UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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| In the Matter of | ) | |
| | ) | |
| ENTERGY NUCLEAR VERMONT | ) | |
| YANKEE, LLC AND ENTERGY | ) | Docket No. 50-271-LT-2 |
| NUCLEAR OPERATIONS, INC.; | ) | |
| CONSIDERATION OF APPROVAL | ) | |
| OF TRANSFER OF LICENSE AND | ) | |
| CONFORMING AMENDMENT | ) | |
| | ) | |
| (Vermont Yankee Nuclear Power Station) | ) | |

**Affidavit of Warren K. Brewer**

I, Warren K. Brewer, being duly sworn, depose and state under penalty of perjury that the foregoing is true and correct:

(1) A true and correct copy of my CV is attached to this declaration.

(2) I have over 40 years of experience in the nuclear industry and have been involved in decommissioning cost estimating and planning since 1989. I am an Executive Consultant for Four Points Group, Incorporated, an engineering consulting firm providing services related to the nuclear industry, including decommissioning cost estimating and planning and cost estimating and analysis with respect to spent fuel management and disposition.

(3) I have a B.S. in electrical engineering from Louisiana Tech University and an M.S. in nuclear engineering from the Massachusetts Institute of Technology. I completed a graduate-level course of study in areas related to nuclear power and power plant design at the Bettis Reactor Engineering School. After obtaining my Master's degree, I worked for 10 years at the Division of Naval Reactors, the joint Department of Defense and Department of Energy organization responsible for all aspects of design, construction, maintenance, and operation of nuclear reactors in U.S. Navy ships and training facilities. I left the Division of Naval Reactors in 1986 and accepted a position with Pickard, Lowe and Garrick, a nuclear industry engineering consulting company. In late 1986, two colleagues and I formed ABZ. I now work with both ABZ and Four Points Group.

(4) I have previously provided expert witness testimony related to the nuclear industry before state regulatory bodies, in arbitrations, before the United States Tax Court, and in numerous proceedings before the United States Court of Federal Claims.

(5) I have reviewed filings related to the proposed sale of Vermont Yankee from Entergy to NorthStar Vermont Yankee, LLC ("NorthStar"), including the "Revised PSDAR" that NorthStar submitted to the NRC on April 6, 2017.

(6) My testimony below is based on my experience in this field, and on information that is currently publicly available.

(7) Based on information made publicly available by Entergy and NorthStar to date, the sale of Vermont Yankee to NorthStar, if approved, could lead to a shortfall in the amount of funding available to fully and safely decommission and radiologically decontaminate Vermont Yankee and manage its spent nuclear fuel. Any such shortfall could place public health, safety, and the environment at risk. Without limitation to other statements I could attest to and affirm, I specifically attest to and affirm the following as support for this statement:

a. The amount of publicly available information is limited. This, in itself, raises a significant concern that, if approved, the sale of Vermont Yankee to NorthStar could lead to a shortfall in the amount of funding available to fully and safely decommission and radiologically decontaminate Vermont Yankee and manage its spent nuclear fuel. This could place public health, safety, and the environment at risk.

b. As explained in detail below, there are at least 8 ways NorthStar could experience significant, unaccounted for, cost overruns that could lead to a shortfall in decommissioning funding that places public health, safety, and the environment at risk:

- Delays in the work schedule leading to increased costs for overhead and project management;

- State-law requirements for site restoration decreasing the amount of funds available, particularly funds beyond the nuclear decommissioning trust fund, to pay for radiological decontamination;

- The discovery of previously unknown radiological or non-radiological contamination;

• A radiological incident at the site (for instance, during the transfer of spent nuclear fuel into dry casks);

• If recovery of spent fuel management costs through litigation or settlement with the U.S. Department of Entergy (DOE) is less than anticipated or on a more protracted schedule than anticipated;

• If DOE requires repackaging of spent nuclear fuel into new containers that DOE has approved for transportation;

• If DOE removes all spent nuclear fuel without requiring repackaging, but DOE is successful in recovering all or some of its past payments for the packaging of spent nuclear fuel into dry casks; or

• If DOE fails to remove all spent nuclear fuel by 2052, and NorthStar has continuing costs beginning in 2053, which could at some point include having to repackage dry casks.

