UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
ENTERGY NUCLEAR GENERATION	)	
COMPANY AND ENTERGY NUCLEAR	)	Docket No. 50-293-LR
OPERATIONS, INC.	)	
	)	
(Pilgrim Nuclear Power Station)	)	

NRC STAFF TESTIMONY OF JAMES V. RAMSDELL, JR., CONCERNING THE IMPACT OF SPECIFIC METEOROLOGICAL CONDITIONS ON THE SEVERE ACCIDENT MITIGATION ANALYSIS

Q1. Please state your name, occupation, and by whom you are employed?

A1. [JVR] My name is James V. Ramsdell, Jr. I am a Senior Technical Researcher employed by Battelle, Pacific Northwest Laboratories. Battelle operates that Pacific Northwest National Laboratory for the U.S. Department of Energy. I have been employed by Battelle as an atmospheric scientist at the Pacific Northwest National Laboratory for more than 43 years. My statement of qualifications is attached as Exhibit ("Ex.") NRC000013.

Q2. Please describe your current responsibilities?

A2. [JVR] I am a technical developer for applied atmospheric dispersion models and conduct environmental and safety reviews for nuclear power plants. I am a principal developer of the NRC's emergency response consequence assessment tool, Radiological Assessment System for Consequence Analysis ("RASCAL") (NUREG-1887). I have developed various atmospheric codes used by NRC for both safety and environmental reviews including HABIT (NUREG/CR-6210), ARCON (NUREG/CR- 6331), EXTRAN (NUREG/CR-5656), and have experience with other NRC codes including PAVAN , XOQDOQ, RADTRAD, and MACCS2. I also developed the atmospheric dispersion and deposition model "RATCHET" used for the Hanford

Environmental Dose Reconstruction Project, which was subjected to extensive peer review and verification and validation and has since been used for other dose reconstruction efforts including the effort for Myak in Russia. In addition to working on RASCAL, I am currently assisting the NRC staff in environmental reviews related to nuclear power plant licensing. Specifically, I assisted in meteorological and climatological reviews and reviews of the consequences of design basis and severe accidents, and in the evaluation severe accident mitigation alternatives.

Q3. Please explain your duties in connection with the Staff's review of the License Renewal Application ("LRA") submitted by Entergy Nuclear Operations, Inc. ("Entergy," "Applicant" or "Licensee") for the renewal of the Pilgrim Nuclear Generating Station's ("Pilgrim") Operating License No. DPR-35.

A3. [JVR] I was not involved in the Staff's Review of the LRA for Pilgrim.

Q4. Why are you testifying here today?

A4. [JVR] I am testifying as an expert witness on issues related to the use the MACCS2 computer code in SAMA analyses for the Pilgrim Nuclear Power Station. I have been asked to discuss issues raised by Pilgrim Watch related to the appropriateness of the use of the MACCS2 code in a coastal environment and Pilgrim Watch's assertion that the use of the MACCS2 code leads to a sufficient underestimation of the benefits of potential Severe Accident Mitigation Alternatives ("SAMA") such that one or more potentially cost-beneficial SAMA will not be identified. Specifically, I am addressing the effects of sea breeze and hot spots on the cost-benefit conclusions made by the SAMA analysis

Q5. What did you review in order to prepare your testimony?

A5. [JVR] I have reviewed the Final Supplemental Environmental Impact Statement

(“FSEIS”) prepared by the NRC Staff,[1] the contention and support proffered by Pilgrim Watch and various pleadings and Orders related to the contention. In addition, I have reviewed the MACCS code documentation, the input and output files for the MACCS2 code runs for Pilgrim submitted by Entergy. I have also reviewed technical literature on sea breeze circulations in the vicinity of the Pilgrim site, NRC Staff guidance related to SAMA evaluation, and the report prepared for Entergy by the staff at Washington Safety Management Solutions, LLC (WSMS-TR-97-0005, Rev. 1).[2]

Q6. Based on your review, what is your expert opinion regarding Pilgrim Watch's Contention 3?

A6. [JVR] In my opinion, it is highly unlikely that the use of the MACCS2 code to develop input on the offsite consequences of severe accidents for the SAMA analysis at Pilgrim would lead to an underestimate of those consequences that would be sufficient to cause an additional SAMA, not previously identified in the FSEIS, to become cost-beneficial.

