EXHIBIT 3

Petition of the State of Vermont, the Vermont Yankee Nuclear Power Corporation, and Green Mountain Power Corporation for Review of Entergy Nuclear Operation, Inc.'s Planned Use of the Vermont Yankee Nuclear Decommissioning Trust Fund

Declaration of William Irwin, Sc.D, CHP (April 20, 2015)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of: Entergy Nuclear Operations, Inc., Vermont Yankee Nuclear Power Station September 4, 2014 License Amendment Request	Docket No. NRC-2015-0029 Docket No. 50-271

Declaration of William Irwin, Sc.D, CHP

I declare 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) Since December 2005, I have been an employee of the Vermont Department of Health, where I am the Radiological and Toxicological Sciences Program Chief.

(3) In my role at the Vermont Department of Health, I have managed or helped manage environmental surveillance and emergency preparedness for the Vermont Yankee Nuclear Power Station.

(4) I was involved in helping draft portions of the State of Vermont's March 6, 2015 Comments ("State's Comments") on Entergy's proposed Post Shutdown Decommissioning Activities Report ("PSDAR").

(5) I attest to and affirm the factual underpinnings of those portions of the State's Comments that speak to radiological contamination discovered at the site that will likely increase the anticipated costs of radiological decommissioning.

(6) In addition, and without limitation on other statements I could attest to and affirm, I specifically attest to and affirm the factual underpinnings discussed in pages 9-19 of the State's Comments, including, among other things the following:

a. The characterization of the site (radiological and non-radiological) has not yet occurred. Rather, Entergy has elected to wait decades until nearly the end of the allowed SAFSTOR period before engaging in this characterization. The decision to delay characterization calls into question all of the cost estimates that Entergy has provided in its PSDAR and related filings. Without a full site characterization, there is no way to determine what it will ultimately cost to perform radiological decommissioning, spent fuel management, and site restoration.

b. The PSDAR also does not describe the depth and breadth of the planned radiological environmental monitoring program.

c. The PSDAR also inadequately describes radiological emergency preparedness during decommissioning. The basis of emergency planning ignores hostile action based scenarios that could destroy key structures storing radioactive materials or result in a zirconium fuel cladding fire while fuel remains in the spent fuel pool.

d. Throughout the SAFSTOR years, large quantities of radioactive materials in solid and liquid form will be left in storage onsite where leaks have occurred in the past, and may occur again. In

addition to radioactive material storage, inventory management and monitoring, and response to leaks into the environment, there is a serious concern about fire protection for the structures, systems, and components containing radioactive materials in storage. Capabilities to monitor for and respond to these kinds of radiological emergencies are not adequately addressed in the PSDAR.

e. One clear omission from the PSDAR and Decommissioning Cost Estimate is the recent discovery of strontium-90 in locations where that contaminant had not previously been discovered. *See* Vermont Department of Health Communications Office, *Strontium-90 Detected in Ground Water Monitoring Wells at Vermont Yankee* (Feb. 9, 2015), http://healthvermont.gov/news/2015/020915_vy_strontium90.aspx. The Department of Health also found cesium-137, strontium-90, and other long half-life radioactive materials in soil samples taken in 2010. *See* http://healthvermont.gov/enviro/rad/yankee/laboratory_testing.aspx. The Department of Health's publication of results regarding strontium-90 in groundwater wells occurred *after* Entergy submitted its PSDAR. At this point, we already know of at least one way in which the Decommissioning Cost Estimate is incorrect—

namely, the analysis underlying the estimated amount of soil removal that will be needed surrounding the advanced off-gas (AOG) building. On that issue, Entergy has stated the following:

> It should be noted that no additional remediation of the soil in the vicinity of the AOG building was included, based upon the earlier remediation (soil removal) performed by Entergy VY and the findings from the GZA groundwater investigation that *only tritium had migrated into the groundwater*. Tritium is a low-energy beta emitter with a half-life of approximately 12.3 years, decaying to non-radioactive helium. As such, any residual sub-grade tritium is not expected to require any further remediation at the time of decommissioning in order to meet site release criteria.

