STATE OF VERMONT

PUBLIC SERVICE BOARD

Petition of Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc., for amendment of their certificates of public good and other approvals required under 10 V.S.A. §§ 6501-6504 and 30 V.S.A. §§ 231(a), 248 & 254, for authority to continue after March 21, 2012, operation of the Vermont Yankee Nuclear Power Station, including the storage of spent-nuclear fuel	)	Docket No. _____

SUMMARY OF PREFILED TESTIMONY OF JOHN R. HOFFMAN

Mr. Hoffman's testimony provides background on the generation and storage of spent-nuclear fuel (or "SNF") at the VY Station. Mr. Hoffman further describes regulation of SNF by the U.S. Nuclear Regulatory Commission. Mr. Hoffman's testimony also addresses the company's management of SNF up to the present and reports on the construction and initial operation of the Interim Spent Fuel Storage Installation approved in Docket No. 7082. Finally, Mr. Hoffman discusses Entergy VY's Spent Fuel Management Plan in the context of continued station operation for 20 years after March 21, 2012.

Mr. Hoffman sponsors the following exhibits:

Exhibit EN-JRH-1	Resume of John R. Hoffman
Exhibit EN-JRH-2	Memorandum of Understanding between Entergy VY and the Department of Public Service, dated June 21, 2005.

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PREFILED TESTIMONY OF JOHN R. HOFFMAN

Q1. State your name.

A1. My name is John R. Hoffman.

Q2. What is your position, and by whom are you employed?

A2. I am retired from Entergy and now self-employed as a consultant to Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc. (to which I refer together as "Entergy VY"). Prior to my retirement in August 2006, I was the project manager for Entergy VY's dry-fuel-storage project and license-renewal project. Exhibit EN-JRH-1 is my resume.

Q3. Have you previously testified before the Vermont Public Service Board?

A3. Yes. I submitted Prefiled Testimony, dated June 16, 2005, and Prefiled Rebuttal Testimony, dated December 12, 2005, on behalf of Entergy VY in Docket No. 7082, which involved Entergy VY's petition for approval to construct and operate a dry-fuel-storage facility at the Vermont Yankee Nuclear Power Station (to which I refer in my testimony as the "VY Station"). As project manager for Entergy VY's Interim Spent Fuel Storage Installation or "ISFSI," I gave overview testimony regarding the facilities to

be installed and the operational changes required for the station to commence operation of the ISFSI. I testified on January 31, 2006, at the technical hearings in that docket.

Q4. What is the purpose of your testimony in this docket?

A4. My testimony addresses Entergy VY's plan for interim storage of spent-nuclear fuel (or "SNF") at the VY Station. I will begin by providing a summary description of how SNF is generated and the approved storage options for SNF.

My testimony will then describe how the VY Station has managed SNF up to the present date. I will then report to the Board on the construction and initial operation of the ISFSI approved in Docket No. 7082. I will demonstrate that the facility has been built in accordance with the requirements of a Memorandum of Understanding (or "MOU") between Entergy VY and the Vermont Department of Public Service (to which I refer as the "Department") as well as conditions imposed by the Board in that docket.

My testimony will also address the number of canisters or casks that will be necessary on the ISFSI pad under several scenarios, if the VY Station continues to operate until 2032 and thereby creates SNF by generating electricity after March 21, 2012. Finally, I will discuss the Spent Fuel Management Plan currently in effect and how that plan is likely to be impacted by operation through March 21, 2032.

I. The Generation and Storage of SNF

Q5. Begin by providing a summary description of how SNF is generated.

A5. The production of electricity through nuclear fission in a Boiling Water Reactor such as the VY Station uses enriched uranium pellets that are assembled into individual fuel rods that are further assembled into fuel assemblies. The fission process generates heat which in turn boils the water in the reactor vessel to generate steam that turns the turbine-generator thereby generating electricity. In general, the rods are productive for approximately 54 months. Roughly every 18 months, Entergy VY conducts a refueling outage in which approximately one-third of the fuel assemblies are replaced with new assemblies. The removed assemblies are what we call SNF.

