UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of:	)	Docket No. 50-255
	)	
Entergy Nuclear Operations, Inc.	)	
(Palisades Nuclear Plant)	)	
	)	December 1, 2014
Operating License Amendment Request	)	

DECLARATION OF ARNOLD GUNDERSEN

Under penalty of perjury, I, Arnold Gundersen, hereby declare as follows:

I. INTRODUCTION

1. My name is Arnold Gundersen. I am Chief Engineer for Fairewinds Associates, a paralegal services and expert witness firm. I have been retained by Beyond Nuclear to intervene in Docket No. 50-255.

2. As discussed below and demonstrated in my attached Curriculum Vitae, I am qualified by training and experience in the field of nuclear reactor engineering.

3. I earned my Bachelor Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude. I earned my Master Degree in Nuclear Engineering from RPI via an Atomic Energy Commission Fellowship. My area of study for my Master Degree in Nuclear Engineering was cooling tower operation and cooling tower plume theory.

4. My career as a reactor operator and instructor began in 1971, and prior to becoming a nuclear engineering consultant and expert witness, I progressed to the position of Senior Vice President for a nuclear licensee.

5. I have testified before the Nuclear Regulatory Commission (NRC) Atomic Safety and Licensing Board (ASLB) and Advisory Committee on Reactor Safeguards (ACRS), the State of Vermont Public Service Board, the State of Vermont Environmental Court, the Florida Public Service Commission, the State of New York Department of Environmental Conservation, and in Federal Court. I have also testified before the NRC's 2.206 Petition Review Board.

6. I am a chapter author of the first edition of the Department of Energy (DOE) Decommissioning Handbook, and the book entitled *Fukushima Daiichi: The Truth and the Way Forward*, Shueisha Publishing, 2012-2-17, Japan.

7. I have more than 42 years of professional nuclear engineering experience, including and not limited to: Nuclear Plant Operation, Nuclear Management, Nuclear Safety Assessments, Reliability Engineering, In-service Inspection, Criticality Analysis, Licensing, Engineering Management, Thermohydraulics, Structural Engineering Assessments, Nuclear Fuel Rack Design and Manufacturing, Nuclear Equipment Design and Manufacturing, Cooling Tower Operation, Cooling Tower Plumes, Consumptive Water Loss, Radioactive Waste Processes, Decommissioning, Waste Disposal, Prudency Defense, Employee Awareness Programs, Public Relations, Contract Administration, Technical Patents, Archival Storage and Document Control, Source Term Reconstruction, Dose Assessment, Whistleblower Protection, and NRC Regulations and Enforcement.

II **SUMMARY**

8. Designed and constructed by Combustion Engineering (CE), the Palisades nuclear power plant, which began operation in 1971, is one of the oldest reactors in the United States. According to the Westinghouse analysis[1], of the neutrons impinging upon the walls of the Palisades reactor, there must be no more than a 1 sigma (20%) variance between the analytical calculations and the physical capsule samples that are sometimes called coupons, are located within the reactor itself, and

[1] The Westinghouse Analysis is discussed in detail in the Significant Analytical Problems Section of this Declaration.

that are made of the same metal as the reactor vessel welds. Without pulling another embrittlement coupon from within the reactor, there can be no assurance that the serious embrittlement is not still occurring and outside the 1 sigma bounds required by the Westinghouse analysis. The current analysis cannot be substantiated because physical data is lacking to support any mathematical analysis. The last physical capsule coupon sample was withdrawn from within the reactor and analyzed more than 10 years ago. The reactor vessel at Palisades is the most important safety barrier to protect the public in the case of a design basis accident. It is impossible to ascertain the condition of the reactor vessel without analyzing the hard physical data by sampling the weld-based capsule coupon and doing a complete analysis. Continued operation of the Palisades nuclear power plant without analyzing the coupon designated to be sampled more than seven years ago means that Entergy may be operating Palisades as a *test* according to 10CFR50.59.

III HISTORY OF REACTOR EMBRITTLEMENT AT PALISADES

9. Designed and constructed by Combustion Engineering (CE), the Palisades nuclear power plant, began operation in 1971 making it one of the oldest operating reactors in the United States. It was the first large-scale commercial reactor vessel designed and fabricated by CE.

10. According to the NRC:

> Reactor pressure vessels, which contain the nuclear fuel in nuclear power plants, are made of thick steel plates that are welded together. Neutrons from the fuel in the reactor irradiate the vessel as the reactor is operated. This can embrittle the steel, or make it less tough, and less capable of withstanding flaws, which may be present. [2]

11. When CE first fabricated the Palisades reactor vessel during the mid-to-late 1960s, the metal used for welding the nuclear reactor pieces together contained metallic components, like copper, that are now considered unacceptable due to impurities that cause Neutron Embrittlement. These impurities were only one piece of the

[2] http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/prv.html

problem that has plagued the Palisades Nuclear Power Plant since its inception. The likelihood of nuclear reactor embrittlement and the importance of surveillance samples within the Palisades reactor cannot be traced solely to the impurity in its weld metal. Even prior to Palisades' start-up, the Atomic Energy Commission (AEC) identified other potentially serious problems[3]. On January 27, 1970, Joseph Hendrie, Chairman, Advisory Committee on Reactor Safeguards, wrote a letter to Glenn Seaborg, Chairman, U.S. Atomic Energy Commission, in which he said,

> ...The nuclear steam supply system for the Palisades Plant is the first of the Combustion Engineering line currently licensed for construction. A feature of the Palisades reactor is the omission of the thermal shield. Studies were made by the applicant to show that omission of the shield would not adversely affect the flow characteristics within the reactor vessel or alter the thermal stresses in the walls of the vessel in a manner detrimental to safe operation of the plant… Surveillance specimens in the vessel will be used to monitor the radiation damage during the life of the plant. If these specimens reveal changes that affect the safety of the plant, the reactor vessel will be annealed to reduce radiation damage effects. The results of annealing will be confirmed by tests on additional surveillance specimens provided for this purpose.

IV **NEUTRON EMBRITTLEMENT**

12. Neutron radiation reduces the strength of metallic materials as in the steel and the welds of the steel nuclear reactor vessel, which holds the nuclear fuel and therefore constitutes the most important part of the nuclear reactor. The nuclear chain reaction inside the reactor that is created to generate energy from high-energy electrons also creates neutrons that impinge upon the inner side of the steel reactor vessel damaging the metal at a nano level and leading to metal embrittlement of reactor vessels. This neutron bombardment weakens all the metal in the vessel, and especially the welds that are made from softer metals. Moreover, these metallic impurities in the welds lead to rapid degradation of the welds from the neutrons' bombardment creating the *neutron embrittlement* phenomena leaving a brittle

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[3] *Joseph M. Hendrie, Chairman, Advisory Committee on Reactor Safeguards, letter to Glenn T. Seaborg, Chairman, U.S. Atomic Energy Commission, "Report on Palisades Plant,"* January 27, 1970. (ML052720270, marked as "Exhibit 1A," pages 3 to 6 of 129 on PDF counter)

nuclear vessel at great risk of cracking. As detailed in the JOM (Journal of Metallurgy) article, *Embrittlement of Nuclear Reactor Pressure Vessels* by G.R. Odette and G.E. Lucas:

> Neutron irradiation embrittlement could limit the service life of some of the reactor-pressure vessels in existing commercial nuclear-power plants. Improved understanding of the underlying causes of embrittlement has provided regulators and power-plant operators better estimates of vessel operating margins.[4]

13. By the early 1980s, even the NRC publicly identified the issue of nuclear reactor neutron embrittlement as so serious that the *New York Times* wrote a special story on the issue, entitled: *Steel Turned Brittle By Radiation Called A Peril At 13 Nuclear Plants*.[5]

> **HARTFORD, Sept. 26—** The thick steel shells … 12 other reactors around the country are being turned brittle by radiation so rapidly, nuclear regulatory officials say, that some of the plants may become unsafe to operate by the end of next year.
>
> Utilities and the Nuclear Regulatory Commission are trying to determine the gravity of the problem, but commission staff members say it is certain that at least some of the plants will need substantial repairs. One high-ranking staff member said that to assure safety, some reactors might have to be modified or shut down by the end of next year.
>
> "On the information available today, I would start to say we'd get very nervous after another year or so," said the staff member, Dr. Thomas Murley, director of safety technology.

14. Less than a decade after the Palisades nuclear reactor began operating, the first capsule samples began indicating severe embrittlement. These metallic capsule samples were put in place in order to determine whether or not neutron bombardment within the nuclear reactor was damaging and embrittling the steel vessel and its welds.

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[4] Light Water Reactors: Overview: *Embrittlement of Nuclear Reactor Pressure Vessels*, G.R. Odette and G.E. Lucas, JOM, 53 (7) (2001), pp. 18-22 http://www.tms.org/pubs/journals/jom/0107/odette-0107.html

[5] *Steel Turned Brittle By Radiation Called A Peril At 13 Nuclear Plants*, Matthew L. Wald, Special to the New York Times, September 27, 1981

15. During the last 33 years since that first national warning was issued by the NRC about severe embrittlement, only one nuclear reactor, Yankee Rowe, was permanently shutdown as a result of it becoming unsafe due to embrittlement. Of greatest concern is the fact that the NRC has acknowledged as recently as March of 2013 that Palisades Nuclear Power Plant is now one of the worst and most severely embrittled reactors in the country, and yet it is still allowed to operate. The NRC stated, "During the March 19 webinar, it was stated that Palisades is "one of the most embrittled plants"." [6]

16. When the Rowe nuclear power plant was permanently closed, the nuclear industry and its regulators were presented with the incredible opportunity to actually test an embrittled vessel and thereby strengthen the accuracy of the analytical underpinnings of embrittlement analysis. Unfortunately, the nuclear industry and its regulators did not avail themselves of the opportunity to conduct accurate destructive tests on portions of the Rowe reactor, and the vessel was decommissioned without being tested. The industry's choice not to collect Rowe embrittlement data has left the Palisades reactor as one of the most damaged in the nation. By its continued operation as an embrittlement experiment, likely in violation of 10 CFR 50.59, the Palisades nuclear plant has become the symbol of a regulator-endorsed national test attempting to determine how long a damaged vessel can continue to operate without failing and having a major radiation release to the highly populated areas surrounding the plant.

