PR 50 and 52
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Pilgrim Watch's Comments Regarding Nuclear Regulatory Commission 10 CFR Parts 50 And 52, RIN 3150–AI10, [NRC–2008–0122] Enhancements to Emergency Preparedness Regulations [NRC Docket ID: NRC-2008-0122]

Pilgrim Watch's comments regarding the Nuclear Regulatory Commission 10 CFR Parts 50 and 52, RIN 3150–AI10, [NRC–2008–0122] Enhancements to Emergency Preparedness Regulations are provided in three sections. Section I, an introduction, expresses stakeholders dismay that the so-called enhancements fail to update emergency preparedness regulations as promised, regulations that have not changed in substance over 30 years. Instead NRC chose to primarily focus on hostile action based emergency planning issues; simply tinker around the edges on non-security issues; and ignore the flawed underlying assumptions upon which all plans are based. Section II shows that the proposed enhancements to emergency preparedness regulations fail to meet current scientific understanding regarding meteorology, dose assessment, and speed an accident requiring protective actions for the public may develop; Section III addresses Part (b) of the proposed regulations, non-security related issues.

I. Introduction

Respectfully we request that the NRC go back to the drawing board and redo the Draft Enhancements to Emergency Preparedness Regulations so that the regulations will address the important basic concerns brought forward by stakeholders who actively participated in the process since 2005.

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For example, representatives from public interest groups and local governments were invited to attend NRC stakeholder meetings in Washington on August 31 and September 1, 2005; the public meeting with non-governmental organizations (NGOs) on May 19, 2006; and subsequent meetings thereafter. During those lengthy meetings, participants documented weaknesses in emergency preparedness plans – comments that are on record. For example, stakeholders addressed the need to correct false assumptions that form the bases, or foundation stones, of emergency planning; identified serious shortcomings in notification systems, evacuation, sheltering and KI distribution plans; addressed the failure of plans to adequately provide for a large number of injured and contaminated; and reviewed weaknesses in exercises.

After the stakeholder meetings, NRC prioritized issues raised during the "fact-finding" process and decided to focus primarily on hostile action-based EP issues and simply tinker around the edges on a few non-security issues. Hostile action events are important; however "reasonable assurance[1]" cannot be provided to the public if the other areas identified are not addressed. The public deserves better; NRC can do better.

II. The Proposed Enhancements to Emergency Preparedness Regulations Fail To Meet Current Scientific Understanding Regarding Meteorology, Dose Assessment, and the Speed Accidents Requiring Protective Actions for the Public May Develop

The proposed rule outlines key skills in emergency planning; they include dose and dispersion assessment (NRC Proposed enhancements in the Federal Register –hereinafter "FR"- at 23278). Although NRC is obligated to base rules on current scientific understanding, NRC chose instead

[1] We note that NRC uses the term "reasonable assurance" but never bothers to define exactly what "reasonable assurance" is supposed to mean. We appreciate that there is a burden to prove "reasonable assurance" with a "clear preponderance" of the evidence [*North Anna Envtl., Coalition v. NRC*, 533 F. 2d 655, 667-68 (D.C. Cir. 1976)]. It is a two step process. It is necessary for NRC to define what level of assurance is "reasonable assurance." For example is it 51%, 99%, or some place in between? Absent a standard, the term "reasonable assurance" has no meaning. For an analogy if the public were told that there was "reasonable assurance" that evidence showed that the rebuilt levees in New Orleans had a 51% probability to withhold water in a storm they would feel far less confident than if they were told that there was "reasonable assurance" from the evidence that there was a >90% chance that they would hold. The public needs a precise definition of "reasonable assurance"- a standard- in these regulations.

in this rulemaking to ignore current scientific understanding regarding dispersion (meteorology and the straight-line Gaussian Plume Model that provides the basis for current emergency planning's "key-hole" concept); ignore current scientific understanding regarding potential releases in a nuclear reactor accident; and ignore the rapid speed that accidents can develop that require protective actions by the public. Until these "foundation stones" to emergency planning are corrected, so that they reflect current scientific understanding, emergency preparedness regulation will fail to provide "reasonable assurance" for the public, irrespective of whether the regulation is for a security or non-security event.

A. Current Scientific Understanding Regarding Meteorology & the Straight-line Gaussian Plume Model ("Key Hole")

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

Plume Modeling – the key-hole: Currently, the NRC, FEMA, State Emergency Management Agencies and KLD [the primary contractor for preparing Evacuation Time Estimates] base regulation, guidance and time estimates on outdated and simplistic assumptions for plume transport models that do not reflect conditions at many, if not all, reactor sites.

Guidance and regulations use steady-state, straight-line plume transport models. The plume supposedly functions much like a beam from a flashlight; this incorrectly assumes that radiation moves in a relatively narrow plume with a size and shape like a key-hole[2]. However actual wind

[2] **NUREG 1887: RASCAL version 3.0.5** is a code, developed in 2007 by NRC. It is currently in use by NRC's emergency operations center for making dose projections for atmospheric releases during radiological emergencies. It uses the **straight-line Gaussian plume** in the "near field" and simply a 2-dimensional puff model in the "far field." Neither the NUREG nor the workbook [NUREG 1889] provides a precise distance for what constitutes the near or far field. Regarding the straight-line Gaussian plume, the NUREG at 4.12 admits that, "...the meteorological *conditions are assumed to be horizontally homogeneous and stationary*. This means that the wind direction and speed responsible for transporting the plume from the release point to the receptor and the turbulence responsible for diffusion are assumed not to change with location throughout the model domain. It also means that the meteorological *conditions do not change as a function of time* during the release and time required for transport. Together, *these assumptions constrain the usefulness of the straight–line plume model* to estimating concentrations and doses at receptors near the release point for short-duration releases; at longer distances another model is required." **Regarding adjusting wind field for topography**, the NUREG counsels that, "If the meteorological

and weather conditions are variable and complex affected by sea/lake breezes, terrain, river valleys, location/clustering of buildings, and variable precipitation. Radiation in an accident will travel in a complex and variable manner at sites at these locations.[3] Therefore the "key-hole" concept has no basis in reality. It is a figment of planers imagination.

Example: NUREG-0654 FEMA-REP 1 Rev. 1 Supp.3- Appendix I states that,

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

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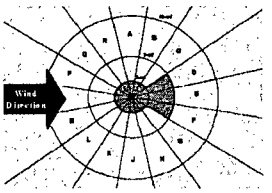
stations reporting data are well placed with respect to major topographic features, the wind fields developed by interpolation will give reasonable puff trajectories. However, *with one meteorological station or a small number of stations, the wind fields may not properly reflect the effects of topography.*" **Regarding Meteorological Input data** (6.3), the NUREG warns that, "The adjusted wind field is most accurate near stations and along trajectories that pass near stations. Wind fields are less accurate elsewhere. Thus, *it is desirable to have wind data near the release point and, if possible, at downwind locations.*" In summary, RASCAL 3.0.5 rests of 1970's technology; it is a simplistic model.[Emphasis added]

