UNITED STATES OF AMERICA
U.S. NUCLEAR REGULATORY COMMISSION
BEFORE THE NRC STAFF

PETITION FOR RULEMAKING TO IMPROVE EMERGENCY PLANNING REGULATIONS (10 C.F.R. 50.47)

I. INTRODUCTION

As provided by 10 CFR § 2.802, the undersigned Petitioners request the U.S. Nuclear Regulatory Commission (NRC) to amend the NRC's offsite emergency planning regulations in 10 CFR § 50.47 and Appendix E to Part 50, as well as including these modifications within 10 C.F.R.§52 Licenses, Certification and Approvals for Nuclear Power Plants for new reactors. These amendments include, among other provisions:

- Expand the radius of the Plume Exposure Pathway Emergency Planning Zone (EPZ) from a 10-mile radius to a 25-mile radius;
- Establish a new 50-mile radius Emergency Response Zone, with more limited requirements than the EPZ;
- Expand the radius of the Ingestion Pathway EPZ from the current 50 mile radius to a 100-mile radius;
- Ensure that emergency plans are tested to encompass initiating and/or concurrent natural disasters that may affect both accident progression and evacuation conduct.

As demonstrated below, the requested amendments are essential for the protection of public health and safety in light of the real-world experience of the Chernobyl and Fukushima disasters, which were more severe and affected a much larger geographical area than provided for in NRC regulations. Other factors that have changed since the existing emergency planning regulations were promulgated over thirty years ago include the increasing age and vulnerability

of operating reactors, changing weather patterns and increased incidents of natural disasters, and significantly larger populations near many existing reactor sites. Studies currently and previously relied upon to justify the existing 10-mile Emergency Planning Zone, including the State-of-the-Art Reactor Consequence Analyses (SOARCA) report and studies of irradiated (or "spent") fuel pool accident risks, are based on assumptions of reactor and fuel pool accident risk and accident progression and consequences that are significantly underestimated based on real-world experience and more recent understanding of the risks of radiation as documented in the National Academy of Sciences Biological Effects of Ionizing Radiation-VII report.

II. STATEMENT OF PETITIONERS' INTEREST IN THE RULEMAKING

Petitioners are environmental and civic organizations with members who live within 100 miles of U.S. nuclear power plants and who are concerned that current NRC emergency planning requirements are not adequate to protect their health and safety in the event of an accident at the plant.

Nuclear Information and Resource Service:

Nuclear Information and Resource Service (NIRS) is a non-profit organization based in Takoma Park, Maryland. NIRS is a national information and networking center for people concerned about nuclear power, radioactive waste, radiation and sustainable energy issues. Since its founding in 1978, NIRS has sought to educate and coordinate the public on specific issues, such as licensing of new reactors, radioactive waste transportation, deregulation of radioactive materials, and nuclear reactor safety.

Other Petitioners:

1. **Bellefonte Efficiency and Sustainability Team**

Bellefonte Efficiency and Sustainability Team was founded in February 2008 by residents of Alabama and Tennessee to urge the Tennessee Valley Authority to adopt efficient, sustainable energy options.

2. **Beyond Nuclear**
   Beyond Nuclear is a non-profit organization based in Takoma Park, Maryland. Beyond Nuclear aims to educate and activate the public about the connections between nuclear power and nuclear weapons and the need to abandon both to safeguard our future. Beyond Nuclear advocates for an energy future that is sustainable, benign and democratic. The Beyond Nuclear team works with diverse partners and allies to provide the public, government officials, and the media with the critical information necessary to move humanity toward a world beyond nuclear.

3. **Blue Ridge Environmental Defense League**
   Founded in 1984, Blue Ridge Environmental Defense League is a regional, community-based non-profit environmental organization active in Virginia, North Carolina, South Carolina, Tennessee, Alabama and Georgia. BREDL's founding principles are earth stewardship, environmental democracy, social justice, and community empowerment. BREDL is a league of community groups which is unitary, with a common incorporation, financial structure and governing board.

4. **Citizen Action Coalition**

   Citizen Action Coalition's mission is to initiate, facilitate and coordinate citizen action directed to improving the quality of life of all inhabitants of the State of Indiana through principled advocacy of public policies to preserve democracy, conserve natural resources, protect the environment, and provide affordable access to essential human services. CAC has been a stalwart opponent of nuclear and coal generation technologies for more than three decades. Having played a key role in the demise of the problem-plagued Marble Hill nuclear power plant, CAC is no stranger to the devastating environmental and financial risks associated with nuclear technology. With a continued emphasis on truly clean renewables, distributed resources, and energy efficiency, CAC is a firm believer that clean, safe, and affordable energy is not only attainable, but it is our right as an essential human service.

5. **Citizens Awareness Network**
   CAN is a volunteer, grassroots organization, committed to the creation of vibrant communities through the replacement of nuclear reactors in the Northeast with sustainable solutions. In a fight to shut a local nuke, frightened, aroused citizens formed CAN. With over 4,000 members, CAN grew from a local to a regional group, with 4 Northeast chapters. Instrumental in closing 3 reactors in New England, CAN won lawsuits against NRC and nuclear corporations, organized tours to radioactive waste communities, national high level waste tours opposing Yucca Mountain as well as 3 Action camps in southern Vermont. CAN organized a high level waste summit, bringing

together reactor and waste communities to create a waste policy that supports the needs of both communities CAN with other groups, ensured through our community organizing work, as well as lobbying efforts, the Vermont Senate vote to close Vermont Yankee in 2010 and stopped a re-vote in 2011.

6. **Citizen Power**
   Citizen Power is the outgrowth of 20 years of work for safe, clean and affordable energy. We work to protect the consumer and the environment by influencing public policy through research, education and advocacy. As educators, we disseminate information, in an understandable format, through the media, and by providing direct educational services to requesting organizations. As advocates, we participate in regulatory and legal proceedings at the state, regional and national level that can impact the environment and the regional economy. For more information, see citizenpower.com.

7. **C-10 Research & Education Foundation**
   C-10's prime mission for 20 years, C-10 Foundation has been operating a radiological airborne monitoring system in the Massachusetts Emergency Planning Zone (EPZ) communities near the Seabrook, NH nuclear power plant. This system operates continuously to act as an early warning in the event of any unusual release from the Seabrook plant. C-10 Foundation is pleased to be under contract with the Massachusetts Department of Public Health, Bureau of Environmental Health.

8. **Citizens' Environmental Coalition**
   Citizens' Environmental Coalition is a statewide coalition of individuals and groups working to protect New York's environment and the public's health from harm. Following the Fukushima disaster in 2011, we determined that to fulfill our mission it would be essential to close all the nuclear reactors in NY, all six of them. We are currently pursuing this agenda through many avenues. New York is home to 6 aged and problem-ridden nuclear reactors. Indian Point, the most publicized, has 2 plants at the juncture of two earthquake faults and could harm 20 million people in the event of a meltdown. Serious events at any of the other NY reactors could harm over 1 million people. Two of our reactors are Mark 1 designs like those at Fukushima with inadequate containment. In the event of a meltdown-- venting radioactive emissions to the public would be necessary. Since the Fukushima disaster the NRC has not adequately addressed three of the most serious problems that are relevant to the disaster-- earthquake potential, Mark 1 nuclear designs, and the dangers of overcrowded spent fuel pools.

9. **Coalition for a Nuclear Free Great Lakes**
   Coalition for a Nuclear Free Great Lakes (CNFGL - 1986) - Is comprised of safe energy and environmental groups throughout the basin (8 states, 2 provinces) who exchange expertise and documentation on all things nuclear, and then formulate campaigns to address these specific threats. The Great Lakes basin constitutes 20% of Earth's surface fresh water, and is among the most precious resources on our planet. There are some 60 nuclear power plants that could directly impact the basin air-shed and watershed. The

Great Lakes are ringed by nuclear reactors and other nuclear installations that represent an acute radiological risk to the region. Chernobyl, and now Fukushima Daiichi, are clear and unmistakable warnings. Eight of ten of the oldest U.S. nuclear reactors are located within the Great Lakes air-shed and watershed.

10. Concerned Citizens of Shell Bluff

Concerned Citizens of Shell Bluff was founded in March 2010 to protect local residents living near Georgia Power's Plant Vogtle from the negative health and economic impacts of nuclear power.