17. Thus far, the industry has not created any method by which it can directly measure the neutron bombardment to the wall of the nuclear reactor other than to sample the coupons of metal welds put inside each vessel when it is manufactured. These capsule coupons were designed to be removed periodically, so that each one may be subjected to destructive testing in order to directly measure the vessel's level of embrittlement. There were 8 coupons installed originally, and 2 supplements added later. Of the 8 original coupons, 4 have been removed and tested. The 2

[6] NRC Statement http://pbadupws.nrc.gov/docs/ML1310/ML13108A336.pdf

supplements have also been removed and tested.[7] Four capsules remain available for testing.

18. According to the NRC, the most recent capsule sample was removed in 2003[8].

> The last two capsules removed from Palisades were capsule SA-240-1 (removed in 2000) and capsule W-100 (removed in 2003).

19. Rather than perform the appropriate metallurgical embrittlement tests, Rowe chose to shut down. Palisades has chosen a different tact, to mathematically analyze its embrittlement rather than perform additional metallurgical measurements and tests. Because the Palisades Nuclear Power Plant is operating with such severe embrittlement and has refused to test its remaining capsules [coupons], it appears to be operating in a *test or experimental capacity*.

20. According to the evidentiary data in this case, four samples currently remain within the Palisades reactor vessel[9]. However, since license renewal approval, Palisades requested and the:

> NRC approved a schedule change which left an additional capsule in the reactor pressure vessel (RPV) which would have been removed in 2007. Therefore there are three capsules in the RPV which can be used to determine properties of neutron irradiation. One capsule is scheduled to be removed during the period of extended operation, and this is tentatively scheduled around 2019. In addition to the capsules used to determine properties of neutron irradiation, one thermal capsule is also in the vessel which can measure thermal exposure effects on the metal, and is available for future use. So there are currently a total of four capsules in the RPV.[10]

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[7] http://pbadupws.nrc.gov/docs/ML1204/ML12040A315.pdf, Footnotes 77-80 pertain to Palisades, on p.81/94. **December 11, 2011**: EPRI Final Report, "Materials...PWR Coordinated RVSP [Reactor Vessel Material Surveillance Program]." See Palisades on Pages 38 to 39 of 94 on PDF counter, including Table 6-40, Palisades Current [Surveillance Capsule] Withdrawal Schedule."

[8] http://pbadupws.nrc.gov/docs/ML1310/ML13108A336.pdf

[9] http://pbadupws.nrc.gov/docs/ML1310/ML13108A336.pdf

[10] Ibid

21. Almost half of the initial capsules [coupon samples] installed 43 years ago still remain inside the embrittled nuclear reactor. The next scheduled coupon removal has been postponed until 2019. If the NRC continues to allow Entergy to postpone the Palisades sampling until 2019, then no accurate current assessment of Palisades' severe embrittlement condition exists. Astonishingly, it will be 16 years since the last sample was reviewed and analyzed if Palisades adheres to the 2019 removal date.

22. Using an incredible display of circular logic, on June 5, 2014, NRC Chair Macfarlane was asked why Palisades had not removed more surveillance samples to determine the severity of the embrittlement. The Chair deferred to the staff, which answered that no additional samples had been withdrawn because if samples were withdrawn, there would be no more remaining samples to withdraw![11] Rather than confirming these estimates with physical testing of actual samples that have been continuously irradiated during the last 43 years of operation, the NRC prefers to defer to the calculational predictions created by Palisades.

23. Moreover, the NRC first claimed it was "very nervous" about vessel embrittlement more than 30 years ago. In spite of these legitimate concerns, the NRC continues to allow Entergy to operate its Palisades Nuclear Power Plant in a compromised and *test condition*. This old and compromised reactor vessel continues to operate well outside the bounds of its design and fabrication without any modifications to the severely embrittled reactor pressure vessel. Instead of maintaining safety parameters during the last three decades, even in the aftermath of five nuclear meltdowns, the NRC has allowed Palisades to make unrealistic, unsupported and imprudent safety calculations based on little more than probabilistic risk, rather than real scientific analysis of hard data that is available inside the Palisades reactor.

24. Three factors have been created by Entergy and accepted by the NRC that specifically allow Palisades to continue to generate electricity:

[11] See the affidavit of three eyewitnesses attached to this motion.

24.1 The configuration of the fuel in the reactor core has been changed to allegedly reduce the number of neutrons impinging the wall of the nuclear reactor vessel. It is possible that these changes may be reducing the number of new neutrons now damaging the reactor pressure vessel welds and therefore these changes are not disputed in this affidavit, but there is no doubt that impingement, while reduced, is still occurring. Had Palisades installed a thermal shield when it became operational, these core changes would have been unnecessary.

24.2 The NRC has allowed Palisades to compare itself to reactors of disparate designs from other vendors, built in different years and operating at diverse power levels.

24.3 In an effort to save money and continue to operate the Palisades Nuclear Power Plant, its owners have claimed that new analytical techniques and regulations make it safe to continue to operate Palisades. In actuality, these recently developed techniques have reduced the margin of safety at Palisades from that originally designed and licensed to safety standards meant to protect public health and safety. These analytical changes continue to reframe embrittlement calculations, so that just as one technique begins to indicate vessel failure might be imminent creating a Pressurized Thermal Shock (PTS) accident, the plant's engineers develop a new analytic methodology that claims that Palisades' embrittlement is not as severe as indicated. This newly created methodology becomes the new standard applied to the Palisades embrittlement problem so that the compromised plant may still operate.

25. As a result of these changed analytical assumptions and the physical changes Entergy has made to the Palisades' reactor core, the transition temperature between ductile and brittle metallic conditions caused by 43 years of neutron bombardment has been increased from 200ºF to in excess of 270ºF. While in 1981, calculations made under postulated Pressurized Thermal Shock (PTS) accident conditions showed that the reactor vessel would shatter at temperatures in excess of 200ºF,

these newly created methodologies have enabled Palisades to operate well beyond the original design limits and clearly reduced the original margin of safety.

V SIMILAR PLANT [AKA: SISTER PLANT] COMPARISONS

26. As the 811 MWe Palisades NPP[12] approached the end of its original 40 year life, Palisades filed for a license renewal that would allow the Palisades plant to operate for 20 more years. While the issue of Neutron Embrittlement was discussed by regulators at that time and was a significant concern for citizens living in proximity to the plant, the NRC ignored the problem at Palisades, by allowing Entergy to compare Palisades to other similar plants, sometimes called *sister plants,* that thus far have not exhibited significant signs of reactor metal embrittlement. To date, an exhaustive review of NRC regulations has not unveiled any regulations that allow for such comparisons, and no record of scientific validation of such methodology.

27. H. B. Robinson 2, a 724 MWe plant that began operation in 1971[13], and Indian Point 2 and 3, two 1,024 and 1,041 MWe [14] reactors that began operation in 1974 and 1976, are the nuclear plants that the NRC has considered *similar sister plants* and has therefore allowed Entergy to compare these reactor vessels at these plants with the aged and embrittled Palisades reactor vessel. The technological problem with comparing the two Indian Point reactors and H.B. Robinson with the Palisades NPP, is that the chosen plants are *very dissimilar*. The Palisades vessel was designed and constructed by Combustion Engineering while the other three aforementioned reactor vessels at H. B. Robinson and Indian Point are a Westinghouse design. While it is true that the material used to weld the reactor plates together to create the reactor vessel is similar among the four plants, the dramatically different nuclear core design and operational power characteristics make an accurate comparison impossible. The difference between the Westinghouse nuclear cores and the Combustion Engineering nuclear core impacts

[12] http://www.entergy-nuclear.com/plant_information/palisades.aspx
[13] http://www.duke-energy.com/power-plants/nuclear/robinson.asp
[14] http://www.entergy-nuclear.com/plant_information/indian_point.aspx

the neutron flux on each reactor vessel, thus making an accurate comparison of neutron bombardment and embrittlement impossible.

28. By allowing Entergy to make this comparison between so-called similar sister-plants, the NRC is allowing Entergy to significantly dilute Palisades' embrittlement calculations. Paradoxically, while the NRC is allowing the comparison among Palisades' allegedly similar sister plants it has not thus far required H. B. Robinson Unit 2 or the two Indian Point plants to assess their embrittlement potential by incorporating the Palisades data.

29. Entergy has claimed that the Palisades plant has similar metallurgical characteristics in its welds to the three other aforementioned plants, and those similar sister plants have thus far shown relatively little embrittlement, unlike Palisades. Entergy then extrapolates this data to claim that therefore Palisades is safe to continue operating. This rogue comparative data is not sound scientific methodology and clearly places the operations of the Palisades NPP in the experimental test venue, possibly as delineated in 10CFR50.59.