Decommissioning Cost Estimate, § 3, page 12 (emphasis added; footnote omitted). The Decommissioning Cost Estimate is clearly out-of-date and incorrect in its claim that "only tritium ha[s] migrated into the groundwater" in this area. *Id.* This new data on strontium-90 creates doubt regarding Entergy's claim in the PSDAR that previous excavation of the AOG leakage site eliminates the need to excavate deeper than three feet below grade. *See id.*; *see also id.* at § 3, page 13 (noting that foundations and building walls will only be removed "to a nominal depth of three feet below grade"). Many long-lived radionuclides are likely to be found in soils and groundwater far from the small excavation made to repair the leaks that likely allowed reactor condensate to enter into the site soils for many years. In addition, these same long-

lived radionuclides are likely to be found in the structures, systems, and components left during SAFSTOR and then later decontaminated and dismantled.

f. The presence of strontium-90 or other long-lived radionuclides could greatly increase the costs of decommissioning and site restoration.

g. Long half-life radioactive materials are expected to be found in soils at Vermont Yankee. These include 5,730-year half-life carbon-14, 100-year half-life nickel-63, 29-year half-life strontium-90, 30-year half-life cesium-137, 13.5-year half-life europium-152, and 12.3-year half-life hydrogen-3. *See* Abelquist, Eric W., *Decommissioning Health Physics, A Handbook for MARSSIM Users* (2d Ed. 2014). These radioactive materials and hard-to-detect radionuclides were found in the decommissioning of both Maine Yankee and Connecticut Yankee in addition to transuranics, radioisotopes of plutonium, curium, neptunium, and americium. *See* Letter from Thomas L. Williamson, Maine Yankee Director of Nuclear Safety and Regulatory Affairs to NRC (Jan. 16, 2002) (ADAMS ML020440651). Further, as the State pointed out to Entergy in the State's December 2014 comments, carbon-14 has been a major issue in the decommissioning of other sites such as Yankee Rowe and is expected to be a concern in the decommissioning of future sites such

as San Onofre. Despite the State's explicit request, Entergy has not yet provided any evaluations, analyses, or other bases for assuming that carbon-14 will not be of concern in decommissioning Vermont Yankee.

h. Conversations with Health Department staff in Maine and with Environmental Conservation Department staff in Connecticut indicate that decommissioning is likely to reveal unanticipated radioactive sources to be remediated. These included pockets of highly contaminated groundwater dammed up by existing structures at Maine Yankee and a 25-foot-deep 225-foot-long excavation of soil around the reactor water storage tank at Connecticut Yankee. These kinds of potential situations are not adequately accounted for in the PSDAR. The PSDAR provides no assurance that the challenges of remediating these radioactive materials are factored into the planning and funding for the decommissioning of Vermont Yankee.

i. Even if strontium-90 had not recently been discovered, the PSDAR would be deficient given other evidence that soil contamination exists—and that remediation is thus likely to be needed—more than three feet below grade. The October 2014 Site Assessment Study documents the 1991 leak in the chemistry lab drain line, the AOG reactor condensate leaks confirmed in 2009, the piping leaks

between the radioactive waste building and the AOG building discovered in 2010, and other spills and leaks of radioactive materials. The area between the Connecticut River, the intake structure, the discharge structure, and the reactor, turbine, and radioactive waste buildings may contain large volumes of contaminated soil requiring excavation to meet the derived concentration guideline levels for appropriate remediation in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual. Significant leakage of reactor condensate and radioactive materials spills have occurred: in the AOG piping tunnel; in piping between the AOG building and the radioactive waste building; in and around the radioactive waste building; in the condensate storage tank courtyard; and between the Connecticut River and the reactor, radioactive waste, and AOG buildings. If Entergy fails to remediate beyond three feet below grade, contamination could reach the groundwater and river water down-gradient of these areas. The PSDAR provides no information to determine whether the human and financial resources required for all necessary soil removal and other remediation will be available at the time the remediation must occur.

j. Entergy's Decommissioning Cost Estimate only addresses so-called contingencies that are "almost certain to occur." Decommissioning

Cost Estimate at xii. Actual contingencies—such as the discovery of strontium-90 and other radionuclides in places not previously thought to be contaminated—have historically led to enormous escalations in decommissioning costs. For instance, at Connecticut Yankee, the discovery of strontium-90—the very same radiological contaminant that was recently discovered in the groundwater at Vermont Yankee—led to an enormous decommissioning cost escalation during the radiological decontamination and dismantlement phase that Entergy intends to postpone until the end of its SAFSTOR period. Yet Entergy categorizes all of these types of potential expenses as "financial risks" and explicitly notes that it "does not add any additional costs to the estimate for financial risk." Decommissioning Cost Estimate § 3, page 6.