Q7. Pilgrim Watch contends that the straight-line atmospheric model in MACCS2 would result in a significant underestimate of offsite consequences of a severe accident because the code does not adequately treat sea breeze circulations. Can you describe the sea breeze phenomenon?

A7. [JVR] The sea breeze circulation is a local wind pattern that can develop along a coast when there is there is no strong synoptic regime. A strong synoptic regime normally occurs

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[1] NUREG-1437, Supplement 29, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Pilgrim Nuclear Power Station - Final Report,” Ex. NRC000002, (July 2007).

[2] WSMS-TR-07-0005, Revision 1, “Radiological Dispersion and Consequence Analysis Supporting Pilgrim Nuclear Station Severe Accident Mitigation Alternative Analysis” Ex. JNT000001 (May 2007).

when there are well-defined pressure systems in the area and these large-scale pressure patterns are responsible for the air flow. In the absence of a strong synoptic regime, a sea breeze pattern may result from differential heating of land and water surfaces. It is a diurnal pattern (i.e. daily pattern) that typically has offshore flow in the early morning hours. As the land surface warms in response to heating, the flow rotates, becoming onshore by late morning or early afternoon. In the evening, the flow rotates becoming offshore once again. In the northern hemisphere, the flow generally rotates in a clockwise direction.

Q8. How frequently do sea breeze events occur in the vicinity of the Pilgrim site?

A8. [JVR] A recent Master's degree thesis analyzed sea breeze events at General Edward Lawrence Logan International Airport ("Logan") in Boston, Massachusetts over a recent ten (10) year period using criteria developed Miller and Keim.[3] Thorp determined from the Logan data that meteorological conditions conducive to sea breeze events occurred an average of about 88 days per year (24%), but actual sea breeze events only occurred an average of about 31 days per year (8.5%). The average time of onset of the sea breeze was about 10:00 am and the average duration was about 8 hours. About 25% of the sea breeze events were marginal events that lasted less than 2 hours, were interrupted by periods of calm, or light and variable winds, or had no clear start or stop. Typical inland penetration of the sea breeze varied from about 10 to 25 miles depending on the underlying synoptic situation. Sea breeze flow patterns presented by Thorp suggest that the sea breeze circulation in the vicinity of Pilgrim is weaker than in the vicinity of Logan and has more limited inland penetration.

Q9. Why would the sea breeze in the vicinity of Pilgrim be weaker than the sea breeze in the

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[3] Jennifer E. Thorp, "The Eastern Massachusetts Sea Breeze Study," Ex. NRC000010 (May 2009) (unpublished) ; Miller, S.T.K., and B.D. Keim, Synoptic-Scale Controls on the Sea Breeze of the Central New England Coast 18 *Weather Forecasting*, 236–248 (2003).

vicinity of Logan?

A9. [JVR] The topographic setting for development of a classic sea breeze pattern is a straight or slightly curved coastline. The Pilgrim site does not fit this description. Cape Cod, Nantucket Sound and Buzzards Bay to the south of Pilgrim would tend to generate local flows under synoptic conditions conducive to sea breeze development that would not be aligned with onshore flow at Pilgrim.

Q10. How does the MACCS2 code treat dispersion and deposition during sea breeze events?

A10. [JVR] Although the MACCS2 code does not explicitly model sea breeze effects, it uses data for all meteorological conditions to determine the transport and dispersion of radionuclides, including conditions. The meteorological conditions for all hours during the year are used to create a joint frequency distribution of transport direction, transport speed, atmospheric stability, and precipitation rate. Transport speed, atmospheric stability, and precipitation rate enter in to the MACCS2 atmospheric dispersion and deposition calculations directly. Data for all hours of a sea breeze event including both the offshore and onshore periods are treated equally in the joint frequency distribution.

Q11. Is this treatment of sea breeze events reasonable?

A11. This treatment of the sea breeze is reasonable for the use to which the code output is being applied and the atmospheric model in MACCS2. This treatment, however, does not incorporate information about the temporal and spatial variation of the meteorological conditions during a sea breeze event that might be utilized in the model of a specific weather event rather than a more generic model of events under unknown conditions. In that sense, the MACCS2 treatment of meteorological conditions and the sea breeze effect is a simplified model.

Q12. What would a more robust treatment of sea breeze events involve?