11. Connecticut Coalition Against Millstone

12. Don't Waste Arizona

Don't Waste Arizona, Inc. (DWAZ) is a non-profit environmental organization based in Arizona. DWAZ is especially concerned about emergency planning, emergency response issues, and nuclear reactor and waste issues, has served as a member of the Maricopa County Local Emergency Planning Committee for over ten years, and operates a website dedicated to emergency planning issues. (Maricopa County is the home of the Palo Verde Nuclear Generating Station.) DWAZ has been a significant enforcer of the Emergency Planning and Community Right to Know Act.

13. Don't Waste Michigan

Don't Waste Michigan (DWM - 1987) first comprised of citizens throughout the state organized to stop the nuclear power industry from targeting Michigan to become a nuclear waste dump, the campaign was successful. DWM continues to be active and to educate the public about nuclear waste, and where it comes from. DWM is a frequent intervenor of record in Federal Court on nuclear matters in Michigan. Currently DWM is intervenor of record to stop the proposed Fermi 3 nuclear plant, and to stop Davis-Besse re-licensing. Recently DWM became intervenor on the Fermi 2 located on Lake Erie south of Detroit calling for shut-down. The Fermi 2 has been identified as the largest Fukushima design (Mark I) reactor in the world. DWM frequently joins in coalition with environmental groups and conducts a series of conference under the banner Nuclear Free Great Lakes Action Camps.

14. The Ecology Part of Florida

The Ecology Party of Florida is a Florida political party that believes environmental destruction is the most important issue facing America today. The goals of the party are: to have elected officials who place environmental issues at the top of their agendas, to inform voters on issues related to the environment, and to use legal means to protect the ecosystem. The Ecology Party was founded in 2007, and is headquartered at 641 SW 6th Ave, Ft Lauderdale, FL.

15. Empire State Consumer Project, Inc.

The purpose of Empire State Consumer Project is to reduce the use of pesticides and other chemicals toxic too human and environmental health and well-being to benefit the health and well-being of all consumers especially children. We have tested products such

as imported jewelry for heavy metals. We are now in the process of working to set standards for the amount of cadmium that can leach from children's jewelry: we are working with Food and Water Watch on setting standards for the amount of arsenic allowed in food; helping consumer deal with contamination of their towns (Le Roy, New York)

16. GRAMMES (Grandmothers, Mothers, and More for Energy Safety)

GRAMMES is a grassroots networking organization working for safe, renewable energy choices. We are part of a coalition that fought the relicensing of Oyster Creek Nuclear Generating Station in New Jersey, and continue efforts to improve safety conditions while lobbying for a closure of the plant.

17. Greenpeace

Greenpeace is one of 40 national Greenpeace organizations worldwide, Greenpeace, Inc. (hereafter "Greenpeace") is a non-profit membership organization registered with the Internal Revenue Service as a 501(c)(4) non-profit entity. Our national headquarters are located in Washington DC, with other offices located across the United States. Greenpeace members rely on Greenpeace to represent their interests in the protection of the environment. We reach out to our members through a quarterly newsletter and occasional e-mail messages, and to the public as well as our members through our website and pursuit of media coverage of our campaigning efforts. Greenpeace uses peaceful protest and creative communication to expose global environmental problems and to promote solutions that are essential to a green and peaceful future. Since 1971, Greenpeace has been a leading voice of the environmental movement in taking a stand against powerful political and corporate interests whose policies put the planet at risk. Greenpeace furthers its mission through research, advocacy, public education, lobbying, and litigation with a staff that includes scientists, lawyers, campaigners, policy experts, and communications specialists.

18. Indian Point Safe Energy Coalition (IPSEC)

The Indian Point Safe Energy Coalition (IPSEC) is a nonprofit, non-partisan coalition of citizen, civic, environmental, health and public policy organizations that formed in the aftermath of the Sept. 11 attack in response to a flood of citizen concerns about the security and safety of the Indian Point nuclear power plants located approximately 24 miles from New York City.

19. Jersey Shore Nuclear Watch

Jersey Shore Nuclear Watch was formed 11 years ago with the mission of shutting down Oyster Creek Nuclear Power Plant as soon as possible. In 2002, we filed a petition with the NRC challenging on site dry cask storage casks and called for a public hearing. Twenty eight out of 33 municipalities supported the JSNW petition. In 2005, JSNW was part of a coalition opposing the relicensing of Oyster Creek. More than 20 municipalities adopted resolutions opposed to relicensing.

20. Missourians for Safe Energy

Missourians for Safe Energy is a grassroots, non-profit group engaged in public education and advocacy to promote a sustainable, clean energy future. MSE is the energy policy arm of Mid-Missouri Peaceworks, a multi-issue, membership-based organization with approximately 500 member households. MSE and MMPW operate under the incorporation of the Missouri Nuclear Weapons Education Fund, a 501.c.3 non-profit corporation. MSE today carries on the legacy of the original Missourians for Safe Energy, founded in 1976. In its current incarnation, MSE has been active since March of 2006.

21. New England Coalition

22. Nuclear Energy Information Service

NEIS provides information about the hazards, safety problems, environmental effects and economic costs of nuclear power, radioactive waste, and radiation exposure; and about viable energy alternatives to nuclear. We are Illinois' nuclear watchdog organization.

23. Not On Our Fault Line

Not on Our Fault Line (NOOFL) is a local citizens group in the Louisa County area which is working to insure that the North Anna reactors are not operating if they are unable to withstand earthquakes in the region. NOOFL is also working to get potassium iodine distributed to local residents and on public education about the reactors.

24. NC WARN

NC WARN is a member-based nonprofit tackling the accelerating crisis posed by climate change – along with the various risks of nuclear power – by watch-dogging utility practices and working for a swift North Carolina transition to energy efficiency and clean power generation. In partnership with other citizen groups, NC WARN uses sound scientific research to inform and involve the public in key decisions regarding their wellbeing.

25. Northwest Environmental Advocates

Northwest Environmental Advocates (NWEA), formerly the Coalition for Safe Power, was founded in 1969 by citizens concerned about the imminent operation of the now-closed Trojan Nuclear Power Plant, in Oregon. NWEA was also involved in the closure of the dual-purpose N reactor at Hanford, Washington. In addition to intervention in the Trojan spent fuel pool expansion hearings, NWEA intervened in the Trojan license amendment proceedings to address control room earthquake safety and the operating license proceedings for the WPPSS and Skagit/Hanford reactors in Washington. NWEA has filed numerous petitions concerning safety matters to the Commission pursuant to 10 C.F.R. § 2.206, including a petition addressing the impacts of the eruption of the Mt. Helens volcano on the ability to carry out Trojan's emergency evacuation plans and one concerning the unsafe construction of the Washington Public Power Supply System ("WPPSS") No. 2 reactor, now renamed the Columbia Generating Station (CGS). NWEA recently petitioned to intervene in the operating license extension proceedings for the CGS and was a party to a petition to the Commission regarding the implications of the Fukushima accident to nuclear reactor safety in the United States

26. People's Alliance for Clean Energy

Peoples Alliance for Clean Energy (PACE) is a Charlottesville VA based group which works on promoting alternatives to nuclear power, rapid phase out of the existing plants and stopping the construction of additional reactors at the North Anna site. PACE organizes protests, public hearings, clean energy symposiums and other public education and political pressure events designed to help move the region away from nuclear solutions.

27. Promoting Health and Sustainable Energy (PHASE) and Council on Intelligent Energy & Conservation Policy (CIECP)

PHASE and CIECP are sister nonprofit, non-partisan, energy public policy groups that advocate for policies that promote clean safe energy.

28. Public Citizen

Public Citizen is a nonprofit organization that does not participate in partisan political activities. We accept no government or corporate money – we rely solely on foundation grants, publication sales and support from our 80,000 members. Since our founding in 1971, we have delved into an array of areas, but our work on each issue shares an overarching goal: To ensure that all citizens are represented in the halls of power. We have five policy groups: our Congress Watch division, the Energy Program, Global Trade Watch, the Health Research Group and our Litigation Group

29. San Luis Obispo Mothers for Peace

San Luis Obispo Mothers for Peace (SLOMFP) is a non-profit organization concerned with the local dangers involving the Diablo Canyon Nuclear Power Plant, and with the dangers of nuclear power, weapons and waste on national and global levels. Since 1973 SLOMFP has been an active legal intervenor challenging the licensing of the Diablo Canyon Nuclear Power Plant (DCNPP) owned and operated by Pacific Gas and Electric Company. In order to qualify for intervenor status, SLOMFP had to demonstrate that its members live within a 50 mile radius of the DCNPP. In 2012 a majority of the members of SLOMFP live within 25 miles of DCNPP. In addition to its intervention in opposition to DCNPP licenses, SLOMFP has also taken an active role in the effort to improve the safety of nuclear power plants nation-wide. Documentation of the past four decades of SLOMFP actions can be found at the organization's website at mothersforpeace.org

30. SEED Coalition:

The Sustainable Energy and Economic Development (SEED) Coalition educates and organizes citizens throughout Texas, leads legal opposition to the proposed South Texas Project and Comanche Peak reactors, and works to limit the radioactive waste being sent to West Texas for disposal. We support energy efficiency and renewable solar, wind and geothermal power, while actively opposing nuclear and coal burning power plants. We raise awareness of the health and safety risks of potential nuclear accidents, including widespread exposure to radioactivity and environmental contamination. We also oppose nuclear power due to its vast water consumption and production of radioactive waste, and because it is unreliable and extremely expensive.

