in Kansas or Oklahoma tells little or nothing about what a comparison made in Plymouth, Massachusetts would show, and the NRC has agreed that it does not. As shown above, the PNPS site is characterized by its coastal location, varying terrain, "forested hills interspersed with urban areas" (Appendix E, 2.1).

In contrast, the Molenkamp studies were performed in areas that are not in the least comparable to the PNPS site. As a predictor of what might happen at PNPS, Entergy's reports are not "comparable;" they are simply meaningless.

Whether the Gaussian plume model is "conservative" or "comparable" relative to the Pilgrim site cannot be determined without running both ATMOS (the Gaussian plume) and an alternative model (e.g. MM5 and CALPUFF) with PNPS site specific data.

The NRC itself said that the Molenkamp study site in central Oklahoma and Kansas did not have "topography that would interact with the large-scale flow producing local modification of wind speed and direction," that it did not have "changes in surface properties that could affect local flow, such as a coastal site with a land-sea breeze" [NUREG/CR 6853, 3], that the Molenkamp sites are "relatively smooth and (have) has minimal effect on the wind field and the surface is fairly uniform and therefore produces relatively little thermal forcing," and that it "would have preferred a site with greater topological and diurnal homogeneity" (NUREG/CR-6853, Oct. 2004, at xi and 2. The NUREG and readily admitted that "it would be best if MACCS2 and RASCAL/RATCHET results could be compared with measurements over the long distances and types of terrain of interest to the NRC;" And that the only reason that "the less desirable comparison with a state-of-the art code was chosen to provide input into the decision on the adequacy of MACCS2 ATD was that such measurements do not exist." (Ibid at 2)

Dr. Egan expresses real concern regarding the validation of ATMOS. He says (Egan 2011 Decl., 7) that:

> The validation history of ATMOS with real observational measurements is very weak. Over the past decades there have been well documented field experiments and data from ambient monitoring networks in a variety of terrain settings that could provide data suitable to be used to produce model performance statistics for ATMOS as used in MACCS2. A validation effort that compared model predictions to observational data for a source at a coastal site and for both short and long distances would be most appropriate for the PNPS.
>
> The US EPA has uses field studies and routine monitoring data to evaluate and improve dispersion models. , Numerous studies have shown that flat terrain type models cannot be relied upon to provide competent predictions when applied to complex terrain settings. Not all models are the same in how they handle plume trajectories and atmospheric dispersion rates do vary by terrain setting and surface conditions.

(4). Entergy misrepresents the intended purpose or use of CALPUFF and AERMOD models recommended by PW. It says that these models "were not designed to perform SAMA analysis but to better predict individual plume behavior in order to meet specific regulatory requirements of the Clean Air Act, typically determining maximum allowable concentrations at any location, which differ from the objectives of a SAMA analysis" (Emphasis added)

Earth Tech, the developers of the CALPUFF modeling system do not restrict the use of CALPUFF as Entergy attempts to do.[9] For example, the developer says very clearly that the model is appropriate for "long range transport of pollutants… and for certain near-field applications involving complex meteorological conditions." The examples the developer provides of applications for which CALPUFF may be suitable show a fit for Pilgrim's SAMA analysis.

> CALPUFF is an advanced non-steady-state meteorological and air quality modeling system developed by ASG scientists. It is maintained by the model developers and distributed by TRC. The model has been adopted by the U.S. Environmental Protection Agency (U.S. EPA) in its Guideline on Air Quality Models as the preferred model for assessing long range transport of pollutants and their impacts on Federal Class I areas and on a case-by-case basis for certain near-field applications involving complex meteorological conditions. The modeling system consists of three main components and a set of preprocessing and postprocessing programs. The main components of the modeling system are CALMET (a diagnostic 3-dimensional meteorological model), CALPUFF (an air quality dispersion model), and CALPOST (a postprocessing package). Each of these programs has a graphical user interface (GUI). In addition to these components, there are numerous other processors that may be used to prepare geophysical (land use and terrain) data in many standard formats, meteorological data (surface, upper air, precipitation, and buoy data), and interfaces to other models such as the Penn State/NCAR Mesoscale Model (MM5), the National Centers for Environmental Prediction (NCEP) Eta/NAM and RUC models, the Weather Research and Forecasting (WRF) model and the RAMS model.
>
> Examples of applications for which CALPUFF may be suitable include:
>
> - Near-field impacts in complex flow or dispersion situations
> - complex terrain