[3] See: State Of New York's Motion For Summary Disposition On Use Of Straight Line Gaussian Air Dispersion Model For The Environmental Impact Analysis Of Significant Radiological Accidents At Indian Point And NYS Contention 16/16A,(DPR-26, DPR-64) August 28, 2009 and accompanying Declaration Of Bruce A. Egan, Sc.D., Statement of Material Facts not in Dispute, and Exhibits, NRC Electronic Library, Adams Accession Number ML 092610906; Pilgrim Watch Answer Opposing Entergy's Motion for Summary Disposition of Pilgrim Watch Contention 3, June 2007- Adams Accession Number ML071840568; Declaration Dr. Bruce Egan, June 2007 attached to Pilgrim Watch's Answer - Adams Accession Number ML071840568; Pilgrim Watch Petition for Review of LBP-07-13, Memorandum and Order (Ruling On Motion To Dismiss Petitioner's Contention 3 Regarding Severe Accident Mitigation Alternatives), 2-1 Decision, October 30, 2007-Adams Accession Number ML083240599; Pilgrim Watch's Brief in Response to CLI-09-11 (Requesting Additional Briefing), Adams Accession Number ML091830846; Pilgrim Watch's Brief in Response to Entergy's Response to CLI-09-11, Adams Accession Number ML091950452;Pilgrim Watch's Brief in Response to NRC Staff's Initial Brief in Response to CLI-09-11, Adams Accession Number ML091950450; What's in the Black Box, Dispersion, Prepared for 2009 National Radiological Emergency Planning Conference, Stephen F. LaVie, Sr. Emergency Preparedness Specialist, Nuclear Security and Incident Response, Division of Preparedness and Response, Adams Accession No. ML091050257



Meteorological Data: Licensees are not required by the NRC to use complex plume models and meteorological data from multiple weather stations; instead they are allowed to base inputs to their simplistic straight-line Gaussian plume model from the single or perhaps two meteorological towers onsite. The on-site "met tower" only tells what the wind direction is onsite but not what happens to the plume as it travels offsite. Computerized combination weather-radiation monitors located appropriately in offsite communities are needed and readily available.[4] Only when NRC requires that licensees have such monitors placed in appropriate offsite locations, determined by a meteorological site-specific analysis, will protective action calls be based on fact.[5]

Implications for emergency planning: By relying on the straight –line Gaussian model to construct a "key hole" planners are likely to make the wrong call - send citizens into a plume; tell folks to stay put when should evacuate; or tell them to evacuate when they should shelter. Complex plume models appropriate to these sites are readily available today and must be required by NRC. For example, the CALPUFF model is appropriate for simulating transport and dispersion in wind fields that change with space and time (Scire, et al., 2000a). It is often coupled to CALMET (Scire, et al., 2000b), a model that computes the needed wind and dispersion fields from meteorological data. CALPUFF may also be coupled to a full mesoscale meteorological flow model such as MM5.[6]

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[4] Ibid

[5] NUREG 1857: "**Regarding adjusting wind field for topography**, the NUREG counsels that, "If the meteorological stations reporting data are well placed with respect to major topographic features, the wind fields developed by interpolation will give reasonable puff trajectories. However, *with one meteorological station or a small number of stations, the wind fields may not properly reflect the effects of topography.*" **Regarding Meteorological Input data** (6.3), the NUREG warns that, "The adjusted wind field is most accurate near stations and along trajectories that pass near stations. Wind fields are less accurate elsewhere. Thus, *it is desirable to have wind data near the release point and, if possible, at downwind locations.*" In summary, RASCAL 3.0.5 rests of 1970's technology; it is a simplistic model."[Emphasis added]

[6] Ibid, Egan Declarations

Although the "key hole" is contradicted by actual weather analysis; it allows for limited resources to appear adequate – providing false assurance and guaranteeing that communities will be caught short in a disaster. Example: Pilgrim's Radiological Emergency Response Plan and Standard Operating Procedures say that school busses housed in upwind EPZ communities and other emergency resources may be directed to downwind EPZ community/communities at the time of the emergency call. Because "downwind" and "upwind" communities are a fiction in Pilgrim's coastal environment where winds are highly variable, the so-called "upwind" communities will be left high and dry and there will be needless chaos and suffering because adequate resources were not pre-arranged to respond from communities well outside the Emergency Planning Zone.

NRC, DOE, EPA, State Officials, Nuclear Trade Groups, & Air Dispersion Modeling Community Agree That Straight Line Gaussian Plume Models Cannot Account For the Effects of Complex Terrain on the Dispersion of Pollutants from A Source [7] (Appendix A lists pertinent documents)

Since the 1970s, the USNRC has historically documented advanced modeling technique concepts and potential need for multiple meteorological towers appropriately located in offsite communities, especially in coastal site regions. But ignored implementing its' own advice. As recent as this year, NRC made a presentation to the 2009 National Radiological Emergency Planning Conference;[8] and NRC concluded that the straight-line Gaussian plume models cannot accurately predict dispersion in a complex terrain and are therefore is scientifically defective for that purpose [full presentation is available at ML091050226, ML091050257, and ML091050269 (page references in Appendix A refer to the portion attached, Part 2, ML091050257).] Likewise, EPA recognized the need for complex models. For example, EPA's 2005 Guideline on Air Quality Models states in Section 7.2.8 *Inhomogenous Local Winds* that, "In very rugged hilly or mountainous terrain, along coastlines, or near large land use

[7] Ibid. Note that Egan's Declaration for Pilgrim Watch focuses on coastal communities, reactors on large bodies of water; Egan's Declaration for the New York Attorney General' s Office focuses on reactors located in complex terrains characterized by river valleys, mountainous and hilly terrains.

[8] Ibid, see: State Of New York's Motion For Summary Disposition On Use Of Straight Line Gaussian Air Dispersion Model For The Environmental Impact Analysis Of Significant Radiological Accidents At Indian Point And NYS Contention 16/16A,(DPR-26, DPR-64) August 28, 2009 and accompanying Declaration Of Bruce A. Egan, Sc.D., 18- ADAMS ML 092610906

variations, the characterization of the winds is a balance of various forces, such that the assumptions of steady-state straight line transport both in time and space are inappropriate." (FR 11/09/05) Most important, EPA's November 2005 Modeling Guideline (Appendix A to Appendix W) lists EPA's "preferred models" and the use of straight line Gaussian plume model, called ATMOS, is not listed.[9] DOE, state officials, nuclear trade groups and air dispersion modeling experts have reached the same conclusion.

Emergency Planning Zone (EPZ) 10 miles- Potential Impact Much Wider:

The NRC has known for a long time that the consequences from an accident can extend beyond 10-miles. For example, in 1982 the Sandia National Laboratory calculated reactor accident accidents for US Nuclear Plants[10] - those calculations extended well beyond 10-miles and were conservative. Example: core melt at Pilgrim NPS, would result in a 20 miles peak 1st year fatal radius; a 65 miles peak 1st year injury radius.

Spent Fuel Pools: Vulnerability analyses of spent fuel pools show that spent fuel pools are not immune to accidents resulting from equipment failure, personnel mishaps, or acts of malice. The consequences of a spent fuel pool accident are likely to exceed the consequences from a core accident because of the far greater amount of radioactivity in the pool.[11] For example, at Pilgrim the inventory of long-lived radionuclides, such as Cesium-137, in the spent fuel pool is eight times that in the reactor core. For reference, consider that the 1986 Chernobyl accident released 2,403,000 curies of C-137; whereas Pilgrim's core, for example, during license extension will have 5,130,000 curies of C-137; and at Pilgrim the inventory of long-lived radionuclides, such as Cesium-137, in the spent fuel pool is eight times that in the reactor core.[12] However emergency

[9] http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

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

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

[12] Ibid

planners ignore accidents in spent fuel pools despite analyses performed by the Massachusetts and New York Attorney General's Offices in license renewal adjudication cases.

Prior to the filings of the Massachusetts and New York State Attorney Generals in license renewal, the National Academy of Sciences, *Safety and Security of Commercial Spent Nuclear Fuel Storage Public Report*, April 2005, said that if a terrorist attack on the spent fuel pool leads to a zirconium cladding fire; it could result in large amounts of radioactive material spreading hundreds of miles.