(7) In addition, and without limitation on other statements I could attest to and affirm, I specifically attest to and affirm the following factual underpinnings discussed in pages 45-46, 49, 51-53, and 57 of the State's Comments:

a. Regardless of a plant's size, other site-specific factors can—and do—affect the potential environmental and other impacts of decommissioning. For instance, Vermont Yankee has an operating elementary school located just 1500 feet from the reactor building. The close proximity of an operating elementary school cannot be ignored. At a minimum, this factor calls for imposing common-

sense mitigation measures that ensure that schoolchildren are not present during certain decommissioning activities, such as the transfer of spent nuclear fuel or the demolition of buildings containing radioactive or non-radiological hazardous materials like asbestos and lead.[1] It is well known that young children are more vulnerable to adverse health reactions to airborne contaminants such as lead. *See, e.g.*, Vermont Dept. of Health, *Lead Poisoning and Prevention*, http://healthvermont.gov/enviro/lead/ ("Young children are at highest risk because their developing bodies absorb lead more easily. Lead dust exposure can have life-long health effects such as lowering a child's IQ."). Thus, in contrast to Entergy's "bounding" claim, a decommissioning activity such as the demolition of a building that contains lead (and the lead dust created from that) might have minimal or no environmental impacts at a larger plant in an isolated area, but significant consequences at Vermont Yankee if even a small amount of lead dust travels the short distance between the plant and the nearby elementary school. Entergy's PSDAR therefore fails to show that these environmental impacts are bounded by previous analyses.

[1] Despite specific requests for such information by the Department of Health and the Agency of Natural Resources in the December 2014 comments that the State provided to Entergy, the PSDAR is silent on the presence and eventual disposition of asbestos-containing materials and lead-based paint, and Entergy has failed to provide this requested information to either the Department of Health or the Agency of Natural Resources.

b. There is known and unknown contamination at Vermont Yankee from previously identified tritium leaks and the more recently identified presence of strontium-90. Entergy has not analyzed the environmental and other effects of any delay during the SAFSTOR period in addressing such leaks, including the well-known fact that migration will increase the area that is contaminated.

c. Entergy's PSDAR announces for the first time that an estimated 1.3 million gallons of highly radioactive water will be stored in the torus within the reactor building during decades of SAFSTOR. Given that it was not until the PSDAR that Entergy revealed plans to deal with this radioactive water in this manner, this issue raises environmental issues that are obviously not "bounded" by any previous environmental analysis. Nor has Entergy pointed to any previous analysis addressing potential environmental impacts associated with storing radioactive water in this manner. Entergy has not yet identified what instrumentation will be used to monitor torus water levels in the PSDAR or what kind of inspection regimen for possible leakage will be used until this water is properly disposed of as radioactive waste. Further, Entergy has not explained when disposal of this water will occur and how.

d. The PSDAR is also inadequate in terms of its environmental analysis related to the need for extensive groundwater monitoring.

To protect public health, safety, and the environment, Entergy must extensively monitor groundwater until decommissioning is complete and its license has been terminated. After tritium contamination was measured in groundwater at many nuclear power plants, the Nuclear Energy Institute developed the Groundwater Protection Initiative (NEI Technical Report 07-07). Throughout the different phases of decommissioning, Entergy should, at a minimum, maintain its current monitoring levels as required by NEI 07-07 at the Vermont Yankee facility until NRC license termination. This is necessary since radioactive materials will remain in storage for decades before decontamination and dismantling. It is particularly important in light of the Department of Health's recent identification of strontium-90 in groundwater.

e. The recent discovery of strontium-90 in groundwater raises additional concerns regarding soil contamination that may enter the groundwater and move in a way that threatens public health, safety, and the environment. This includes contamination from previously mentioned long half-life radioactive materials, as well as shorter half-life materials in the soils at Vermont Yankee. For instance, cobalt-60, cesium-134, zinc-65, and manganese-54 have been all been documented in soils and as sources in previously investigated leaks at Vermont Yankee. *See* Site Assessment Study;

Department of Health, *Laboratory analyses for soil samples collected March 17, 2010 at locations along the Vermont Yankee Advanced Off-Gas Pipe Tunnel leak pathway*, *available at* http://healthvermont.gov/enviro/rad/yankee/documents/VY_Data_soil_samples_march2010.pdf.