9 http://www.src.com/calpuff/calpuff1.htm

- stagnation, inversion, recirculation, and fumigation conditions
- overwater transport and coastal conditions
- light wind speed and calm wind conditions
- Long range transport
- development
- Secondary pollutant formation and particulate matter modeling

The Federal Register /Vol. 68, No. 72 /Tuesday, April 15, 2003 /Rules and Regulations 18441, similarly says "*Scientific merits and accuracy*: CALPUFF in its current configuration is suitable for regulatory use for long range transport, and on a case-by-case basis for complex wind situations." The Southeastern Massachusetts Coast is a complex wind situation.

(5) Model predictions at long distances and the importance of spatially varying parameters: As Dr. Egan says: (2011 Decl.,pp.5-6)

> The discussions and modeling demonstrations of the impacts of the ATMOS model at large distances from the PNPS underscore the need to have more appropriate models applied to predict atmospheric transport. The model to model comparisons cited do not shed any light on how well the straight-line format of the MAACCS2 model will predict concentrations at the very distances where impacts dominate the population dose and economic consequences of accidents of concern. One cannot really expect that a single anemometer located at the PNPS site will accurately predict the destination of emissions over such long distances. This is the reason that other regulatory agencies advocate using long range transport model capable of utilizing meteorological measurements that allow a simulation of regional scale differences in air flow patterns for air quality and environmental impact analyses.
>
> Further, the compromises in credibility associated with running the MACCS2 model with a single value of the roughness length to be used year round and a single value of precipitation rate data to be used for all locations within a 50 mile radius (about

7850 square miles) are substantial and unnecessary given today's computer modeling capabilities.

This reinforces that model accuracy at distances beyond 50 miles is important.

Dr. Egan's Declaration also says: (Egan 2011, 6)

> One of the computational limits of the ATMOS model is that is can utilize only one value of the surface roughness parameter for the entire modeling domain, in this case the area located within a radius of 50 miles. More advanced models allow roughness length as well as other surface characteristics to vary spatially. CALPUFF, for example can additionally utilize information about surface albedo and the Bowen Ratio, two other parameters that research efforts show are needed to improve the establishment of wind speed, wind speed profiles and dispersion rates for transport and dispersion models.
>
> An example of a systematic bias in the ATMOS application at the PNPS that is especially important at large distances from the PNPS is the use of only the seasonally averaged afternoon mixing depths. Because the afternoon mixing depths are generally much larger than morning mixing depths, and because at large distances from a source, ground level concentrations will be lower with increased mixing depth, this is not a conservative assumption.

(6) Model Development Issues: In response to Entergy's question 59 and 60, Entergy's experts discuss supposed difficulties associated with trying to improve the MACCS2 code. Dr. Egan (2011 Decl.,4) shows this is not so. He says that,

> In response to Questions 59 and 60, Drs. O'Kula and Hanna discuss difficulties associated with trying to improve the MACCS2 code. The comment that eight years were required to develop the AERMOD code needs to be placed in context. The initial multiyear work effort of the AMS/EPA Regulatory Model Improvement Committee (AERMIC) which is responsible for the development of AERMOD, was to sort out, test and determine the best ways to integrate the findings of

meteorological research studies and efforts that addressed improving the parameterization of the transport and dispersion characteristics of air flow in the planetary boundary layer. That research effort was time consuming but, it was completed and is well published. It would not need to be done again for purposes of improving ATMOS. Importantly, the results are viewed as representing a major step forward in defining the algorithms for computer simulations ranging from Gaussian dispersion type models to advanced numerical simulation models. The upgrades to the AERMOD code resulting from this research have flowed to improving the CALPUFF model, the Emissions and Dispersion Modeling System (EDMS) used by the FAA for aircraft operations as well as in modeling codes advanced by the National Park Service and other environmental protection agencies in the US and abroad.