c. *Delays in the work schedule leading to increased costs for overhead and project management.* Although NorthStar claims that it intends to use performance bonds to create fixed costs for each discrete task, it does not appear from presently available information that NorthStar has accounted for the cost impact of delays in work schedule. In particular, if a specific activity takes longer than anticipated, then even if NorthStar does not have to pay more than the fixed cost for the direct work associated with that activity, the entire decommissioning schedule may be delayed. This would lead to increased, currently unaccounted for, costs for overhead and project staffing and management. These costs could be significant. For instance, at the Humboldt Bay facility, a 2006 TLG Report estimated the staff costs for that project at $107.6 million after escalation to 2010 dollars. After the start of the project, the estimate for expected staff costs was increased to $168 million in 2010 dollars.

d. *State-law requirements for site restoration decreasing the amount of funds available, particularly funds beyond the nuclear decommissioning trust fund, to pay for radiological decontamination.* Because NorthStar proposes to perform license termination and site restoration activities concurrently, there may be difficulty in maintaining segregation of funds for the two activities. Further, state-law requirements for site restoration may

impact the duration or scheduling of license termination activities given the concurrent nature of performance. As a result, if the site restoration account is not fully segregated from the fund that is reserved for license termination activities and a rigorous process is not followed to allocate incurred costs between these segregated funds, then additional funds may be required for license termination work as a direct result of the site restoration requirements. It is currently impossible to determine the detailed scope or cost of site restoration because the state standards for site restoration have not yet been determined. Yet NorthStar's cost estimates assume certain standards, including, for instance, that underground structures will need to be removed only "to a depth of 4 feet below ground surface." Revised PSDAR at 12. The State of Vermont could, however, require removal of all underground structures, regardless of depth. This would lead to a significant cost increase for site restoration, and, if the funds are not fully segregated, a corresponding decrease in the amount of money available for radiological decommissioning.

e. *The discovery of previously unknown radiological or non-radiological contamination.* According to the PSDAR, Revised PSDAR, and related filings, Entergy has never done a full site investigation and characterization, and NorthStar does not intend to do a full site investigation and characterization including actual measurements and sampling before purchasing Vermont Yankee. Also, Entergy's Decommissioning Cost Estimate states that it only addresses so-called contingencies that are "almost certain to occur." Decommissioning Cost Estimate at xii. This does not account for unexpected contingencies that could lead to significant cost increases. Entergy categorizes those as "financial risks" and says it "does not add any additional costs to the estimate for financial risk." Decommissioning Cost Estimate § 3, page 6. Nor does NorthStar's Revised PSDAR appear to address these risks. Without a full site investigation and characterization, there is no way to minimize risk in what it will ultimately cost to perform radiological decommissioning, spent fuel management, and site restoration. Simply put, you cannot know what you do not know, and many things at this site will not be known until NorthStar does ground-penetrating radar and starts digging. If NorthStar discovers previously unknown radiological or non-radiological contamination, it could significantly increase the costs of decommissioning.

f. *A radiological incident at the site (for instance, during the transfer of spent nuclear fuel into dry casks).* Although the likelihood of a radiological incident decreases once fuel is removed from the reactor, there is still a risk of such an incident even at a decommissioning nuclear power plant. For instance, there is a risk of an incident during the transfer of spent fuel from the spent fuel pool to dry casks. If such an incident were to occur, it could greatly increase the costs of decommissioning both directly and indirectly by causing substantial delay in the decommissioning efforts. It is not clear from presently available information if NorthStar accounts for this risk of accident.

g. *If recovery of spent fuel management costs through litigation or settlement with the US Department of Entergy (DOE) is less than anticipated or on a more protracted schedule than anticipated.* In addition to the Vermont Yankee decommissioning trust fund and site restoration fund, NorthStar's proposal relies on recovering hundreds of millions of dollars from litigation against (or settlement with) DOE. It is true that DOE is in breach of the Standard Contract and that NorthStar will likely recover a significant portion of spent fuel expenses from DOE. But, as with any litigation, recoveries are not guaranteed. If NorthStar's litigation or settlement with DOE is less successful than anticipated or occurs on a more protracted schedule than anticipated, is unclear from the presently available information how NorthStar plans to compensate to ensure sufficient funding for decommissioning.