VI **SIGNIFICANT ANALYTICAL PROBLEMS**

30. When comparing similar sister plants, the most significant analytical problem is the extraordinary difficulty comparing data from four separate plants while still maintaining one standard deviation (1σ) or 20% between all the data. According to the *Palisades Reactor Pressure Vessel Fluence Evaluation*, one standard deviation is required, however there has never been a discussion of how this was achieved between the four sister units:[15]

> During the first 14 operating fuel cycles at the Palisades plant, five sets of in-vessel surveillance capsule dosimetry and three sets of ex-vessel dosimetry were irradiated, withdrawn, and analyzed. The results of these dosimetry evaluations provide a measurement data base that can be used to demonstrate that the neutron fluence calculations completed for the

[15] ML14316A207, *Attachment 4, Westinghouse, WCAP-15353 – Supplement 2 – NP, Revision 0, Palisades Reactor Pressure Vessel Fluence Evaluation,* July 2011.

> Palisades reactor meet the uncertainty requirements described in Regulatory Guide 1.190.[6] That is, the calculations and measurements should agree within 20% at the 1σ level.

31. I note that Westinghouse states that "five sets of in-vessel surveillance capsule dosimetry…were irradiated, withdrawn, and analyzed"; yet the Dec. 11, 2011 EPRI document – cited previously says 4 sets, initially installed, and 2 supplemental sets, added later, or 6 sets have been analyzed. I cannot account for the discrepancy between the Westinghouse and EPRI data.

32. A 1σ analysis appears to be binding within the Palisades data. Moreover, the NRC lowers the bar when comparing data from similar sister plants that are included in Entergy's analysis of the Palisades reactor vessel without requiring the same 1σ variance with Palisades.

33. There can be no assurance that the 20% error band at Palisades encompasses the 20% error band at the Robinson or Indian Point plants. To compare this different data without assurance that the 1σ variance from each plant overlaps the other plants lacks scientific validity.

34. In addition to the problems associated with a 1σ analytical comparison, there is extraordinary variability between the neutron flux across the nuclear core in this Combustion Engineering reactor. For instance, Table 2.2-3 from the same WCAP report shows a flux variation of as much as 300% between the 45-degree segment and the 75-degree segment. It is mathematically implausible that a 20% deviation is possible when the neutron flux itself varies by 300%.

Table 2.2-3
Summary of Calculated Maximum Pressure Vessel Neutron Flux (E > 1.0 MeV)
For Cycles 15 through 21 and for Future Projection
Traditional Beltline Materials

Fuel Cycle	Cycle Time (EFPY)	Neutron (E > 1.0 MeV) Flux (n/cm²-s)			
		0 Deg.	15 Deg.	30 Deg.	45 Deg.
15	1.1	9.671E+09	1.572E+10	1.277E+10	7.924E+09
16	1.2	1.068E+10	1.614E+10	1.330E+10	7.797E+09
17	1.3	1.080E+10	1.875E+10	1.332E+10	7.613E+09
18	1.3	1.292E+10	2.102E+10	1.352E+10	7.337E+09
19	1.3	1.059E+10	1.940E+10	1.445E+10	7.037E+09
20	1.4	1.123E+10	2.021E+10	1.517E+10	8.143E+09
21	1.4	1.138E+10	2.032E+10	1.501E+10	8.506E+09
22	Projected	1.153E+10	2.024E+10	1.454E+10	7.756E+09
23+	Projected	1.138E+10	2.032E+10	1.501E+10	8.506E+09

Fuel Cycle	Cycle Time (EFPY)	Neutron (E > 1.0 MeV) Flux (n/cm²-s)			
		60 Deg.	75 Deg.	90 Deg.	
15	1.1	1.105E+10	1.679E+10	1.257E+10	
16	1.2	1.135E+10	1.761E+10	1.401E+10	
17	1.3	9.781E+09	1.968E+10	1.539E+10	
18	1.3	1.088E+10	2.236E+10	1.664E+10	
19	1.3	1.090E+10	2.232E+10	1.743E+10	
20	1.4	1.161E+10	2.197E+10	1.650E+10	
21	1.4	1.172E+10	2.152E+10	1.618E+10	
22	Projected	1.128E+10	2.204E+10	1.669E+10	
23+	Projected	1.172E+10	2.152E+10	1.618E+10	

35. Not only is there extraordinary variability with neutron flux, but also the neutron fluence in each portion of the nuclear core can be higher or lower in an unpredictable fashion between different fuel cycles. Table 2.2-4 of the same WCAP is illustrative. The 30, 45, and 60-degree segments show an increase in neutron fluence after the 18th cycle, while the 0, 15, 75 and 90-degree segments show a decrease in neutron fluence over time.

Table 2.2-4
Summary of Calculated Maximum Pressure Vessel Neutron Flux (E > 1.0 MeV)
For Cycles 15 through 21 and for Future Projection
Extended Beltline Materials

Fuel Cycle	Cycle Time (EFPY)	Neutron (E > 1.0 MeV) Flux (n/cm^2-s)			
		0 Deg.	15 Deg.	30 Deg.	45 Deg.
15	1.1	4.105E+08	6.613E+08	5.420E+08	3.363E+08
16	1.2	4.495E+08	6.751E+08	5.597E+08	3.281E+08
17	1.3	4.639E+08	7.990E+08	5.722E+08	3.270E+08
18	1.3	5.553E+08	9.001E+08	5.811E+08	3.154E+08
19	1.3	4.652E+08	8.452E+08	6.347E+08	3.091E+08
20	1.4	4.956E+08	8.844E+08	6.695E+08	3.594E+08
21	1.4	4.830E+08	8.625E+08	6.370E+08	3.610E+08
22	Projected	4.913E+08	8.624E+08	6.200E+08	3.315E+08
23+	Projected	4.830E+08	8.625E+08	6.370E+08	3.610E+08

Fuel Cycle	Cycle Time (EFPY)	Neutron (E > 1.0 MeV) Flux (n/cm^2-s)			
		60 Deg.	75 Deg.	90 Deg.	
15	1.1	4.690E+08	7.135E+08	5.336E+08	
16	1.2	4.777E+08	7.415E+08	5.896E+08	
17	1.3	4.201E+08	8.449E+08	6.611E+08	
18	1.3	4.677E+08	9.607E+08	7.152E+08	
19	1.3	4.788E+08	9.796E+08	7.657E+08	
20	1.4	5.124E+08	9.700E+08	7.282E+08	
21	1.4	4.975E+08	9.136E+08	6.868E+08	
22	Projected	4.811E+08	9.384E+08	7.102E+08	
23+	Projected	4.975E+08	9.136E+08	6.868E+08	

36. This extraordinary neutron variability occurs within the Palisades nuclear reactor itself. If this variability exists within the Combustion Engineer reactor core, it is reasonable to question the variability in the Westinghouse cores of the purported similar sister units. The net effect is that while 1σ accuracy within the Palisades reactor may be attainable, comparing other reactors and expecting common 1σ variations is impossible.

37. Even though Westinghouse demands fluence accuracy of 20%, documentation available in ADAMS for Palisades shows that this level of accuracy is impossible to achieve.[16]

> Section 4.3 Calculational Uncertainty
> **A number of factors contribute to the uncertainty in the projected peak fast fluence at the reactor vessel wall.** These factors are due to the conversion of measured activity data to fluxes, **uncertainties in material composition,** neutron cross sections, power distributions, **as-built core/vessel dimensions and cycle-by-cycle variation in the fast flux lead factors. An uncertainty of [plus or minus] 25% is estimated in the calculated vessel wall fluence,** typical of current neutron transport methodology uncertainties...] **(Emphases Added)**

38. An accurate prediction of exactly where the fluence reaches its highest level is critical to embrittlement calculations at Palisades. While fluence at the 0 degree location appears to be decreasing according to Westinghouse, fluence is increasing at the 30-degree location. This is important because the limiting vessel welds are at these specific locations. Palisades' data in the ADAMS database indicates that

> Accumulated fast fluence distributions at the end of Cycle 9 and EOL at the clad-base metal interface is shown in Figure 4.4. Based upon Reg. Guide 1.99, Revision 2, fluence limits corresponding to base metal, axial, and circumferential welds are also presented in Figure 4.4. From this figure it can be noted that **the fluence values at the axial welds at 0 [degrees] and 30 [degrees] are limiting the life of the Palisades reactor pressure vessel.**
>
> Table 4.2 summarizes the cycle specific fluence...and accumulated fast fluence at the clad-base metal interface for each of Cycles 1 through 9. For the selected azimuthal locations: 0º (axial weld location), 17º (maximum of peak at base metal), 30º (axial weld location) and 45º, effective full power years...for each cycle and the accumulated EFPY's are also presented. Table 4.3 provides **the fluence limit violation dates with Cycle 9 fluence rates for plant operations beyond the end of Cycle 8 date of September, 1990.**][17] **[Emphasis Added]**

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[16] pbadupws.nrc.gov/docs/ML0527/ML052720270.pdf, May 17, 1990

[17] pbadupws.nrc.gov/docs/ML0527/ML052720270.pdf, page 33, first and second paragraphs

39. In my opinion, if Palisades installed a thermal shield when it became operational, the issues related to embrittlement would not have occurred. The Westinghouse Analysis delineates that a 20% variation is mandatory, yet the effective fluence variability can be as high as 300%; therefore, the analytical data does not support relicensure without destructive testing and complete embrittlement analysis of additional capsule samples.