I have personal experience as the Project Director responsible for the staffing, budget and performance of contract efforts to develop and validate dispersion atmospheric dispersion models. I agree that an effort would be involved to upgrade ATMOS, but believe that the coding part would not be nearly as difficult as implied by these responses. The code to include radioactive decay used in ATMOS would need to be integrated into any new code but this could retain the structure presently used in ATMOS.

Statements made in Mr. Ramsdell's affidavit also support my earlier assertions that computational time to run more sophisticated models should not be a deterrent to adopting advanced models. Mr. Ramsdell says at A32, referring to his involvement in the NUREG-6853 study (Molencamp et al, 2004): "Data preparation for MACCS2 was completed in a few hours, and code execution took less than 10 minutes on a PC. Data preparation for RASCAL required somewhat longer, but still only a few days. RASCAL code execution took about an hour on a PC. Finally, weeks were spent getting data ready to run the ADAPT/LODI codes and the execution of these codes took almost a week of calculation on a mainframe computer."

First, it is clear that running MACCS2 took hardly any time. RASCAL, a model which incorporates some of the advanced atmospheric science features of

AERMOD, also takes very little data preparation and execution time. ADAPT /LODI required more time in data gathering and in execution time but still not an unreasonable amount of effort for an important analysis

One would think that the licensing of a nuclear power plant would be an important enough application that data preparation time and computer resources would not be constraining factors.

I note that the draft description of RASCAL Version 4 (Ramsdell et al, 2010) describes the model as using a straight-line Gaussian plume model "near the release point where travel times are short" and a Lagrangian-trajectory Gaussian puff model "at longer distances where temporal or spatial variations in meteorological conditions may be significant". From this perspective, RASCAL appears more advanced than ATMOS.

3. Entergy: The meteorological data inputs used for the Pilgrim SAMA analysis are both temporally and spatially representative. We disagree. (See Entergy Dir. at A61-A72)

Entergy' expert compared the annual wind rose (which shows the frequency that the wind is blowing in each of 16 wind directions) at Pilgrim for 2001 to the annual wind roses at Pilgrim from 1996-2000, apparently to show that the 2001 annual wind rose at the Pilgrim Station is representative of other years; and he then compared the annual wind rose at Pilgrim to the wind roses for 18 other sites in the 50-mile region of interest shows that the Pilgrim site wind direction frequencies are within the range of statistical expectation for 18 other sites and that the Pilgrim data are representative of the 50- mile SAMA region.

But these comparisons avoid the real point: measurements from a single tower in time tells what direction the plume will travel when first leaving the site but do nt show not what will happen to the plume once it goes offsite in a complex environment. We do not question Dr. Hanna's research and finding that the initial wind direction from various sites was essentially similar but it does not address the question of what would happen next as the plume was affected by various site specific factors such as the differential between the water and land temperatures, topography, buildings.

Dr. Egan (Egan 2007 Decl., 13) explained that, "The simple fact is that measurements from a single 220' high anemometer will not provide sufficient information to project how an accidental release of a hazardous material would travel. For cases when the sea breeze was just developing and for cases when the onshore component winds do not reach entirely from the ground to the anemometer height, the occurrence of a sea breeze would not be identified. The anemometer would likely indicate an offshore wind indication." [Egan, 2007 Decl., at 13)

Further, PW demonstrated that basing wind direction on the single on-site meteorological tower data ignores "shifting wind patterns away from the Pilgrim Plant including temporary stagnations, re-circulations, and wind flow reversals that produce a different plume trajectory." [Rothstein, Town of Plymouth Nuclear Matters Committee Recommendation to Selectmen, Appendix A Meteorology, 13, Exhibit 5, Exhibits 3,4**]** And Mr. Rothstein added that, "Since the 1970s, the USNRC has historically documented all the advanced modeling technique concepts and potential need for multiple meteorological towers especially in coastal regions." [Rothstein, June 24, 2006 letter, 2] NRC Regulatory Guide 123 (Safety Guide 23) On Site Meteorological Programs 1972, 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."[Ibid., cited in Appendix 1]; and an EPA 2000 report, Meteorological Monitoring Guidance for Regulatory Model Applications, EPA-454/R-99-005, February 2000, Sec 3.4 points to the *need for multiple inland meteorological monitoring sites.* See also 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.