31. Sierra Club of South Carolina

The Sierra Club chapter in South Carolina routinely makes comments and appearances at nuclear regulatory hearings and procedures urging the utilities and the industry to heighten awareness and plan for the inevitable. South Carolina has several reactors that could in accident scenario potentially affect hundreds of thousands of people including the Myrtle Beach area. As far as we can tell there are little if any plans on this scale or scope. As populations grow it is imperative that emergency plans grow as well. The lessons at Fukushima should teach us that we must do more to prepare emergency personnel and citizens for likelihood of event around accident. New information is showing that even low levels of radiation causes serious health problems and this is why we believe that evacuation zones should be greater.

32. Southern Alliance for Clean Energy

SACE is a non-profit, non-partisan, membership organization that promotes responsible energy choices that solve global warming problems and ensure clean, safe, and healthy communities throughout the Southeast. SACE has staff and members throughout the Southeast, including offices in Tennessee, Georgia, Florida and the Carolinas.

33. Three Mile Island Alert

Three Mile Island Alert, Inc. is a non-profit citizens' organization based in Harrisburg, Pennsylvania and founded in 1977. TMI-Alert monitors nuclear power plants located on the Susquehanna River including: the Peach Bottom Atomic Power Station, the Susquehanna Steam Electric Station Unit, Three Mile Island Nuclear Generating Station and the proposed Bell Bend Nuclear Power Plant.

34. Tri-Valley CARE

35. HEAL Utah

HEAL Utah (Healthy Environment Alliance of Utah) is a non-profit grassroots advocacy organization that works to protect Utah's environment and health from nuclear threats. We enjoy the support of thousands of supporters state-wide and use the tools of civic engagement--lobbying, public comment, and speaking out in the media--to ensure that it is the public, and not polluters, who determine our nuclear waste and energy policies.

36. Vermont Public Interest Research Group

Vermont Public Interest Research Group ("VPIRG") is a nonprofit organization based in Montpelier, Vermont. Founded in 1972, VPIRG's mission is to promote and protect the health of Vermont's environment, people, and locally-based economy, and bring the voice of citizens to public policy debates that shape the future of Vermont. VPIRG currently has over 14,000 active supporters. The organization's top priority campaign over the past five years has been to promote an energy future based on local renewable energy resources. VPIRG has been involved in the legislative and regulatory processes regarding the Vermont Yankee nuclear plant for decades. Over the past five years more

than 3,500 Vermont households have played an active role with VPIRG to ensure that the Vermont Yankee reactor is retired on schedule.

37. We The People, Inc.

III. DESCRIPTION OF CURRENT EMERGENCY PLANNING REGULATIONS

A. Emergency Planning Rules Were Developed to Provide Essential Protection of Public Health and Safety in the Event of Reactor Accidents Causing Offsite Radiological Releases.

The history of the NRC's emergency planning regulations demonstrates that they are a fundamentally important part of the NRC's mandatory safety requirements for protection of public health and safety under the Atomic Energy Act. Before 1980, the NRC did not require offsite emergency plans as a condition for reactor operating licenses. State and local governments prepared emergency plans on a voluntary basis, if at all. The Commission was jolted into a reappraisal of the importance of emergency planning by the 1979 accident at Three Mile Island, when the emergency response "was dominated by an atmosphere of almost total confusion."[1]

Not only did the NRC establish mandatory emergency planning requirements in response to the TMI accident, but it made clear that henceforth those requirements would be a "primary" and essential part of the NRC's regulatory scheme for protecting public health and safety from the dangers of nuclear reactor operation. As the NRC explained, the regulations were:

> "[p]redicated on the Commission's considered judgment in the aftermath of the accident at Three Mile Island that safe siting and design-engineered features alone do not optimize protection of the public health and safety. Before the accident it was thought that adequate siting in accordance with existing staff guidance coupled with the defense-in-depth approach to design would be primary public protection. Emergency planning was conceived as a secondary but additional measure to be exercised in the unlikely event that an accident would happen. The Commission's perspective was severely altered by the

[1] *Report of the President's Commission on the Accident at Three Mile Island – The Need for Change: The Legacy of TMI* at 17 (1979).

> unexpected sequence of events that occurred at Three Mile Island. The accident showed clearly that the protection provided by siting and engineered safety features must be bolstered by the ability to take protective measures during the course of an accident."[2]

B. Requirements of 1980 Regulations

The emergency planning regulations established by the NRC in 1980 remain essentially the same today. The regulations require the establishment of two emergency planning zones ("EPZs") around each nuclear power plant: a 10 mile radius plume exposure pathway EPZ and a 50 mile radius ingestion exposure pathway EPZ:

> Generally, the plume exposure pathway EPZ for nuclear power plants shall consist of an area about 10 miles in radius and the ingestion pathway EPZ shall consist of an area about 50 miles in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to the local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case by- case basis for gas-cooled reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway. [3]

In determining the size of the plume exposure pathway EPZ and the ingestion pathway EPZ, a task force composed of NRC and U.S. Environmental Protection Agency (EPA) officials looked at factors like risk, probability, cost effectiveness and accident consequence spectrum.[4] In examining the probability of needing to evacuate populations beyond the EPZ, the task force examined the probability of design-basis/loss-of-coolant accidents (DBA/LOCA), and concluded, among other things, that for most plants the 25-rem (thyroid) and 5-rem (whole-body) EPA protective action guides would not be exceeded beyond 10 miles from the plant, even

[2] Proposed Rule, 44 Fed. Reg. 75,167, 75,169 (Dec. 19, 1979).
[3] 10 C.F.R. § 50.47(c)(2).
[4] NUREG-0396 Appendix I- Rationale for the Planning Basis.

using conservative assumptions and analyses.[5] As for serious Class 9 accidents involving core melt and containment failure, the Report concluded that these protective action guides generally would not be exceeded beyond 10 miles *unless the containment failed catastrophically and there was a very large release of radioactive material.* (emphasis supplied). The Report further concluded that even for very large releases, emergency actions such as sheltering or evacuation within 10 miles would result in significant reductions in deaths and early injuries.[6] From a probability standpoint, the Report concluded that the probability of large doses from core-melt accidents drops off substantially at about 10 miles from the reactor.

C. Little Change to Emergency Planning Regulations in 30 Years

With the exception of a 2011 rule requiring licensees to use current U.S. census data to prepare evacuation time estimates (ETEs) and update them every 10 years,[7] the NRC has made few significant improvements to its offsite emergency response regulations since they were promulgated in 1980. The NRC rebuffed requests to upgrade offsite emergency preparedness and expand the Emergency Planning Zone in the aftermath of the Chernobyl accident. In *Citizens Task Force of Chapel Hill, et al*. 32 N.R.C. 281 (1990), the NRC denied a set of petitions to increase the size of the plume exposure pathway EPZ and the ingestion pathway EPZ. The Commission declined to revisit the assumptions about severe reactor accident risks that underlie its emergency planning regulations, concluding that the existing size of the EPZs was adequate to achieve "reasonable and feasible dose reduction" under the circumstances of each individual reactor site. The NRC also concluded that both the Chernobyl RBMK reactor

[5] Report, Appendix I at 4–6
[6] Report at 6-7.
[7] 10 C.F.R. Part 50, Appendix E, § IV, in *Enhancements to Emergency Planning Regulations*, 76 Fed. Reg. 72,560 (Nov. 23, 2011). The NRC also modified its regulatory guidance to account for this change. *Emergency Planning Guidance for Nuclear Power Plants*, 76 Fed. Reg. 75,771 (Dec. 5, 2011).

and the Soviet regulatory scheme were so different from the U.S. reactors that they did not provide a sufficient basis for amending the U.S. emergency planning regulations.[8]

IV. Experience since the Three Mile Island Accident Shows that Current NRC Emergency Planning Regulations Must be Strengthened to Protect Public Health and Safety Adequately.