40. In at least one case, Palisades was allowed to ignore the scientifically acceptable 1σ variation identified by Westinghouse (above).

> That is, the calculations and measurements should agree within 20% at the 1σ level.

41. Despite this 1σ requirement, on February 28, 1984, the NRC authorized deletion of sample SA-60-1 from consideration because its measured neutron value exceeded this 1σ variation [18].

> As of October 31, 1982, the licensee indicates that Capsule A-60 had accumulated approximately $8.7x10^{18}$ n/cm2 (E>1MeV) neutron fluence. Since the neutron fluence accumulated by the Capsule is significantly greater than the predicted EOL fluence for the Palisades reactor vessel and Capsule A-240 has provided material properties that can be utilized to predict the EOL material properties of the Palisades reactor vessel, Capsule A-60 will provide no useful fracture toughness data and may be deleted from the surveillance program.

42. Simply put, this particular sample was discarded precisely because it gave an answer that would have required Palisades to be shut down. It follows that the analytical basis for continuing operation is distorted, and since specific sample data has been disregarded, Entergy may be putting the public at risk by operating Palisades under unsafe conditions.

[18] https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML020800206 Page: 8 of 9 on PDF counter.

VII NEW AMENDMENTS TO THE PALISADES LICENSE

43. Evidently the licensing framework that the NRC is applying to allow Palisades to continue to operate until 2017 includes both non-conservative analytical changes and mathematically dubious comparisons to allegedly similar sister reactor vessels. As Palisades' neutron embrittlement dilemma continues to worsen as the plant ages, Palisades has repeatedly requested life extensions. The table below is illustrative of how embrittlement problems have been ignored and deferred for decades by Palisades' management.

44. **Palisades Embrittlement End of Life Chronology**

Document Name	Document Date	Projected EOL Date
Report by Palisades Engineering Department[19]	May 1990	September 2001
Inside NRC[20]	December 12, 1994	Downward revision from 2004 to1999
Generic Letter 1992-001, Supplement 1[21]	May 19, 1995	Late 1999
License Renewal Application[22]	March 22, 2005	2014
Palisades Letter To NRC[23]	December 20, 2010	April 2017
Palisades Letter To NRC[24]	June 25, 2013	August 2017
Palisades Letter To NRC[25]	July 29, 2014	Change analytical Approach to extend even further

[19] *Analysis Of The Reactor Pressure Vessel Fast Neutron Fluence And Pressurized Thermal Shock ... For The Palisades Nuclear Plant*, May 1990 Performed by the Reactor Engineering Department Palisades Nuclear Plant Consumers Power Company, page 4 "With flux reduction incorporated in Cycle 9 and beyond, the PTS limit would be exceeded at the axial welds again, but not until about September, 2001. These predicted dates are far short of the assumed nominal plant operating license expiration date of March 2011."

[20] *Inside NRC* on December 12, 1994 "As recently as October 28th [1994], when NRC staff issued Secy 94-267, "Status of Reactor Pressure Vessel Issues," the agency projected that Palisades would reach its PTS screening criteria in 2004. On November 18 [1994], Consumers Power submitted a revised evaluation of the PTS issue that indicated the vessel would reach the critical level in 1999."

[21] *Recent NRC Staff Evaluations of RPV Structural Integrity Data for PTS Events* https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML031070449, Excerpt p. 3 of 9
"The staff issued a safety evaluation report to the licensee for Palisades on the variability of reactor vessel weld properties for the Palisades reactor vessel on April 12, 1995 [Ref. 2]. The staff agreed with the licensee's best estimate analysis of the chemical composition of the reactor vessel welds and concluded that continued operation through Cycle 14 (late 1999) was acceptable. As discussed previously, while performing the evaluation, the staff noted larger variability in the chemical composition of the welds compared to that assumed for the development of the PTS rule. The staff evaluated the implications of this larger variability on the PTS rule generic margins for the Palisades vessel using the same analytic methods as those used in formulating the rule. The staff has reviewed the other PWR vessels and, based upon currently available information, believes that the Palisades vessel will reach the PTS screening criteria by late 1999, before any other PWR."

[22] ML050940429

[23] ML110060692

[24] ML13176A412

[25] ML14211A524

45. Now, juxtaposed against this industry unique background of deteriorating embrittlement conditions within the Palisades reactor, the aged plant requests two more license amendments:

    45.4 Disturbingly, one of these amendments proposes a significant analytical deviation from the regulatory requirements of 10CFR50.61 to §50.61a (Alternate Fracture Toughness Requirements). This newest amendment request once again introduces further non-conservative analytical assumptions into the troubled calculational history of Palisades 43 operational years.[26]

    45.5 On top of the aforementioned analytical deviation is an even more alarming License Amendment Request (LAR) containing an equivalent margins evaluation that was only recently released from the public document room, even though the document was filed more than four months ago in July 2014. Once again, Entergy's Palisades NPP is seeking NRC approval for another untried methodological approach to measure the neutron bombardment induced reactor vessel embrittlement in such a manner, that the Palisades NPP could continue to operate under additional relaxed measurement conditions.[27]

46. A License Amendment Request (LAR) is a serious request for any operating nuclear power plant because it seeks to assure the public that if these changes are made the plant will still retain and operate within its safety margins and be as safe as it was before the changes were implemented. From the evidence reviewed, it appears that this specific LAR is required because prior evaluations suggest that three portions of the nuclear reactor vessel will not meet the NRC required 50 ft-lb ductility stress limit. It also appears, from the five documents attached to the LAR, that Westinghouse has reanalyzed and manipulated the Palisades data so that the final calculations keep the reactor vessel within the regulatory acceptable range above the minimum 50 ft-lb ductility stress limit.

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[26] ML14211A524
[27] ML14316A370

47. Finally, the evidence I reviewed in the five attachments to the LAR, suggests that Entergy may have chosen not to apply the Westinghouse reanalysis because that analysis would not allow Entergy to operate the Palisades NPP in the manner it wished. As a result, Entergy submitted what it calls an equivalent margin analysis to show that even in the portions of the nuclear reactor that did not meet the NRC minimum required 50 ft-lb ductility stress limit, the reactor will still provide sufficient safety margins for continued operation of the Palisades Nuclear Power Plant.

VIII TEST OR EXPERIMENT

48. The latest equivalent margins evaluation is a red flag indicating that the reactor vessel at Palisades is operating in more uncharted territory than imagined. Basically, Entergy is proposing to operate its Palisades NPP well outside the norm by proposing to reanalyze the deteriorating metallurgical conditions without using the readily available physical samples that are designed specifically for this purpose.

49. Even before these two new proposed amendments to its license, the NRC is already on record telling the Advisory Committee on Reactor Safeguards (ACRS) that Palisades is "special".[28] According to the transcript:

> Member Banerjee: Yes, but I mean what is special about Palisades? That's what I was going to ask.
>
> Mr. Kirk: Well, there are so many things that are special about Palisades.

50. The problems identified by the need for an equivalent margins analysis in conjunction with Palisades' long history of metallurgical concerns proves that continued operation in the future will be on an experimental basis. Clearly the "special" condition of the Palisades reactor and its ranking as one of the most

[28] ACRS subcommittee meeting of Metallurgy and Reactor Fuels, October 16, 2014 transcript, ML14296A342, Page 30 [31 of 168 on PDF counter].

embrittled reactors in the United States qualify its continued operation as a test. Therefore, it appears that these newly proposed changes to the Palisades license and possibly to the statutory definition of "experiment" within 10CFR50.59 will trigger the requirement for additional public scrutiny in the form of a public licensing process

IX **ALTERNATIVE TO AN ANALYTICAL LICENSE CHANGE**

As the Palisades NPP continues to amend its operating license by reanalyzing the projected end of life for its compromised and embrittled reactor vessel, extrapolation beyond 2014 is problematic and potentially dangerous. It has been more than a decade since an actual sample was removed from inside the Palisades nuclear reactor vessel, so there is no physical data to benchmark the analysis described in 10CFR50.61 and in 10CFR50.61(a). Even the NRC has acknowledged that its 50.61(a) models require validation in order to provide assurance of safe operation at Palisades[29].

> As far as weakening NRC safety regulations by approving the alternate rule, 10 CFR 50.61a: as was mentioned during the webinar, this alternate rule is justified by an improved state of both theoretical and ***practical knowledge***, more accurate models, and ***model validation***. (**Emphasis Added**)

51. Validating the analytical models by testing additional samples gives Entergy and the NRC Regulators a methodology by which to assure the public that Palisades' continued operation in its embrittled condition does not jeopardize public health and safety. Abundant capsule coupon samples remain inside the reactor and should be removed and tested rather than the Entergy proposal of a license change based only upon an extrapolated analysis.

[29] http://pbadupws.nrc.gov/docs/ML1310/ML13108A336.pdf

X CONCLUSION

52. In any scientific and engineering analysis, both the analysis and hard field data must be linked. At Palisades, more than a decade has transpired since the last capsule coupon was removed and analyzed, so it is impossible to assure that the new analysis proposed by Palisades meets the 1σ requirement without removing at least one capsule coupon and performing the requisite destructive testing.

53. The NRC would seem to agree that using all possible samples is important to an accurate outcome. According to the October 16, 2014 meeting notes [November 6, 2014 transcript] of the ACRS:[30]

> …the vehicle for doing that is doing a statistical comparison of a particular reactor's ***plant specific surveillance data*** with the general trends. ***(Emphasis Added)***

54. Until a new capsule sample is removed and analyzed, the analytical assumptions created for the proposed license amendment are unable to be validated and verified. In my professional opinion, the NRC should not approve any change to Palisades' operating license without such validation and verification.

