STATE OF VERMONT
PUBLIC SERVICE BOARD

Amended Petition of Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc., for amendment of their certificate of public good and other approvals required under 30 V.S.A. § 231 (a) for authority to continue after March 21, 2012, operation of the Vermont Yankee Nuclear Power Station, including the storage of Spent nuclear fuel	October 22, 2012 Docket No. 7862

PREFILED TESTIMONY OF RAYMOND SHADIS
ON BEHALF OF NEW ENGLAND COALITION

Summary of Testimony

Mr. Shadis describes and documents negative impacts and potential negative impacts of the proposed extended period of operation of the Entergy Vermont Yankee Nuclear Power Station. Mr. Shadis discusses a growing number of uncertainties which are embedded in the proposed extended period of operation and which militate in favor of denial of the requested amendment of Petition of Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc.'s certificate of public good and other approvals and findings required under 30 V.S.A. § 231 and 30 V.S.A.§ 248.

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Q-1. Please state your name and place of residence.

A-1. My name is Raymond Shadis and I reside at 47 Shadis Road, Edgecomb, Maine.

Q-2. Please state your qualifications to provide testimony in this matter.

A-2. My relevant curriculum vitae are provided as Exhibit NEC-RS-1. With respect to the particular events and conditions addressed by my testimony, I would supplement my CV by recounting the following relevant experience. From 1996 through 2005 I represented the only environmental advocacy organization directly involved in the decommissioning of Maine Yankee Atomic Power Station. In that role, I participated in Maine Yankee Atomic Power Company's Community Advisory Panel on Decommissioning and, as a pro se litigant, in Maine Yankee-related dockets before the Maine Public Utilities Commission, Federal Energy Regulatory Commission and U.S. Nuclear Regulatory Commission. During that period I also

negotiated decommissioning standards and numerous decommissioning enhancements directly with Maine Yankee Atomic Power Company.

Among them was a radiological clean up standard more than twice as strict as federal law (this was later embodied by agreement into Maine law and the NRC license termination amendment). In addition, I negotiated a prohibition of "rubblization" (onsite disposal of concrete demolition debris) and a commitment by Maine Yankee to prohibit redevelopment of the site for any nuclear-related purposes, and I worked with Maine Yankee to develop an expanded historical site survey that discovered forgotten areas of contamination by inquiring of the anecdotal recollections of former employees. I also worked with Maine Yankee to implement safety and security enhancements to the Maine Yankee spent fuel pool and the independent spent fuel storage installation (ISFSI), as well as offsite radiological survey initiatives, including a deep water marine sediment survey and an inter-tidal zone survey of sediment and biota. Included in each agreement was a confirmatory oversight role, which required ongoing detailed communication of technical information with Maine Yankee (and Maine Yankee contract) personnel.

My work on Maine Yankee safety and environmental issues from 1995 forward led to Maine Yankee's sponsorship of my involvement in the scoping and review process for the NRC Staff Report entitled, "Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Stations" (NUREG-1738), and NRC's sponsorship of my participation as the sole NGO representative in the agency's Initial Implementation Evaluation Panel for the New (2000) Reactor Oversight Process ("ROP"). This in turn led to my being invited to participate in NRC's early review of

its safety significance determination process ("SDP"), a key element of issuing findings in the ROP. The work undertaken with Maine Yankee and NRC during this period (1995-2005) was an immersion experience in nuclear technology and regulation that led to numerous positive assessments of my performance by colleagues in both the industry and agency.

Following industry practice, I have of necessity become familiar and experienced in the review of risk-information and cost-benefit analysis as it pertains to nuclear operation and regulation.

In addition, I would like to state that my nine years (1997-2006) of experience as staff technical advisor to New England Coalition on Nuclear Pollution and the six succeeding years as a technical consultant to New England Coalition have provided me with in-depth experience in the review of Entergy Nuclear Vermont Yankee operations, and NRC regulatory exercise and related activities. Through my education, experience and relevant research, I have become well-versed in not only the operational aspects of Entergy Nuclear Vermont Yankee, but also in the criteria applied by the Public Service Board when determining whether to issue a Certificate of Public Good. Moreover, my particular focus on the Vermont Yankee plant operations, and the regulations governing the plant, has resulted in my having expertise in the reliability, environmental impacts, and conditions of the Entergy Nuclear Vermont Yankee plant.

Q-3. Have you previously testified before the Vermont Public Service Board and has that testimony been admitted into evidence?

A-3. Yes, I have testified and my testimony was admitted in Docket 6545 (Sale of Vermont Yankee), Docket 7195 (Vermont Yankee Steam Dryer Investigation), Docket 7440 (Authority to Continue Operation of Vermont Yankee after March 21, 2012), and Docket 7600 (Vermont Yankee Groundwater Contamination Investigation).