> "Finding 3B ... a terrorist attack that partially or completely drained a spent fuel pool could lead to a propagating zirconium cladding fire and the release of large quantities of radioactive materials to the environment. Details are provided in the committee's classified report." NAS, 6
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> "Such (zirconium cladding) fires would create thermal plumes that could potentially transport radioactive aerosols hundreds of miles downwind under appropriate atmospheric conditions." NAS, 50
>
> "The excess cancer estimates ...to between 2,000 and 6,000 cancer deaths." NAS, 45

The most recent and comprehensive discussion of spent fuel pool vulnerability and consequences were in response to NRC's Waste Confidence Decision Update, NRC's Rulemaking Docket, NRC-2008-0428 at http://www.nrc.gov/reading-rm/doc-collections/rulemaking-ruleforum/rulemaking-dockets/2008/index.html by Texans For A Sound Energy Policy And Commenters On Proposed Waste Confidence Decision Update And Proposed Rule Regarding Consideration Of Environmental Impacts Of Temporary Storage Of Reactor Operations Prepared By Ms. Diane Curran, Esq; New York Attorney General's Office, 02,06,09, comment 26; and Comment of The Offices of the Attorneys General of the States of New York and Vermont and the Commonwealth of Massachusetts on Waste Confidence Decision Update and Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation 2009/02/06, Comment (21)

Meteorology: The likely spread of radiation beyond 10- miles that necessitates protective action for the public requires planners to understand current meteorological understanding concerning the flow of air in coastal areas, river valleys, lake regions, and hilly terrain. Winds are variable in these locations and the spread of a concentrated release of radiation may be carried at a far greater distance.

Planning should, but does not, reflect understanding of the flow of air over and around large bodies of water. As an example at Pilgrim, located on New England's Coastline, winds initially headed out to sea will remain tightly concentrated due to reduced turbulence over water until the winds blow the puffs back over land.[13] This can lead to hot spots of radioactivity in unexpected places - beyond 10 miles that should be instructed and prepared to take protective actions. For example, the compacted plume could be blown ashore to Cape Cod, directly across the Bay from Pilgrim and heavily populated in summer. The summer population is about 600,000, the year round about 210,000. However because the Cape is outside the 10 - mile EPZ, there are no plans to evacuate or shelter the population in the event of a radiological disaster at Pilgrim.

The State Of New York's Motion For Summary Disposition On Use Of Straight Line Gaussian Air Dispersion Model For The Environmental Impact Analysis Of Significant Radiological Accidents At Indian Point And NYS Contention 16/16A, (DPR-26, DPR-64) August 28, 2009, Declaration of Bruce A. Egan, Sc.D., explains that concentrated radiation can spread at distances far greater than 10-miles along river valleys.

[13] Zager M, Tjernstrom M, Angevine W. 2004, New England coastal boundary layer modeling. In: AMS 16th Symposium on boundary Layers and Turbulance, August 2004, Portland, Maine. Angevine WM. Tjernstrom M, Senff CJ, White AB. 2004. Coastal Boundary layer Transport of urban pollution in New England In: 16th Symposium of boundary layers and turbulence Portland, Maine, 13th Symposium on Turbulance and diffusion, August 2004, Portland, Maine. Angevine WM. Tjernstrom M, Zager M. 2006. Modeling of the Coastal Boundary Layer and Pollutant Transport in New England, J. of Appl. Meteorol. & Climatol. 45: 137-154. Scire JS, Strimaitis DG, Yamatino RJ. 2000 A User's Guide for the CALPUFF Dispersion Model (Version 5). Concord MA: Earth Tech, Inc.

B. Emergency Dose Assessment

Accurate and honest dose assessment is a key element in emergency response – the quantity and types of radionuclides. NRC, FEMA and state planners downplay the potential consequences of a radiological disaster at a nuclear plant. This began by NRC after TMI when offsite emergency response plans were designed for commercial reactors. NRC mischaracterized the accident then and continues to do so today.

TMI Facts: TMI's radiation monitors onsite were off-scale. All radiation estimates are based upon off-site dose readings to which mathematical assumptions were applied. We know that:

- Early on in the accident, the NRC estimated that 10,000,000 Curies of radiation were released. The NRC estimate is based on a report by NRC manager, Mr. Lake Barrett.NUREG-0637, Appendix C. Barrett used time averaged plume dispersion (Chi/Q); assumed the center (highest concentration) of the plume hits the detector; and then averaged many days of releases. Time averaged plume dispersion can be wrong, on the low side by a factor of 10. Center line Chi/Q can be wrong on the low side by a factor of a 1000. Averaging the data is wrong on the low side by a factor of 3.4. Barrett recorded the maximum curies released each day; the grand total of each day's recording adds up to 36,062,000; yet NRC insists that only 10,000,000 curies were released.
- During the 1994 TMI Trial, John Daniel (industry's expert), determined that 17,000,000 Curies were released. Industry's own expert estimated that more radiation was released than the NRC, the guardian of public safety. Another industry expert report by Dr. Sinovy V. Reytblatt, structural engineer from the University of Bridgeport, estimated that 8-10% of containment was released as result of the spike in pressure inside the containment. The containment had 10 billion curies – 10%= 1 billion curies.
- A thorough analysis of the TMI accident indicates that releases were 100 to 1000 times higher than the NRC estimated and that the containment failed after the hydrogen detonation.[14]

[14] http://www.nirs.org/reactorwatch/accidents/tmipowerpoint.pdf

- However NRC and FEMA continue to misrepresent the consequences of TMI to justify reducing the area required for protective actions and generally water down plans and exercise scenarios. NRC's Senior Advisor for Emergency Preparedness, Patricia Milligan, explained this to a class in Boston, August 2008. [15] She said that emergency plans for the public were written right after TMI. At that time the extent of core damage was unknown; NRC maintained that releases were minimal (10,000,000 curies) and claimed that there were no radiation-linked health effects offsite. However she said that today NRC fully appreciates that the accident was far more serious then was thought at the time NRC wrote and required offsite emergency plans. Despite that fact, NRC assures TMI's releases were relatively small and there were no radiation-linked disease in the communities. Therefore, NRC concludes that emergency plans written after TMI were too conservative and now can be scaled back. This is an incorrect conclusion; it rests on false data about the true extent of releases from TMI and health effects in the population. Subsequent studies show radiation-linked disease in the communities exposed from TMI. [16]

C. Plans Incorrectly Assume Slow Breaking Accidents

NRC and FEMA argue that they do not have to assume a "worst case scenario;" however we believe that it does not follow that this allows planning simply for the "best case scenario." Plans and the proposed enhancements assume a slow breaking accident. Data in NRC's own rules indicate otherwise.

NUREG-0654 FEMA-REP 1 Rev. 1 Supp.3- Appendix I: Example BWR Sequences P. 1-18 says that,

> Transient (loss of offsite power) plus failure of core shut down systems (scram). Could lead to core melt in several hours with significant potential for containment failure. More severe consequences if pumps trip does not function.

[15] Theory explained by NRC Patricia Milligan as lecturer at Harvard School Public Health, Radiological Emergency Planning: Terrorism, Security, and Communication August 7, 2008.

[16] Wing S, Richardson D, Armstrong D, Crawford-Brown D. A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Plant: The Collision of Evidence and Assumptions. Environmental Health Perspectives 1997.105(1):52-67; and the utility paid out more than $15 million in settlements to citizens for damages.

> Small or large LOCAs with failure of ECCS to perform leading to core melt degradation or melt in minutes to hours with significant potential of loss of containment integrity.
>
> Estimates of containment performance under severe accident conditions are based on information in Chapter 9 of NUREG-1150, "*Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*," December 1990.

Assuming a slow breaking accident is especially unrealistic post 9/11 and in the consideration of the large inventory of spent fuel stored in overcrowded pools on site at reactors. Emergency planning should be designed to account for the full spectrum of potential consequences, including the so-called "fast-breaking" release scenarios in which radioactive releases would begin within 30 minutes after an attack. This is one of the major conclusions of the report conducted for the government of New York by James Lee Witt Associates.[17] Certain terrorist attack scenarios could be capable of causing such rapid releases.