55. In order to protect public health and safety, the Code of Federal Regulations is the governing document for the operation of all US nuclear power reactors. Palisades' record is clear. Analysis is no replacement for testing the capsule coupon. Quite simply, operating the Palisades nuclear reactor without the removal and analysis of a capsule sample for almost two decades (2003 to 2019 is 16 years**)** seems to qualify the operation of the Palisades NPP as a *Test or Experiment* under 10CFR50.59. A License Amendment Request that seeks to extend the life of an already severely embrittled reactor should be considered a *Test or Experiment* triggering a full evaluation and full public participation in the license amendment process including full public License Amendment Hearings and careful analysis shared in a public forum.

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[30] http://pbadupws.nrc.gov/docs/ML1432/ML14321A542.pdf, page 20, [Page 22 of 268 via PDF].

Under penalty of perjury, I declare that the foregoing statements of fact are true and correct to the best of my knowledge and that the foregoing statements of my opinion are based on my best professional judgment.

(Electronically signed pursuant to 10 C.F.R. §304(d)(1))

_____

Arnold Gundersen, MENE, RO
Fairewinds Associates, Inc
Burlington, Vermont 05401
Date: December 1, 2014

CURRICULUM VITAE
Arnold Gundersen
Chief Engineer, Fairewinds Associates, Inc
December 1, 2014

Education and Training

ME NE Master of Engineering Nuclear Engineering
Rensselaer Polytechnic Institute, 1972
U.S. Atomic Energy Commission Fellowship
Thesis: Cooling Tower Plume Rise

BS NE Bachelor of Science Nuclear Engineering
Rensselaer Polytechnic Institute, Cum Laude, 1971
James J. Kerrigan Scholar

RO Licensed Reactor Operator, U.S. Atomic Energy Commission,
License # OP-3014

Qualifications – including and not limited to:

- Chief Engineer, Fairewinds Associates, Inc
- Nuclear Engineering, Safety, and Reliability Expert
- Federal and Congressional hearing testimony and Expert Witness testimony
- Former Senior Vice President Nuclear Licensee
- Former Licensed Reactor Operator
- Atomic Energy Commission Fellow
- 44-years of nuclear industry experience and oversight
    - Nuclear engineering management assessment and prudency assessment
    - Nuclear power plant licensing and permitting – assessment and review
    - Nuclear safety assessments, source term reconstructions, dose assessments, criticality analysis, and thermohydraulics
    - Contract administration, assessment and review
    - Systems engineering and structural engineering assessments
    - Cooling tower operation, cooling tower plumes, thermal discharge assessment, and consumptive water use
    - Technical patents, nuclear fuel rack design and manufacturing, and nuclear equipment design and manufacturing
    - Radioactive waste processes, storage issue assessment, waste disposal and decommissioning experience
    - Reliability engineering and aging plant management assessments, in-service inspection
    - Employee awareness programs, whistleblower protection, and public communications
    - Quality Assurance (QA) & records

Publications

Published Lecture — *The Lessons of the Fukushima Daiichi Nuclear Accident* published in the *International Symposium on the Truth of Fukushima Nuclear Accident and the Myth of Nuclear Safety,* August 30, 2012 University of Tokyo, Iwanami Shoten Publishers, Tokyo, Japan

Author — *The Echo Chamber: Regulatory Capture and the Fukushima Daiichi Disaster, Lessons From Fukushima,* February 27, 2012, Greenpeace International

Co-author — *Fukushima Daiichi: Truth And The Way Forward,* Shueisha Publishing, February 17, 2012, Tokyo, Japan.
Co-author — *Fairewinds Associates 2009-2010 Summary to JFC, July 26, 2010* State of Vermont, Joint Fiscal Office, (http://www.leg.state.vt.us/jfo/envy.aspx).
Co-author — *Supplemental Report of the Public Oversight Panel Regarding the Comprehensive Reliability Assessment of the Vermont Yankee Nuclear Power Plant July 20, 2010,* to the Vermont State Legislature by the Vermont Yankee Public Oversight Panel.
Co-author — The Second Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding buried pipe and tank issues at Entergy Nuclear Vermont Yankee and Entergy proposed Enexus spinoff. See two reports: *Fairewinds Associates 2nd Quarterly Report to JFC* and *Enexus Review by Fairewinds Associates.*
Author — Fairewinds Associates, Inc *First Quarterly Report to the Joint Legislative Committee*, October 19, 2009.
Co-author — *Report of the Public Oversight Panel Regarding the Comprehensive Reliability Assessment of the Vermont Yankee Nuclear Power Plant*, March 17, 2009, to the Vermont State Legislature by the Vermont Yankee Public Oversight Panel.
Co-author — *Vermont Yankee Comprehensive Vertical Audit – VYCVA – Recommended Methodology to Thoroughly Assess Reliability and Safety Issues at Entergy Nuclear Vermont Yankee, January 30, 2008 Testimony to Finance Committee Vermont Senate.*
Co-author — *Decommissioning Vermont Yankee – Stage 2 Analysis of the Vermont Yankee Decommissioning Fund – The Decommissioning Fund Gap*, December 2007, Fairewinds Associates, Inc. Presented to Vermont State Senators and Legislators.
Co-author — *Decommissioning the Vermont Yankee Nuclear Power Plant: An Analysis of Vermont Yankee's Decommissioning Fund and Its Projected Decommissioning Costs*, November 2007, Fairewinds Associates, Inc.
Co-author — *DOE Decommissioning Handbook, First Edition*, 1981-1982, invited author.

Patents
Energy Absorbing Turbine Missile Shield – U.S. Patent # 4,397,608 – 8/9/1983

Honors
U.S. Atomic Energy Commission Fellowship, 1972
B.S. Degree, Cum Laude, RPI, 1971, 1st in nuclear engineering class
Tau Beta Pi (Engineering Honor Society), RPI, 1969 – 1 of 5 in sophomore class of 700
James J. Kerrigan Scholar 1967–1971
Teacher of the Year – 2000, Marvelwood School
Publicly commended to U.S. Senate by NRC Chairman, Ivan Selin, in May 1993 – "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service."

Committee Memberships
Member Board of Directors of Fairewinds Energy Education Corp, 501(c)3
Vermont Yankee Public Oversight Panel, appointed 2008 by President Pro-Tem Vermont Senate
National Nuclear Safety Network – Founding Board Member
Three Rivers Community College – Nuclear Academic Advisory Board
Connecticut Low Level Radioactive Waste Advisory Committee – 10 years, founding member
Radiation Safety Committee, NRC Licensee – founding member
ANSI N-198, Solid Radioactive Waste Processing Systems

Expert Witness Testimony and Nuclear Engineering Analysis and Consulting

NRC Before the Commission – November 6, 2014, *Second Supplemental Declaration Of Arnold Gundersen*, In the Matter of Florida Power & Light Co., Docket No. 50-389, St. Lucie Plant, Unit 2.

NRC Atomic Safety and Licensing Board (ASLB) – October 10, 2014 –Diablo Canyon Nuclear Power Plant, Units 2 and 3 –, *Gundersen Affidavit Supporting Friends Of The Earth's Petition To Intervene*: In the matter of Pacific Gas & Electric Company Docket No. 50-275-LR & Docket No. 50-323-LR, License Renewal Application.

NRC Hearing Request – March 10, 2014 – *Declaration Of Arnold Gundersen Supporting Hearing Request* – retained by Southern Alliance For Clean Energy (SACE) in the matter of Florida Power & Light Co., Docket No. 50-389, St. Lucie Plant, Unit 2

NRC ASLB Proceeding Fermi Unit 3 52-033-COL – October 30, 2013 – Retained by Don't Waste Michigan, Beyond Nuclear et al, Oral Expert Witness Testimony regarding Contention 15: Quality Assurance.

State of Utah Seventh District Court of Emory County – September 25, 2013 – Retained by HEAL Utah et al as an expert witness testifying on cooling tower consumptive use of water for a proposed nuclear power plant owned by Blue Castle Holdings and located on the Green River. Defendants were Kane County Water Conservancy District.

Canadian Nuclear Safety Commission – May 29-30, 2013 – Retained by Durham Nuclear Awareness to present expert witness testimony in hearings regarding the proposed life extension for the Pickering Nuclear Station owned Ontario Power Generation.

Nuclear Regulatory Commission – May 30, 2013 – Expert witness report Before The Secretary NRC *In the Matter of Detroit Edison Nuclear Power Station: Rebuttal Testimony Of Arnold Gundersen Supporting Of Intervenors' Contention 15: DTE COLA Lacks Statutorily Required Cohesive QA Program.* Retained by Don't Waste Michigan, Beyond Nuclear et al.

Nuclear Regulatory Commission – May 20, 2013 – Expert witness report Before The Secretary NRC *In the Matter of Davis Besse Nuclear Power Station: Expert Witness Report Of Arnold Gundersen To Support The Petition For Leave To Intervene And Request For Hearing By Beyond Nuclear, Citizens Environment Alliance Southwest Ontario Canada, Don't Waste Michigan, and The Sierra Club.* Retained by Beyond Nuclear, Citizens Environment Alliance Southwest Ontario Canada, Don't Waste Michigan, and The Sierra Club.