Q-4. What is the purpose of the direct testimony you are now presenting?

A-4. The purpose of my testimony is to assist the Board in determining if, on balance, granting Entergy's petition for continued operation of the Vermont Yankee station will be in the public interest, and whether the Board should grant a Certificate of Public Good pursuant to 30 V.S.A. § 248.

Q-5. Have you reached a conclusion as to whether Entergy's petition merits a CPG? If so, what is your conclusion?

A-5. I have. My review of the petition, the testimony of Entergy's witnesses, recent plant operational, condition, and maintenance documents, applicable NRC documents, and (generally) official, regulatory, and professional literature pertaining to nuclear power plant operation, the nuclear fuel cycle, regional electric power supplies in New England, Canada, and the Northeast, leads me to conclude that, on balance, granting Entergy's petition would not be in the public interest; nor would it serve the public good. Accordingly, it is my conclusion that the Applicant has failed to meet the requirements of 30 V.S.A. § 248(b), and therefore its petition for a Certificate of Public Good should be denied. My analysis relies entirely upon considerations squarely within the purview and jurisdiction of the Vermont Public Service Board, regarding the State's non-preempted concerns over the economic, environmental and land use implications of continued operation of the plant.

Q-6. Have you any general observations about the petition and the prefiled direct testimony of Entergy witnesses supporting the petition?

A-6. Yes, Entergy and its witnesses have failed to provide a complete picture of the proposed period of extended operation. Entergy has especially failed to adequately describe the risks, challenges, liabilities and likely extraordinary costs associated with continued operation. In addition, Entergy has failed to provide reasonable plans for maintaining the plant (if at all possible) from 2012 to 2032. For example, Entergy does not say if it agrees under the terms of the Docket 6545 MOU that it must come to the Vermont Public Service Board for a CPG for any additional extension of operation. Under NRC regulation, a licensee may file for a second 20-year renewal the day after its original license expires. That there are business reasons for filing a renewal 20 years in advance of the (next) license expiration is evidenced by the fact that NextEra, LLC has filed for renewal of Seabrook Station's license, which does not expire until 2032.

Left unanswered by Entergy's pre-filed testimony is whether Entergy intends to continue exaggerating, and relying exceedingly upon, its preempted status as an independent wholesale (merchant) generator. Will Entergy assume that preemption will allow it to add nuclear generating capacity on its present site without submitting to the authority of the State of Vermont? How will Entergy cover the extraordinary costs of NRC-mandated analyses, inspections, and modifications required in response to the lessons-learned from the Fukushima incident? How does Entergy plan on turning a profit given the need to replace the main condenser and spare transformers, and undertake cooling tower upgrades? For the last few years Entergy VY has

declared that Vermont Yankee has barely covered O&M costs, so how does that square with the foregoing expenditures that need to be made? The failure of Entergy to adequately discuss these matters within its testimony renders its petition incomplete, and its position in favor of a CPG untenable. The Board cannot find, on the record put forth by the Petitioner, that continued operation of the plant will be in the public good, especially considering Entergy's failure to fully provide and explain the vital information and issues presented above.

Q-7. Please outline your testimony.

A-7. I will begin with a discussion the question of reliability (with subsets of availability and viability) in practical terms, as NEC sees reliability attaching to this petition and material to a VPSB decision in non-preempted space. I will then discuss the prospect of changes to plant systems, structures, and components and plant operations as mandated by NRC in response to the destruction of nearly identical reactors at Fukushima, Japan due to the loss of vital electrical power. Some of the anticipated changes I describe are also inherent in operation beyond the design life of systems, structures, and components at conditions found in exceeding original licensed thermal power. I will additionally discuss the recent history of selected plant systems, structures, and components, and plant operations and maintenance as they impact reliability. Finally, I will discuss selected plant operations that produce negative, non-radiological impacts to the environment.

Q-8. Please begin with a discussion the question of reliability (with subsets of availability and viability) and explain how reliability is material to a VPSB decision in non-preempted space.

A-8. My practical, fact-based analysis is as follows: Entergy offered a small selection of public benefits, which it claims will result from 20 years of additional operation. The Board can only issue a CPG if it finds that, on balance, 20 more years of operation of VY will benefit the people of Vermont. On the positive side of the scales, Entergy offers 300-350 jobs, tax revenue, and a record of charitable donations. It can also claim, to some degree, to aid in stabilizing the New England electric grid, purportedly benefitting the State of Vermont and the rest of New England.

These benefits, Entergy claims, will flow throughout the 20 years of additional operation; however, these purported "benefits" will continue only so long as the plant operates. Such benefits will diminish to some degree as power output below current maximum achievable output diminishes, and all benefits will diminish as plant reliability diminishes. Therefore, the value (benefits) of extended operation can only be projected in tandem with projections of reliability. Thus, I felt comfortable taking New England Coalition's assignment to look into questions of reliability (with its subsets of availability and viability), despite Entergy's broad claims of federal preemption.