f. Despite the clear need for robust environmental monitoring until license termination, the PSDAR is mostly silent on this subject. For protection of the environment and public health, monthly sampling from all 32 groundwater monitoring wells and all three drinking water wells currently sampled at Vermont Yankee should continue through license termination, and split samples from those wells should be provided to the Vermont Department of Health for independent confirmatory analysis. In addition, Entergy should continue to perform radiological environmental monitoring of the pathways to the public, direct gamma radiation, soils, sediments, fish and other flora and fauna as conducted during operation of the facility until the large volume of radioactive materials stored onsite are removed by decontamination, dismantling, and licensed disposal. Along with those samples currently split with the Department of Health, including onsite groundwater and drinking water, sediments and fish from the Connecticut River, and direct gamma radiation measurements by dosimeter, the State of

Vermont must be provided split samples from the final status surveys that are intended to document that soil and structure remediation will allow release of the site for unrestricted use at NRC license termination. The PSDAR fails to include any such requirement and is thus deficient in this regard.

g. The PSDAR also inadequately describes what fire protection systems will be in place at Vermont Yankee. Throughout every stage of decommissioning, large quantities of radioactive material will exist within the remaining structures, systems, and components until they are decontaminated and dismantled. In the event of a fire, these materials may result in radioactive contamination of, and radiation doses to, firefighters and other first responders. Consumption by fire of radioactive materials may also result in offsite contamination. No evidence is provided in the PSDAR that local fire department personnel are fully prepared for onsite firefighting with limited support offered by reduced staff at Vermont Yankee. There is also no evidence in the PSDAR as to how offsite responders can manage offsite contamination that results from fires that consume radioactive materials stored onsite.

(8) In light of these and other concerns, there is a significant risk that the Vermont Yankee Nuclear Decommissioning Trust Fund will have a shortfall and will not be able to cover all of the costs of radiologically decontaminating the site if

the Nuclear Regulatory Commission does not closely monitor withdrawals from that fund.

Executed on April 20, 2015 in Montpelier, Vermont

/s/ *William Irwin*
William Irwin, Sc.D., CHP
Vermont Department of Health
Radiological and Toxicological
Sciences Program Chief
108 Cherry Street
Burlington, VT 05401

William E. Irwin, Sc.D., CHP

Education

- **Doctor of Science, Work Environment Engineering**, University of Massachusetts Lowell
- **Master of Science, Radiological Sciences**, University of Massachusetts Lowell
- **Master of Business Administration**, Southern New Hampshire University
- **Bachelor of Arts, Philosophy and History**, Christopher Newport University

Experience

- ***Vermont Department of Health, December 2005-present: Radiological and Toxicological Sciences Program Chief.*** Manage a staff of scientists who provide guidance to the public, state agencies and other stakeholders on the health risks and methods of health protection for acute and chronic exposures to ionizing and non-ionizing radiation and toxic materials. Provide guidance to citizens of Vermont and advice to members of Vermont state government on regulated and unregulated radiological and toxicological health matters. Manage environmental surveillance and emergency preparedness for the Vermont Yankee Nuclear Power Station.
- ***Harvard University, October 2001-September 2005: Health Physicist, Laser Safety Officer, Associate Radiation Protection Officer.*** Directed technical services for environmental health and safety programs at Harvard University. Managed a staff of eight technicians and physicists at the Harvard Medical School and the Faculty of Arts and Sciences. Significant accomplishments included direction of radiological and environmental health activities during the decommissioning of the Harvard Cyclotron Laboratory, and development and initial implementation of the Harvard University Laser Safety Program. Taught courses in laser health physics.
- ***Massachusetts Institute of Technology, October 1992-October 2001: Health Physicist, Assistant Radiation Protection Officer*** Managed the safe use of ionizing and non-ionizing radiation producing devices for campus research laboratories. Designed safety measures for radiological hazards, taught courses in radiological health protection, performed measurements and calculations for radiological emissions, supervised technicians, and determined doses and potential consequences of radiological exposures. Special projects included leading the MIT-Cambridge Collaboration on Education for the Environment.
- ***Biological, Chemical and Radiological Occupational Health Consultant, 1994-2005:*** Praecis Pharmaceuticals; Suntory Pharmaceuticals, Wolfe Laboratories, Inc.; Satori Pharmaceuticals, Inc.; Cubist Pharmaceuticals; Arcturus Pharmaceuticals; Millenium Pharmaceuticals; Kinetix Pharmaceuticals; Animal Rescue League of Boston; W.R.Grace; Sontra Pharmaceuticals, Inc.; Implant Sciences; East Coast Chiropractic; Chemical & Atomic Workers Union; Lasertron; Vizidyne; Duracell; Gillette; Senior Flexonics; Telephotonics; Esdaile, Barret & Esdaile; AT&T Wireless; Bell Atlantic Mobile; Entel; NLS; Omnipoint;Verizon Wireless; Sprint PCS; T-Mobile Communications; the Town of Medfield, MA; the Town of Wrentham, MA; General Dynamics, Inc.
- ***North Atlantic Energy Services, July 1990--October 1992:*** Health Physics and Supervisor Training Instructor. Designed, developed and taught courses in health physics, nuclear power plant operations, and supervision. Emergency Responder and Emergency Response Trainer.
- ***Arizona Public Service Company, December 1985 –July 1990:*** Health Physics, Chemistry, and Engineering Training Instructor and Supervisor. Designed, developed and taught courses in health physics, nuclear power plant operations, and chemistry. Led the team of instructors who prepared and presented courses in engineering and plant operations, and supervised the team of chemistry instructors.
- ***Contract Health Physics Instructor and Technician during refueling and maintenance outages, June 1984 -December 1985:*** Virginia Power (Surry and North Anna Stations); Southern Nuclear Operating Company (Farley Station); South Carolina Electric & Gas (Brunswick Station); Carolina Power & Light (V.C. Summer Station).