Nuclear Regulatory Commission – May 6, 2013 – Expert witness report Before The Secretary NRC: *Expert Witness Report Of Arnold Gundersen To Support The Petition For Leave To Intervene And Request For Hearing By The Blue Ridge Environmental Defense League, Bellefonte Efficiency And Sustainability Team, And Mothers Against Tennessee River Radiation.* Retained by BREDL et al.

Nuclear Regulatory Commission – April 30, 2013 – Expert witness report to Atomic Safety and Licensing Board: *Testimony Of Arnold Gundersen Supporting Of Intervenors Contention 15: DTE Cola Lacks Statutorily Required Cohesive QA Program.* Retained by Don't Waste Michigan, Beyond Nuclear et al.

Canadian Nuclear Safety Commission (CNSC) – April 29, 2013 – Expert witness report to Canadian Nuclear Safety Commission (CNSC): ***Analysis Of The Relicensing Application For Pickering Nuclear Generating Station*. Retained by Durham Nuclear Awareness.**

Nuclear Regulatory Commission – January 16, 2013 – Expert witness presentation to NRC Petition Review Board: 2.206 Presentation San Onofre Units 2 and 3 Replacement Steam Generators Meeting With Petitioner Friends Of The Earth, Requesting Enforcement Action Against Southern California Edison Under 10 CFR 2.206

Expert Witness Report For Friends Of The Earth – July 11, 2012 – San Onofre's Steam Generators: Significantly Worse Thank All Others Nationwide, Fairewinds Associates, Inc

Expert Witness Report For Friends Of The Earth – May 15, 2012 – *San Onofre's Steam Generator Failures Could Have Been Prevented*, Fairewinds Associates, Inc

Expert Witness Report For Friends Of The Earth – April 10, 2012 – *San Onofre Cascading Steam Generator Failures Created By Edison: Imprudent Design And Fabrication Decisions Caused Leaks,* Fairewinds Associates, Inc

Expert Witness Report For Friends Of The Earth – March 27, 2012 – *Steam Generator Failures At San Onofre: The Need For A Thorough Root Cause Analysis Requires No Early Restart,* Fairewinds Associates, Inc

Expert Witness Report For Greenpeace – February 27, 2012 – *Lessons From Fukushima: The Echo Chamber Effect,* Fairewinds Associates, Inc

Nuclear Regulatory Commission – December 21, 2011 – Expert witness report to Atomic Safety and Licensing Board: *Prefiled Direct Testimony of Arnold Gundersen Regarding Consolidated Contention RK-EC-3/CW-EC-1 (Spent Fuel Pool Leaks)*

New York State Department Of Environmental Conservation – November 15-16, 2011 – Expert witness report for Riverkeeper: hearing testimony regarding license extension application for Indian Point Units 2 and 3 – contention: tritium in the groundwater.

Nuclear Regulatory Commission – November 10, 2011 – Expert witness report entitled: *Fukushima and the Westinghouse-Toshiba AP1000, A Report for the AP1000 Oversight Group by Fairewinds Associates, Inc,* and Video. Submitted to NRC by the AP1000 Oversight Group.

Nuclear Regulatory Commission – October 7, 2011 – *Testimony to the NRC Petition Review Board Re: Mark 1 Boiling Water Reactors*, Petition for NRC to shut down all BWR Mark 1 nuclear power plants due to problems in containment integrity in the Mark 1 design.

New York State Department Of Environmental Conservation – October 4, 2011 – *Prefiled Rebuttal Testimony Of Arnold Gundersen On Behalf Of Petitioners Riverkeeper, Inc., Scenic Hudson, Inc., And Natural Resources Defense Council, Inc. To The Direct Testimony Of Matthew J. Barvenik (Senior Principal GZA Geoenvironmental, Inc.) Regarding Radiological Materials*

Southern Alliance for Clean Energy (SACE) submission to TVA Board of Directors – August 3, 2011– Expert witness report entitled: *The Risks of Reviving TVA's Bellefonte Project,* and Video prepared for the Southern Alliance for Clean Energy (SACE).

New York State Department Of Environmental Conservation, July 22, 2011 – Prefiled Direct Testimony Of Arnold Gundersen On Behalf Of Petitioners Riverkeeper, Inc., Scenic Hudson, Inc., And Natural Resources Defense Council, Inc. Regarding Radiological Materials

Nuclear Regulatory Commission – May 10, 2011 – *Comment to the proposed rule on the AP1000 Design Certification Amendment Docket ID NRC-2010-0131 As noticed in the Federal Register on February 24, 2011* Retained by Friends of the Earth as Expert Witness.

Nuclear Regulatory Commission – May 10, 2011 – *Comment to the proposed rule on the AP1000 Design Certification Amendment Docket ID NRC-2010-0131 As noticed in the Federal Register on February 24, 2011* Retained by Friends of the Earth as Expert Witness.

NRC Advisory Committee on Reactor Safeguards (ACRS) – May 26, 2011 – Lessons learned from Fukushima and Containment Integrity on the AP1000.

Vermont Energy Cooperative (VEC) – April 26, 2011 – Presentation to the Vermont Energy Cooperative Board of Directors, *Vermont Yankee – Is It Reliable for 20 more years?*

Vermont State Nuclear Advisory Panel (VSNAP) – February 22, 2011 – Testimony and presentation entitled the *Vermont Yankee Public Oversight Panel Supplemental Report* regarding management issues at the Vermont Yankee Nuclear Power Plant to the reconvened Vermont State Nuclear Advisory Panel.

Vermont State Legislature Senate Committee On Natural Resources And Energy – February 8, 2011. Testimony: *Vermont Yankee Leaks and Implications*. (http://www.leg.state.vt.us/jfo/envy.aspx)

Vermont State Legislature – January 26, 2011 – House Committee On Natural Resources And Energy, and Senate Committee On Natural Resources And Energy – Testimony regarding Fairewinds Associates, Inc's report: *Decommissioning the Vermont Yankee Nuclear Power Plant and Storing Its Radioactive Waste* (http://www.leg.state.vt.us/jfo/envy.aspx). Additional testimony was also given regarding the newest radioactive isotopic leak at the Vermont Yankee nuclear power plant.

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – *Decommissioning the Vermont Yankee Nuclear Power Plant and Storing Its Radioactive Waste* January 2011. (http://www.leg.state.vt.us/jfo/envy.aspx).

U.S. Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards (NRC-ACRS) AP1000 Sub-Committee – *Nuclear Containment Failures: Ramifications for the AP1000 Containment Design,* Supplemental Report submitted December 21, 2010. (http://fairewinds.com/reports)

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – *Reliability Oversight Entergy Nuclear Vermont Yankee, December 6, 2010.* Discussion regarding the leaks at Vermont Yankee and the ongoing monitoring of those leaks and ENVY's progress addressing the 90-items identified in Act 189 that require remediation. (http://www.leg.state.vt.us/jfo/envy.aspx).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – *Declaration Of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contention Regarding Consumptive Water Use At Dominion Power's Newly Proposed North Anna Unit 3 Pressurized Water Reactor* in the matter of Dominion Virginia Power North Anna Power Station Unit 3 Docket No. 52-017 Combined License Application ASLBP#08-863-01-COL, October 2, 2010.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – *Declaration Of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's New Contention Regarding AP1000 Containment Integrity On The Vogtle Nuclear Power Plant Units 3 And 4* in the matter of the Southern Nuclear Operating Company Vogtle Electric Generating Plant, Units 3&4 Combined License Application, Docket Nos. 52-025-COL and 52-026-COL and ASLB No. 09-873-01-COL-BD01, August 13, 2010.

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – July 26, 2010 – Summation for 2009 to 2010 Legislative Year For the Joint Fiscal Committee Reliability Oversight Entergy Nuclear Vermont Yankee (ENVY) Fairewinds Associates 2009-2010. This summary includes an assessment of ENVY's progress (as of July 1, 2010) toward meeting the milestones outlined by the Act 189 Vermont Yankee Public Oversight Panel in its March 2009 report to the Legislature, the new milestones that have been added since the incident with the tritium leak and buried underground pipes, and the new reliability challenges facing ENVY, Entergy, and the State of Vermont. (http://www.leg.state.vt.us/jfo/envy.aspx)

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – *Declaration Of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions* in the matter of Dominion Virginia Power North Anna Station Unit 3 Combined License Application, Docket No. 52-017, ASLBP#08-863-01-COL, July 23, 2010.

Florida Public Service Commission (FPSC)
Licensing and construction delays due to problems with the newly designed Westinghouse AP1000 reactors in *Direct Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy (SACE)*, FPSC Docket No. 100009-EI, July 8, 2010.

U.S. Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards (NRC-ACRS) AP1000 Sub-Committee – Presentation to ACRS regarding design flaw in AP1000 Containment – June 25, 2010 Power Point Presentation: http://fairewinds.com/content/ap1000-nuclear-design-flaw-addressed-to-nrc-acrs.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – *Second Declaration Of Arnold Gundersen Supporting Supplemental Petition Of Intervenors Contention 15: DTE COLA Lacks Statutorily Required Cohesive QA Program* – June 8, 2010.

NRC Chairman Gregory Jaczko, ACRS, Secretary of Energy Chu, and the White House Office of Management and Budget – *AP1000 Containment Leakage Report Fairewinds Associates - Gundersen, Hausler, 4-21-2010.* This report, commissioned by the AP1000 Oversight Group, analyzes a potential flaw in the containment of the AP1000 reactor design.

Vermont State Legislature House Committee On Natural Resources And Energy – April 5, 2010 – Testified to the House Committee On Natural Resources And Energy – regarding discrepancies in Entergy's TLG Services decommissioning analysis. See *Fairewinds Cost Comparison TLG Decommissioning* (http://www.leg.state.vt.us/jfo/envy.aspx).