The crux of PW's argument is comparing long-term wind rose data for the same site, or between various sites, is irrelevant unless you simply want to show that the long-term prevailing wind directions are similar in southeastern MA. But, that has nothing to do with evaluating plume trajectory/concentrations/doses at each receptor, which would be more reliably predicted using variable trajectory dispersion modeling coupled with multiple offsite meteorological tower data. EPA would not have gone to the time and expense to develop advanced modeling techniques if the simple straight-line Gaussian models were sufficient.

Evaluation of the 2001 Plymouth Municipal Airport annual precipitation data used in the Pilgrim SAMA analysis shows that the data are representative of the precipitation levels from 1995-2009 at Plymouth and at eight other sites in the 50-mile region. What are left out of the analysis are measurements of fog and humidity that would affect contamination.

4. Entergy: Coastal Breezes are appropriately accounted for in the Pilgrim SAMA analysis, (See Entergy Dir. at A73-A81) Pilgrim Watch disagrees.

Entergy's experts say that merely changing meteorological inputs to account for coastal breezes will not make any difference. The only reason that is so is because Entergy has "averaged out" the effects of any differences in meteorology; and because Entergy's chosen inputs into the MACCS2 code and Entergy's use of that code ensure that the effect of Pilgrim's site specific meteorological conditions are effectively ignored.

Entergy (A.79) explains that, "SAMA cost benefit analysis sums (takes a mean average of) population dose and economic consequences across a 50 mile radius based on one-year's worth of hourly meteorological data; (and) Coastal sea and land breezes occur only about forty or fifty days per year, very roughly about 10 to 15% of the year, and for a limited duration of about 6 hours on each day." Therefore sea breeze has no impact if a mean average is used; however its significance would be apparent if the 95% percentile were used.

However if Entergy had not "averaged out" the effects of any differences in meteorology and ensured by their chosen inputs into the MACCS2 code, the effect of coastal breezes on increasing consequences would be apparent.

For example, "on days with significant sea breezes, they average about 5 to 10 miles inland penetration, with occasional larger values of up to 30 miles or so" (Entergy A.74). Therefore the sea-breeze would contaminate more densely populated areas where long term health effects and requirements for cleanup would significantly affect cost.

Entergy (A.76) claims that coastal breezes decrease radiological doses because sea and land breezes are not a concentrating phenomenon (increasing the maximum plume centerline concentration). Rather they are a dispersive one. Dr. Egan disagrees. He said (Egan 2007 Decl., at 13):

> [Mr. O'Kula's] contention that the seabreeze is 'generally beneficial in dispersing the plume and in decreasing doses' is incorrect. In fact, the development of seabreeze flow that would transfer a release inland is the greatest danger. Contrary to the implications of this declaration, the development of a sea breeze flow is the common meteorological condition that must be most closely monitored at the PNPS.
>
> [Mr. O'Kula's] statement reflects a misconception that the sea breeze is "generally a highly beneficial phenomena that disperses and dilutes the plume concentration and thereby lowers the projected doses downwind from the release point." If the same meteorological conditions (strong solar insolation, low synoptic-scale winds) that are

conducive to the formation of sea breezes at a coastal site occurred at a non coastal location, the resulting vertical thermals developing over a pollution source would carry contaminants aloft. In contrast, at a coastal site, the sea breeze would draw contaminants across the land and inland subjecting the population to potentially larger doses.

Dr. Egan (Egan 2007 Decl., pg.13) previously disputed other points raised by Entergy's expert Kevin O'Kula, 2007,and his comments remain directly applicable to the same conclusions that Entergy hs repeated in its Initial Statement. (A-61-A72)

1) [Mr. O'Kula's] statement that the meteorological data collected at the PNPS site would reflect the occurrence of the sea breeze in terms of wind speeds and direction is not necessarily true.
2) A measurement at a single station tower, 220 feet, will not provide sufficient information to allow one to project how an accidental release of a hazardous material would travel.[10] Measurement data from one station will definitely not suffice to define the sea breeze.