III. NRC Enhanced Rule Section (b), Non-Security Related Issues

A. Backup Means for Alert and Notification Systems

The proposal revises Part 50, Appendix E, section IV. D.3. It would "require backup measures to be implemented when the primary means of alerting and notification are unavailable." The specifics are described in Section V, Federal Register[18] [hereinafter FR] at 23275. NRC proposes the following.

1. NRC's rule does not specify which backup measures are required to allow "flexibility."

Pilgrim Watch (hereinafter "PW") Comment: It is acceptable not to specify which particular backup measures are required; however it is necessary for NRC to require that whatever backup measure is chosen that it must have the same capability to be heard and understood by the public. In other words, a standard of capability must be set.

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[17] *Review of Emergency Preparedness of Areas Adjacent to Indian Point and Millstone,* James Lee Witt Associates, 2003, http://www.wittassociates.com/search.xml

[18] Federal Register, Vol. 74, No. 94, Monday, May 18, 2009, Proposed Rules

2. NRC's rule does not impose specific time requirements for using a backup method based on the assumption that, "State and local officials will have substantial time available to make a judgment regarding activation of the warning system to alert and notify the public."

PW Comment:

a. The assumption underlying the proposal is incorrect. NRC assumes that the accident is slow breaking. NRC specifically said that, "State and local officials will have substantial time..." The luxury of "substantial time" cannot be assumed[19] and especially post 9/11, discussed above at C, page 11.

b. NRC's own emergency management specialist recently said that a short and specified time for using a backup method must be required. See *What's in the Black Box Known as Emergency Dose Assessment*, Stephen LaVie, Sr. Emergency Management Specialist, NRC, 2009 National Radiological Emergency Planning Conference [20] in which he said, "timely protective actions, preferably prior to the start of the release, were necessary for protecting the public" [slide 5].

3. *NRC: Guidance provided regarding the need to ensure that the backup methods could alert and notify the public in the entire plume exposure pathway EPZ. However the backup means could be designed to be implemented using a phased approach in which populations most at risk*

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[19] NUREG-0654 FEMA-REP 1 Rev. 1 Supp.3, July 1996, P. 1-17; 1-18

Example BWR Sequences

a. Transient (loss of offsite power) plus failure of core shut down systems (scram). Could lead to core melt in several hours with significant potential for containment failure. More severe consequences if pumps trip does not function.

b. Small or large LOCAs with failure of ECCS to perform leading to core melt degradation or melt in minutes to hours with significant potential of loss of containment integrity.

Example PWR Sequences

a. Small and large LOCAs with failure of ECCS to perform leading to severe core degradation or melt in from minutes to hours. Ultimate failure of containment possible for melt sequences. (**Several hours likely** to be available to complete protective actions unless containment is not isolated)

b. Transient initiated by loss of feedwater and condensate systems (principal heat removal system) followed by failure of emergency feedwater system for extended period. Core melting possible in several hours. Ultimate failure of containment possible if core melts.

Estimates of containment performance under severe accident conditions are based on information in Chapter 9 of NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," December 1990.

[20] *What's in the Black Box Known as Emergency Dose Assessment*, Stephen LaVie, Sr. Emergency Management Specialist, NRC, 2009 National Radiological Emergency Planning Conference Adams Accession Number ML091050226

are alerted and notified first, followed by notifying those in less immediately affected areas within the EPZ.[Emphasis added]

PW Comment:

a. In order to provide "reasonable assurance" requirements are needed. In first line change "Guidance provided" to "there is a requirement that;"and change "could alert" to "shall alert."

b. PW objects to a phased approach inside the EPZ for the following reasons.

(1) Licensees and planning officials have no clear idea what populations are most at risk. This is because: (a) NRC allows licensees to use a straight-line Gaussian plume model that ignores in coastal areas, river valleys and hilly terrain, the plume travels in a variable manner so that it will not be possible for authorities to accurately determine which populations within the EPZ are most at risk, as explained above in Section I. (b) NRC allows licensees to assess meteorological conditions on the basis of the onsite anemometer which can tell where the plume is going onsite but not where it goes offsite, as explained in Section 1 above.

(2) The phased approach ignores the fact that today's communication capabilities assure that news will travel quickly – emails, text messaging, cell phones, etc. We are a highly interconnected society. News of the disaster will travel fast and those not considered by authorities as being "most at risk" will self evacuate anyway. It is both naïve and dangerous to think otherwise; dangerous because permitting a phased approach means that it is unlikely that sufficient personnel and equipment will be available and at the ready to control a large scale evacuation.

(3) The phased approach ignores "shadow evacuation." Studies regarding "shadow evacuation" inside and outside the EPZ indicate that the public will respond once they become aware. Examples: Three Mile Island: the Pennsylvania Governor issued an evacuation advisory (note, it was not an order). It was expected to have precipitated the flight of only 3,400 people (pregnant women and pre-school children within five miles of the plant); instead, a total of 144,000 people (a government figure) evacuated the surrounding region. Subsequent surveys in New York by

Dr. Zeigler indicated that the public outside the 10-mile EPZ would evacuate once they heard there was a nuclear emergency. Recognizing that the public has a greater fear of radiation than natural disasters, a shadow evacuation occurred during Hurricane Floyd in 1999 and Hurricanes Katrina and Rita. Again in a chemical accident, the shadow evacuation was studied and documented in the Graniteville South Carolina chlorine spill in 2005. [21]

(4) Employing a phased approach will undermine authority. It is essential for planning that the public trust the authorities in order for there to be some assurance that the public will follow directions. If the authorities only inform some of the population, or appear to inform the population in a piecemeal fashion, irrespective of intentions, they will lose all credibility, increasing the likelihood of a chaotic response.

c. PW General Comment Primary & Back-Up Methods Notification

(1) Require Diverse Primary Systems: Sirens are the primary method of public notification; however they are essentially outdoor warning systems and often cannot be heard above normal ambient noise by people who live and work inside. This is especially true in cooler climates where houses are insulated and outfitted with storm windows; in hot climates where air conditioners are standard; and in suburban and exurban areas where houses are set back on sizeable lots with generous landscaping that buffers sound. We recommend that rapid dialing systems, electronic reader boards, low frequency dedicated radio capability and EAS be required. As technology advances, notification system must be updated.

a) Rapid dialing systems have the capability to notify workers and every household and business within the EPZ in less than 15 minutes by telephone, fax, email, text messaging.

[21] Zeigler, Donald, Johnson, James, Jr., "Evacuation Behavior In Response To Nuclear Power Plant Accidents," The Professional Geographer, May, 1984; Zeigler, Donald, Testimony Prepared for Westchester County Legislature, Dec 13, 2001, http://www.closeindianpoint.org/evacuation_testimonial.htm; Witt, James Associates, "Review of Emergency Preparedness of Areas Adjacent to Indian Point and Millstone," James Lee Witt Associates, March 2002, http://www.wittassociates.com/index.xml; Seminole County Division of Emergency Management, Evacuation Plans, http://www.seminolecountyfl.gov/dps/em/emprep_evacuation.asp; Duhe,Duke, Evacuation Behavior in Response to the Graniteville, South Carolina, Chlorine Spill, Hazards Research Lab, University South Carolina, 2005, http://www.colorado.edu/hazards/research/qr/qrl178/qr178.html

They should be required and tested regularly. These telephone systems, today's version of the Town Crier, are on the market and readily available today.

(b) Reader boards should also be required along our roadways to provide notification to motorists that there is an accident; the protective action recommended; and alternative routes, if required. They, too, belong in test scenarios.