- ***Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia, Radiological Controls Technician. October 198 –June 1984.*** Trained and worked according to the US Navy Training Criteria of NAVSEA 389-0288 on submarines, aircraft carriers and guided missile cruisers.

Professional Certifications

- **Certified Health Physicist**, certified by the American Board of Health Physics, comprehensive examination passed July, 1996. Re-certified in 2000, 2004 , 2008, 2012.
- **Hazardous Materials Technician/Specialist/Crew Chief**, Vermont Hazardous Materials Response Team, August 2007.
- **Firefighter I**, certified by the Vermont Fire Service Training Council, May 2008
- **Firefighter II**, certified by the Vermont Fire Service Training Council, February 2012
- **Emergency Medical Technician,** certified by the National Registry of Emergency Medical Technicians, June 2013
- **AgriSafe Provider,** certified by the University of Iowa Center for Agricultural Safety & Health, July 2013.
- **Professional Ski Instructor**, certified by the Professional Ski Instructors of America, March 2009

Professional Affiliations

- **Conference of Radiation Control Program Directors** (CRCPD), Chair-Elect (2004-2005), Director Member; Chair of CRCPD Homeland Security/Emergency Response Task Force 4 for evaluation of resources for radiological and nuclear emergency response; Advisor to CRCPD Environmental Task Force 43 for radiological data sharing policy development.
- **National Council on Radiation Protection and Measurements (NCRP)**, Member of Council Committee CC-1 *Radiation Protection Guidance for the United States* and Scientific Committee SC 3-1, *Guidance for Emergency Responder Dosimetry*.
- **New England Radiological Health Conference**, Executive Board Member.
- **American Academy of Health Physics**, Diplomat.
- **Health Physics Society**, Plenary Member
- **Vermont Firefighters Association**, Member
- **Bakersfield Volunteer Fire Department**, Fire Captain and EMT

Specialized Training

- **Turbo FRMAC, Assessment Scientist**, 24 hour course conducted by Sandia National Laboratories on the use of derived response level, derived intervention level and emergency worker protection computer software, July 2013.
- **Emergency Medical Technician,** 144 hour course with scheduled completion by April 2013.
- **Agricultural Medicine and Occupational Safety Training**, 48 hour course on agricultural illnesses, injuries and exposures with a focus on prevention, as well as care presented by the University of Iowa Center for Agricultural Safety & Health and the New York Center for Agricultural Medicine & Health, July 2013.
- **Computer Assisted Management of Emergency Operations**, 24 hour course conducted by the Environmental Protection Agency, May 2013.
- **HazCat Field Identification Course,** 32 hour course presented by Haz Tech Systems , Inc., February 2013.
- **Firefighter II**, 90 hour training and certification provided by the Vermont Fire Service Training Council, February 2012.
- **Turbo FRMAC, Assessment** Scientist, 24 hour course conducted by Sandia National Laboratories on the use of derived response level, derived intervention leve and emergency worker protection computer software, March 2009.
- **HazCat Field Identification Course,** 32 hour course presented by Haz Tech Systems , Inc., October 2008.