Q6. What happens to the SNF?

A6. When the reactor is shut down (*i.e.*, the controlled fission process is stopped), the fuel assemblies contain radioactive elements that generate heat as they decay. Fuel assemblies that are in the reactor vessel are cooled by the decay heat-removal system (also called the residual heat-removal system). The SNF (fuel assemblies that have completed the three cycles in the reactor vessel) also contains radioactive materials that must be managed in a way to keep the SNF cooled and provide shielding for the radioactive material. There are two methods of storing SNF that have been licensed and approved by the Nuclear Regulatory Commission (or "NRC"): wet storage in a spent-fuel pool and dry storage in NRC-approved casks or canisters. All operating commercial, nuclear-power plants have spent-fuel pools where some portion of their SNF is stored.

As those wet-storage pools have become full over the years, many plants have moved older fuel into dry casks for storage.

Q7. You mentioned the NRC. What role does the NRC play in the storage of SNF?

A7. The NRC regulates all aspects of the storage of SNF. Under 10 CFR Part 50, the NRC regulates the wet storage of SNF. Storage of SNF is described in the plant's Updated Final Safety Analysis Report (or "UFSAR") and subject to Technical Specification(s) (or "Tech Spec(s)") requirements, just like all other aspects of plant operation. Because of the safety significance of spent-fuel storage, the NRC requires that any change in the design of the spent-fuel racks or increase in spent-fuel-pool storage capacity be submitted for review and approval as a license amendment.

The NRC regulates the storage of SNF in dry casks under 10 CFR Part 72. Part 72 provides the high-level legal requirements for the issuance of an NRC license for a dry-fuel-storage system. Very detailed technical requirements (essentially the NRC translation of the legal requirements into engineering requirements) are provided in the NRC Standard Review Plan for Dry Cask Storage Systems (NUREG-1536). All aspects of the dry-fuel-storage system (design, fabrication and operation) are controlled via NUREG-1536. In addition, each dry-fuel-storage system, once approved by the NRC, is issued its own Final Safety Analysis Report ("FSAR") and Tech Specs as part of the general license. Any organization choosing to utilize that dry-fuel-storage system (nuclear plant operator or private, fuel-storage-facility operator) is governed by those documents. The NRC inspects the construction of dry-fuel-storage system components at

the vendor facilities and also performs inspections of construction and implementation activities at the nuclear operator's plant sites.

Q8. Has the NRC stated a preference between wet or dry storage of SNF?

A8. No. The NRC has issued regulations governing both types of SNF storage and considers both methods safe. The following quotation is from the NRC' public website [http://www.nrc.gov/waste/spent-fuel-storage.html]:

> "Storage of Spent Nuclear Fuel
>
> What We Regulate
>
> There are two acceptable storage methods for spent fuel after it is removed from the reactor core:
>
> Spent Fuel Pools - Currently, most spent nuclear fuel is safely stored in specially designed pools at individual reactor sites around the country.
>
> Dry Cask Storage - If pool capacity is reached, licensees may move toward use of above-ground dry storage casks."

Q9. What has the industry experience been in choosing between wet and dry storage for operating reactors?

A9. As I previously referenced, both methods of storage are safe. Current operating reactors were designed and constructed when the "back end" of the fuel cycle was planned to utilize reprocessing. The general strategy was to store fuel for a few years and then ship it to a reprocessing facility. Spent-fuel pools generally had the capacity for a few refueling discharges and one full-core offload. When the policy of the United States was changed to prohibit reprocessing, it became necessary to re-think the SNF storage strategy. Nuclear plant operators "re-racked" their spent-fuel pools one or more times

utilizing high-density, spent-fuel racks. Once the capacity of the pool can no longer be increased by re-racking, on-site, dry-fuel storage or transfer to an off-site storage facility is required (or else the reactor must shut down).

Q10. You mentioned that the NRC has exclusive authority over the regulation of storage of SNF. What role does the Department of Energy (or "DOE") play?