h. *If DOE requires repackaging of spent nuclear fuel into new containers that DOE has approved for transportation.* NorthStar's cost estimates assume that DOE will accept the planned 58 dry casks at Vermont Yankee as packaged for dry storage, and not require repackaging for transportation. But, as Entergy (and many other licensees) have on many occasions argued in testimony and in briefs before the U.S. Court of Claims and the U.S. Court of Appeals for the Federal Circuit, DOE has the authority to mandate that licensees repackage spent fuel into DOE-approved transportation casks. DOE has the authority to mandate this regardless of whether repackaging is technically necessary. If DOE does so, this could lead NorthStar to incur significant unaccounted-for expenses. The cost overrun for repackaging would be exacerbated by the fact that this would occur after Vermont Yankee's spent fuel pool has been dismantled. Without a spent fuel pool onsite, repacking spent

fuel might involve first transporting the fuel to another power plant, or building an onsite Dry Transfer Station (none of which currently exist in the United States). This could lead to cost overruns on the order of hundreds of millions of dollars.

i. *If DOE removes all spent nuclear fuel without requiring repackaging, but DOE is successful in recovering all or some of its past payments for the packaging of spent nuclear fuel into dry casks.* Even if DOE accepts the spent nuclear fuel for transportation without repackaging, DOE may then pursue recovery from NorthStar for some or all past payments that DOE made for the original packaging of Vermont Yankee's planned 58 dry casks. (Entergy has recovered those costs to date on the theory that DOE has to date been unwilling to agree to acceptance of the fuel without repackaging.) This could lead to a significant cost overrun, and it is unclear from presently available information how NorthStar would compensate for any additional costs to ensure adequate funding for decommissioning.

j. *If DOE fails to remove all spent nuclear fuel by 2052, and NorthStar has continuing costs beginning in 2053, which could at some point include having to repackage dry casks.* NorthStar does not have a valid basis for assuming that DOE will have removed all spent nuclear fuel from Vermont Yankee by 2052. The history of spent fuel storage demonstrates that licensees cannot count on DOE to meet any projected performance dates regarding its obligation to remove spent nuclear fuel. If DOE fails to pick up the spent fuel by 2053, then NorthStar will begin incurring significant and ongoing cost overruns for spent fuel management. These annual costs would, generally speaking, be the same as the annual costs that NorthStar identifies for security of the dry casks during the years 2019-2052 (assuming those costs are accurate—in my experience, licensees have often underestimated the annual cost of spent fuel management). However, these costs could go on for decades or perhaps even centuries. This raises a significant risk of much larger cost overruns, on the order of hundreds of millions of dollars. The NRC's Continued Storage Rule (NUREG-2157), which Entergy's PSDAR relies upon (PSDAR at 36) explicitly recognizes that spent fuel may be stored indefinitely at each reactor site. In that scenario, the NRC's Continue Storage Rule assumes that each reactor operator will need a Dry Fuel Transfer Station to move spent fuel into new dry casks every 100 years. This is because, at sites like Vermont Yankee, there would no longer be a spent fuel

pool once the fuel is moved to dry storage to facilitate decommissioning. The PSDAR, Revised PSDAR, and other available information do not presently account for how NorthStar would address the contingency of indefinite onsite storage, including all safety and environmental concerns regarding transferring fuel into new dry casks every 100 years. The PSDAR and Revised PSDAR also do not identify any funding source for: (a) the construction of a Dry Fuel Transfer Station; (b) the purchase of 58 new casks and all the labor and material costs for transferring the fuel every 100 years; and (c) the costs of maintaining security at the site indefinitely. These costs, that are currently unaccounted for, could easily run hundreds of millions of dollars

k. Each of the cost overruns listed above could lead to a significant shortfall in decommissioning funding. The shortfall could be even greater if more than one of the above cost overruns occurs, or if NorthStar encounters other cost overruns not listed above.

l. NorthStar plans to use the same three funding sources (the Vermont Yankee decommissioning trust fund, potential litigation or settlement recoveries from DOE, and the Vermont Yankee site restoration fund) for all license termination, spent fuel management, and site restoration expenses. Because of this and the concurrent nature of the NorthStar plan for performing license termination, spent fuel management, and site restoration, a cost overrun or delay in any of these three categories has the potential to jeopardize funding for the other areas.