1. Chernobyl, September 11, and Fukushima experiences

The accident at Fukushima, added to the experience of the Chernobyl disaster, demonstrates that the 10 mile plume exposure pathway EPZ and the 50 mile ingestion pathway EPZ are inadequate to protect the public health and safety, both because severe accidents are clearly more likely than any government previously has estimated and because their effects are far more widespread. In both instances, containments failed catastrophically and very large releases of radiation resulted. And in both instances—although the accident causes and progressions were considerably different—these very large radiation releases occurred on a sustained basis and affected very large geographical areas.

The terrorist attacks of September 11, 2001 indicate a new and previously inconceivable ability and willingness by terrorist groups to target large civilian populations. Notwithstanding enhanced security measures at nuclear facilities since that date, nuclear reactors remain attractive targets for attack, thus increasing the need for offsite preparedness.

a. Chernobyl

As discussed above, in 1990 the NRC rejected petitions to strengthen its offsite emergency planning regulations based on the experience of the Chernobyl accident. Petitioners respectfully submit that the effects of the accident should be re-examined, because they show that the effects of a significant radiological release are severe, long lasting, and widespread. With

[8] 32 N.R.C. at 299-300, 316.

respect to the severity and duration of effects, the 18-mile radius surrounding the reactor has been labeled a "dead zone," and is expected to remain uninhabitable for several hundred years. The explosion has caused increased incidents of cancer in residents of Ukraine, Belarus and Russia.[9]

The Chernobyl accident also demonstrates that a very large area may be affected significantly by a radiological release from a reactor. While evacuations initially were limited to several zones within an 18-mile radius of the reactor, in fact, the 30 kilometer exclusion zone was amended and expanded to cover 4300 square kilometers, stretching as far as 300 miles north.[10] Between the years 1986 and 2000 approximately 350,400 people were evacuated from severely contaminated areas of Belarus, Russia and Ukraine.[11] Additionally, areas up to 500 kilometers away in neighboring Belarus remain uninhabitable.

Petitioners recognize that evacuation to protect against the most severe consequences of a nuclear disaster is the not the same as re-location to avoid long-term contamination and resultant illness. In retrospect, however, it is clear that had adequate emergency plans and radiation monitoring been in place in the Soviet Union during 1986, many—probably most—of the towns and areas would have been evacuated to protect against exposure from the radioactive "hotspots" that plagued enormous geographical areas rather than relocating people when these "hotspots" were actually identified—well after they were created. "Hotspots" obviously were created immediately after the accident, as radiation deposited on the ground. That they were not

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[9] "Health Effects of the Chernobyl Accident Overview," April 2006. http://www.who.int/mediacentre/factsheets/fs303/en/index.html

[10] "Chernobyl Accident 1986," updated Sep. 2011, http://www.world-nuclear.org/info/chernobyl/inf07.html

[11] UNDP and UNICEF. 2002. The Human Consequences of the Chernobyl Nuclear Accident.. 22 Jan. 2002. p. 32 (Table 2.2 Number of people affected by the Chernobyl accident (to December 2000)). Retrieved 17 September 2010.

identified until sometimes months or even years later was a failure of emergency planning and radiation monitoring, not evidence that relocation may be taken at a leisurely pace.

Finally, food contamination continues to plague the Chernobyl region. Radionuclides including iodine 131, cesium 134 and cesium 137 tainted crops and animal products in Belarus, which is some 70 miles from Chernobyl.[12] Belarus was once known as the "bread basket" of the Soviet Union. After the Fukushima disaster, samples of milk, berries, and potatoes in areas grown outside the Chernobyl exclusion zone were taken.[13] Those samples continued to exhibit contamination. Meanwhile, thousands of miles away, sheep in Wales continue to be prohibited from public consumption because of contamination from Chernobyl, indicating that food interdiction from a nuclear accident knows nearly no boundaries—but also indicating that the current 50 mile ingestion pathway zone is woefully inadequate for real-world nuclear accidents.[14]

b. September 11, 2001 attacks

On September 11, 2001, successful attacks were made by the subnational group Al Qaeda on the World Trade Center and the Pentagon, causing catastrophic damage and resulting in the evacuation of the immediate areas. Recognizing that nuclear facilities are attractive targets for attacks by subnational groups, the NRC undertook a "top-to-bottom" review

[12] WIT's World Ecology Report, Vol. 8, No. 1 (1996) http://collections.infocollections.org/ukedu/ru/d/Jwit17e/4.html

[13] Greenpeace: Food in Ukraine Still Contaminated from Chernobyl, http://www.voanews.com/english/news/europe/Greenpeace-Food-in-Ukraine-Still-Contaminated-From-Chernobyl-119265069.html

[14] *Farms still suffering Chernobyl restrictions*, http://www.walesonline.co.uk/news/wales-news/2010/05/10/farms-still-suffering-chernobyl-restrictions-91466-26411200/, Wales Online, May 10, 2010

of security at nuclear power plants.[15] Although a September 11-style attack on a nuclear power plant or irradiated fuel pool could result in a catastrophic accident with significant offsite radiation releases, the NRC did not re-examine its offsite emergency planning regulations as part of this "top-to-bottom" review.

c. Fukushima accident and emergency response

On March 11, 2011 the Great East Japan Earthquake, a 9.0 magnitude rated earthquake, occurred 130 kilometers off the coast of Japan. Approximately 40 minutes later, an earthquake-triggered tsunami reached Japan that was about 15 meters high (a little more than 49 feet) when it struck the Fukushima Daiichi Nuclear Power Plant.[16] The tsunami inundated and flooded the site causing extensive damage and complete loss of ac electrical power at 5 out of the 6 reactor units, although there are some indications that the earthquake itself caused significant damage to Unit 1 of Fukushima Daiichi.[17]

Evacuation efforts began first in a three-kilometer zone on March 11, 2001, which was quickly expanded to a 10 kilometer radius around Fukushima Daiichi and then to 20 kilometers (12 miles). By March 12, 2011, 140,000 people had been evacuated from the area.[18] On March 15, 2011 U.S. NRC Chairman Greg Jazcko urged Americans within 50 miles of the Fukushima

[15] Holt, Mark and Anthony Andrews, "Nuclear Power Plants: Vulnerability to Terrorist Attack" CRS Report for Congress, Resources, Science and Industry Division. Available at http://www.fas.org/sgp/crs/terror/RS21131.pdf

[16] Okada, Yuji and Aaron Sheldrick, "Tsunami that Struck Fukushima was 15 Meters High," Apr. 10, 2011. http://www.bloomberg.com/news/2011-04-10/tepco-says-damaged-fukushima-nuclear-plant-was-hit-by-a-15-meter-tsunami.html

[17] See for example, "Real Cause of Nuclear Crisis," Dec. 13, 2011, http://www.japantimes.co.jp/text/eo20111213a1.html,

[18] Meyers, Chris and Kim Kyung-Hoon, "Quake-hit Japan Nuclear Plant Faces Fresh Threat," Mar. 12, 2011, http://www.reuters.com/article/2011/03/12/us-japan-quake-idUSTRE72A0SS20110312

Daiichi plant to evacuate.[19] This recommendation was followed by a similar statement from the U.S. State Department.[20] Around March 25, 2011, the Japanese government established a new zone, covering the area 20 to 30 kilometers from the Daiichi site and encouraged (but did not require) evacuation from that zone.[21] About three weeks later, the government issued mandatory evacuation orders for some communities about 25 miles (40 km) northwest of the Fukushima Daiichi site, where heavy radiation levels were measured that exceeded evacuation criteria.[22] Japan's government was strongly criticized, both in Japan itself and internationally, for delaying the evacuation of these communities. These people should have been evacuated much earlier—a tested evacuation plan and appropriate radiation monitoring likely would have substantially reduced this population's exposure to radiation. For these kinds of reasons, in October 2011, Japan announced plans to expand its own emergency planning zones to include a 30 kilometer (18-mile) evacuation zone and a 50 kilometer (30-mile) Plume Protection Planning Zone.[23]

During the months following commencement of the Fukushima accident, numerous hotspots have been found throughout north-central Japan, 100 miles and more from the Fukushima Daiichi site.[24] The National Academy of Sciences published detailed maps in mid-

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[19] Vastag, Brian et, al, "U.S. urges Americans within 50 Miles of Japanese Nuclear Plant to Evacuate; NRC Chief Outlines Dangerous Situation, Mar. 16, 2011. http://www.washingtonpost.com/national/us-urges-americans-within-50-miles-of-japanese-nuclear-plant-to-evacuate/2011/03/16/ABwTmha_story.html