A10. From an engineer's perspective, DOE is responsible for the long-term storage and disposal of SNF. Mr. Jay Thayer of Entergy VY addresses DOE's responsibilities in his prefiled testimony in this docket. For purposes of my testimony, it is important to recognize that DOE has the ultimate responsibility for removing SNF from commercial nuclear-power plants such as the VY Station but that Entergy VY is responsible for storing the fuel at the station, under the jurisdiction of the NRC, until such time as the SNF is transferred to DOE. Note that DOE is also required to receive an NRC license to store SNF at its facility.

II. Vermont Yankee Experience with SNF

Q11. Describe how the VY Station has handled the storage of SNF during the tenure of the prior owner, Vermont Yankee Nuclear Power Corporation, and up to the present with Entergy VY.

A11. The VY Station maintains a spent-fuel pool where it stores the SNF generated since the commencement of operations. The original spent-fuel-storage racks provided the capability to store 900 fuel assemblies. This provided for a full-core offload of 368 fuel assemblies and several refueling discharges (to be stored until they could be shipped for reprocessing). When the option of reprocessing was no longer available, the pool was re-

racked twice, resulting in increased storage capacity in the pool. As I discussed previously, both of these re-racking activities were subject to NRC review and approval as license amendments. Despite the increases in the capacity of the storage pool, the pool currently has sufficient capacity to store SNF generated only through 2008, and thus without additional storage the plant would have had to shut down prior to March 21, 2012. Entergy VY therefore chose to proceed under 10 CFR Part 72 to construct an ISFSI for the dry storage of SNF.

Q12. What are the requirements for the operation of an ISFSI under federal law?

A12. Part 72 requirements for construction and operation of an ISFSI require that the operator have either a site-specific license or a general license issued by the NRC. The ISFSI at the VY Station has a general license, so that is the process I will describe. The NRC has reviewed a number of dry-fuel-storage system designs and has issued Certificates of Compliance (known as a "C of C") to the vendors for those designs. In general, the C of C certifies that the dry-fuel-storage system complies with NRC requirements and can be used to store SNF as long as the user complies with the FSAR, Tech Specs and any special C of C requirements applicable to the system. The use of the general-license process eliminates the need for special NRC licensing proceedings for the ISFSI. In a few cases, plant-specific conditions precluded the use of the general license, and those facilities were required to obtain site-specific licenses. Independent of whether a general license or a site-specific license is used, the ISFSI and its components are subject to NRC inspection requirements. The NRC performs inspections at the vendor facilities to verify that engineering and manufacturing are being performed in accordance with

requirements. Inspections are conducted at the plant site to verify that the ISFSI is constructed to requirements. In addition, the NRC witnesses the utility's "dry run," which is a simulated cask-loading operation, to ensure the utility is prepared to load the casks. The NRC inspections are in addition to Entergy VY's comprehensive, quality-assurance oversight of the dry-fuel-storage process.

Q13. What dry-fuel-storage system did Entergy VY choose to use for the VY Station?

A13. Entergy VY decided to use the NRC-licensed HI-STORM system manufactured by Holtec International. As described in the detailed testimony of Dr. Kris P. Singh in Docket No. 7082, the HI-STORM system consists of two main components—the concrete overpack, which provides for physical protection to SNF and radiation shielding of the SNF, and the Multi-Purpose Canister (or "MPC"), which holds the SNF assemblies. I will summarize some of the key features of the storage system that were presented by Dr. Singh in his testimony.

The Holtec system, like all dry-fuel-storage systems, is initially licensed for 20 years, with the ability to apply for additional 20-year terms. The 20-year term is a regulatory/legal time period; it is not limited by physical or technical issues. The materials of construction of the HI-STORM system (concrete, coated carbon steel and stainless steel) are capable of well in excess of 100 of years service when properly maintained.