(c) In addition, we recommend that low frequency dedicated radio capability is required along our major evacuation routes and roadways.

(d) EAS must be tested and also in testing to determine whether citizens with Satellite dishes can receive EAS TV alerts.

Problems with current notification systems are underscored in a recent GAO document, EMERGENCY PREPAREDNESS, Improved Planning and Coordination Necessary for Development of Integrated Public Alert and Warning System, Sept 30, 2009, GAO-09-1044T. Although the report does not reference nuclear reactor accidents; it seems clear that GAO's comments apply here. GAO concludes at page 12 that,

> Emergency communications are critical in crisis management and for protecting the public in situations of war, terrorist attack, or natural disaster; yet, FEMA has made limited progress in implementing a comprehensive, integrated alert system as is the policy of the federal government. Management turnover, inadequate planning, and a lack of stakeholder coordination have delayed implementation of IPAWS and left the nation dependent on an antiquated, unreliable national alert system. FEMA's delays also appear to have made IPAWS implementation more difficult in the absence of federal leadership as states have forged ahead and invested in their own alert and warning systems. In order that IPAWS achieve the federal government's public alert and warning goals, it is essential that FEMA define the specific steps necessary in realizing a modernized and integrated alert system and report on the progress toward achieving that end. Additionally, effectively implementing an integrated alert system will require collaboration among a broad spectrum of stakeholders.

2. Back-Up Systems:

a. Sirens are important outdoor warning systems and all should be required to have backup power. Pilgrim Watch disagrees with FEMA's draft that says, "Backup power for fixed sirens is not required unless mandated by other regulation or legislative act." At the General Emergency NUREG 0654, Supp. 3 calls for State and/or Local Offsite Authority to, "Activate *immediate* public notification of emergency status and provide public periodic updates," [Emphasis added.] If fixed sirens do not work and backup coverage "theoretically" can take 45 minutes, public notification cannot be considered to be "immediate." There is reason for immediacy, defined as within 15 minutes, because the sooner the public knows to take protective actions the greater probability that consequences will be reduced. Prompt notification followed by prompt protective actions during an emergency is central to providing reasonable assurance that public safety will be best protected.

b. Route Alerting is another standard back-up system. It calls for local emergency personnel to drive up and down streets where sirens fail to warn residents over their PA system. Route notification may take considerably longer than 15 minutes; it cannot be assumed only one or so closely located sirens fail. Route notification is a waste of now scarce human resources (budget cuts to local communities has resulted in reducing emergency management resources) and is not likely to accomplish the task. For example, the towns within Pilgrim's Emergency Planning Zone have large wooded areas; and areas with houses on large lots sited and landscaped to provide privacy and quiet - away from the street and traffic noise. Also many EPZ communities have many miles of roads – Duxbury, for example, has >127.54 miles of roads. Plymouth, the host community, and largest town in the Commonwealth, has >521 miles of roads. It is clear that: (1) Local emergency personnel are not capable of covering roads in approximately 15 minutes, if sirens fail at a distance from one another and from emergency personnel headquarters and many fail at once– too many miles of roads, too few personnel; (2) The PA systems or bullhorns on those vehicles are unlikely to be heard inside due to how property is sited, landscaped, insulated and the real uncertainty of whether windows will be open.

B. Emergency Declaration Timeliness

NRC's proposed rule opted to propose a capability criterion rather than an "inflexible performance criterion." It "would allow licensees some degree of flexibility during an actual radiological emergency in addressing extenuating circumstances that may arise when an emergency declaration may need to be delayed in the interest of performing plant operations that are more urgently needed to protect public health and safety." [34] The changes are discussed in Section V, at FR 23274-75.

Section V, FR 23275: Licensees must have the capability to assess, classify, and declare an emergency condition within 15 minutes. "The licensee would be expected to, but not required, to declare the emergency condition once it had been determined that the condition cannot be corrected before the specified duration is exceeded."

PW Comment: PW objects because the proposal does not properly distinguish between notification requirements offsite versus notification requirements onsite. The public offsite must be notified within 15 minutes so that they can take the proper protective actions in order to reduce consequences in a radiological disaster. Again we refer for support to *What's in the Black Box Known as Emergency Dose Assessment*, Stephen LaVie, Sr. Emergency Management Specialist, NRC, 2009 National Radiological Emergency Planning Conference said, "timely protective actions, preferably prior to the start of the release, were necessary for protecting the public." [slide 5] Therefore requiring a short and specific time for notifying offsite follows. In contrast, it seems reasonable to provide flexibility for onsite to allow the licensee to assign personnel to jobs to try to control the accident before assigning those personnel to onsite emergency response duties.

C. Emergency Operations Facility—Performance-Based Approach

1. NRC's proposed rule, Consolidated Facilities: In response to requests for NRC approval to combine EOFs for plants within a state or in multiple states into a consolidated EOF, NRC would no longer require "near-site" facility. The original EOF siting required called for the

facility to be located near the reactor and imposed a 20-mile upper limit, later modified to 25 miles. Rationale provided includes: advances in computer and communication technology; "nuclear utility consolidation has resulted in initiatives to standardize fleet emergency plans, use consolidated EOFs, and staff EOFs by designated corporate personnel. Standardized plans, implementing procedures, and accident assessment tools... allow emergency responders in a consolidated facility to effectively perform their functions for multiple sites, even if the EOF in not a near-site facility." NRC Functional Requirements Consolidated Facilities: Section V, FR 23273, not require near-site facility; instead a performance-based approach that they meet certain functional requirements.
The requirements are listed on FR 23276.

PW Comment Consolidated Facilities: PW objects to consolidated facilities for the following reasons.

a. Reactors differ in design (PWRs, BWRs); age; history of repairs and partial repairs; quirks; site-specific characteristics of the surrounding communities. Therefore it is likely that there would be a loss or degradation of knowledge base at a consolidated EOF.
b. Allowing a consolidated EOF incorrectly assumes that there will be no communication issues. If the EOF is close to the site, within 10- 25 miles, likelihood increased that supplemental and less sophisticated communication will function.

2. NRC: Provisions for NRC & Offsite Officials to Relocate to Facility Nearer Reactor: If the EOF is located >25 miles from the site then have provisions for NRC site team and offsite agency responders closer to the site (10-25 miles from site); or if EOF < 10 miles from site, then need a backup facility within 10-25 miles.

PW's objections to near and far facilities:

a. What overlap in capability is there for near and consolidated EOFs? If they have the same capability, as they should, what is the rationale for a consolidated EOF, other than saving the energy company money?

b. Who is in charge, those in the near or consolidated facility? Split control, authority, is usually a bad idea for minute to minute decision-making before the conclusions are fed up the chain of command. Communication and decision-making is more effective when players can walk across the room to effectively communicate than to do so over the computer or phone. In the later case information is lost

D. Evacuation Time Estimate Updating

1. NRC: Current regulations do not require any review or revisions of ETE's following initial licensing. Proposed NRC Rule [Section V, FR 23273]: Within 180 days 2010 census [expected in 2011], ETE revisions submitted to NRC for review and approval.