Before moving into issues that could affect reliability, some discussion of what I view as reliability subsets - availability and viability - is warranted. Although Entergy has claimed exemption from considerations of reliability under 30 V.S.A.§248 because Entergy is not selling electricity to Vermont utilities, Entergy witnesses opine that Vermont Yankee-generated electricity is available and will be available following issuance of the proposed CPG to Vermont Utilities as a benefit that would provide stable power at competitive prices. For example, Entergy states:

> A new CPG should be granted because continued operation of the VY Station will promote the general good of the State of Vermont, producing

substantial economic benefits to Vermont as well as a diversified, environmentally sound source of power for Vermont and the New England region, as it has done for the last 40 years. [Emphasis added]

Prefiled Testimony of T. Michael Twomey, June 29, 2012, page 8, Line 8

Q52. Is Entergy now willing to enter into a PPA with Vermont utilities on any terms?
A52 Yes, Entergy is willing to enter into a PPA with the Vermont Utilities to sell power that is not otherwise committed under contract to another party at market rates and under terms and conditions that are mutually agreeable. [Empasis added]

Prefiled Testimony of Marc Potkin, June 29, 2012, page.17, lines 6-9,

Q55. Do you believe that the continued operation of VY Station a PPA with Vermont utilities would provide an economic benefit to Vermont?
A55. Yes. Even beyond the benefits associated with the well-paying jobs provided by Entergy VY and the taxes paid by it, which are described by Mr. Heaps in his testimony, the VY Station's continued operation provides a large block of baseload supply that tends to hold down market prices for the benefit of electric customers in Vermont and elsewhere in the New England region, which is discussed by Mr. Tranen. [Emphasis added]

Prefiled Testimony of Marc Potkin, June 29, 2012, pages17-18, lines 21,22, 1-5

It is therefore clear from Entergy's own testimony that Entergy's claims of economic benefit, in support of its petition for a CPG, are at least in part predicated on the plant being an available and viable source of power generation for the State of Vermont. Whether ENVY is, in fact, available and viable as a source of power generation for the Sate of Vermont is, therefore, an important question tied to the plant's reliability.

Q-9. What is meant by availability in the context of the petition for a CPG?

A-9. The VY Station must be available (and reliable) for Vermont to reap any benefit from the contracts that Entergy appears to be offering as enticements to endorse the CPG. In addition, ENVY must be available (and reliable) in order to have down-pressure on

market prices, which Entergy's witnesses claim as a benefit of continued operation. If the ENVY plant is broken and on the way to dismantling, or if it is down for an extended period for repairs or retrofitting, the benefits claimed by Entergy's experts are illusory. Interruptions that would cause the plant to run with greatly reduced power production levels, due to the constrictions of failing components or otherwise, reduce the value of potential power contracts or potentially holding down market prices. Therefore, Entergy's witnesses Twomey and Potkin can not actually prove ENVY has the benefits to offer that those witnesses claim.

By invoking the greenhouse gas initiative, job creation, the potential for electric supply contracts and Vermont's energy portfolio generally, Entergy is describing Vermont Yankee as a Vermont energy generator, rather than a Vermont energy provider - a resource (untapped) rather than a source, and a part of Vermont's electric generation inventory. Before the VPSB attempts to establish the value of Entergy's proposed benefits, it should require Entergy to provide evidence as to the quality and term of those benefits; that is, their reliability and their effective period of availability.

The testimony provided by Entergy leaves the actual, tangible "benefit" an open question. Can the Board find with any assurance that VY Station will continue to set breaker-to-breaker and 500 day continuous runs throughout the proposed period of extended operation (PEO), or will it breakdown? If it is likely to break down, when will it do so and for how long? When the plant is not operational, due to reliability issues I have identified, what would be the VY Station's value to Vermont? Would the value to the State be greater if decommissioning commenced forthwith? Entergy's failure to provide sufficient testimony on these matters renders its application incomplete, and the

Board should therefore consider the actual benefits claimed by Entergy to be nominal at best, and illusory at worst.

Q-10. How do you consider viability in the context of the petition for a CPG?

A-10. It begins with asking a question: "What is the value or potential liability to Vermont of entertaining Entergy's extended operation plan if it has only limited or marginal viability?"