I affirm under the penalties of perjury that the foregoing is true and based upon my personal knowledge this 12th day of June 2017.

Warren K. Brewer

SWORN TO AND SUBSCRIBED before me on this 12th day of June 2017.

Notary Public
My commission expires: 08/31/2017

ANGEL BALBUENA
NOTARY PUBLIC 7576590
COMMONWEALTH OF VIRGINIA

## WARREN K. BREWER

## EDUCATION

Bettis Reactor Engineering School, 1976

M.S., Nuclear Engineering, Massachusetts Institute of Technology, 1976

B.S., Electrical Engineering, Louisiana Tech University, 1974

## EXPERIENCE

### 1986 - Present - ABZ, Incorporated and Four Points Group, Incorporated starting 2017

Executive Consultant specializing in nuclear power plant operations, decommissioning cost estimating and planning and severe accident analysis. This experience has included work related to regulatory compliance, inservice inspection and testing (ISI/IST), configuration management, procedure and technical specification reviews and design basis documentation.

More specifically, the experience in these areas has included:

Provided engineering and management services as part of an integrated team to validate and update the Southern California Edison San Onofre nuclear plant design basis documentation.

Managed the development of advanced computer systems for assisting nuclear plant staff in compliance with regulatory requirements. These systems assisted in scheduling of NRC required plant condition dependent surveillance testing, collecting and evaluating test data, managing of system operability information and plant license limiting conditions for operation, compliance with nuclear plant operator scheduling and overtime regulations, and compliance with NRC event reportability regulations. The surveillance test scheduling system was used by one utility for almost 20 years with no failures.

Developed methods for verification and validation of expert system computer codes based on industry guidelines and accepted criteria for conventional codes. Presented lecture to the NRC on methods of verification and validation as part of a lecture series on software quality assurance

Provided expert assistance to the programmers in developing a state-of-the-art desktop nuclear power plant simulator for training operators to learn and understand event-based Emergency Operating Procedures (EOPs).

Over 20 years experience in preparation and review of decommissioning plans and cost estimates. Participated in conferences and workshops on decommissioning costs and funding adequacy. Provided on-site monitoring of decommissioning activities.

Provided assistance concerning decommissioning costs, planning and progress as part of process to negotiate sale of a nuclear plant.

Conducted specific studies relative to projected costs of low-level waste disposal and spent fuel management providing the results to state agencies and companies in the nuclear industry.

Prepared reports for state regulators evaluating cost estimates for decommissioning, low-level waste disposal, and extended spent fuel storage. Provided training to state regulators on decommissioning technology and methodology of decommissioning cost estimating.

Developed methodology for evaluating costs for recovery from severe reactor accidents. This methodology has been used by the majority of the US nuclear industry, foreign utilities and nuclear insurers to advise them on potential losses and insurance recoveries as well as to assist risk managers in determining the coverage levels to obtain.

Performed evaluations of the liability claims that could arise from transportation of nuclear material. These evaluations included assessment of the technical conditions that might result from such events, the probability of such events, and all liability costs that might be incurred (cleanup, property damage, health effect, business interruption or losses, etc.).

Performed reviews of maintenance, operations, and quality assurance programs. Such reviews included comparison of the program elements with the regulations, evaluation of specific work packages and implementation of work in the field.

Provided DOE with expert assistance in evaluating the generic environmental impact statements for the New Production Reactor. This included verification and validation of offsite releases, environmental impacts, and the technical aspects of operation.

Managed and participated in the development of computer program for fluid flow analysis. The program is applicable to a wide range of facilities and industries. The program has been marketed world-wide since 1992 with an estimated 25,000 users.

Extensive experience in providing litigation support and expert witness services related to nuclear plant operation, decommissioning planning and costs, spent fuel management and general engineering. Expert testimony has been provided before the US Court of Federal Claims, US Tax Court, state regulatory agencies and arbitration tribunals.