PW Comment: PW agrees that there must be review by the NRC of ETE's based upon population changes.[22]

2. Thereafter licensees required to review changes in population EPZ and most populous EPZ planning area (ERPA). NRC's rationale: Population density in EPZ generally not homogenous and EPZ evacuation times are significantly influenced by the ERPA with the largest population." ERPAs are local areas typically defined by geographic or political boundaries that are used to communicate protective actions to members of the public in familiar geographic terms. When new population, including transient and permanent residents, in either EPZ or ERPA would be less than 90% or greater than 110% of the population that formed the currently approved ETEs, the licensee would be required to update the ETE. The NRC considered review of all ERPAs or individual counties and States in addition to the whole EPZ. "Review of ERPA with the largest populations was considered to be a reasonable balance between the burdens on the

[22] PW makes note that the Boston Globe, September 8, 2009, Immigration activists urge census boycott, Hope effort spurs legislation, Maria Sacchetti reported that "A small but vocal group of advocates is urging illegal immigrants and their supporters nationwide to boycott the 2010 Census to protest the government's inaction on immigration legislation." The proposed boycott - organized this spring by the National Coalition of Latino Clergy and Christian Leaders, a group based in Washington that represents 20,000 churches nationwide. If the census boycott is successful, population counts around reactors with significant percentages of immigrants would be significantly undercounted. How does NRC and FEMA plan to deal with this?

licensees... and need to ensure that the ETE is accurate because the ERPA with the largest population is generally the one with the most impact on evacuation times."

PW Comment, Objection:

a. NRC's assumption that, "the ERPA with the largest population is generally the one with the most impact on evacuation times" is not necessarily true. PW contends that the greatest impact on evacuation times is the density of the population in communities that abut and/or feed into the major evacuation routes. This is because of shadow evacuation, both inside and outside the official EPZ – a phenomena not fully appreciated by the NRC. Examples of the shadow evacuation are provided in the foregoing at 14.

b. PW contends that the regulation should, but currently does not provide detailed functional requirements for ETEs. We base this comment on an analysis of *KLD Pilgrim Nuclear Power Station Development of Evacuation Time Estimates*, Prepared for Entergy Nuclear Northeast by KLD Associates, Inc. October 2004, KLD TR-382. Pilgrim's KLD is fundamentally similar in its assumptions and methodology to ETEs prepared by KLD for other reactor sites.

(1) KLD ignored peak traffic periods. NRC must require that ETEs consider peak traffic periods - holidays, peak commuter traffic, and inclement weather coinciding with peak traffic periods.

(2) KLD incorrectly assumed the straight-line Gaussian Plume Model. However in coastal locations, lake regions, river valleys and hilly terrain a variable trajectory model is required. KLD by incorrectly assuming a straight-line Gaussian plume incorrectly assumes that not everyone within 10 miles of the reactor would have to evacuate, instead of only those 2-miles around and others in the direction of the narrow radiation plume, most within the 2-5 mile wedge. If a variable trajectory model was used clearly a greater number of people would be required to evacuate. NRC must require that ETEs base their estimates on a site appropriate plume model. (Please refer to Section I)

(3) KLD does not consider a severe accident in making evacuation time estimates whereby citizens beyond 10 miles would be required to take protective action. Granted NRC does not require the "worst case scenario" but neither is it proper to consider only the "best case scenarios" especially post 9/11 and with large inventories of assemblies stored onsite in spent fuel pools never designed to hold that large of an inventory.[23] Further, underestimating the likely spread of contamination flows from NRC's continued under-representation of the actual consequences of TMI, discussed in Section I.

(4) KLD ignored shadow evacuation of those outside the 10 mile zone. NRC must require the consideration of shadow evacuation occurring both inside and outside the EPZ.

E. Amended Emergency Plan Change Process

1. NRC's proposed rule regarding changes that result in a "reduction in effectiveness." *The proposed rule says that the License Amendment process is correct process to use in reviewing submittals involving a proposed emergency plan change that "the licensee has determined constitutes a reduction in the effectiveness of the plan." [46] Section V, FR 23271: "The phrase 'reduction in effectiveness' would be an evaluation concept that would be used... to differentiate between changes that the licensee would be allowed to make without prior NRC approval and those that would require prior NRC approval. A determination that a change may result in a reduction in effectiveness does not imply that the licensee could no longer implement its plan and provide adequate measures for the protection of the public. The NRC may approve a proposed emergency plan change that the licensee determined is a reduction in effectiveness, if the NRC can find that the emergency plan, as modified, would continue to meet the requirements of Appendix E, and for the nuclear power reactor licensees, the planning standards of 54.47(b), and would continue to provide reasonable assurance that adequate measures can and will be taken in the event of a radiological emergency."*

[23] See for example: Comment (26) of Texans for a Sound Energy Policy, et. al., on PR 51 Waste Confidence Decision Update and PR-51 Regarding Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation, February 6,2009, Adams Accession ML090700781;Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene with Respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plant Operating Licensee Massachusetts, May 2006 -Adams Accession Number ML061630088;

2. PW Comment: We concur that the license amendment process is appropriate. We take issue with the proposed rule's language that, "The NRC may approve a proposed emergency plan change that the licensee determined is a reduction in effectiveness, if the NRC can find that the emergency plan, as modified, would continue to meet the requirements of Appendix E, and for the nuclear power reactor licensees, the planning standards of 54.47(b), and would continue to provide reasonable assurance that adequate measures can and will be taken in the event of a radiological emergency" for the following reasons.

a. The proposed rule says that NRC may approve a plan change if it provided "reasonable assurance that adequate measures can and will be taken in the event of a radiological emergency." The problem is that "reasonable assurance" is not defined by NRC. What level of assurance is reasonable? NRC's technical judgment must be related to a defined level of assurance (51% is very different from >90%) and backed up with verification – a clear preponderance of facts that the defined level of assurance will be met. Please refer to footnote 1, page 2.

b. The draft rule says that a proposed change may be approved if the plan continues to meet the requirements of Appendix E and the planning standards of 54.47(b). This incorrectly assumes that the requirements of Appendix E and the planning standards of 54.47 (b) are sufficient to provide "reasonable assurance" that public health and safety shall be protected. We do not believe that the regulations are sufficient.

Appendix E: Appendix E does not provide "reasonable assurance." It requires updates that this proposal failed to address. Example: Section E Appendix E (*Emergency Facilities and Equipment)* says that "Adequate provisions shall be made and described for emergency facilities and equipment, including: 2. Equipment for determining the magnitude of and for continuously assessing the impact of the release of radioactive materials to the environment." However, as explained above in Section I, NRC currently does not require meteorological and radiation equipment placed in appropriate locations in offsite communities for "assessing the impact of the release of radioactive materials to the environment" in locations that NRC knows have variable

meteorological conditions – reactors located in coastal areas, along river valleys, near mountains or hilly terrain.

54.47 (b) is subject to the same criticism. For example: It says at (9) that, "Adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition are in use." We have shown that this is not so.

54.47 (b) is simply a set of planning standards that do not indicate precise standards of capability. For example 54.47(b)(5) says that, "Procedures have been established for ... notification of ... the public has been established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone have been established;" however as explained above (at page 12) primary and back-up systems to alert the public are not adequate. The primary notification system, sirens, are simply outdoor warning systems and most of the populace within the plume exposure pathway Emergency Planning Zone do not sleep or work outside.

G. Biennial Exercises

1. Functional Areas of Emergency Response

a. NRC Proposal, Section V, FR 23277, says that, "*The current language in Section IV.F.2.b requires that licensees ensure that adequate emergency response capabilities are maintained to address several emergency response functional areas. The NRC is proposing to expand the list of principal functional areas of emergency response in paragraph F.2.b. to include event classification, notification of offsite radiological releases, and development of protective action recommendations." A bullet list is provided of the key skills necessary to implement the plan.*

b. PW Comment: No specifics are provided. For example, the third bullet in the list is: "Assessment of radiological releases onsite and offsite. However as explained in Section I, NRC does not specify what meteorological plume model and monitoring equipment is appropriate for each site to assess radiological releases offsite. Therefore it is a meaningless listing.