Over the last few years, Entergy has on multiple occasions alluded to the marginally profitable, or even non-profitable, status of VY. In the mid-1990's, in a strikingly similar electricity market with an abundance of newly-developed Canadian hydropower and ever-cheaper natural gas-fueled generation, I witnessed the struggles of Maine Yankee Atomic Power Company, and to a lesser extent, Connecticut Yankee, in trying to find the money to deal with an ever-growing backlog of repairs, emergent design flaws, necessary equipment replacement and up-grades. At both plants an in-depth NRC inspection or series of inspections rooted out additional and previously undetected flaws that the companies could not afford to correct. These costs are analogous to what VY faces in the upgrades required in response to the Fukushima incident and repairs/replacements necessary to keep this aging plant (with several failing and leaking components) operating. At Maine Yankee, in something of an understatement, NRC's inspection team attributed a root-cause of the plant's many accumulated flaws to an insufficiency of allocated resources. Entergy appears to be facing similar prospects with VY.

Entergy Vermont Yankee's proposed period of extended operation is a walk into a veritable forest of financial uncertainties; something quite remarkable and possibly

foolhardy for a company whose CEO, J. Wayne Leonard, told a 2011 Earnings Call that VY had barely met O&M costs. A high ticket item at the VY Station will be the near-term and necessary condenser re-tubing , condenser (tube) re-bundling, or full main (two-part) condenser replacement, which will cost $100 to $200 million by some estimates.

We don't know if Entergy noted a leaking condenser when the company did a due diligence review prior to purchase (completed in 2002), but Entergy engineers were complaining of the main steam condenser's terrible condition as early as 2003. Entergy responded with a series of stop gap (no-pun intended) measures that included the insertion of sleeve tubing to cover tube flaws near the condenser tube-sheet, staking to limit tube movement in the turbulent condenser currents, and in refueling outage (RFO) 29, a seriously lame plastic coating of the tubes. These activities so reduced condenser efficiency that VY Station had to power down in the first half of 2012, prompting a "Red" System Health Report for the Second quarter of 2012. Red is the most severe or negative of four color rankings (Green, white, Yellow, Red) employed by Entergy in evaluating system health:

> The condensate system is Red. - CR-VTY-2012-3511.
> The primary driver of the system's health color is the poor performance from the main condenser. It is well known by the station that condenser has shown a significant decrease in performance following RFO29. This has resulted in station power derates to maintain suitable condenser backpressure and several deep down powers to support troubleshooting and corrective actions. The condenser backpressure issue is captured in CR-2012-0309 and described in detail in the HT-ACE. The performance of the main condenser has increased since the beginning of the year following several evolutions which removed plates which were blocking flow in a waterbox, removed a portion Plastocor from the air removal region, placed the second SJAE into service, throttling of the SJAE suction valves, and tube brushing of the A condenser. There are additional corrective actions pending which include reclamation of stainless steel tubes in the air removal region of the A-1 waterbox where 75% of the tubes are plugged in the most critical area. This corrective action is

targeted for RFO-30 implementation. Down-tube Plastocor removal is also under consideration however an effective removal method has not yet been identified.

...

SIPD-68 to replace the condenser tubes in RFO-32 is not currently funded and is high priority. ... All parameters in the condensate system are acceptable with the exception of those associated with the main condenser. It is well known by the station that the condenser has shown a significant decrease in performance following RFO29. This has resulted in station power derates to maintain suitable condenser backpressure by 5-15 MWe and several deep down powers to support troubleshooting and corrective actions such as deckplate removal in the A-2 waterbox, Plastocor removal in the air removal region(~4' downtube) of the A-1 & A-2 waterboxes, tube brushing of the A-1 and A-2 waterboxes, and installation of a temp mod to allow throttling of the air ejector suction valves for the A condenser. The performance of the main condenser has improved based on these actions and is stable however further degradation and MWe loss is evident at the above stated values at elevated CW [cooling water] temperatures. Condenser backpressure remains unacceptable as compared to historical values however the condenser performance has improved sufficiently to minimize aggregate losses to within reasonable values. Based on the troubleshooting/maintenance initiatives condensate system performance monitoring system trends are not within acceptable ranges, but improving.

Indicator: Planning / Long Range Vulnerabilities / Obsolescence Issues
The long range plan for condensate is yellow.
SIPD VY-68: Condenser tube replacement is scheduled for RFO-32 and is in the initial stages of development. This is a high consequence item with an action plan and is **not currently funded**.,, [Emphasis added]

(Excerpt) Entergy VY Health System Report- Condensate System - VTY CR 2012-3511.

The NRC has put forward a three-tiered program to address lessons-learned from the accident in Japan and the agency has, under the first tier (highest priority) issued three orders to Vermont Yankee and others requiring (1) installation of harden, reliable, primary containment vents, (2) examination of potential plant vulnerabilities to extraordinary natural phenomena, such as earthquakes flooding and so forth, and (3) the installation of spent fuel pool remote-reading monitoring equipment. Industry groups are

estimating the cost of these NRC-mandated "Fukushima" upgrades at an average $250 million per plant. Entergy has yet to provide a cost estimate for these upgrades, nor has it provided an estimate for its proposed stand-alone 3 MWe diesel generator unit. Entergy's failure to provide this information with its application materials and testimony renders its application incomplete, and its arguments regarding the costs and benefits of continued operation must be taken by this Board for what they are – incomplete and unreliable.