Dr. Bixler, NRC Staff expert, agreed with Pilgrim Watch and Dr. Egan, [Egan Decl.,13, Item 20] and said in his affidavit that "*the effect of sea breeze is not taken into account*" in Entergy's studies.

10. (NEB) Material Fact number 19 states that the effect of sea breeze is taken into account in the Pilgrim site meteorological data. *Although the wind speed and direction of a sea breeze may be included in the actual PNPS meteorological data, the effect of sea breeze is not taken into account.* The effect that is not taken into account is that the *complex flow pattern under sea breeze conditions differs substantially from the straight-line pattern used in the MACCS2 analyses*. The sea

[10] License Application 2.10 Meteorology and Air Quality at 2-31; and at Attachment E, E.1.5.2.6 at E.1-63]

breeze occurrences are typically diurnal events, occurring during daylight hours and during warmer seasons.[11]

NRC Staff cannot paper away Dr.Bixler's that he made when he was put forth as an expert witness in 2007 and signed an affidavit "declaring under the penalty of perjury that the foregoing was true and correct to the best of [his] knowledge, information and belief," by saying that he is not qualified to speak on this issue today.

5. "Hot spots" as claimed by Pilgrim Watch are both technically incorrect and immaterial. See Entergy Dir. at A82-A89.

Entergy's experts say that merely changing meteorological inputs to account for the behavior of plumes over water will not make any difference. But that again is because Entergy has "averaged out" the effects of any differences in any site specific meteorology; and because Entergy's chosen inputs into the MACCS2 code and Entergy's use of that code ensure that the effect of Pilgrim's site specific meteorological conditions are effectively ignored.

However if Entergy had not "averaged out" the effects of any differences in meteorology and ensured by their chosen inputs into the MACCS2 code, the effect of a concentrated plume over water increasing costs would be seen.

Entergy's Gaussian plume model assumed that plumes blowing out to sea would have no impact. PW showed that a plume over water, rather than being rapidly dispersed, will remain

[11] Affidavit of Joseph A. Jones and Dr. Nathan Bixler Concerning Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 25, 2007 prepared for NRC Staff response to Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 29, 2007

tightly concentrated due to the lack of turbulence. The marine atmospheric boundary layer provides for efficient transport. Because of the relatively cold water, offshore transport occurs in stable layers. Wayne Angevine's (NOAA) research of the transport of pollutants on New England's coast concluded that major pollution episodes along the coast are caused by efficient transport of pollutants from distant sources. "The transport is efficient because the stable marine boundary layer allows the polluted air masses or plumes to travel long distances with little dilution or chemical modification. The sea-breeze or diurnal modulation of the wind, and thermally driven convergence along the coast, modify the transport trajectories." Therefore a plume will remain concentrated until winds blow it onto land. (Zager et al.; Angevine et al. 2006[12]) If Angevine's research found this to be true for contaminants that result in smog then why would it not hold true for radionuclides? The meteorological phenomena would be the same and the only difference would be factoring in the half-lives of released radionuclides, many of which are long lived. Dr. Beyea said that this can lead to hot spots of radioactivity in places along the coast, certainly to Boston. [Beyea, 11] The compacted plume also could be blown ashore to Cape Cod, directly across the Bay from Pilgrim and heavily populated in summer. (Rep. Patrick Decl., pg., 2) An alternative model that Entergy did not use, CALPUFF, could account for reduced turbulence over water and could be used for sensitivity studies. [Beyea, 11-12].

Further, Dr. Egan observed (2011 Decl., 6) that:

> In the discussion about wind over the ocean, I found Dr. Hanna's response to Question 85 to be out of context with the potential accidental configurations at the PNPS and therefore leading to an erroneous implication about the role of overwater

[12] Angevine, Wayne; Tjernström, Michael; Žagar, Mark**,** Modeling of the Coastal Boundary Layer and Pollutant Transport in New England, Journal of Applied Meteorology and Climatology 2006; 45: 137-154, Exhibit 6

transport. Dr. Hanna states that "a factor of 2 greater wind speed over the ocean would, by itself, contribute to a reduction of maximum concentrations by approximately a factor of two". This would strictly be true only if the source were also within the airflow over the ocean. As Dr. Hanna correctly states in response to question 28, the dilution effect of wind speed and the inverse wind speed relationship to concentration only applies to the initial dilution of the emission source. What often does happen with an onshore flow, since the air over the water is often more stable than that over land, is that a fumigation type event occurs. This is associated with the fact that the surface roughness change and the warm land surface create more turbulence in the surface layer that would mix plume material from an elevated plume down to the surface, resulting in increased ground level concentrations.