The MPC concept was proposed by the DOE as an efficient waste-package concept. The term "multi-purpose" means that once the fuel is packaged in the canister, it can be stored safely at the site's ISFSI or shipped to an away-from-the-reactor (or "AFR") storage facility or a permanent repository without having to repackage the fuel. Furthermore, the MPC may be stored in a repository long-term without having to handle individual spent-fuel assemblies. The MPC, in short, dispenses with the need to handle fuel on an individual basis and thus minimizes the occupational radiation dose to workers.

The HI-STORM 100S overpack is Holtec's latest model, an above-ground overpack engineered to maximize radiation shielding so as to minimize occupational exposure to the plant's workers and not contribute significantly to the dose at the site boundary. The radiation dose at the site boundary at a distance of 900 feet from the storage area will be about 0.3 millirems per year (assuming six casks), which is three orders of magnitude smaller than the background radiation.

The central performance mission of the overpack is to provide blockage of radiation emanating from the MPC and protection to the MPC and its contents from missiles, projectiles and the like. The overpack consists of a heavy-walled, steel weldment with high-density concrete installed in the space between inner and outer steel shells to provide radiation shielding. The composite-shell weldment is enclosed by a 2-inch-thick, bottom plate and loaded with 26.75 inches of concrete shielding. The overpack contains no rebar. It has a heavy-bolted, concrete-filled, steel lid. The cask provides the

biological shielding and structural strength necessary to protect the cask's contents against natural phenomena such as tornado-wind loading and any wind-driven missiles.

The overpack's inner shell has channels attached to its interior surface to guide the MPC during insertion and removal, which also serve to provide a flexible medium to absorb impact loads under postulated tipover events, while allowing cooling air to circulate freely through the overpack. The overpack uses the ductility and strength of steel and the radiation-shielding characteristics of concrete. The steel weldment carries all mechanical loads, and the concrete serves as the principal radiation barrier. Complete encapsulation of concrete in steel also has the added benefit of preventing concrete degradation from rainwater, freezing weather or saline environments.

The cask has four air inlets and four air outlets (ducts) located at the lower and upper ends of the cask to permit cooling of the contained MPC by natural convection. The ducts are equipped with a duct-photon attenuator (a patented device) that acts to scatter gamma radiation, which further reduces off-site dose. The overpack's carbon-steel body is covered with a protective coating of a high temperature, radiation-resistant, peel-resistant paint system on all exterior and interior surfaces.

In summary, the HI-STORM overpack has the following attributes that make it a structurally-rugged, regulatory-compliant and As Low As Reasonably Achievable or

"ALARA"-maximized (which means minimum radiation exposure to employees and off-site personnel) storage system:

i. The structural backbone of the overpack, made of low-carbon steel, is qualified to meet ASME Section III, subsection NF. It is a strong, ductile metal that can sustain over 15% strain before failure.

ii. The shielding capability of the overpack can be increased by increasing the density of concrete aggregate used, a facility available in the HI-STORM because of the structural reserve in its steel-weldment structure.

Q14. You testified on behalf of Entergy VY in Docket No. 7082 regarding the request for a Section 248 certificate of public good (or "CPG") to construct and operate the ISFSI. Can you provide a summary description of the project that was reviewed and approved by the Board in that docket?

A14. The Board reviewed Entergy VY's proposed, dry-fuel-storage project under the requirements of Section 248 and 10 V.S.A. § 6522 and approved the project by an order dated April 26, 2006. The project as approved involved the construction of a highly-engineered ISFSI pad, large enough to hold 36 HI-STORM casks, on the north side of the reactor building as well as minor modifications to the reactor building and facility to allow for the movement of SNF from the spent-fuel pool to the ISFSI pad in dry casks. In addition to the facility improvements, the Board also approved an MOU, dated June 21, 2005 ("DFS MOU"), between Entergy VY and the Department, and placed several conditions on Entergy VY including the filing of a Spent Fuel Management Plan and the provision of additional financial assurances related to the storage of SNF.