These costs, moreover, are not the end of the story. In addition, the Cooling Tower Institute estimates design life of the VY cooling towers to be 50 years and they have suffered significant structural failures before they even turned 40. Entergy is approaching cooling tower structural degradation opportunistically and piecemeal by replacing individual wooden structural members as they crack or show signs of rot. The weakness of this approach in failing to catch critical weak points was made evident by the cooling tower large structural failures of 2007 and 2008. I believe that Entergy will soon have to face and except the necessity of cooling tower replacement. As I discuss later in my testimony under environmental impacts, both closed (wet cooling tower) and once-through systems have negative environmental consequences, so Entergy may find itself considering a yet more expensive option: installation of dry cooling towers.

Further, the US NRC has undertaken three rule makings that could pose serious financial impacts at VY. First is a revisit of maximum design temperature for nuclear fuel cladding under accident conditions (peak cladding temperature). All design reactor operating parameters flow from this calculated peak temperature. If the agency adopts a lower, more conservative peak cladding temperature, then, in addition to the expense of

recalculating the reactor operating parameters, licensees may find themselves required to modify or retrofit components and derate.

The second proposed rule would require environmental qualification of safety-related underground electrical components, especially electrical components susceptible to wetting or flooding. Here the impact on VY would not be so great, as, following a flooding incident more than two years ago, Entergy has undertaken a program of monitoring, water removal, and vulnerable vital cable replacement. The potential future costs of this program, however, remain unknown.

The third rulemaking regards NRC consideration of the environmental impacts of long-term high level waste at plant sites in licensing and relicensing, even if a national repository is never sited. Entergy's plan is to deploy 36 high level waste casks over the PEO. Dry high-level nuclear waste casks cost roughly a million dollars each. It is uncertain if these costs can be recovered from the Department of Energy, but it is fairly certain that the upfront costs will need to be paid by Entergy VY along with a commitment to guard the waste for a very long, but indefinite period. Some argument might exist to complain that the DOE failed to fulfill its contract to remove waste when we believed that a national repository was imminent; however, this is not a reasonable basis for extending and relying on that contract now knowing that it cannot be fulfilled in our lifetimes.

Utilities have in fact passed off ownership and stewardship of nuclear waste off to other entities under these circumstances. For example, the high level waste stored at the decommissioned Trojan nuclear Plant is now guarded by and independent contractor; Trojan ownership having come apart in the Enron scandal. At Maine Yankee, however,

we have a more typical situation, a company struggling and begging to go out of business, which it cannot do until the spent fuel is removed.

At a recent gathering of Maine Yankee's Community Advisory Panel, Maine's State Nuclear Safety Inspector told the community that in his opinion they could expect to host the waste for the next 100 to 300 years. At the time of Maine Yankee's decommissioning, Stone and Webster Engineering proposed siting and construction of a modern dual-cycle gas-fired generator at the Maine Yankee site only to find that, in consideration of the security of the stored fuel, the site could not be reused. Maine Yankee's shorefront industrial site (35 acres) remains off-limits to development today and it will remain so for the next 100 to 300 years or until the spent fuel is gone. The same prospects regarding the potential reuse of the VY site are at issue in this docket.

In Vermont, 20 years of additional operation will increase spent fuel to one and a half times the present amount. NRC, meanwhile, has undertaken, in cooperation with spent fuel licensees, physical studies of spent fuel storage hoping to confirm that dry cask storage will remain as secure and free from environmental degradation as we had first hoped. At Maine Yankee, for example, where concrete casks have begun to crack and spall, the company is participating in a study to determine the potential deleterious effects of salt air on the stainless steel canisters of fuel that the casks house; in particular the weld areas of the canisters. These uncertainties make it difficult, if not impossible, for the Board to conclude that extended operation will not severely limit the potential future reuse of the site. The only reasonable conclusion is that increasing the amount of SNF stored on-site is simply not in the public good.

A final uncertainty with respect to viability that I wish to touch on is the electricity market; one that so resembles the market (1991-1997) when four of New England's nine nuclear stations were permanently closed for "economic" reasons. If the price of natural gas continues its downward trend, there is a tipping point at which VY, with its added costs, is no longer viable and becomes a liability to Entergy rather than an asset. If Seabrook Station had power to sell to Vermont utilities for less than Entergy VY's lowest offer, I would question Entergy VY's security as a baseload market provider. The flip side of the industry's brag that nukes provide baseload power is that for technical reasons, nukes are not practical as demand or standby generators. This, along with the many uncertainties discussed above, render the benefits of extended operation claimed by Entergy to be as unreliable as the station itself.