2. General Emergency Not Required

NRC Proposal says that, *during each exercise cycle licensees would be required to vary content – including no radiological release or a minimal release that does not require public protective actions.*

PW Response: A scenario involving no radiological release or a minimal radiological release that does not require public protective actions is not an acceptable exercise. Biennial Exercises are meant to identify weaknesses in planning so that they can be fixed before a real emergency occurs. Allowing no release violates a basic planning principle that if responders are trained and prepared for a more serious emergency than they will be prepared and trained for a minor or no offsite release but it does NOT work the other way around. Just as, if college math students are tested simply on simple addition and subtraction problems, their scores will not be indicative of how well they are prepared to meet the challenges presented in a job requiring advanced math skills.

3. Exercises of Hostile Action Events

a. NRC: *The proposal says that the frequency of exercises involving response to a hostile action event is not to exceed 8 years.*
PW: 8 years is too infrequent to prepare for the challenges presented by a hostile action event.

b. NRC: The proposal changes the following language, *"the drills could focus on onsite training objectives" to "the drills may focus on onsite training objectives" to make the permissive intent of the regulatory language clear."*

PW: The language should be changed to make it clear that hostile action event exercises shall focus on *both* onsite and offsite training objectives to make protection of public safety the intent of the regulatory language instead of "permissive" to the licensees.

c. NRC: The proposal says that *licensees in hostile action exercises are required to provide an expanded range of protective measures for onsite personnel against a hostile action event; and further that, "The new requirement would not direct any specific actions, but would allow licensees flexibility to determine the most effective protective measures for onsite personnel protection on a site-specific basis."*

PW: We object to the NRC's lack of specificity. Specific actions should be required; otherwise there is no real ability for enforcement.

Flexibility: Allowing licensees "flexibility" is a theme throughout the proposed regulation. The net effect is that the proposed Enhancements to Emergency Preparedness Regulations amount to a de-regulation, instead of enhancing a regulation to better protect public health and safety.

Respectfully submitted,

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APPENDIX A

NRC, DOE, EPA, State Officials, Nuclear Trade Groups, & Air Dispersion Modeling Community Agree That Straight Line Gaussian Plume Models Cannot Account For the Effects of Complex Terrain on the Dispersion of Pollutants from A Source[24]

NRC

Since the 1970s, the USNRC has historically documented advanced modeling technique concepts and potential need for multiple meteorological towers appropriately located in offsite communities, especially in coastal site regions. But ignored implementing its' own advice.

In 2009, the NRC made a presentation to the National Radiological Emergency Planning Conference[25] concluded that the straight-line Gaussian plume models cannot accurately predict dispersion in a complex terrain and are therefore scientifically defective for that purpose [full presentation is available at ML091050226, ML091050257, and ML091050269 (page references used here refer to the portion attached, Part 2, ML091050257).]

Most reactors, if not all, are located in complex terrains. In the presentation, NRC said that the "most limiting aspect" of the basic Gaussian Model, is its "inability to evaluate spatial and temporal differences in model inputs" [Slide 28]. Spatial refers to the ability to represent impacts on the plume after releases from the site e.g., plume bending to follow a river valley or sea breeze circulation. Temporal refers to the ability of the model to reflect data changes over time, e.g., change in release rate and meteorology [Slide 4].

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[24] For the foregoing references please see : State Of New York's Motion For Summary Disposition On Use Of Straight Line Gaussian Air Dispersion Model For The Environmental Impact Analysis Of Significant Radiological Accidents At Indian Point And NYS Contention 16/16A,(DPR-26, DPR-64) August 28, 2009 and accompanying Declaration Of Bruce A. Egan, Sc.D., Statement of Material Facts not in Dispute, and Exhibits, NRC Electronic Library, Adams No. ML092610906

[25] Ibid

Because the basic Gaussian model is non-spatial, it cannot account for the effect of terrain on the trajectory of the plume – that is, the plume is assumed to travel in a straight line regardless of the surrounding terrain. Therefore, it cannot, for example, "'curve' a plume around mountains or follow a river valley." NRC 2009 Presentation, Slide 33. However, many reactors are located near mountains or along river valleys. Further it cannot account for transport and diffusion in coastal sites subject to the sea breeze. Sea breeze also applies to any other large bodies of water. The sea breeze causes the plume to change direction caused by differences in temperature of the air above the water versus that above the land after sunrise. If the regional wind flow is light, a circulation will be established between the two air masses. At night, the land cools faster, and a reverse circulation (weak) may occur [Slide 43]. Turbulence causes the plume to be drawn to ground level [Slide 44].

The presentation goes on to say that, "Additional meteorological towers may be necessary to adequately model sea breeze sites" [Slide 40].

Significantly, the NRC 2009 Presentation then discussed the methods of more advanced models that *can* address terrain impact on plume transport, including models in which emissions from a source are released as a series of puffs, each of which can be carried separately by the wind, (NRC 2009 Presentation Slides 35, 36). This modeling method is similar to CALPUFF. Licensees are not required, however, to use these models in order to more accurately predict where the plume will travel to base protective action recommendations.

The NRC recognized as early as 1977 that complex terrain presented special problems that a model must address if the air dispersion analysis is to be accurate.[26] For example: NRC, Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors* (July 1977) (Draft for Comment) says that, "Geographic features such as hills, valleys, and large bodies of water *greatly* influence dispersion and airflow patterns. Surface roughness, including vegetative cover, affects the degree of turbulent mixing." (Emphasis added).

[26] Ibid

This is not new information; knowledge of the inappropriateness of straight-line Gaussian plume in at complex sites goes back a long way within NRC. For example:

1972: 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."

1977: NRC began to question the feasibility of using straight line Gaussian plume models for complex terrain. *See* U.S.NRC, 1977, Draft for Comment Reg. Guide 1.111 at 1c (pages 1.111-9 to 1.111-10)

1983: In January 1983, NRC Guidance [NUREG-0737, Supplement 1 "Clarification of TMI Action Plan Requirements," January 1983 Regulatory Guide 1.97- Application to Emergency Response Facilities; 6.1 Requirements],suggested that changes in on-site meteorological monitoring systems would be warranted if they have not provided a reliable indication of monitoring conditions that are representative within the 10-mile plume exposure EPZ.

1996: The NRC acknowledged the inadequacy of simple straight-line Gaussian plume models to predict air transport and dispersion of a pollutant released from a source in a complex terrain when it issued RTM-96, *Response Technical Manual,* which contains simple methods for estimating possible consequences of various radiological accidents. In the glossary of that document, the NRC's definition of "Gaussian plume dispersion model" states that such models have important limitations, including the inability to "deal well with complex terrain." NUREG/BR-0150, Vol.1 Rev.4, Section Q; ADAMS Accession Number ML062560259,

2004: A NRC research paper, *Comparison of Average Transport and Dispersion Among a Gaussian, A Two- Dimensional and a Three-Dimensional Model*, Lawrence Livermore National Laboratory, October, 2004 at 2. ("Livermore Report") had an important caveat added to the Report's summary about the scientific reliability of the use of a straight-line Gaussian model in complex terrains: ". . . [T]his study was performed in an area with smooth or favorable terrain and persistent winds although with structure in the form of low-level nocturnal jets and severe

storms. In regions with *complex terrain*, particularly if the surface wind direction changes with height, *caution should be used.* **Livermore Report** at 72. (emphasis added)

2005: In December, 2005, as part of a cooperative program between the governments of the United States and Russia to improve the safety of nuclear power plants designed and built by the former Soviet Union, the NRC issued a Procedures Guide for a Probabilistic Risk, related to a Russian Nuclear Power Station. The Guide, prepared by the Brookhaven National Laboratory and NRC staff, explained that atmospheric transport of released material is carried out assuming Gaussian plume dispersion, which is "generally valid for flat terrain." However, the Guide the caveat that in "specific cases of plant location, such as, for example, a mountainous area or a valley, more detailed dispersion models may have to be considered." *Kalinin VVER-1000 Nuclear power Station Unit 1 PRA, Procedures Guide for a Probabilistic Risk Assessment,* NUREG/CR- 6572, Rev. 1 at 3-114; excerpt attached as Exhibit 8, full report available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6572.