6. The CALMET Wind Trajectory Analysis shows that any short-term differences in observed winds across the SAMA domain have negligible affect on the annual frequencies of trajectory directions and on the Pilgrim SAMA consequences. See Entergy Dir. at A92-A105.

Entergy's expert, Dr. Hanna, says that any short-term differences in observed winds across the SAMA domain have negligible effect on the annual frequencies of trajectory directions and on the Pilgrim SAMA consequences; but he admits that the only reason that is so is because Entergy has "averaged out" the effects of any differences in meteorology. Also true is that Entergy's chosen inputs into the MACCS2 code and Entergy's use of that code ensure that the effect of Pilgrim's site specific meteorological conditions are effectively ignored in the SAMA analysis.

Second, Dr. Hanna's analysis did not address the real dispute: the difference between a Gaussian plume model and a variable trajectory model on the area impacted and deposition within that area cannot be determined without running both ATMOS (the Gaussian plume) and an alternative model (e.g. MM5 and CALPUFF) with PNPS site specific data. Dr. Hanna did not do this so that we have not answered the question.

7. Terrain is conservatively treated for purposes of the Pilgrim SAMA Analysis. See Entergy Dir. at A106-A114. We agree that they "appear" to be without merit as a result of the many ways that "real" consequences are minimized and masked by Entergy's methodology.

If Entergy had not "averaged out" the effects of terrain on dispersion, the real and important effect of terrain on increasing consequences would have been clear. Dr. Egan (2011 Decl)

Entergy explains that terrain is conservatively treated. We disagree. NRC Staff's expert, Dr. Bixler is in full accordance with PW's argument that whether a Gaussian model is conservative depends entirely on "*the trajectory of the plume compared with population centers*[13]*;*" and PW submitted significant evidence that the straight-line Gaussian plume could not, and did not, predict site-specific atmospheric dispersion for Pilgrim's coastal region, or accurately predict what population centers the likely variable plume would affect. (Pilgrim Watch's Brief in Response to CLI-09-11, [Requesting Additional Briefing], June 25, 2009, 4-10, 14, 17)

8. Entergy incorrectly claims that Pilgrim Watch's other Contention 3 issues are without merit. (See Entergy Dir., A.115-A.118.).

[13] Affidavit of Joseph A. Jones and Dr. Nathan Bixler Concerning Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 25, 2007 prepared for NRC Staff response to Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 29, 2007, Bixler paragraph 8

We agree that they "appear" to be without merit, but that is only the result of the many ways that "real" consequences are minimized and masked by Entergy's methodology. In the "real world," real issues are raised and are important in analyzing costs. For example:

Resuspension: Pilgrim Watch MACCS2 Guidance Report, June 2004,[14] is even clearer that Entergy's inputs to the code do not account for variations resulting from *site-specific* conditions such as those present at PNPS. The "code does not model dispersion close to the source (less than 100 meters from the source)," thereby ignoring resuspension of contamination blowing offsite.

Again Entergy rendered this meaningless by averaging one-year of meteorological data over the 50-mile radius area. For example, the consequences of resuspension of contaminants blowing off Pilgrim's site is obvious if there are strong winds or on days with significant sea breezes. Dr. Hanna (A.74 estimated that the inland penetration of sea breezes average about 5 to 10 miles inland penetration, with occasional larger values of up to 30 miles or so. Densely populated areas such as Metropolitan Boston, Cape Cod and smaller cities such as Brockton and Quincy are within 30 miles.

VI. CONCLUSION

Entergy concluded that, "The meteorological modeling in the Pilgrim SAMA analysis is adequate and reasonable to satisfy NEPA. Furthermore, as demonstrated by the CALMET trajectory wind analysis, accounting for the meteorological patterns and issues of concern to

[14] MACCS2 Guidance Report June 2004 Final Report page 3-8:3.2 Phenomenological Regimes of Applicability

Pilgrim Watch cannot credibly alter the Pilgrim SAMA analysis conclusions on which SAMAs are cost-beneficial to implement." Entergy's conclusions are simply wrong.