Q-11. Are there any other uncertainties that could be avoided if the CPG were denied?

A-11. Yes. First, the Board must recognize that federal preemption applies only to those areas where federal agencies actually regulate. NRC has admitted that prior to the Fukushima accident, they had not really considered the socio-economic costs of an accident in terms of their risk consequences analyses. Dislocation, community disruption, anxiety and so on, are not often thought of as costs or effects of radiation protection, and it may be that the states deserve some say with respect to their willingness to accept those particular non-radiological, social and economic risks of a potential nuclear accident. The Commission has asked the NRC staff to look into the question, prompted by an address given by NRC Chairman Jazcko:

> While these initiating events are of very low likelihood, the events at Fukushima reinforced that any nuclear accident with public health and safety or environmental consequences of that magnitude is inherently unacceptable. While we focused on the radiological consequences of this

event, I believe we cannot ignore the large social and economic consequences such an event poses to any country with a nuclear facility that deals with such a crisis. In Japan, more than 90,000 people remain displaced from their homes and land, with some having little prospect for a return to their previous lifestyle in the foreseeable future. While not easy to characterize, these are significant hardships, and they are inherently unacceptable.

So as we look to the future, and we look in a proactive way, we ultimately will have to address the issue of how we deal with significant nuclear events that lead to significant land contamination and displacement, perhaps permanently, of people from their homes and their livelihoods and their communities. These are difficult questions that do not have simple answers, but they are ultimately issues that we have to address now while they are fresh in our minds. Any nuclear accident that happens like Fukushima in this country will be unacceptable.

Despite the conservatisms in the margins that ultimately protect people from receiving radiation doses that are unlikely if ever to lead to any type of immediate health impact, we must ask ourselves a very fundamental question: "Is it acceptable to have significant releases of radioactive material even if there are only very minor latent health effects?" This is, as I said, a very difficult question. I think the answer, if asked today, based on our safety goals, would be that, "yes, it is acceptable." But based on the concern, focus and effort of the industry, the agency and the public after the Fukushima accident, I believe that quite clearly the true answer to this question is, "no." And that means a significant reevaluation of our regulatory philosophy. This is a challenge that will take many, many years to address if we do not put the appropriate focus and attention to it. And I remind you, all of this will have to happen on top of all of the other immediate reactive work that we have to do to deal with Fukushima...

Moving Forward for Safety Remarks by The Honorable Gregory B. Jaczko Chairman ,U.S. Nuclear Regulatory Commission at The Regulatory Information Conference, Rockville, MD ,March 13, 2012

These non-preempted concerns should be considered by the Board in determining whether continued operation of an aging nuclear power plant, with a long record of mishaps and mismanagement, is within the public good of the State of Vermont.

Q-12. In the CPG petition, Entergy speaks of breaker-to-breaker and 500 plus day runs. Are these a good indicator of future reliability?

A 12 No. It is my view that these long power runs can only be maintained by assuming the unwarranted risk of major malfunction or equipment damage. The risk accumulates in two ways: First, refueling outages are shortened, invariably leaving some maintenance items deferred until the next outage, 18 months away. The VY transformer fire of 2004 quite possibly occurred because inspection and maintenance of generator bus duct expansion or flex joints was not performed on schedule, but was put off until the next outage. Before that outage however, a material failure of one of the flex joints caused an electrical short circuit which triggered a cascade of events leading to the transformer fire, a hydrogen gas burn in the turbine building, and electrical convulsions throughout the plant. A few hours or a few additional personnel on the outage would have made all the difference.

Second, many minor malfunctions that would have required a plant to have to shutdown or power down in years past are now deferred or repaired on the fly. From the earliest days of commercial nuclear power, federal regulators required redundancy in all plant systems that were important to safety. Where practicable, plants contain two of every system, every pipe, valve and pump, so that in case one failed, operators would have a backup immediately available and operable. However, today's nuclear industry uses redundancy as a means to do on line maintenance; performing a risk analysis that allows taking one entire system or train out of service for repair or replacement of components. This makes redundancy less like a safety brake or parking brake and more like an 'alternative' brake. Thus a safety feature becomes a maintenance convenience.