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – February 22, 2010 − The Second Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding buried pipe and tank issues at Entergy Nuclear Vermont Yankee and Entergy proposed Enexus spinoff. See two reports: *Fairewinds Associates 2nd Quarterly Report to JFC* and *Enexus Review by Fairewinds Associates*. (http://www.leg.state.vt.us/jfo/envy.aspx).

Vermont State Legislature Senate Natural Resources – February 16, 2010 – Testified to Senate Natural Resources Committee regarding causes and severity of tritium leak in unreported buried underground pipes, status of Enexus spinoff proposal, and health effects of tritium.

Vermont State Legislature Senate Natural Resources – February 10, 2010 – Testified to Senate Natural Resources Committee regarding causes and severity of tritium leak in unreported buried underground pipes. http://www.youtube.com/watch?v=36HJiBrJSxE

Vermont State Legislature Senate Finance – February 10, 2010 – Testified to Senate Finance Committee regarding *A Chronicle of Issues Regarding Buried Tanks and Underground Piping at VT Yankee.* (http://www.leg.state.vt.us/jfo/envy.aspx).

Vermont State Legislature House Committee On Natural Resources And Energy – January 27, 2010 – *A Chronicle of Issues Regarding Buried Tanks and Underground Piping at VT Yankee*. (http://www.leg.state.vt.us/jfo/envy.aspx).

Submittal to Susquehanna River Basin Commission, by Eric Epstein – January 5, 2010 – *Expert Witness Report Of Arnold Gundersen Regarding Consumptive Water Use Of The Susquehanna River By The Proposed PPL Bell Bend Nuclear Power Plant* In the Matter of RE: Bell Bend Nuclear Power Plant Application for Groundwater Withdrawal Application for Consumptive Use BNP-2009-073.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – *Declaration of Arnold Gundersen Supporting Supplemental Petition of Intervenors Contention 15: Detroit Edison COLA Lacks Statutorily Required Cohesive QA Program*, December 8, 2009.

U.S. NRC Region III Allegation Filed by Missouri Coalition for the Environment – Expert Witness Report entitled: *Comments on the Callaway Special Inspection by NRC Regarding the May 25, 2009 Failure of its Auxiliary Feedwater System,* November 9, 2009.

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – Oral testimony given to the Vermont State Legislature Joint Fiscal Committee October 28, 2009. See report: *Quarterly Status Report - ENVY Reliability Oversight for JFO* (http://www.leg.state.vt.us/jfo/envy.aspx).

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee − The First Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding reliability issues at Entergy Nuclear Vermont Yankee, issued October 19, 2009. See report: *Quarterly Status Report - ENVY Reliability Oversight for JFO* (http://www.leg.state.vt.us/jfo/envy.aspx).

Florida Public Service Commission (FPSC) − Gave direct oral testimony to the FPSC in hearings in Tallahassee, FL, September 8 and 10, 2009 in support of Southern Alliance for Clean Energy (SACE) contention of anticipated licensing and construction delays in newly designed Westinghouse AP 1000 reactors proposed by Progress Energy Florida and Florida Power and Light (FPL).

Florida Public Service Commission (FPSC) – NRC announced delays confirming my original testimony to FPSC detailed below. My supplemental testimony alerted FPSC to NRC confirmation of my original testimony regarding licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Supplemental Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy*, FPSC Docket No. 090009-EI, August 12, 2009.

Florida Public Service Commission (FPSC) − Licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Direct Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy (SACE)*, FPSC Docket No. 090009-EI, July 15, 2009.

Vermont State Legislature Joint Fiscal Committee Expert Witness Oversight Role for Entergy Nuclear Vermont Yankee (ENVY) – Appointment from July 2009 to May 2010. Contracted by the Joint Fiscal Committee of the Vermont State Legislature as an expert witness to oversee the compliance of ENVY to reliability issues uncovered during the 2009 legislative session by the

Vermont Yankee Public Oversight Panel of which I was appointed a member along with former NRC Commissioner Peter Bradford for one year from July 2008 to 2009. At the time, Entergy Nuclear Vermont Yankee (ENVY) was under review by Vermont State Legislature to determine if it should receive a Certificate for Public Good (CPG) to extend its operational license for another 20-years. Vermont was the only state in the country that had legislatively created the CPG authorization for a nuclear power plant. Act 160 was passed to ascertain ENVY's ability to run reliably for an additional 20 years.

U.S. Nuclear Regulatory Commission – Expert Witness Declaration regarding Combined Operating License Application (COLA) at North Anna Unit 3 *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions* (June 26, 2009).

U.S. Nuclear Regulatory Commission – Expert Witness Declaration regarding Through-wall Penetration of Containment Liner and Inspection Techniques of the Containment Liner at Beaver Valley Unit 1 Nuclear Power Plant *Declaration of Arnold Gundersen Supporting Citizen Power's Petition* (May 25, 2009).

U.S. Nuclear Regulatory Commission – Expert Witness Declaration regarding Quality Assurance and Configuration Management at Bellefonte Nuclear Plant *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions in their Petition for Intervention and Request for Hearing*, May 6, 2009.

Pennsylvania Statehouse – Expert Witness Analysis presented in formal presentation at the Pennsylvania Statehouse, March 26, 2009 regarding actual releases from Three Mile Island Nuclear Accident. Presentation may be found at: http://www.tmia.com/march26

Vermont Legislative Testimony and Formal Report for 2009 Legislative Session – As a member of the Vermont Yankee Public Oversight Panel, I spent almost eight months examining the Vermont Yankee Nuclear Power Plant and the legislatively ordered Comprehensive Vertical Audit. Panel submitted Act 189 Public Oversight Panel Report March 17, 2009 and oral testimony to a joint hearing of the Senate Finance and House Committee On Natural Resources And Energy March 19, 2009. http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm

Finestone v Florida Power & Light Company (FPL) (11/2003 to 12/2008) Federal Court – Plaintiffs' Expert Witness in United States District Court for the Southern District of Florida. Retained by Plaintiffs' Attorney Nancy LaVista, from Lytal, Reiter, Fountain, Clark, Williams, West Palm Beach, FL. Case# 06-11132-E. This case involved two plaintiffs in cancer cluster of 42 families alleging that illegal radiation releases from nearby nuclear power plant caused children's cancers. Production request, discovery review, preparation of deposition questions and attendance at Defendant's experts for deposition, preparation of expert witness testimony, preparation for Daubert Hearings, ongoing technical oversight, source term reconstruction and appeal to Circuit Court.

U.S. Nuclear Regulatory Commission Advisory Committee Reactor Safeguards (NRC-ACRS) – Expert Witness providing oral testimony regarding Millstone Point Unit 3 (MP3) Containment issues in hearings regarding the Application to Uprate Power at MP3 by Dominion Nuclear, Washington, and DC. (July 8-9, 2008).

Appointed by President Pro-Tem of Vermont Senate Shumlin (now Vermont Governor Shumlin) to Legislatively Authorized Nuclear Reliability Public Oversight Panel – To oversee Comprehensive Vertical Audit of Entergy Nuclear Vermont Yankee (Act 189) and testify to State Legislature during 2009 session regarding operational reliability of ENVY in relation to its 20-year license extension application. (July 2, 2008 to present).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – Expert Witness providing testimony regarding *Pilgrim Watch's Petition for Contention 1 Underground Pipes* (April 10, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – Expert Witness supporting *Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions Against Dominion Nuclear Connecticut Inc.'s Millstone Power Station Unit 3 License Amendment Request For Stretch Power Uprate* (March 15, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – Expert Witness supporting *Pilgrim Watch's Petition For Contention 1*: *specific to issues regarding the integrity of Pilgrim Nuclear Power Station's underground pipes and the ability of Pilgrim's Aging Management Program to determine their integrity*. (January 26, 2008).

Vermont State House – 2008 Legislative Session –

- House Committee on Natural Resources and Energy – Comprehensive Vertical Audit: *Why NRC Recommends a Vertical Audit for Aging Plants Like Entergy Nuclear Vermont Yankee (ENVY)*
- House Committee on Commerce – Decommissioning Testimony

Vermont State Senate – 2008 Legislative Session –

- Senate Finance – testimony regarding Entergy Nuclear Vermont Yankee Decommissioning Fund
- Senate Finance – testimony on the necessity for a Comprehensive Vertical Audit (CVA) of Entergy Nuclear Vermont Yankee
- House Committee on Natural Resources and Energy – testimony regarding the placement of high-level nuclear fuel on the banks of the Connecticut River in Vernon, VT

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – MOX Limited Appearance Statement to Judges Michael C. Farrar (Chairman), Lawrence G. McDade, and Nicholas G. Trikouros for the "Petitioners": Nuclear Watch South, the Blue Ridge Environmental Defense League, and Nuclear Information & Resource Service in support of *Contention 2: Accidental Release of Radionuclides, requesting a hearing concerning faulty accident consequence assessments made for the MOX plutonium fuel factory proposed for the Savannah River Site*. (September 14, 2007).

Appeal to the Vermont Supreme Court (March 2006 to 2007) – Expert Witness Testimony in support of *New England Coalition's Appeal to the Vermont Supreme Court Concerning:*

Degraded Reliability at Entergy Nuclear Vermont Yankee as a Result of the Power Uprate. New England Coalition represented by Attorney Ron Shems of Burlington, VT.