- **Small-scale Chemical and Biological Weapons Production,** 40 hour course by Responders Resource Technology, January 2007.
- **Homeland Security Exercise Evaluation Program**, Vermont Homeland Security Unit, November 2008
- **Firefighter I**, 160 hour training and certification provided by the Vermont Fire Service Training Council, May 2008.
- **Hazardous Materials Technician**, Vermont Hazardous Materials Response Team, February 2007-2012.
- **Hazardous Materials Emergency Responder.** 24-hour course presented by Harvard University, 2001, 2002, 2003, 2004, 2005.
- **Multi-Agency Radiological Survey and Site Investigation Manual.** 8-hour course presented by the American Academy of Health Physics, July 2004.
- **Concepts and Methods for Communicating with Responders and the Public**. 8-hour course presented by the American Academy of Health Physics, July 2003.
- **Medical Management of Patients from Radiological Terrorist Events.** 8-hour course presented by the American Academy of Health Physics, June 2002.
- **Incident Command System.** NIMS 700, ICS 100, 200, 300, 400 and 441 qualified through courses presented by the Vermont Criminal Justice Training Council through May 2006-September 2011.
- **Non-Ionizing Radiation Safety: Evaluation and Management Techniques**, 24-hour course presented by Narda Microwave, November 1998.
- **Radiofrequency Radiation Safety in the Telecommunications Industry**, 8-hour course presented by Narda Microwave, September 1996.
- **Advanced Laser Safety**, 24-hour course presented by the Engineering Technology Institute, August 1996.
- **Health Physics at Research Reactors**, 8-hour course presented by the American Academy of Health Physics, July 1996.
- **Radiation Physics at Accelerators**, 8-hour course presented by the American Academy of Health Physics, July 1995.
- **Environmental Radioactivity Quantification**, 8-hour course presented by Canberra Industries, June 1994.
- **Laser Safety**, 32-hour course presented by the Engineering Technology Institute, June 1993.
- **MIT Reactor Safety Study,** 40-hour course presented by the Massachusetts Institute of Technology, Department of Nuclear Engineering, July 1988.
- **Arizona Public Service, Instructor Development:** Instructor Platform Skills; Course Documentation; Conducting Topic, Task and Paradigm Analysis; Incorporation of Operating Experiences in Training Programs; Learning Objectives; Evaluating Student Performance; Maintaining Training Materials; Motivating Students and Responding to Student Needs; Advanced Platform Skills; Laboratory instruction.
- **Arizona Public Service Technical Development:** Management Oversight and Risk Tree Root Cause Analysis; Emergency Planning; Fundamentals of Working Fluids; Chemistry; Mitigating Core Damage; Plant Modifications; Instrumentation and Process Controls; Systems, Plant Components and Design Bases; reactor Theory; Plant Operations, Human Performance Evaluation Systems; Hazardous Materials Control; Nuclear Reactor Safety
- **U.S. Naval Reactors Radiological Controls**, three-month training program presented by Newport News Shipbuilding and Dry Dock Company, October-December 1981.

Publications

- ***Symptoms Associated with prolonged Radio Frequency Radiation Exposure,*** Lee, Ernest C., Irwin, William E. and Winters, Thomas H., Environmnetal Health Perspectives, June 2004.
- ***Radio Frequency Radiation Risk - A Focus on Wireless Telephones***. Dissertation for The University of Massachusetts Lowell, 2002.
- ***New Technology in Art.*** Encyclopedia of Occupational Health and Safety, Fourth Edition, International Labour Office, Geneva, Switzerland, 1996.

Software Knowledge

- **HPAC, RASCAL, TurboFRMAC, RES/RAD, MetPac,** and **HotSpot** for response and recovery from radiological and nuclear emergencies.
- **CAMEO** for computer assisted management of emergency operations for chemical releases.
- **Microshield** for external dose and shielding calculations.
- **Varskin** for skin dose calculations.
- **INDOS** for internal dose calculations.
- **Lazan** for laser nominal hazard zone, MPE and OD calculations
- **SPSS** for epidemiological statistics and **Stata** for other statistics.
- **Microsoft Word** for word processing, **Excel** for spreadsheets, **Powerpoint** for presentations, **Access** for databases, and **Project** for project management.