Included in the breaker-to-breaker toolbox is egregious use of what is termed a limiting or limited condition of operation - an "LCO." An LCO generally applies to safety-related components, but the reason for avoiding a shutdown does not so much matter as the potential result of using this to avoid a shutdown. LCOs are also "risk-informed" and it goes like this: based on the odds of redundant equipment failure, the failure of the next barrier in line or an accident before lunch or tomorrow, I will keep the plant running even though I have a very important piece of equipment or even an entire system disabled, so long as I get it fixed before the time specified in the applicable LCO. That could be within three hours or three days and failing that, the plant must be shutdown. Variations on this theme within the regulations allow a plant to be slowed down rather than to be brought to a complete stop in order to fix many components. Entergy VY will get to the next refueling (hopefully) prepared to brag about how many days they ran in eighteen months. But just in the first six months of 2012, the plant powered down and even shutdown to repair and adjust many items.

A description of the periods when daily averages were significantly below 95% follows:

1/30/12 – 2/3/12 Planned downpower for rod sequence exchange; #2 turbine stop valve repair; condenser water box inspections 3/5/12 – 3/6/12 Condenser water box foreign material removal 3/24/12 – 3/30/12 Plastocor removal from condenser air removal tubes .4/10/12 – 4/12/12 E-6-1B-4 Condenser tube leak repair, 4/24/12 – 4/29/12 Planned downpower for rod sequence exchange and condenser tube cleaning, 5/7/12 – 5/11/12 'C' reactor feedwater pump low oil pressure; flow control valve FCV-4 drain line leak repair;

rod pattern adjustment, 6/12/12 – 6/14/12 Planned downpower for turbine gland seal header repair, 6/18/12 – 6/30/12 'A' motor generator trip, repair and recovery, 7/12/12 – 7/14/12: Loss of upstream river temperature monitoring, 7/17/12 – 7/19/12 Power reduction due to high service water,7/30/12 – 7/31/12: Planned downpower for rod sequence exchange. Please note that planned 'downpowers' are those planned at least 28 days in advance.

A review of the whole record therefore reveals a picture of remarkable plant performance layered over a disturbing decline in material condition and human performance. What is at risk is major equipment or component failure that will suddenly and without an opportunity for affected entities to plan, have the plant idle for the long-term and possibly permanently. This undermines Entergy's claims regarding reliability, and undercuts the benefits it relies on for its application for extended operation of the plant.

Q-13. Are there non-radiological, negative impacts to the environment from Vermont Yankee operation that the Board and appropriate Vermont agencies should investigate?

A-13. Yes, there are many and I am hopeful that the Agency for Natural Resources ("ANR") and other parties such as Connecticut River Watershed Council ("CRWC") and Vermont Natural Resources Council ("VNRC") have most of them covered. Clearly Entergy has ignored many of these matters in its testimony, and apparently hopes that the Board will do so as well in ruling on its petition. I am hopeful that the Board will not, and will fully consider the various environmental consequences of continued operation that will be brought forth by others.

There are two impacts concerning water use that I believe must be quantified and weighed in consideration of the CPG that may not be addressed by ANR or the other parties that I would like to bring to the Board's attention. One issue that has not received much attention is the effect of shutdown on the aquatic community during winter months; termed "cold shock." This occurs when fish and other river creatures become conditioned to warm water discharge and adopt the warmed plume of discharge as their winter habitat. Then as a plant is shutdown, the aquatic world is suddenly transformed from quite warm to very cold. Hence, we have "cold-shock."

A number of peer-reviewed papers point to resulting death, injury, and behavioral changes in varied aquatic species. (Please see, NEC Exhibit-RS-2) The number of injuries may be large or small. It may or may not have significant effect on the larger aquatic community. Without quantification, we will never know. Entergy should be required to provide a thorough study of cold shock effects at Vermont Yankee as part of its CPG petition.

The second concern is one that I have raised before the Board in previous dockets and it was rejected based on the weight given to the testimony of Entergy's witness. The concern is quantifying the negative impact of the 50 thousand gallons or so of chemically and/or biologically contaminated cooling tower drift that during closed cycle operations is daily carried up to a mile and occasionally more from the VY cooling towers to be deposited on surrounding land and waters. In previous discussions, our conversation focus on a certain oxidizing biocide that Entergy's witness asserted was used up or "consumed" in the process of killing off fungus and algae in Vermont Yankee's

circulating and service water systems and being "consumed" there was no residue or chemical reaction product to be dissolved or entrained in the drift.

The Board approved of Entergy's explanation, as opposed to my "death-rains-from-the-skies" scenario. However, I have since been told by responsible VY personnel that the chemical in question, glutaraldehyde, is no longer in use at VY, was only used for a brief period and that the company reverted to the use of Chlorine and Bromine compounds. Troubled by the fact that I could find no chemical reaction equation for these compounds that ends in zero (i.e. consumed) and by the fact that the spray or drift coming from the cooling towers on two of my site visits did not smell or feel free of contaminants, I delved into the literature and found that cooling tower drift droplets not only carry chemical and mineral contaminants, but the contaminants are concentrated by evaporation, sometimes to salts, as they ride the wind.