A12. [JVR] To specifically represent the temporal and spatial variations of meteorological conditions would require a more complex atmospheric model and more meteorological data from multiple sites. Temporal variation of meteorological conditions could be modeled using actual meteorological data time series for Pilgrim and a time-dependent model.

Q13. In light of your response to the previous question, is the straight-line atmospheric model in MACCS2 appropriate for use at Pilgrim?

A13. [JVR] The straight-line model in MACCS2 is appropriate. The SAMA analysis included in the Pilgrim FSEIS is a screening analysis to disclose potentially cost-beneficial alternatives SAMAs to decision makers. The model in MACCS2 is consistent with the models in other NRC codes used in licensing and evaluation of compliance with regulations. It would be inappropriate to use a more complex model requiring more data for a screening calculation involving a low probability event than is used for licensing calculation or calculations used to demonstrate compliance with regulations.

Q14. In your expert opinion, how would the sea breeze effect alter the offsite consequence outputs from MACCS2 and affect cost-benefit determination of the SAMA analysis?

A14. The straight-line model in MACCS2 does not account for changes in dispersion conditions (transport direction, speed, etc.) after the beginning of a release. MACCS2 will calculate consequences out to 50 miles in the initial transport direction even though the actual wind direction may change between the time of release and the time the release leaves the model domain. For example, in a typical sea breeze event at Pilgrim, radioactive isotopes released in the morning prior to the onset of the sea breeze will initially be transported into Cape Cod Bay. As the event progresses, the material will move to the south and then to the west or northwest, crossing the shoreline south of Pilgrim. Finally, when the flow reverts to a land breeze, the material will be carried offshore again. The consequences of the release will be south and west of Pilgrim. The plume is unlikely to get to the large population area 30 to 50 miles west of Pilgrim. MACCS2 will model the plume across Cape Cod, calculating consequences for the population on Cape Cod. Based on the meteorological data for Pilgrim and the typical rotation of winds for the location, isotopes in a release, beginning after the onset of the sea breeze, will generally move west or northwest for several hours and then turn to the east in the offshore flow in the evening. Inland penetration of the plume would be limited to the inland extent of the sea breeze—typically less than 30 miles based on the information presented by Thorp. MACCS2 would model the plume as if it extended east to 50 miles, exposing the large population between 30 and 50 miles. The likelihood of the release beginning in the morning before the onset of the onshore flow is about 0.42 (10 hrs in 24 hrs).[4] Similarly, the likelihood of the release beginning during the onshore flow is about 0.33 (8 hrs in 24 hrs).[5] We can assume that MACCS2 underestimates consequences in the first case (release prior to onset of onshore flow), and it is likely that MACCS overestimates consequences in the second case (release during onshore flow). Recalling that sea breeze events occur about 8.5% of the days, we can then estimate that the MACCS2 wind model would underestimate offsite consequences about 3.5% of the time (8.5% X 0.42) during the year because it didn't represent the sea breeze circulation explicitly.[6] We can also estimate that MACCS2 would overestimate offsite consequences about 2.8% of the time (8.5% x 0.33).[7] The input to the SAMA analysis from the MACCS2 results consists of two numbers, an average population dose (person-rem) and an average offsite economic consequence (dollars), both cumulative values for the entire 50-mile radius model domain. Consequently, errors in offsite consequence assessments as a result from not modeling the sea breeze effect tend to be off-setting. The residual error in the

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[4] Jennifer E. Thorp, "The Eastern Massachusetts Sea Breeze Study," Ex. NRC000010 (May 2009) (unpublished).

[5] *Id.*

[6] *See supra* at A8.

[7] *Id.*

input to the SAMA analysis will be small and is unlikely to affect the cost-benefit analysis especially in light of other conservatisms in the SAMA analysis, like conservative source terms and assuming that the mitigation measures reduce the risk of an accident or release to zero.

Q15. In light of your responses to the previous questions regarding the sea breeze effect, is the straight-line atmospheric model in MACCS2 appropriate for use at Pilgrim?

A15. [JVR] The straight-line model in MACCS2 is appropriate for use at Pilgrim for the identification of potentially cost beneficial SAMAs.

Q16. Why is the straight-line atmospheric model in MACCS2 appropriate for use at Pilgrim?