Presentations

- ***Vermont Yankee Decommissioning,*** New England Chapter of the Health Physics Society, May 2014.
- ***Science and Response to a Nuclear Reactor Accident,*** National Academies of Science, May 2014.
- ***Regional Rad/Nuc Exercises,*** Conference of Radiation Control Program Directors, May 2014
- ***Chemical and Biological Weapons***, Vermont Hazardous Materials Response Team, July 2013.
- ***The Vermont Dairy Air: Formaldehyde Use on Farms,*** National Environmental Health Association, July 2013.
- ***Public Health Response to an Improvised Nuclear Device.*** Vermont Emergency Medical Services Conference, Burlington, Vermont, October 2012.
- ***Public Health Response to an Improvised Nuclear Device.*** New England Radiological Health Conference, October 2012.
- ***Public Health Response to an Improvised Nuclear Device.*** Vermont Healthcare Preparedness Conference, Burlington, Vermont, June 2012.
- ***Tri-State Radiological Analysis of Fish.*** New England Radiological Health Conference, October 2012.
- ***Vermont Yankee Groundwater Protection and the 2010 Tritium Leak.*** Northeast Epidemiology Conference, October 2012.
- ***The CRCPD Radiological/Nuclear Emergency Toolbox for Response and Recovery for an RDD or IND.*** Conference of Radiation Control Program Directors, Orlando, Florida, May 2012.
- ***TMI, Chernobyl, Fukushima and their Impacts on Vermont Yankee.*** Vermont Emergency Preparedness Conference, Stowe, Vermont, November 2011.
- ***The Fukushima Reactor and Spent Fuel Pool Accidents.*** Vermont Healthcare Preparedness Conference, Stowe, Vermont, October 2011.
- ***Situational Awareness and Assessment.*** CDC Radiation Emergencies Bridging the Gaps Conference, Atlanta, Georgia, March 2011.
- ***Vermont Yankee Tritium Release.*** International Emergency Management Conference, Porsmouth, NH, December 2010.
- ***Vermont and Empire 09.*** The National Radiological Emergency Preparedness Conference, Chicago, Illinois, July 2009.
- ***The NERHC 2007 RDD Conference Exercise.*** Conference of Radiation Control Program Directors, Columbus, Georgia, May 2009.
- ***Radiological/Nuclear Emergency Response for EMS.*** Vermont Emergency Medical Services Conference, Burlington, Vermont, March 2009.
- ***The Health Physics of Radon.*** Vermont Radon Conference, Bolton, Vermont, January 2009.
- ***Radiological/Nuclear Emergency Response for Emergency Department Directors.*** Killington, Vermont, September 2007.
- ***Radio Frequency Radiation Risk from Base Stations in the Environment***. Hundreds of Presentations to communities in Massachusetts, Connecticut, Rhode Island, New Hampshire and New York; January 1993 to September 2004.
- ***Radio Frequency Radiation Risk - A Focus on Wireless Telephones***. Presentation to the Health Physics Society, Washington, DC, July 2004.

- ***Decommissioning of the Harvard Cyclotron***. Presentation to the Health Physics Society, Washington, DC, July 2004.
- ***Decommissioning of the Harvard Cyclotron***. Presentation to the New England Chapter of the Health Physics Society, Westford, MA, June 2003.
- ***Radon in the Home and Laser Safety***. Presentations for the Massachusetts Institute of Technology Independent Activities Period, 1995 - 2000.
- ***Radiation Safety***, for the Massachusetts Safety Council, Braintree, MA, December 2000.
- ***Laser Accidents at the Massachusetts Institute of Technology***. Presentation to the North American Campus Radiation Safety Officers, 17th Biennial CRSO Conference, July 1999.

Testimony

- Testimony before the Vermont Public Service Board relative to the granting of a Certificate of Public Good for the on Vermont Yankee Nuclear Power Station, June 2013.
- Testimony before Vermont Legislature on wind turbine sound, radiofrequency radiation from smart meters, Vermont Yankee Nuclear Power Station and radiological program funding from 2009 to present.
- Testimony on the physics and health impacts of wind turbine sound at the Vermont Public Service Board, February 2011.
- Testimony on the physics and health effects of electromagnetic field and radio frequency radiation sources:
    - In Massachusetts - Arlington, Barnstable, Billerica, Boston, Boxboro, Braintree, Brighton, Brookline, Bridgewater, Brookfield, Brookline, Burlington, Cambridge, Dedham, Dennis, Dorchester, Easton, Fairhaven, Fall River, Fitchburg, Gloucester, Grafton, Groton, Groveland, Hamilton, Hanson, Harvard, Harwich, Holliston, Hudson, Jamaica Plain, Lancaster, Lexington, Lincoln, Lynnfield, Mansfield, Marblehead, Marshfield, Mattapoisett, Maynard, Medfield, Methuen, Middleton, Millis, Nantucket, Needham, Newton, Norfolk, Northborough, North Dartmouth, Norton, Norwell, Ogunquit, Orleans, Oxford, Peabody, Plymouth, Provincetown, Quincy, Randolph, Reading, Revere, Rochester, Rockport, Saugus, Sharon, Scituate, Stoneham, Sudbury, Sutton, Swampscott, Tewksbury, Tisbury, Townsend, Waltham, Wellfleet, Westborough, Weston, West Roxbury, Westminster, Westwood, Weymouth, Winthrop, Worcester and Wrentham
    - In New Hampshire - Candia, Derry, Goffstown, Hollis, Hudson, Nashua, Sutton and Pelham
    - In New York - Duanesburg and Saratoga Springs
    - In Rhode Island - Barrington, Johnston, Portsmouth, Providence, Middletown, North Providence, North Smithfield, Smithfield, Warwick and Woonsocket.