Both Pilgrim Watch's Pre-Filed Testimony (January 3, 2011) at 16 and Section II of this response fully demonstrated that the meteorological modeling in Pilgrim's SAMA analysis is inadequate and not reasonable to satisfy NEPA; and instead that PW's recommended alternate meteorological modeling does not pose any conflict with NEPA's Rule of Reason. Entergy's arguments (Entergy's Initial Statement of Position, January 3, 2011, pgs.2-5) are without merit.

Dr Egan (2011 Decl.,5) discussed that numerous studies have shown that flat terrain type models, such as was used in ATMOS, cannot be relied upon to provide competent predictions when applied to complex terrain settings, such as Pilgrim's. Not all models are the same in how they handle plume trajectories and atmospheric dispersion rates do vary by terrain setting and surface conditions. He says that,

> The discussions and demonstrations of the impacts of the ATMOS model at large distances from the PNPS underscore the need to have more appropriate models applied to predict atmospheric transport. The model to model comparisons do not shed any light on how well the straight-line format of the MACCS2 model will predict concentrations at the very distances where impacts dominate the population dose and economic consequences of accidents of concern. One cannot really expect that a single anemometer located at the PNPS site will accurately predict the destination of emissions over such long distances. This is the reason that other regulatory agencies advocate using long range transport model capable of utilizing meteorological measurements that allow a simulation of regional scale differences in air flow patterns for air quality and environmental impact analyses.
>
> Further, the compromises in credibility associated with running the MACCS2 model with a single value of the roughness length to be used year round and single values of precipitation rate data to be used for all locations within a 50 mile radius (about

7850 square miles) are substantial and unnecessary given today's computer modeling capabilities.

As is pointed out in many times in these affidavits, the SAMA objectives can be met with a model that only produces long term average concentration and deposition of radio nuclides. Yet the technology used to obtain these long term averages requires addressing the impact of every hour in the year. The only numbers that matter to the results are the annual averages of all these computations. Lost is valuable information about the statistical ranges of individual predicted events. For example, the 90th or 95th percentiles of the predictions are not available to help interpret the statistical significance of the annual averages. These numbers can be easily produced by post processing the dispersion model outputs. By limiting the modeling to only 1 year of meteorological data (we note that EPA generally requires 5 years of data even for annual averages.), one does not have any measure of year to variability of the single annual average which determines the SAMA alternatives.

Because of the focus on long term averages, the relevance of the impact of individual potential accidents is entirely lost. It is not clear why Entergy relies upon the use of a single year of meteorological data when (for example) DOE's guidance Revised Chapter 4, *Meteorological Monitoring*, of Guide DOE/EH-0173T (PW Exhibit 13) says that the joint-frequency distribution and choices of meteorological conditions for the accident analyses should be based on a minimum of 5 years of hourly-averaged data acquired by a meteorological program that meets the objectives and principles of ANSI/ANS-3.11-2000 and EPA-454/R-99-005.

Pilgrim Watch concludes that we do not disagree with many of Entergy's expert's positions that merely changing meteorological inputs will make any difference. But the reason for that has nothing to do with whether different meteorology would in fact lead to vast differences in the consequences to an area affected under those meteorological conditions.

As we have said many times before,

- Entergy's choice of the source term to be used in its analyses,
- Entergy's failure to ask what the result of any particular meteorological data might be; and its use of the average of a year's worth of meteorological data to mask any particular site-specific meteorology,
- Entergy's minimizing of economic costs (especially health costs and cleanup costs),
- Entergy's highly questionable use of an unsupportable "probability" to reduce by orders of magnitude the consequences of an actual accident, and
- Entergy's decision to minimize that already diminished amount by using a "mean" rather than a "95th percentile" analysis

ensured not only that meteorology in and of itself (the question posed by the Board for phase 1 of this remand hearing) will not make any difference, but that Entergy will never have to adopt any meaningful SAMAs to reduce future risk.

Respectfully Submitted,

Signed Electronically,

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