[20] Travel Warning, Embassy of the United States Tokyo, Japan. http://japan.usembassy.gov/e/acs/tacs-travel20110317.html

[21] Biddle, Sam. "Japan Widens Evacuation Zone Around Crippled Nuke Plant," Mar. 25, 2011. http://gizmodo.com/5785675/japan-widens-evacuation-zone-around-crippled-nuke-plant

[22] Westall, Sylvia. "High Radiation Outside Japanese Exclusion Zone: IAEA," Mar. 30, 2011. http://www.reuters.com/article/2011/03/30/us-japan-radiation-idUSTRE72T78120110330

[23] "30-km Anti-Disaster Zone Proposed for Nuclear Accidents," Oct. 21, 2011. http://ajw.asahi.com/article/0311disaster/fukushima/AJ2011102115389,

[24] Sanchanta, Mariko, "The Geiger Club: Mothers Bust Silent Radiation Consensus," Jun. 17, 2011. http://blogs.wsj.com/japanrealtime/2011/06/17/the-geiger-club-mothers-bust-silent-radiation-consensus/

November 2011 identifying hot spots where radioactivity levels were highest.[25] According to an article published by the Los Angeles Times, the eastern part of Fukushima near the epicenter of the earthquake had levels of Cesium-137 that leave food production in that area "severely impaired."[26] There have been widespread reports of discoveries and interdiction of tainted food, crops, livestock and soil. A major area of concern is rice contamination. Shortly after the disaster, Iodine-131 was found in milk and spinach in towns within Fukushima Prefecture some 18 kilometers away from Fukushima Daiichi.[27] Some farms 100 kilometers and further away have been contaminated by radiation from Fukushima.[28] Radioactive beef from outside the exclusion zone was found to have been sold in Japanese markets and possibly even sold abroad.[29] Japanese authorities stopped shipments of rice from farms some 60 kilometers north of Fukushima in November 2011 due to high levels of radioactive Cesium.[30] In December 2011, radioactive particles were found in infant formula produced in a plant north of Tokyo.[31]

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[25] Yasnuri, Teppei, et. al., "Cesium-137 desposition and contamination of Japanese Soils due to the Fukushima Nuclear Accident," available at http://www.pnas.org/content/early/2011/11/11/1112058108.

[26]Kahn, Amina, "Studies Detail post-Fukushima Radioactivity Levels," Nov. 19, 2011. http://articles.latimes.com/2011/nov/19/world/la-fg-fukushima-radiation-20111120

[27] Marder, Jenny. "Radiation in Japan's Food Supply: Dangerous or Benign?" PBS News, Mar. 22, 2011. http://www.pbs.org/newshour/rundown/2011/03/radiation-in-japans-food-supply-dangerous-or-benign.html

[28] "Japan plans to ban Fukushima beef," BBC News, Jul. 18, 2011. http://www.bbc.co.uk/news/business-14181046

[29] *Japan Won't Rule Out Possibility Radioactive Fukushima Beef Was Exported*, http://www.bloomberg.com/news/2011-07-20/japan-won-t-rule-out-possibility-radioactive-fukushima-beef-was-exported.html, July 20, 2011

[30] New Radiation Scare for Rice in Japan, http://articles.cnn.com/2011-11-17/asia/world_asia_japan-fukushima-rice_1_fukushima-daiichi-fukushima-prefecture-cesium?_s=PM:ASIA

[31] Tabuchi, Hiroko. Japanese Tests Find Radiation in Infant Food, Dec. 6, 2011. http://www.nytimes.com/2011/12/07/world/asia/cesium-found-in-japanese-baby-formula.html

On August 21, 2011, the *New York Times* published an article stating that a large zone immediately surrounding the plant will be labeled a dead zone and will be uninhabitable for decades.[32] On August 31, 2011 the Japanese government revealed that 34 locations in a 100-kilometer area surrounding Fukushima have higher levels of radiation than the threshold used for Chernobyl evacuations. The evacuation threshold for radioactive contamination of Cesium-137 from Chernobyl was 1.48 million becquerels per square meter.[33]

Significantly, an estimated 80% of the radioactive Cesium released by the Fukushima Daiichi disaster did not deposit over land, but rather was blown by prevailing easterly winds directly over the Pacific Ocean, according to a study by the Norwegian Institute for Air Research.[34] Had the wind been blowing in any different direction during the period of the greatest radiation releases, the consequences of the Fukushima Daiichi accident would have been much more dire—possibly including exposures causing acute effects—and likely would have affected even larger geographical areas prompting larger evacuations. Not all nuclear accidents will have the benefit of such favorable wind patterns.

During March 2011, the Japanese government actually drew up plans for a mandatory 170 kilometer (about 100 miles) evacuation zone around Fukushima Daiichi, and a voluntary 250 kilometer (150 miles) zone, in the event the accident worsened.[35]

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[32] Fackler, Martin. "Large Zone Near Japanese Reactors to be Off Limits," http://www.nytimes.com/2011/08/22/world/asia/22japan.html?_r=2, Aug. 21, 2011.

[33] "Japanese Government Finds Areas Around Fukushima More Dangerous than Chernobyl Standards," http://gizmodo.com/5835742/japanese-government-finds-34-spots-around-fukushima-more-uninhabitable-than-chernobyl?popular=true

[34] Paddock, Catherine,"Fukushima Radiation Fallout Bigger Than Officially Reported," Oct. 31, 2011. http://www.medicalnewstoday.com/articles/236811.php

[35] *Government envisioned Tokyo evacuation in worst-case scenario*, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201201070039, The Asahi Shimbum, January 7, 2012

All of the above indicates that Japan was presented with a real-world nuclear accident that extended far beyond its own previous six-mile Emergency Planning Zone as well as the existing U.S. 10-mile Emergency Planning Zone, as well as an accident that held food, milk and water ramifications far beyond the existing U.S. 50-mile Ingestion Pathway Zone. Had a larger Emergency Planning Zone been in place and plans regularly exercised, it seems likely that some of the more serious consequences of the Fukushima accident might have been amelioriated. These consequences include the high likelihood of unnecessary cancers and latent fatalities caused both by avoidable radiation exposure and consumption of contaminated food products.

Estimates of these consequences vary widely and wildly—from zero to tens of thousands of people—and petitioners do not attempt to quantify them or endorse any particular study or projection. But petitioners do assert that many, perhaps most, of whatever consequences do occur would have been avoidable with adequate emergency planning and response.

Shortly after the Fukushima accident commenced, the NRC Commissioners appointed a high-level task force to study the regulatory implications of the accident. The Task Force examined the disaster at Fukushima and published a report in July 2011 which addressed the issues of protecting against accidents resulting from natural phenomena, mitigating the consequences of such accidents, and ensuring emergency preparedness.[36] In the area of emergency preparedness, the Task Force made several recommendations, including strengthening and integrating onsite emergency response capabilities such as emergency operating procedures, severe accident management guidelines, and extensive damage mitigation

[36] Recommendations for Enhancing Reactor Safety in the 21st Century, The Near Term Task Force Review of Insights From the Fukushima Daiichi Accident, pg. viii, available at http://pbadupws.nrc.gov/docs/ML1118/ML111861807.pdf

guidelines.[37] There was discussion of several recommendations that would strengthen on-site preparedness for emergencies involving a station blackout and/or multiple reactors.[38] However, the task force failed to make any recommendations on improving emergency response capabilities or expanding EPZ size, despite the Task Force's acknowledgement that it was necessary to evacuate Japanese residents up to and beyond a 20-kilometer (12-mile) area around Fukushima.[39]

2. Real-World experience and improved understanding of severe accident risks at nuclear reactors

The NRC's existing emergency planning regulations (and the NRC's decision in *Citizens Task Force of Chapel Hill)* are based primarily on experience gained by the Three Mile Island accident and on NRC reactor safety studies conducted from the 1950s through the 1970s (for example, WASH-1400 and NUREG-1150) and are encapsulated in NUREG-0396. More recently, in 2006, the NRC began the State-of-the-Art Reactor Consequence Analyses (SOARCA) project to re-evaluate the "realistic consequences of a severe reactor accident."[40] An October 2010 draft of SOARCA indicates that 1,000 cancer fatalities could be expected within a 50-mile radius under certain conditions from an accident at Peach Bottom. This study, however, is essentially a "best case" scenario of a nuclear power plant accident and failed to take into consideration differing weather patterns and worst case scenario situations. Additionally, the figures on cancer deaths were largely based on the assumption that everyone would evacuate within 20 miles of a nuclear reactor—an unsupportable assumption given the current 10 mile

[37] Id. at 53
[38] Id. at 54
[39] Id. at 60
[40] The SOARCA Process, updated Mar. 31, 2011, http://www.nrc.gov/about-nrc/regulatory/research/soar/soarca-process.html.