Teaching Experience

- **Harvard University, 2001-September 2005, *Laser Safety*:** Two-hour course delivered to research faculty, students and staff on the physics of lasers, biological effects of lasers, engineering and administrative controls for laser safety.
- **Massachusetts Institute of Technology, 1992-2001, *Radiation Safety:*** Three-hour course to research students, faculty and staff on physics of radiation, biological effects of radiation, radiation detection methods, and radiation protection regulations. ***Laser Safety*:** Two-hour course delivered to research faculty, students and staff on the physics of lasers, biological effects of lasers, engineering and administrative controls for laser safety. ***Occupational and Environmental Law, Radiological Risk Management in High Technology Enterprise, Environmental Health and Safety Case Studies - The Microelectronics and Biotechnology Industries***; ***Comprehensive Environmental Health and Safety Program Design Projects***: Presentations for the MIT Independent Activities Period, 1999.
- **North Atlantic Energy Services, 1990-1992, *Team Building*:** As part of the overall management training program, this eight-hour course used a variety of tools to better understand people and how they might be motivated to become part of a highly successful team. ***Kepner-Tregoe Problem Solving and Decision Analysis:*** As part of the management Training Program, this 24-hour course presented a set of tools for systematic analysis of work situations leading to effective decisions and well-planned

strategies for work. ***Power Plant Fundamentals*:** Forty-hour course in mathematics, physics and chemistry fundamentals; nuclear fission; electrical power generation; plant systems and components; instrumentation and control; normal and emergency plant operations

- **Arizona Public Service, 1985-1990*, Nuclear Power Plant Operations*:** Forty-hour course as part of the engineering and chemistry training programs that presented power plant fundamentals, nuclear fission, reactor systems, startup, routine operations, and emergency operations. ***Plant Systems*:** Forty-hour course in all major systems of a nuclear power plant, including the nuclear reactor, steam generation, electricity generation and safety system components.

Educational Details

- **University of Massachusetts Lowell, Work Environment Engineering, Doctor of Science:** Doctoral courses in Biostatistics, Epidemiology, Ergonomics, Industrial Hygiene, Environmental Law, Occupational Law, Pollution Prevention, Cleaner Production and Healthy Work Organization Design. Research in occupational cancer policy, recombinant DNA health protection, radio frequency radiation risk and the Environmental Protection Agency. Dissertation: A risk assessment on wireless telephones.
- **University of Massachusetts, Lowell, Radiological Sciences, Master of Science:** Masters courses in Mathematical Methods, Radiochemistry, Internal Dosimetry, Radiation Shielding, Radiation Dosimetry and Radiation Safety and Control. Research thesis on Gamma Spectroscopy.
- **Southern New Hampshire University, Masters in Business Administration:** Graduate courses in Managerial Accounting, Finance, Statistics, Economics, Marketing, Management, Business Law, Strategic Analysis, Operations Management, Research Methods, Database Management, Information Engineering, Organizational Behavior and Computer Information Systems. Research in electric utility operations management.
- **Arizona State University, Business Administration:** Computer Information Systems, Managerial Statistics, Management, Managerial Marketing, Legal Environment of Business, Managerial Accounting, Financial management, Managerial Communications and Macro- and Micro-economics.
- **Old Dominion University, Physics:** Algebra, Trigonometry, Calculus and Chemistry.
- **Christopher Newport University, Bachelor of Arts in Philosophy and History:** In addition to the required curriculum for a bachelor's degree, courses in Logic, Ethics, Aesthetics, Epistemology, Metaphysics, Politics, Existentialism, and Chinese, Indian, and Greek Philosophy; American, European, Russian and Asian History. Thesis in Architectural History.