A16. [JVR] In order to evaluate why a particular model is appropriate for a selected use, it is important to understand the reason why a model is being employed. Here, the primary purpose of the model is to identify which mitigation measures are potentially cost beneficial for low probability events and screen out those measures that are clearly not cost-beneficial. The errors resulting from the atmospheric model include both overestimates and underestimates of offsite consequences. Because MACCS2 both overestimates and underestimates of the economic consequences during sea breeze events and the frequency of sea breeze events is small, the errors in the mean offsite consequence of severe accidents will be smaller than either the overestimates or underestimates. Given the screening nature of the SAMA analysis and the generally conservative assumptions made in other aspects of MACCS2 assessment of mean offsite consequences, the atmospheric model in MACCS2 is appropriate.

Q18. Are you familiar with the term “source term” as it used regarding SAMAs?

A18. [JVR] Yes.

Q19. What is a source term?

A19. [JVR] The source term in MACCS2 refers to the characteristic of the set of radionuclides that are released to the environment following a reactor accident. The characteristics include: isotope, amount of the isotope released, and the deposition characteristics of each isotope. The source term may also refer to the characteristics of the release, such as the duration of the release and the release height.

Q20. How are source terms determined for SAMAs?

A20. [JVR] The source terms are derived from the isotopic inventory of the reactor core at the time of the accident considering the path from the reactor core to the environment. The release path may include delays, filters and sprays. It may involve release through the containment or it may involve a bypass of the containment. Potential release paths are determined using probabilistic risk assessment considering severe accident initiating events and potential failures of equipment and humans. Accidents with similar release paths are grouped into release categories and assigned a source term. The Pilgrim severe accident consequence assessment includes evaluation of consequences for 19 release categories. The overall consequence assessment is a probability weighted mean assessment with probabilities assigned on the basis of the Pilgrim Level 1 and Level 2 PRAs.

Q21. In your expert opinion, are the source terms utilized in Pilgrim's SAMAs conservative?

A21. [JVR] I believe the source terms used in MACCS2 for the Pilgrim SAMA evaluation to be conservative because they were developed for Chapter 19 of the Final Safety Analysis Report.

Q22. Why do you conclude that the source terms are conservative?

A22. Safety analyses conducted following NRC regulatory guidance and standard review plan pursuant to NRC's responsibilities under the AEA have an intentional conservative bias. Typically they involve assumptions that overestimate adverse consequences. For example, atmospheric dispersion calculations used in evaluating accident consequences use dispersion parameters that are exceeded no more than 5% of the time.[8] In contrast, NRC guidance

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[8] *See, e.g.*, Regulatory Guide 1.145, Rev. 1, "Atmospheric Dispersion Models For Potential (continued. . .)

indicates that reasonable estimates of consequences should be used in environmental impact statements prepared under NEPA.

Q23. What is the effect of using conservative source terms on the overall SAMAs and especially in the transport and deposition of contamination?

A23. [JVR] The population dose and economic consequences calculated by MACCS2 are linearly related to the source term (isotopic release quantity). Doses and economic consequences are calculated from the concentration of radionuclides in the air and deposited on the surface. Therefore, conservative source terms translate directly to conservative consequences.

Q24. Are you familiar with the meteorological models Dr. Egan has suggested would be more appropriate to use at Pilgrim?

A24. [JVR] I am familiar with the types of models suggested by Dr. Egan.

Q25. What type of model is AERMOD?

A25. [JVR] AERMOD is a straight-line Gaussian plume model.

Q26. What type of model is CALPUFF?

A26. [JVR] CALPUFF is a Gaussian puff model that is capable of addressing both temporal and spatial variations in atmospheric conditions.

Q27. In your expert opinion, would AERMOD and/or CALPUFF be more appropriate for use in the SAMA analysis?

A27. [JVR] The AERMOD and CALPUFF models were developed for specific applications that generally require estimates of concentration and deposition. They do not go beyond

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Accident Consequence Assessments At Nuclear Power Plants," 1.145-5 (1983).

concentration and surface contamination estimates to consequences such as population dose or costs associated with cleanup and relocation. Without these components, the AERMOD and CALPUFF codes would not be more appropriate for severe accident consequence assessment than MACCS2. Implementing the AERMOD or CALPUFF atmospheric models within the MACCS2 framework would be a major undertaking, as would adding the consequence assessment capabilities of MACCS2 to the AERMOD or CALPUFF.

The NRC does have a code, RASCAL, that has many of the features suggested by Dr. Egan. RASCAL is used for assessing consequences of accidents as part of the NRC emergency response capability.