This litigation support and expert witness experience has included:

Over 12 years experience in evaluation of claims resulting from the US Department of Energy's (DOE) breach of the contract with nuclear plant operators for the disposal of spent nuclear fuel. This has included evaluation of spent fuel storage options, dry storage facilities and cask designs, specific plant decisions, equipment, incurred costs and spent fuel transportation options. Prepared expert witness reports and provided expert testimony.

Provided rate case support in proceedings before state and federal regulators. Issues addressed included the adequacy of decommissioning cost estimates, as well as

prudence of operational actions, management effectiveness, technical soundness of operation, technical design basis and details, and regulatory compliance and adherence to industry standards. Work included testimony, as well as assisting in preparing data and information for testimony by others. Prepared reports for state regulators evaluating cost estimates for decommissioning, low-level waste disposal, and extended spent fuel storage. Provided training to state regulators on decommissioning technology and methodology of decommissioning cost estimating.

**1986 - Pickard, Lowe and Garrick, Inc.**

Consulting Engineer.

Conducted detailed review of technical specification surveillance test requirements for a nuclear power plant. This included detailed review of the implementing programs and procedures, and providing detailed comments for procedure revisions to ensure regulatory compliance.

Conducted detailed review of technical specification requirements, technical specification basis, regulatory background, industry practice, and implementing procedures at a nuclear power plant for required logic system functional testing and simulated automatic actuation testing of emergency core cooling systems and primary containment isolation.

Reviewed plant-specific probabilistic risk assessment (PRA). Along with general evaluation, provided assessment of operational considerations and/or lessons resulting from the PRA.

Participated in procedure review and upgrade project.

**1982 - 1986 - United States Navy, Division of Naval Reactors**

Head, Reactor Plant Systems - New Design Submarine.

Lead responsibility for reactor plant performance, safety, and quality.

Conducted various trade-off studies to establish overall design criteria for new design reactor and propulsion plant. This included evaluation of possible performance maintainability, survivability, constructability, and cost. Established general design characteristics for further development.

Evaluated various proposed core designs to determine optimum design to fit overall propulsion plant design goals. This included evaluation of thermal hydraulic performance, safety evaluation, normal plant response analysis, and reactor structural design assessment, including response under shock loading.

Reviewed and approved conceptual system designs, performance criteria, and detailed design bases. As design progressed, this included increasing levels of detail to system design descriptions, design calculations, component sizing, system schematics, and construction details.

Participated in design of major plant components to ensure structural soundness, compliance with overall design goals, and ability to interface with other systems and propulsion plant arrangement.

Reviewed and approved design of reactor plant structures, such as component foundations.

Reviewed and approved plant equipment and system arrangements.

Reviewed reactor and plant control system designs for compatibility with mechanical system designs and core performance and capabilities.

Reviewed and approved operating transient response predictions to be used in life-cycle evaluations of plant.

Developed life-cycle plant operating profile based on mission requirements and data from previous submarine classes.

Had lead responsibility for design initiatives to mitigate the consequences of complete loss of AC power and to ensure safety of surrounding population if this type event occurred near port.

Participated in extensive effort to reduce plant weight. Potential weight reduction concepts were each evaluated for its total effect on capability, constructability, life-cycle cost, and maintainability.

Participated in Naval Reactors crew quizzes for crews of operating submarines to test knowledge and ability of ship crew to safely and efficiently operate the propulsion plant. Responsibility was mainly for testing in the area of reactor plant mechanical system operation.

**1980 - 1982 - United States Navy, Division of Naval Reactors**

Head, Reactor Plant Systems - TRIDENT Submarines.

Supervised engineering group. Directed efforts concerning design, construction, operation, maintenance, testing, and configuration control of reactor plant fluid systems and structures for TRIDENT submarine. Similar duties in connection with land-based TRIDENT reactor plant prototype.

Responsible for shock design of shipboard reactor plant components and structures. Similarly, responsible for seismic design of structures, systems, and components unique to land-based prototype. Seismic design was done to the same criteria imposed on commercial nuclear power plants.

Developed IST/ISI program for land-based prototype conforming to ASME Code, Section XI. These programs were in compliance with the requirements imposed on commercial nuclear power plants.