III. Construction and Initial Use of the ISFSI

Q15. Please review the actions taken by Entergy VY to construct the ISFSI in accordance with the requirements of the NRC, the DFS MOU between Entergy VY and the Department and the requirements of the Board's order in Docket No. 7082.

A15. The DFS MOU defined actions Entergy VY would take in conjunction with the construction of an ISFSI at the VY Station. Exhibit EN-JRH-2 is a copy of the DFS MOU. Items 1, 2, 4 and 5 pertain to the construction of the ISFSI. Items 3 and 6 pertain to the operation of the ISFSI. The remaining items are not directly associated with the ISFSI, but are additional, SNF-related actions that Entergy VY has committed to follow.

Since the ISFSI is not yet completed, I interviewed personnel directly responsible for implementing the ISFSI design. Entergy VY has executed or has plans to execute Items 1 through 6. Specifically:

Item 1—line-of-sight barriers have been erected;

Item 2—the pad was constructed as shown on the plans filed with the petition, which places the pad at least 100 feet from the 500-year floodplain;

Item 3—Entergy VY will be placing the first five casks in a single row along the north side of the pad, which will provide access to each cask without having to move any others;

Item 4—no roads were constructed in support of the project;

Item 5—an electronic temperature-monitoring system will be installed with continuous readout, and plant procedures will be developed to require monthly surveillance of each cask; and

Item 6—signs will be posted on the ISFSI pad prohibiting the use of corrosive or flammable chemicals as de-icing agents.

Entergy VY also entered into its corrective-action program items to ensure the DFS MOU requirements were addressed prior to loading fuel on the ISFSI.

Q16. Report to the Board on the initial loading of casks and their placement on the pad.

A16. Entergy VY is currently scheduled to begin the transfer of SNF and loading of casks in Spring 2008. Entergy VY plans to locate the initial campaign of five casks along the northern edge of the ISFSI pad starting at the eastern edge. This will ensure that DFS MOU Item 3 is addressed. Radiation measurements will be taken and compared to predicted values; corrective action will be taken, if necessary.

Q17. Item 9 of the DFS MOU addresses the density of SNF in the fuel pool. Can you address what Entergy VY has done to comply with this requirement?

A17. Yes. Item 9 requires the company to configure the spent-fuel pool so that high-decay-heat assemblies of SNF are surrounded by low-decay-heat assemblies. Procedures are in place to ensure this occurs.

IV. Current Spent Fuel Management Plan

Q18. Has Entergy VY developed a Spent Fuel Management Plan in response to the Board's order in Docket No. 7082?

A18. Yes. Entergy VY has developed and filed with the Board a Spent Fuel Management Plan addressing the short and long-term storage of SNF at the VY Station. Mr. Thayer sponsors the plan with his prefiled testimony as Exhibit EN-JKT-2.

Q19. Could you describe the current Plan?

A19. The Plan is divided into four sections. The first section contains definitions and a general description of the ISFSI project and the location of the pad. The second section describes operational requirements for the facility, including reference to the operative NRC requirements. Section 3 addresses long-term planning for the storage of SNF. Section 4 discusses transfer and closure procedures in connection with the eventual transfer of SNF to DOE.

Q20. Does the Plan address the use of the ISFSI to store SNF on the assumption that the VY Station continues to operate after March 21, 2012, and ceases operations 20 years later?

A20. Yes. If the VY Station operates past March 21, 2012, Entergy VY will discharge spent fuel at a rate of approximately 124 assemblies every 18 months. The actual discharge rate may vary slightly based on the specific reload design. Since each DFS unit holds 68 fuel assemblies, Entergy VY will need periodically to transfer SNF from the spent-fuel pool to the ISFSI. The number of casks loaded in a campaign will be guided by a number of factors: the status of full-core offload capability, integration with plant refueling-outage schedules, efficient use of skilled worker resources and compliance with existing

and future NRC requirements. As described during the proceedings in Docket No. 7082, the ISFSI pad is sized to accommodate 36 casks, allowing Entergy VY to store all SNF generated through 2032 while maintaining full-core discharge capability.