Moreover, cooling tower drift has been found to carry live pathogens, such as, L. pneumophila bacterium bacillus, from the warm waters of the scum and fungus-coated cooling tower basin and interior walls, and to spread them in field and village (Please see NEC EXHIBIT RS 3). I also found out that "consumed," in commercial biocide literature, is applied to oxidizing biocides and refers only to the consumption of available oxygen in any biocide compound. Some compounds break down to innocuous substances like water and carbon dioxide, so you might not be able to measure them. But they are not zero and in the case of chlorine and bromine they are measurable. Vermont Yankee provided me with a circulating-water and a service-water spread sheet that shows chemicals used and the schedule and duration of their use and then purports to show concentrations in the water as for the most part "N/D", non-detectable. What the spread

sheet does not show is when the water samples were taken - that is, after what period of dilution - nor what the lower limits of detection might be. According to the literature, even background chemical and mineral contaminants, naturally-occurring and otherwise, that are in the river water even before the water is drawn into the plant can be reduced to strong concentrations in the cooling tower and subsequently in the cooling tower drift:

> Clean water, once in abundance, is becoming increasingly difficult to locate. In some instances, one plant's effluent is, with its chemical pollutants, the influent for another plant downstream. Also, natural pollution is being noticed in some water supplies, including groundwater with certain contaminants like phosphate, nitrates, iron, manganese and sulfides, and salinity. Advanced water treatment and conservation techniques are required to cope with the situation. This especially applies to cooling water.
>
> Open evaporative cooling water (CW) systems provide economical heat sinks since they can handle high heat loads with minimum water loss, mainly attributable to evaporation. Thus, open evaporative cooling water provides efficient water reuse. However, this capability simultaneously is associated with a very important phenomenon—the concentration effect. Evaporation results in increased concentration of dissolved and suspended impurities in the remaining cool water. This concentration of impurities, combined with the natural action of water on system metals and temperature variations within a system, leads to myriad of water-related problems.

S. G. Choudhary, Emerging Microbial Control Issues in Cooling Water Systems, Hydrocarbon Process Journal, May 1998.

> ENVIRONMENTAL CONSIDERATIONS IN COOLING TOWERS DRIFT
>
> The environmental concerns of operating a cooling tower are generally related to the undesirable release of chemicals from the system. The most common release of chemicals in cooling tower operation is through drift loss, although chemicals may also be lost through splash-out or overflowing of the basin. Drift occurs when water droplets are entrained in the tower discharge air stream and exit the tower. Though water vapor exiting the tower is in the form of pure water, the entrained liquid droplets may contain concentrations of corrosive chemicals, suspended solids, and even microorganisms from the circulating water in the tower system. The chemicals present in the drift typically come from water treatment chemicals used to optimize the operation of the tower, but can also be

> remnants of any substances that contaminate the circulating water from external processes. Chemical residue from uncontrolled cooling tower drift is responsible for thousands of dollars worth of property damage each year, creates obvious safety hazards for personnel and increases water and chemical costs, since additional chemicals must be added to compensate for the drift losses.
>
> Potentially even more serious is the threat posed by the microorganisms present in drift that are passed to the surrounding environment. Legionnaire's Disease for example, can be contracted by inhaling L. pneumophila bacterium containing aerosols. These aerosols are formed by cooling tower distribution systems and transmitted through the drift. Consequently, the reduction of drift losses in a cooling tower can have a significant impact on the environment, property and human health.

http://www.ctowers.com/TCTC%20paper%20on%20environmental%20issues.doc

> The spray drift, like the circulating water, contains an appreciable concentration of dissolved minerals and additives. These dissolved solids in the spray drift form a fine particulate matter, which is emitted from the towers as the drift droplets evaporate. As such, these Project towers, individually and collectively, will result in particulate matter emissions... Finally, cooling tower spray drift can also result in salt deposition when salt is present in the intake water drawn into the towers. Salt deposition, unlike airborne inhalable particulate emissions which pose a significant human health threat, can cause damage to vegetation and equipment if in sufficiently large quantities.

Cooling Tower Impact Analysis *for the* Entergy Indian Point Energy Center Westchester County, New York *prepared for* Entergy Nuclear Indian Point 2, LLC Entergy Nuclear Indian Point 3, LLC *prepared by* TRC Lyndhurst, New Jersey as a subcontractor to: Enercon Services, Inc. Kennesaw, GA September 1, 2009

Based on the preceding and the attached exhibit, Entergy should be required to have cooling tower drift sampled at varying distances from the plant; have the samples subjected to chemical and biological analysis and submit those samples for consideration as part of this CPG petition.

Q-13. Does that conclude your testimony?

A-13. Yes.