Responsible for design, acceptance testing, operation and maintenance procedure for emergency core cooling system for the land-based prototype. This system was

designed to comply with NRC requirements imposed on commercial power plants for similar systems.

Responsible for preparation of reactor plant operating, maintenance, and test procedures.

Evaluated operation incidents and established corrective actions based on these evaluations.

Evaluated and resolved construction deviations from specified requirements.

Participated in examination of prototype operating crews to evaluate level of knowledge and capability to safely operate the reactor plant.

Responsible for design, construction, operation, and maintenance of support systems, such as process cooling water and associated cooling tower to support prototype operation.

**1976 - 1980 - United States Navy, Division of Naval Reactors**

Project Engineer, TRIDENT Class submarine propulsion plant design.

Coordinated government laboratory and shipyard work in all phases of design, construction, operation, testing, and maintenance of steam plant fluid systems for TRIDENT submarines and land-based TRIDENT submarine prototype.

Responsible for design of shipboard structures and piping systems in accordance with shock design criteria.

Responsible for preparation of verbatim compliance operating and maintenance procedures. This included performance of procedure verification and validation.

Responsible for design of safety systems unique to the land-based prototype, including compliance with NRC requirements for similar systems in commercial power plants.

Evaluated and resolved shipyard construction deviations for structures and systems.

Participated in the evaluation, analysis, and resolution of large-scale shipyard error resulting in unapproved material substitutions. This involved tracking and identifying where incorrect materials had been used, evaluating and testing the acceptability of the material as-built, and approving the as-built condition or specifying the required rework.

## Testimony

State of New Hampshire Decommissioning Finance Committee hearing on the Seabrook Nuclear Power Plant decommissioning funding, 1994.

Mitsubishi Heavy Industries, Ltd (Japan) v. Finmeccanica S.p.A., Azienda Ansaldo (Italy), as successor in interest to Ansaldo S.p.A., International Court of Arbitration, Case Number 10269/OL/ESRT/TE, June 2001.

Tennessee Valley Authority v. United States of America, Case No. 01-249C, July 2005.

SFI Mississippi v. United States of America, Case No. 03-2624C, September 2006.

Boston Edison v. United States of America, Case No. 99-447C and 03-2626C, June 2007.

Wisconsin Electric v. United States of America, Case No. 00-697C, September 2007.

Dairyland Power Cooperative v. United States of America, Case No. 04-0106C, July 2008.

Entergy Corporation and Affiliated Subsidiary Companies v. Commissioner of Internal Revenue, Docket No. 10557-08, June 2008.

Consolidated Edison Company of New York, Inc. v. United States of America, Case No. 04-33C, June 2009.

Entergy Nuclear Indian Point 2, LLC v. United States of America, Case No. 03-2622C, June 2009.

Entergy Nuclear Generation Company v. United States of America, Case No. 03-2626C, September and October 2009.

Entergy Nuclear Vermont Yankee, LLC v. United States of America, Case No. 02-898C, March and April 2010.

Portland General Electric, the City of Eugene Oregon, and Pacificorp v. United States of America, Case No. 04-0009C, November 2011.

System Fuels, Inc. and Entergy Arkansas, Inc. v. United States, Case No. 03-2623C, October and November, 2012.

State of Vermont Public Service Board, Docket No. 7862, Petition for Amendment of Certificate of Public Good for Vermont Yankee Nuclear Power Station.

System Fuels, Inc. and Entergy Arkansas, Inc. v. United States, Case No. 12-389C, July 2014.

System Fuels Inc., System Energy Resources, Inc., and South Mississippi Electric Power Association v. United States, Case No. 11-511C, October 2014.

Entergy Gulf States, Inc. and Entergy Gulf States Louisiana, LLC. V. United States, Case No. 03-2625C, May 2015.

Entergy Nuclear FitzPatrick, LLC., Entergy Nuclear Indian Point 3, LLC., and Entergy Nuclear Operations, Inc. v. United States, Case No. 03-2627C, August 2015.

Entergy Nuclear Indian Point 2, LLC v. United States, Case No. 13-19C, April 2016.

Sacramento Utility District v. United States, Case No. 15-577C, October 2016.