Emergency Planning Zone. If not everyone could evacuate from the region in time, then cancer figures certainly would be increased. This indicates that the improved computer modeling and more sophisticated understanding of the progression of reactor accidents incorporated in SOARCA have not substantially changed outcomes—indeed, they may be more severe than previously believed depending on the scenario chosen. But real-world experience at Fukushima trumps the computer modeling of SOARCA in any case and has presented the world—and the NRC—with an actual accident that exceeds postulated scenarios.

In denying emergency planning petitions in *Citizens Task Force of Chapel Hill*, the NRC Commissioners relied on the studies that pre-date Fukushima and Chernobyl and also on an assertion that an accident scenario that could cause the most severe consequences would involve a fast-moving "small highly concentrated puff" of radiation. In the scenario described by the Commissioners (and in NUREG-0396) there would be no evacuation for 24 hours and people would shelter instead. The Commissioners stated this scenario brought about the largest number of casualties postulated under NUREG-0396, but that its probability was "near zero" and "the calculated consequences are greatly overestimated."

This position stated by the Commissioners is fundamentally flawed, as evidenced by the real-life accident at Fukushima. In fact, at Fukushima, the probability that most people within10 miles would not be evacuated within 24 hours turned out to be 100%, not "near zero." The probability that affected people outside 10 miles would not be evacuated was exactly 100%. And, at Fukushima, the "near-zero" probability of a "small highly concentrated puff" of radiation turned out to be days and weeks of massive sustained radiation releases.

Computer models, simulations, evaluations of projected scenarios—all can be useful tools in evaluating the relative risks of complex systems like nuclear reactors. They can even be useful—in the absence of real-world information—in establishing regulations. But they exist

primarily to generate postulated data in the absence of actual data—they are not a substitute for actual, real-world experience.[41]

In the case of Fukushima, Tokyo Electric Power has acknowledged that fuel melted at three reactors and that molten fuel ruptured the reactor pressure vessel and penetrated the concrete basemat at Unit 1 at least.[42] And the accident at Fukushima resulted in sustained very large radiation releases over a period of weeks, and continuing releases—which on their own would spark public demands for evacuation in the U.S.--over many months. Most of the damage to populated areas was caused by two relatively short-lasting wind shifts that occurred during the several-week period of the highest releases. The heavily-contaminated area to the northwest of the Fukushima Daiichi site, for example, such as the town of Iitate about 40 kilometers (25 miles) from the plant, was caused by a wind shift on the day of March 15, four days after the

[41] Simulation results can vary widely. For example, three simulations conducted by non-governmental organizations came to conclusions that differ significantly from those that underpin NRC safety studies relied on for emergency planning purposes. A Physicians for Social Responsibility simulation at Braidwood predicted that 20,000 people could receive lethal doses of radiation and 200,000 people could suffer from radiation sickness. A Union of Concerned Scientists simulation at Indian Point concluded that 44,000 people could die as the result of a nuclear accident within a year, and 518,000 people could contract and die from cancer over time. After Fukushima, the Natural Resources Defense Council, in conjunction with Riverkeeper, took another look at the implications of a major accident at Indian Point. In addition to looking at the UCS figures, the NRDC used the U.S. Department of Defense computer model HPAC (Hazard Predication and Assessment Capability) to calculate resulting fallout from plumes. The study determined that releases from Indian Point would be similar to those at Fukushima, resulting in roughly a release of 8 percent of the core inventory. Three Indian Point source terms were calculated and it was determined that a gap release would be roughly 2/3 of Fukushima Daiichi, in-vessel severe core damage would be four to five times higher than Fukushima Daiichi, and vessel melt through would be nine times higher than Fukushima. The large disparity between these simulations and those conducted for NRC safety studies is a further indication that real-world experience, such as the Fukushima Daiichi accident, is more relevant and reliable for planning purposes than any simulations.

[42]"The Evaluation Status of Reactor Core Damage at Fukushima Daiichi Nuclear Power Plant Units 1 to 3," Nov. 30, 2011. http://www.tepco.co.jp/en/nu/fukushima-np/images/handouts_111130_04-e.pdf

onset of the accident, accompanied by rain and snow that forced the radiation to the ground.[43] Similarly, radioactive hotspots found well to the south of the Fukushima Daiichi site, 100 miles and more, were caused by a similar shift in the wind to the south from March 21-23.[44]

The Commissioners, in deciding *Citizens Task Force of Chapel Hill*, clearly did not contemplate a nuclear accident affecting multiple reactors and irradiated fuel pools at a single site. Nor did the Commissioners anticipate a nuclear disaster that resulted in extremely large sustained radioactive emissions over a period of several days, even weeks. In fairness, before March 2011, current petitioners did not anticipate such a scenario either. Yet that is exactly the reality that was presented by the Fukushima Daiichi accident in March 2011. These are facts, not hypothesis, not simulation. No reactor safety study, to the best of our knowledge, that ever has been published has attempted to analyze such a scenario. And it is clearly insufficient to rely upon computer models and simulations and safety studies when we have been presented with the actual fact of multiple meltdowns, fuel pool failures and sustained large radiation releases over long periods of time. NRC regulations must be grounded in reality, and certainly cannot ignore reality.

The Commissioners decision in *Citizens Task Force of Chapel Hill* may have been defensible at the time, but it is not defensible now. Nor is simple reliance on hypothetical reactor safety studies when real world disaster has exploded across the world's television screens.

The reality is that Japan evacuated an area already far larger than the NRC's 10 mile zone, and was forced belatedly, by extremely high radiation levels —and to its citizens' detriment—to expand that evacuation area more than twice as far as current NRC regulations

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[43] *The Radioactive Rains of March*, http://blogs.wsj.com/japanrealtime/2011/11/15/the-radioactive-rains-of-march/?mod=WSJBlog&utm_source=twitterfeed&utm_medium=twitter, Wall Street Journal, November 15, 2011

[44] Ibid.

require. Yet the area around Fukushima Daiichi, especially to the hard-hit area northwest of the site, is not heavily populated. Imagine the difficulties of using a 10 mile planning zone as the basis for a rapid expansion of the zone to 25 miles or more in a heavily urban area such as near Indian Point in New York, Limerick in Pennsylvania or many other existing reactor sites. Clearly, the NRC has not adequately imagined those difficulties to date. And, perhaps the NRC can imagine the public outcry in the United States if it evacuated those further away areas—especially in highly-populated areas—as slowly as did Japan (or earlier, Ukraine, Belarus and Russia).

Add to all that the fact that the wind blew the vast majority of the radiation released during the first week of the Fukushima Daiichi accident over the ocean and away from land—had the wind been blowing in a different direction, could Japan have evacuated a large enough area fast enough? Would the U.S. be able to do so in a similar scenario? The answer to both questions is almost certainly no. And yet, this is real world data—the NRC cannot rely upon favorable wind patterns as an emergency response measure.

3. Real-World experience and improved understanding of severe accident risks at nuclear fuel pools

Nuclear fuel pools pose a serious and dangerous threat to the populations surrounding nuclear plants. Accidents could cause widespread contamination of highly radioactive materials. When fuel rods in a nuclear reactor are "irradiated" or no longer usable, they are removed from the reactor core and replaced with new fuel rods.[45] However, these rods continue to generate heat for many years and are placed in pools of water to cool. In theory, this form of storage is

[45] "Safer Storage of Spent Nuclear Fuel, The Problems with Spent Fuel Pools," last revised Mar. 24, 2011. http://www.ucsusa.org/nuclear_power/nuclear_power_risk/safety/safer-storage-of-spent-fuel.html

meant to be temporary.[46] But, because offsite storage of irradiated fuel is currently unavailable, high density storage of this material has been permitted to occur. [47] These densely packed pools create a situation where cooling them could be incredibly difficult under accident conditions, as was the case at Fukushima Daiichi (where the pools were not as densely packed as is typically the case in the U.S.). In the case of a loss of water in the pool, convective air cooling would be relatively ineffective in such a "dense-packed" pool.[48] Irradiated fuel recently discharged from a reactor could heat up relatively rapidly to temperatures at which the zircaloy fuel cladding could catch fire and the fuel's volatile fission products, including 30-year half-life Cesium-137, would be released.[49] The fire could well spread to older irradiated fuel.[50] Radiation exposure would be significantly worse if there were to be an irradiated fuel pool accident in addition to a reactor accident. The irradiated fuel pools can hold 5 to 10 times more long lasting radioactive material than the reactor core.[51] The NRC has already stated that the effects of radiation could be felt as far away as 500 miles.[52] According to former Department of Energy official Robert Alvarez, nearly 40 percent of the radioactivity in U.S. irradiated fuel is cesium-137 (4.5 billion curies) —