Q21. Will a separate ISFSI pad be required at any time in the future?

A21. Whether or not Entergy VY continues operations after 2012, the Spent Fuel Management Plan provides for the possibility that a separate ISFSI pad will need to be constructed as part of decommissioning activities depending on DOE's fulfillment of its contract to remove spent fuel. If plant operations were to cease in March 2012, approximately 3800 SNF assemblies will have been generated from plant operation. The ISFSI capacity of 36 casks will provide for storage of 2448 SNF assemblies. As a minimum, a new ISFSI would need to be constructed to store the additional 20 casks, assuming no DOE action.

Q22. If a new ISFSI pad is required at some point in the future, where would it be located?

A22. In Docket No. 7082, Entergy VY stated that it is likely that any new pad would be constructed on the VY Station property, but far enough from the reactor building and other structures to allow for decommissioning activities. The storage facility would have to be large enough to accommodate all SNF already contained in dry casks as well as the remaining SNF in the spent-fuel pool, again depending on the status of DOE's removal of the fuel.

Entergy VY has stated that one place where such a pad could be located is the so-called "North 40," an area of land located to the north of the reactor building and other facilities. It is too early, however, to state with any certainty where such a facility would be located

since the exact location or dry-fuel-storage technology to be used will depend upon engineering analyses of soil and geological properties as well as the development of new NRC-approved technologies in the future. The VY Station is located on 125 acres of land, and it is likely any new ISFSI could be located at a number of viable locations within the existing boundaries.

V. Amendment of Spent Fuel Management Plan

Q23. Section 3.3 of the Spent Fuel Management Plan states that if Entergy VY seeks to renew its operating license beyond expiration of its current license, it agrees to amend its plan to reflect operational experience, industry guidance and regulatory requirements with respect to spent-fuel management. Are you aware of any new developments in the area of operational experience, industry guidance or regulatory requirements that would require amendment of the Plan at this time?

A23. I note that the Plan was dated and filed with the Board in June, 2006. I am not aware of any such developments that would require amendment of the Plan at this time.

That is not to say that new developments are not likely to occur that would require amendment of the Plan either prior to March 21, 2012, or during a 20-year extension of operations. As presently drafted, the Plan appears to be consistent with the company's plans as I understand them and operational experience, industry guidance and regulatory requirements. I believe, however, that the requirement to maintain and periodically update the Plan should continue during the period of extended operation granted by license renewal.

Q24. Section 3.3 of the Plan also states that if Entergy VY seeks to continue operations for an additional 20 years it may, depending on the then-existing legal requirements, address the possibility of reducing the number of spent-fuel rods installed in the spent-fuel pool and consider the possibility of constructing a separate ISFSI to accommodate the larger number of dry casks required by accelerated removal of fuel from the spent-fuel pool. Do you have any comments on this section?

A24. As I understand this section and the Board's final order in Docket No. 7082, the Board declined to adopt a condition requested by certain parties in the docket that would require Entergy VY to lower the density of SNF in the spent-fuel pool. The Board based its decision in part on the fact that such a condition could conflict with the results of an ongoing NRC evaluation of spent-fuel pool densities. I am told that the review is still on-going. In any event, the storage of SNF is directly regulated by the NRC, and Entergy VY would need to continue to comply with any new NRC requirements regarding the density of the existing, spent-fuel pool.

The Board's order also acknowledged the fact that the current ISFSI pad is designed to hold sufficient casks so that the Station can operate through 2032 while maintaining full-core offload capability but that it could not accommodate the additional dry casks needed to store SNF from the spent-fuel pool if a reduction in density were required while still maintaining full-core offload capability.

In summary, while I cannot speak for Entergy VY, it appears that at the present time there is no basis to revisit or interfere with the NRC's decision to allow nuclear-power-plant operators to store SNF in spent-fuel pools, and therefore there is no reason to amend the Spent Fuel Management Plan to require the accelerated movement of SNF from the pool to dry casks.

Q25. Does that conclude your testimony?

A25. Yes it does.