Q28. In your expert opinion, would you expect the use of CALPUFF or AERMOD to identify any mitigating measures as being cost beneficial solely because of the selection of an alternative meteorological model?

A28. [JVR] No, I would not.

Q29. Has the Gaussian plume model used in the MACCS2 code ever been compared to models like those suggested by Pilgrim Watch?

A29. [JVR] In 2004, the NRC Office of Nuclear Regulatory Research funded an atmospheric transport model comparison study, involving three classes of atmospheric models.[9] The atmospheric model in MACCS2 was the simplest model in the comparison. The other models were the NRC's RASCAL code which incorporates a two-dimensional Lagrangian puff dispersion model and uses meteorological data from several meteorological stations and Lawrence Livermore National Laboratory's ADPIC/LODI models which are fully three-

[9] NUREG-6853, "Comparison of Average Transport and Dispersion Among a Gaussian, a Two-Dimensional, and a Three-Dimensional Model," Ex. JNT000001.

dimensional time dependent models.

Q30. What were the conclusions of those comparisons of MACCS2 to the more complex models?

A30. [JVR] The models predicted the mean air concentrations for both non-depositing and depositing material and surface concentration for depositing material to distances beyond 50 mi for 610 randomly selected release times. The mean concentration and deposition estimates which are directly related to SAMA analysis input were generally within a factor of 2 for the three models. The estimates of the MACCS2 dispersion model were generally within the bounds of the other two models.

Q31. Are there any other results of the study that are relevant to the input SAMA analyses?

A31. [JVR] Yes there are.

Q32. Will you describe those results.

A32. [JVR] While the study focused on evaluation of the atmospheric dispersion and deposition aspects of the three codes, it is useful to note the time and effort required to make the calculations since MACCS2 is used as a screening tool. 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 took 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.

Q30. Were you involved in the comparison study?

A30. [JVR] Yes, I performed the RASCAL model calculations and assisted in analysis and interpretation of the results of the study.

Q33. Did you agree with the conclusions of the study when you published the results.?

A33. [JVR] Yes.

Q34. Has anything occurred since that study was completed that would make doubt the conclusions or want to pursue additional analysis?

A34. [JVR] No.

Q35. Are you aware of any alternative meteorological models that are likely to identify additional mitigation as cost beneficial?

A35. [JVR] I am not aware of any model that would be likely to identify any additional severe accident mitigation alternatives as cost beneficial.

Q36. Why do you come to that conclusion?

A36. [JVR] For an additional SAMA to become cost beneficial, the mean offsite consequences would have to increase more than could be expected from use of more complex meteorological model. An initial estimate of the amount of increase that would be required can easily be calculated from the available information. The SAMA evaluation process involves several screening steps. The initial steps eliminated all but 5 SAMAs from an initial list of 281 potential SAMAs. The cost of implementing the next least costly SAMA was determined to be more than twice the potential benefit assuming that the SAMA would eliminate all severe accident risk. The cost to implement this SAMA has not been contested and is not based on MACCS2 calculations. Similarly, the cost of onsite consequences is known and is not based on MACCS2 calculations. Therefore, equating the costs of the consequences with the SAMA costs involves only one unknown, the offsite consequences that are based on MACCS2 calculations, as shown below.

Offsite Consequences + Onsite Consequences = Cost of the SAMA

Rearranging this equation to solve for the minimum value of offsite consequences that would indicate that the SAMA is potentially cost-beneficial is simple. Using the values in the FSEIS, an increase in the value of the offsite consequences by a factor of about 2.5 would be needed to make the next lowest cost SAMA appear cost-beneficial. It is highly unlikely that a different atmospheric model that treats sea breezes explicitly would increase the mean offsite consequence estimate by a factor of about 2.5.

Q37. Are you familiar with a meteorological pattern commonly referred to as a “hot spot?”

A37. [JVR] Yes.

Q38. Please describe a hot spot?

A38. [JVR] The term “hot spot” is not particularly well defined. In the MACCS2 lexicon, the term refers to an area in which the dose rate from surface contamination exceeds a user specified value. When I hear or see the term, I generally think of an area in which the surface contamination is greater than the contamination in surrounding areas. I don’t know of any criterion for how much greater the contamination has to be for an area to be considered a “hot spot”

Q39. How are hot spots formed?