[46] Id.
[47] Alvarez, Robert. "Reducing the Hazards from Stored Spent Power Reactor Fuel in the United States," http://www.ips-dc.org/reports/reducing_the_hazards_from_stored_spent_power-reactor_fuel_in_the_united_states at pg. 2
[48] Id.
[49] Id.
[50] Id.
[51] Alvarez, Robert. "What about the Spent Fuel Pool," Bulletin of the Atomic Scientists, pg. 1, available at http://www.nirs.org/radwaste/atreactorstorage/alvarezarticle2002.pdf
[52] Mason, Margie and Joe McDonald, "Risks from Radiation Low in Japan but Panic High," Mar. 17, 2011, http://www.washingtonpost.com/wp-dyn/content/article/2011/03/17/AR2011031701214.html (The figure is derived from a study issued in 2000 by the NRC regarding a hypothetical event).

roughly 20 times more than released from all atmospheric nuclear weapons tests. U.S. irradiated pools hold about 15-30 times more cesium-137 than the Chernobyl accident released.[53]

The long-term land-contamination consequences of such an event could be significantly worse than those from Chernobyl. Aside from concerns associated with the dense packing of a pool, the pools themselves are located outside of the primary containment which is designed to keep radiation which is released during an emergency event from escaping in to the environment.[54] Because they are outside of the primary containment structure, they are more vulnerable than the core to natural disasters and terrorist attacks.

At Fukushima, the fuel pool at Unit 3 was essentially destroyed by the explosion that also devastated that unit's reactor building. Video of the fuel pool shows no evidence of intact fuel rods—the presumption is that these rods were thrown out and perhaps vaporized in the explosion.[55] It is likely that small pieces of the fuel rods that once were in this pool have contributed to the creation of intensely-radioactive hotspots onsite as well as across north-central Japan.

The NRC Commissioners in deciding *Citizens Task Force of Chapel Hill* did not consider the effects of irradiated pool failure. Rather, the Commissioners examined containment and core failure as the main sources of severe accident consequences. Failing to address this serious and growing issue may not have been as flawed in the early 1990's, but given what is known about

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[53] Alverez, Robert. "Spent Nuclear Fuel Pools in the U.S.: Reducing the Deadly Risks of Storage." http://www.ips-dc.org/reports/spent_nuclear_fuel_pools_in_the_us_reducing_the_deadly_risks_of_storage

[54] "Safer Storage," http://www.ucsusa.org/nuclear_power/nuclear_power_risk/safety/safer-storage-of-spent-fuel.html

[55] See, for example, this video uploaded to YouTube by NEI Magazine October 18, 2011, which appears to show few, if any, intact fuel rods in the Unit 3 fuel pool: http://www.youtube.com/watch?v=7qMi6azQCaE

the long term effects of irradiated fuel pools and how serious of a threat they are, continued failure to address these risks is now flawed.

4. Particular problems associated with pressure suppression containments

The failure of a pressure suppression containment can result in widespread radioactive contamination of areas surrounding nuclear plants. With the Three Mile Island accident, a hydrogen explosion caused sudden pressure to spike. While containment did not fail, if TMI had had a pressure suppression containment system, designed only to withstand overpressures of less than one atmosphere, then containment failure and large release of radioactive material would have been extremely likely.[56] With Chernobyl, which employed a weak containment using the pressure suppression concept, the containment did fail and the reactor's protective barriers were breached to such a degree that a significant part of the radioactive core was blown to the atmosphere. In Japan, hydrogen explosions occurred at (at least) three GE Mark I reactors using a pressure suppression system. NRC, and earlier, AEC safety officials have warned about the dangers of this containment concept for more than 40 years.

The argument that an accident on a scale of Chernobyl cannot happen here was flawed, and after Fukushima, is even more flawed. There are 23 GE Mark I nuclear reactors—about one-quarter of the nation's reactors--essentially identical to the reactors that were destroyed at Fukushima, that are operational in the United States.[57] This design has been subject to much scrutiny and criticism for its design flaws, specifically the fact that it is susceptible to explosion

[56] Lyman, Edwin. "Thirty Years After TMI: Five Continuing Vulnerabilities." Mar. 23, 2009, http://www.thebulletin.org/web-edition/features/thirty-years-after-tmi-five-continuing-vulnerabilities

[57] Zeller, Tom. "Experts Had Long Criticized Potential Weakness in Design of Stricken Reactor," Mar. 15, 2011, http://www.nytimes.com/2011/03/16/world/asia/16contain.html

and containment failure.[58] The NRC can no longer dismiss the reality of devastating nuclear accidents based on supposedly superior U.S. reactor designs.

Not only can the NRC no longer dismiss such accidents in the U.S., the NRC must instead assume that such accidents can occur in the U.S. and even, given the history of the nuclear age that large nuclear accidents are occurring at a much greater frequency than previously postulated, the NRC—at least for emergency planning purposes if nothing else—must assume that such accidents will occur in the U.S.

5. *Improved understanding of the health effects of radiation*

There is no "safe" dose of radiation, and as such the consideration of the effects of release of radiation should be given greater consideration. The National Research Council of the National Academy of Sciences BIER VII Report in 2006 confirmed that any exposure to radiation – including background radiation – increases a person's risk of developing cancer.[59] This report obviously was published well after promulgation of the NRC's existing emergency planning regulations and its decision in *Citizens Task Force of Chapel Hill.* The greater understanding of the risks of radiation exposure revealed by BEIR VII must inform NRC regulations.

For example, Japan has been criticized internationally for increasing its allowable radiation exposure levels for the general public twenty-fold from pre-Fukushima standards to 20 MilliSieverts/year (2 rems/year), apparently to avoid much larger evacuations/relocations than already undertaken.

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[58] Atomic Energy Commission, Hanauer Report, available at: http://graphics8.nytimes.com/images/blogs/greeninc/hanauer.pdf

[59] Lessons From Fukushima and Chernobyl for U.S. Public Health, Physicians for Social Responsibility, Spring 2011. http://www.psr.org/assets/pdfs/fukushima-and-chernobyl.pdf

Even so, this 2 rems/year level is considerably lower than the Protective Action Guide (PAG) referred to by the NRC Commissioners in *Citizens Task Force of Chapel Hill* of an emergency response goal of preventing exposure to 5 rems/year. Given BEIR VII, this exposure level is hopelessly outdated and indefensible.

For example, BEIR VII clarifies that women and children are much more susceptible to radiation exposure than the "average man."[60] Indeed, according to BEIR VII, exposure to 2 rads in a single year (roughly equivalent to the new Japanese standard of 20 MilliSieverts or 2 rems in one year) will cause cancer in about 1 in 200 juvenile males, and the same exposure will cause 1 cancer in about 100 juvenile females.[61] Given the Linear No-Threshold model adopted by BEIR VII, the guideline of 5 rems would cause cancers at more than double those rates for children.[62]

It is difficult to imagine any NRC appointee or employee successfully defending a policy in the aftermath of a nuclear accident in the U.S. that would allow a cancer rate among schoolchildren in the neighborhood of 1 in 50 to 1 in 100.[63] And, indeed, that must not be the NRC's policy. Emergency response planning must, of course, first be oriented toward preventing

[60] Biological Effects of Ionizing Radiation (BEIR) VII, Phase 2 report, "Health Risks from Exposure to Low Levels of Ionizing Radiation" Table 12D-3 on pg. 312, Published by the National Academy Press in 2006, Washington D.C.

[61] BEIR VII, Phase 2 Report, Table 12D1-12D2, pg. 311. BEIR VII, page 311, Tables 12D-1 (incidence) and 12D-2 provides conclusions on the exposure of various age groups to .1Gy of radiation, reported per 100,000 exposed. Because of the clear difference in gender response to radiation, NIRS finds it important to report the findings for both males and females. The most vulnerable require the greatest protection, so we report the numbers for the youngest, most vulnerable age group, adjusted for the 20 mSv comparison.

[62] Id. Note that subsequently issued PAGs have not offered any increased public protection.

[63] Of course, if people did not evacuate and remained in such a contaminated zone, they would be at proportionately higher risk. At 5 rads/year over a five year period, the risk would be on the order of an unimaginable 1 cancer in 20 young girls.