2007: NRC revised their Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants. On page 11, the section entitled *Special Considerations for Complex Terrain Sites* says that,

> At some sites, because of complex flow patterns in nonuniform terrain, additional wind and temperature instrumentation and more comprehensive programs may be necessary. For example, the representation of circulation for a hill-valley complex or a site near a large body of water may need additional measuring points to determine airflow patterns and spatial variations of atmospheric stability. Occasionally, the unique diffusion characteristics of a particular site may also warrant the use of special meteorological instrumentation and/or studies. The plant's operational meteorological monitoring program should provide an adequate basis for atmospheric transport and diffusion estimates within the plume exposure emergency planning zone
> [i.e., within approximately 16 kilometers (10 miles)].[27]

[27] For example, if the comparison of the primary and supplemental meteorological systems indicates convergence in a lake breeze setting, then a "keyhole" protective action recommendation (e.g., evacuating a 2-mile radius)

These excerpts from Regulatory Guide 1.23 demonstrate that the NRC recognizes there are certain sites, such as those located along river valleys (like Indian Point and Vermont Yankee) and those located in coastal areas (like Pilgrim and Seabrook) that multiple meteorological data input sources are needed for appropriate air dispersion modeling. Not simply one or two meteorological towers onsite. Since, for the reasons discussed above, the straight-line Gaussian plume model is incapable of handling complex flow patterns and meteorological data input from multiple locations, Regulatory Guide 1.23 is an NRC recognition that it should not be used at a any site with complex terrain.

EPA

Likewise, EPA recognized the need for complex models. For example: EPA's 2005 Guideline on Air Quality Models says in Section 7.2.8 *Inhomogenous Local Winds* that,

> In very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characterization of the winds is a balance of various forces, such that the assumptions of steady-state straight line transport both in time and space are inappropriate. (Fed. Reg., 11/09/05).

EPA goes on to say that, "In special cases described, refined trajectory air quality models can be applied in a case-by-case basis for air quality estimates for such complex non-steady-state meteorological conditions." This EPA Guideline also references an EPA 2000 report, *Meteorological Monitoring Guidance for Regulatory Model Applications,* EPA-454/R-99-005, February 2000. Section 3.4 of this Guidance for coastal Locations, discusses the need for multiple inland meteorological monitoring sites, with the monitored parameters dictated by the data input needs of particular air quality models. EPA concludes that a report prepared for NRC [28] provides a detailed discussion of considerations for conducting meteorological measurement programs at coastal sites, reactors on large bodies of water. Most important, EPA's November

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

2005 Modeling Guideline (Appendix A to Appendix W) lists EPA's "preferred models" and the use of straight line Gaussian plume model, called ATMOS, is not listed. Sections 6.1 and 6.2.3 discuss that the Gaussian model is not capable of modeling beyond 50 km (32 miles) and the basis for EPA to recommend CALPUFF, a non - straight line model.[29]

DOE

DOE, too, recognizes the limitations of the straight-line Gaussian plume model. They say for example that Gaussian models are inherently flat-earth models, and perform best over regions of transport where there is minimal variation in terrain. Because of this, there is inherent conservatism (and simplicity) if the environs have a significant nearby buildings, tall vegetation, or grade variations not taken into account in the dispersion parameterization.[30]

Nuclear Utility Groups

Nuclear utility Meteorological Data Users Group (NUMUG): At the 1994 American Nuclear Society Topical Meeting Environmental Transport and Dosimetry Aug 31-Sept 3, 1993, Charleston, SC, a paper titled *An Atmospheric Dispersion Model for Emergency Response, K. Jerry Allwine (Pacific Northwest Laboratory, Richland, Washington) NUMUG 1994* said in its introduction that,

> Predicting the dispersion of accidental releases of material to the atmosphere in regions of nonuniform terrain can be very challenging. Wind patterns can be highly variable in time and space, because of the synoptic influences, the influences of nonhomogenous surfaces (sea breeze, heat inland), and terrain-induced processes such as slope flows, channeling, blocking, mountain-valley winds, stagnations, layered flows. During the nighttime terrain effects can dominate the atmospheric motion, especially near the surface. Consequently, an important component of any emergency response model is the wind model which must

[29] http://www.epa.gov/scram001/guidance/guide/appw_05.pdf
[30] the MACCS2 Guidance Report June 2004 Final Report, page 3-8:3.2 Phenomenological Regimes of Applicability

> reasonably represent the winds in complex terrain using a limited number of input wind observations that are generally not of sufficient coverage to completely define the winds in the modeling domain.

State Authorities - example

New York State Office of Attorney General: State of New York's Motion for Summary Disposition on Use of Straight Line Gaussian Air Dispersion Model For The Environmental Impact Analysis of Significant Radiological Accidents at Indian Point and NYS Contention 16/16A, DPR-26,DEPR-64, August 28, 2009

Aubrey Godwin, Director, Arizona Radiation Regulatory Agency Public Meeting on the Review of Emergency Preparedness Regulations and Guidance for Commercial Nuclear Power Plants (8/31 - 9/1/05), at 17 regarding the keyhole said that,

> ...everyone recognizes that wind shifts and it does not matter where you are in the country...So, effectively you're going to have to add 360 before (the event is) over with and I think you need to be prepared for that and plan for that...Then there is the other condition that happened during Three Mile Island when the Commission was advising the state to evacuate and they asked in which direction and they said downwind and it was pointed out the wind wasn't blowing. So you need to think more than just downwind. You need to think of 360 degrees and I hope that the Commission and the staff recognize that you need to look beyond the keyhole effect...

Atmospheric Scientists & Meteorologists

For over three decades atmospheric scientists and meteorologists have been identifying problems in the use of models similar to ATMOS for such settings. Example: Steven R. Hanna, Gary A. Briggs, Rayford P. Hosker, Jr., National Oceanic and Atmospheric Administration, Atmospheric Turbulence and Diffusion Laboratory, *Handbook on Atmospheric Diffusion* (1982)).

The inability of a simple Gaussian plume model to accurately predict air transport and dispersion in complex terrains is such a basic flaw that it is discussed in a textbook for a college-level introductory course in environmental science and engineering (Environmental Science and Engineering, J. Glynn Henry & Gary W. Heinke, (Prentice-Hall 1989) at 528 (Chapter 13 authored by William J. Moroz). In listing the assumptions that are made to develop a simple straight line Gaussian plume model, the textbook warns that:

> The equation is to be used over relatively flat, homogeneous terrain. It should not be used routinely in coastal or mountainous areas, in any area where building profiles are highly irregular, or where the plume travels over warm bare soil and then over colder snow or ice covered surfaces.

Rulemaking Comments

From:	Mary Lampert [mary.lampert@comcast.net]
Sent:	Monday, October 19, 2009 1:57 PM
To:	Rulemaking Comments
Subject:	Pilgrim Watch's Comments Regarding Nuclear Regulatory Commission 10 CFR Parts 50 And 52, RIN 3150-AI10, [NRC-2008-0122] Enhancements to Emergency Preparedness Regulations [NRC Docket ID: NRC-2008-0122].
Attachments:	NRC Docket ID NRC 2008-0122 PW Comments 10.19.09.doc

Attached please find, *Pilgrim Watch's Comments Regarding Nuclear Regulatory Commission 10 CFR Parts 50 And 52, RIN 3150–AI10, [NRC–2008–0122] Enhancements to Emergency Preparedness Regulations [NRC Docket ID: NRC-2008-0122].*

I would appreciate your consideration of sharing these comments with the NRC Commissioners.

If you have difficulty in opening the document, please call Mary Lampert at 781-934-0389.

Thank-you.

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