A39. [JVR] My first encounter with the term was related to fallout patterns from nuclear tests. Those “hot spots” were generally due to either debris from the test cloud coming to the ground or with the debris plume encountering precipitation. Other mechanisms can be postulated for “hot spot” formation. It is my understanding in this matter, the term is being used to describe the area where a plume comes onshore after an overwater transport.

Q40. Does the area surrounding Pilgrim experience hot spots?

A40. [JVR] A “hot spot” could be formed in the vicinity of Pilgrim if a severe accident release were to occur with the right set of meteorological conditions. However, not all meteorological conditions would lead to a “hot spot”.

Q41. What conditions are necessary for Pilgrim to experience the hot spot following a severe accident?

A41. [JVR] In my opinion, the most likely meteorological conditions that might lead to a “hot spot” in the vicinity of Pilgrim would be related to precipitation starting after the release was underway. Similarly, most of the large release pathways for severe accidents are ground-level releases, so “hot spot” mechanisms associated with elevated releases would come into play.

Q42. How often do the meteorological conditions for a hot spot occur at the Pilgrim site?

A42. [JVR] I would estimate that the conditions that might lead to a precipitation “hot spot” in the vicinity of Pilgrim might exist 10% to 20% of the time. If the “hot spot” definition is expanded to include areas where a plume comes on shore, the frequency would likely be somewhat higher, perhaps 20 to 30 percent.

Q43. How did you determine how often the hot spot occurs at the Pilgrim site?

A43. [JVR] Climatological records for the area indicate that precipitation occurs on about 35% of the days. I started with the 35% and reduced the estimate assuming that precipitation in most cases precipitation is continuous for several hours at a time and that a “hot spot” is likely if a release occurs in the few hours before the onset of precipitation. I also looked at the meteorological data summary for 2001 in the Pilgrim MACCS2 run. It indicates that precipitation occurred on 2020 hours (23% of the year), and that precipitation started after the release about 14% of the time.

Q44. Does the MACCS2 code model the hot spot?

A44. [JVR] MACCS2 models meteorological conditions that could lead to a precipitation caused “hot spot.” It does not model “hot spots” that might be caused by the onshore arrival of an offshore plume.

Q45. How is the hot spot modeled in the MACCS2 code?

A45. MACCS2 calculated the deposition resulting from precipitation. The combination of wet deposition due to precipitation and the normal dry deposition results in areas that have greater surface contamination than areas only contaminated by dry deposition. MACCS2 models the onset of precipitation as a function of distance from the release point. Therefore, in my opinion, MACCS2 creates a hot spot whenever the onset of precipitation occurs at distances of more than 2 miles from Pilgrim.

Q46. Why is it reasonable to model a hot spot in this manner?

A46. [JVR]. This approach to dealing with “hot spots” is consistent with the general atmospheric modeling approach in MACCS2. The same general deposition mechanisms would be used in more complex models.

Q47. Assuming for a moment that the MACCS2 code does not account for the onshore arrival hot spot, in your expert opinion would inclusion of this hot spot result in the identification of any new cost beneficial SAMAs?

A47. [JVR] In my opinion, the modeling of “hot spots” is not essential to the evaluation of SAMAs and is unlikely to affect the identification of potentially cost beneficial SAMAs.

Q48. Why are you able to make this conclusion?

A48. [JVR] In many respects, the rationale for concluding that the MACCS2 treatment of hot spots is reasonable is similar to the rationale for concluding that explicit treatment of sea breeze events is not essential for SAMA analyses. A “hot spot” is a relatively small area compared to the model domain and the magnitude of “hot spots” would be small. Consequently the affect of the hot spot on the two spatially and temporally integrated parameters (population dose and economic cost) used in the SAMA analysis is small when a hot spot exists. Further, considering the frequency of conditions that might lead to a hot spot, the affect of hot spots on the climatological mean parameter values is even smaller. Finally, in the case of Pilgrim, the population dose and economic cost parameter values would have to increase by more than a factor of 2 before the next least costly SAMA would be identified in the screening process as being potentially cost beneficial. Therefore I can conclude that even if MACCS2 included effects from hot spots related to onshore arrival of plumes it would not lead to identification of another cost beneficial SAMA at Pilgrim.

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(Pilgrim Nuclear Power Station)	)	

AFFIDAVIT OFJAMES V. RAMSDELL, JR.

I, James V. Ramsdell, Jr., do hereby declare under penalty of perjury that my statements in the foregoing testimony and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

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