Rather than allowing unacceptably high radiation exposures, the NRC and licensees must recognize that their emergency response programs must be designed to protect not only against radiation levels that would cause acute effects, but also radiation levels that would exceed annual exposure limits—in real-life, the American public simply will not allow otherwise. Petitioners believe allowable annual exposures under NRC and EPA regulations already are too high, although we are not challenging those with this petition. But a government policy that implicitly states, as do NRC's existing emergency planning regulations, that radiation exposure levels higher than normally allowable—by orders of magnitude—are acceptable under emergency conditions, is a government policy that is unsupportable and without basis in reality.

6. Natural Disasters and Emergency Response Planning

Natural disasters have become increasingly prevalent in recent years causing concerns for nuclear reactors that are susceptible to various weather phenomena and disasters. Before March 2011, few would have believed that a 9.0 earthquake and 40+ foot tsunami would strike the coast of Japan. And before August 2011, few would have believed that an earthquake would strike central Virginia resulting in ground motion acceleration about twice the design basis of a U.S. nuclear power plant. Yet both of these happened within six months of each other.

From the horror of Hurricane Katrina in 2005 and the resultant devastation of a major American city (not to mention a complete failure of emergency evacuation and response plans) to Hurricane Irene in 2011 and the accompanying unprecedented flooding in the northern state of Vermont, natural phenomena are playing a much greater role in our lives than ever before. . Indeed, many have termed 2011 as the most damaging weather year ever for the United States.[64]

[64] *Billion dollar Weather Disasters of 2011 Break Record*, http://www.accuweather.com/en/weather-news/billion-dollar-weather-diaster-1/58914, December 13, 2011, accuweather.com

Many, including petitioners, believe much—perhaps most—of this is due to the reality of climate change. If this is correct, "unprecedented" natural disasters will not only continue to occur, they will accelerate.

At Fukushima, the earthquake and tsunami initiated a nuclear accident. Hurricanes Katrina or Irene (or many others) would have greatly compromised evacuation had a nuclear emergency occurred concurrently. So could a tornado (during 2011, tornados caused loss of offsite power—the root cause of the Fukushima accident-- at the Browns Ferry and Surry nuclear reactors sites), wildfire (for example, a major wildfire threatened nuclear storage sites at Los Alamos National Laboratories during 2011), floods (a major flood on the Missouri River during 2011 threatened the Fort Calhoun and Cooper reactors in Nebraska and put evacuation routes under water) and other natural disasters.

Current NRC emergency planning regulations do not reflect that natural disasters can both cause nuclear accidents and/or may occur concurrently with nuclear accidents. In either event, natural disasters can greatly complicate the ability to evacuate a given area, or even to provide sufficient communication to assure sheltering or other protective actions within a given area.

Emergency response planning for nuclear facilities must incorporate regionally-relevant initiating and concurrent natural disasters as a regular part of emergency exercises, to assure the most effective possible emergency response in the event of a nuclear accident triggered by or complicated by a natural disaster. For this reason, we propose that every other emergency exercise include a scenario that includes a regionally-relevant initiating or concurrent natural disaster. By "regionally relevant" we mean that plans should be made and exercises undertaken for the type of natural disaster most likely to affect a given licensee site (for example,

earthquakes on the west coast, hurricanes in the southeast, etc.). However, for areas that may be affected by more than one type of natural disaster—for example, Midwest reactors could be affected by tornadoes and earthquakes along the New Madrid Fault; reactors over much of the country could be affected by hurricanes, tornadoes, ice storms, floods and earthquakes, all of which could cause extended loss of offsite power and meltdown—each exercise should include a different regionally relevant scenario.

V. PROPOSED UPGRADES TO EMERGENCY PLANNING STANDARDS.

A. Creation of a three-tiered Emergency Planning Zone.

The NRC should amend 10 C.F.R. 50.47(c)(2) to create a three-tiered emergency planning zone, including an expansion of the current 10 mile EPZ to include area within a 25 mile radius of a reactor site, establishing an emergency evacuation zone of a 50 mile radius within a reactor site, and expand the radius of the ingestion pathway to a 100 mile radius within a reactor site.

1. 25 Mile Plume Exposure Pathway EPZ

> A Plume Exposure Pathway zone shall consist of an area about 25 miles (40 km) in radius. Within this zone, detailed plans must be developed to provide prompt and effective evacuation and other appropriate protective measures, including conducting of biannual full-scale emergency evacuation drills. Sirens will be installed within this zone to alert the population of the need for evacuation. Transportation for elderly, prison and school populations shall be provided within this zone. Emergency shelters shall be located outside of the 25-mile zone.

This zone would be an expansion of the Plume Exposure Pathway EPZ which currently has a 10 mile radius limitation. It would provide no new requirements other than expansion of

the EPZ. The real-world accidents at Chernobyl and Fukushima demonstrate that the radiological effects from nuclear power plant disasters have far reaching effects—well beyond ten miles. The NRC's establishment of the 10 mile EPZ in 1980 may have been seen as appropriate and protective at the time; actual events have now supplanted it—it is manifestly inadequate to address the consequences of accidents that have, in fact, occurred.

Nor does a 10 mile EPZ, and the accompanying required emergency exercises within this zone, any longer provide a sufficient basis for an ad hoc evacuation beyond the zone. Delays in evacuation that occurred because of a lack of preparation in Ukraine and Belarus and Japan have had life-threatening consequences.

2. 50 Mile Emergency Response Zone

> The plume exposure pathway EPZ shall be about 50 miles in radius. Within this 50 mile zone, the licensee must identify evacuation routes for all residents within this zone and annually provide information to all residents within this zone about these routes and which they are supposed to take in the event of an emergency. The licensee must make basic pre-arrangements for potential transport of disabled/hospital/prison populations. Emergency centers for the public currently located less than 25 miles out shall be relocated to 25 miles or further out. Information shall be made available to the public within this zone through television, internet and radio alerts, text message notices, and other appropriate means of public communication.

This would require measures be carried out between the new 25 mile Plume Exposure Pathway EPZ and a new Emergency Response Zone of about a 50 mile radius. Within this zone, the emergency evacuation requirements and biannual exercises of the Plume Exposure Pathway EPZ are not required. Rather, this new zone would provide a modest level of pre-planning that would enable rapid expansion of the 25 mile zone when necessary. Information regarding evacuation such as identification of evacuation routes and locations of emergency shelters in the

event of a large scale disaster would be identified and would be provided to members of the public annually, and a limited number of other pre-arrangements would be made. Given the large scale of the evacuations at both Chernobyl and Fukushima, evacuation and/or other protective actions for populations beyond 25 miles of a nuclear accident site would be highly likely in the event of a serious nuclear accident.

3. 100 mile Ingestion Exposure Pathway Zone:

> The ingestion pathway EPZ shall be about 100 miles in radius. In the event of a radioactive release, the deposition of radionuclides on crops, other vegetation, bodies of surface water and ground surfaces can occur. Measures will be implemented to protect the public from eating and drinking food and water that may be contaminated. Information shall be made available to the public within this zone through television and radio alerts, text message notices, and other appropriate means of public communication.

The current Ingestion Exposure Pathway Zone exists to protect food, water and anything intended for human consumption within 50 miles of a nuclear power plant. However, the effects of radiation at Fukushima and Chernobyl have extended far beyond that 50 mile radius, as stated above. Given that radiation can, and does, have far-reaching effects on food on a large radius, the Ingestion Pathway EPZ should be expanded.

Other Related Amendments to Enhance Emergency Planning:

Amend 10 C.F.R. 50.47(b)(14) by adding: Within the emergency evacuation zone full scale drills and exercises will be conducted on a biannual basis. Every other exercise

and drill shall include a scenario involving an initiating or concurrent regionally-appropriate natural disaster.

VI. CONCLUSION:

The Petitioners believe that amending 10 C.F.R. 50.47 to expand the Plume Exposure Pathway to about a 25 mile radius of a reactor site, create a new Emergency Response Zone of about 50 miles, and expanding the ingestion pathway zone to about 100 miles would more likely provide adequate protection to the public than current regulations, which do not provide adequate protection. Events that the NRC believed 30 years ago were nearly impossible to occur have in fact occurred and, in the case of Fukushima, continue to occur. Waiting to see how bad an emergency gets before expanding evacuation beyond a planned radius is not a plan of action, it is a recipe for disaster and an abdication of responsibility. Action to expand Emergency Planning Zones and improve emergency response capability must be taken now in light of real-world evidence and the demonstrated history of the widespread damage nuclear accidents cause.

Respectfully submitted
This 15th day of February 2012,

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