State of Vermont Environmental Court (Docket 89-4-06-vtec 2007) – Expert witness retained by New England Coalition to review Entergy and Vermont Yankee's analysis of alternative methods to reduce the heat discharged by Vermont Yankee into the Connecticut River. Provided Vermont's Environmental Court with analysis of alternative methods systematically applied throughout the nuclear industry to reduce the heat discharged by nuclear power plants into nearby bodies of water and avoid consumptive water use. This report included a review of the condenser and cooling tower modifications.

U.S. Senator Bernie Sanders and Congressman Peter Welch (2007) – Briefed Senator Sanders, Congressman Welch and their staff members regarding technical and engineering issues, reliability and aging management concerns, regulatory compliance, waste storage, and nuclear power reactor safety issues confronting the U.S. nuclear energy industry.

State of Vermont Legislative Testimony to Senate Finance Committee (2006) – Testimony to the Senate Finance Committee regarding Vermont Yankee decommissioning costs, reliability issues, design life of the plant, and emergency planning issues.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB) – Expert witness retained by New England Coalition to provide Atomic Safety and Licensing Board with an independent analysis of the integrity of the Vermont Yankee Nuclear Power Plant condenser (2006).

U.S. Senators Jeffords and Leahy (2003 to 2005) – Provided the Senators and their staffs with periodic overview regarding technical, reliability, compliance, and safety issues at Entergy Nuclear Vermont Yankee (ENVY).

10CFR 2.206 filed with the Nuclear Regulatory Commission (July 2004) – Filed 10CFR 2.206 petition with NRC requesting confirmation of Vermont Yankee's compliance with General Design Criteria.

State of Vermont Public Service Board (April 2003 to May 2004) – Expert witness retained by New England Coalition to testify to the Public Service Board on the reliability, safety, technical, and financial ramifications of a proposed increase in power (called an uprate) to 120% at Entergy's 31-year-old Vermont Yankee Nuclear Power Plant.

International Nuclear Safety Testimony – Ten Days advising the President of the Czech Republic (Vaclav Havel) and the Czech Parliament on their energy policy for the 21st century.

Nuclear Regulatory Commission (NRC) Inspector General (IG) – Assisted the NRC Inspector General in investigating illegal gratuities paid to NRC Officials by Nuclear Energy Services (NES) Corporate Officers. In a second investigation, assisted the Inspector General in showing that material false statements (lies) by NES corporate president caused the NRC to overlook important violations by this licensee.

State of Connecticut Legislature – Assisted in the creation of State of Connecticut Whistleblower Protection legal statutes.

Federal Congressional Testimony –

- Publicly recognized by NRC Chairman, Ivan Selin, in May 1993 in his comments to U.S. Senate, "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service."
- Commended by U.S. Senator John Glenn, Chair NRC Oversight Committee for public – for testimony to NRC Oversight Committee

PennCentral Litigation – Evaluated NRC license violations and material false statements made by management of this nuclear engineering and materials licensee.

Three Mile Island Litigation – Evaluated unmonitored releases to the environment after accident, including containment breach, letdown system and blowout. Proved releases were 15 times higher than government estimate and subsequent government report.

Western Atlas Litigation – Evaluated neutron exposure to employees and license violations at this nuclear materials licensee.

Commonwealth Edison – In depth review and analysis for Commonwealth Edison to analyze the efficiency and effectiveness of all Commonwealth Edison engineering organizations, which support the operation of all of its nuclear power plants.

Peach Bottom Reactor Litigation – Evaluated extended 28-month outage caused by management breakdown and deteriorating condition of plant.

Presentations & Media

- *Should Nuclear Energy be Expanded to Help Create a More Sustainable Future?* Invited guest speaker in Debate at Hofstra University, November 20, 2014
- *Radiation Knows No Borders* – August 2, 2014, Invited speaker at The Wave Conference, Life Chiropractic West, San Francisco, CA
- *Thirty-five Years and Five Meltdowns Later: The Real Lessons of Three Mile Island* Three Mile Island at 35 (TMI@35) Symposium at Penn State – March 28, 2014 – Harrisburg, PA – Keynote Speaker
- *The Nuclear Renaissance? Is It Too Big To Fail?* November 20, 2013, University North Carolina, Chapel Hill, NC.
- *Speaking Truth to Power,* October 22, 1913 – Clarkson University, Potsdam, NY.
- *The United States At A Crossroads: Two Futures* – October 17 2013, Global Forum, Waitsfield, Vermont
- *A Road Less Taken*: *Energy Choices for the Future* – October 16, 2013, Johnson State College, Johnson, Vermont.
- *Fukushima: Ongoing Lessons for Boston* – October 9, 2013 – Boston, Massachusetts State House. Speakers were Arnie Gundersen, Former Japanese Prime Minister Naoto Kan,

Former NRC Chair Gregory Jaczko, Former NRC Commissioner Peter Bradford, and Massachusetts State Senator Dan Wolf.

- *Fukushima: Ongoing Lessons for New York* – October 8, 2013 – New York City 82nd Street YMCA. Speakers were Arnie Gundersen, Riverkeeper President Paul Galley, Former Japanese Prime Minister Naoto Kan, Former NRC Chair Gregory Jaczko, Former NRC Commissioner Peter Bradford, and Ralph Nader.
- *Fukushima: Ongoing Lessons for California* – June 4, 2013 – New York City 82nd Street YMCA. Speakers were Arnie Gundersen, Riverkeeper President Paul Galley, Former Japanese Prime Minister Naoto Kan, Former NRC Chair Gregory Jaczko, Former NRC Commissioner Peter Bradford, and Friends of the Earth Nuclear Campaigner Kendra Ulrich.
- *What Did They Know And When? Fukushima Daiichi Before And After The Meltdowns,* Symposium: The Medical and Ecological Consequences of the Fukushima Nuclear Accident, The New York Academy of Medicine, New York City, NY, March 11, 2013
- *A Mountain of Waste 70 Years High,* Presentation: Old *and New Reactors*, University of Chicago, December 1, 2012
- Congressional Briefing September 20, 2012; invited by Representative Dennis Kucinich
- Presentations in Japan August/September 2012: Presentation at University of Tokyo (August 30, 2012), Presentation at Japanese Diet Building (members of the Japanese Legislature - August 31, 2012), Presentation to citizen groups in Niigata (September 1, 2012), Presentations to citizen groups in Kyoto (September 4 , 2012), Presentation to Japanese Bar Association (September 2, 2012), and Presentation at the Tokyo Olympic Center (September 6, 2012)
- Multi-media Opera: *Curtain of Smoke,* by Filmmaker Karl Hoffman, Composer Andrea Molino, and Dramatist Guido Barbieri, Rome, Italy (2012-5-21,22)
- Curtain of Smoke Symposium (2012-5-21), with Dr. Sherri Ebadi 2004 Nobel Laureate
- The Italian National Press Club Rome (2012-5-21) with Dr. Sherri Ebadi 2004 Nobel Laureate: the relationship between nuclear power and nuclear weapons
- Radio 3 Rome (2012-5-21) Discussion of Three Mile Island and the triple meltdown at Fukushima Daiichi (Japan),
- Sierra Club Panel Discussions (2012-5-5): Consequences of Fukushima Daiichi with Paul Gunter and Waste Disposal with Mary Olson,
- Physicians for Social Responsibility Seattle (2012-3-17),
- Fukushima Daiichi Forum with Chiho Kaneko, Brattleboro, VT (2012-3-11),
- Physicians for Global Responsibility Vancouver (2012-3-11) Skype Video Lecture, University of Vermont (2 – 2011),
- Boston Nuclear Forum, Boston Library (6/16/11),
- Duxbury Emergency Management (6/15/11),
- Vermont State Nuclear Advisory Panel (VSNAP), Elder Education Enrichment,
- New Jersey Environmental Federation (5/14/11),
- Quaker Meeting House,
- Press Conference for Physicians for Social Responsibility (5/19/11),
- St. Johnsbury Academy – Nuclear Power 101.

Educational videos on nuclear safety, reliability and engineering particularly Fukushima issues.
Videos may be viewed @ fairewinds.org (501c3 non-profit)

Expert commentary (many more unnamed): CNN (8), The John King Show (16), BBC, CBC, Russia Today, Democracy Now, Al Jazeera America, KPBS (Radio & TV) VPR, WPTZ, WCAX, WBAI, CCTV, NECN, Pacifica Radio, CBC (radio & TV) (4), Rachel Maddow Show, *Washington Post*, *New York Times*, *Tampa Bay Times, The Guardian*, *Bloomberg* (print & TV), *Reuters*, *Associated Press*, *The Global Post*, *Miami Herald*, *Orange County Times, LA Times, Al Jazeera* (print)*, The Tennessean*, The Chris Martinson Show, *Mainichi News*, TBS Japan, *Gendai Magazine*, NHK television, *Scientific American*. *Huffington Post* (Paris) named Fairewinds.com the best go to site for information about the Fukushima Daiichi accident (5/9/11).

Special Remediation Expertise:

Director of Engineering, Vice President of Site Engineering, and the Senior Vice President of Engineering at Nuclear Energy Services (NES) Division of Penn Central Corporation (PCC)

- NES was a nuclear licensee that specialized in dismantlement and remediation of nuclear facilities and nuclear sites. Member of the radiation safety committee for this licensee.
- Department of Energy chose NES to write *DOE Decommissioning Handbook* because NES had a unique breadth and depth of nuclear engineers and nuclear physicists on staff.
- Personally wrote the "Small Bore Piping" chapter of the DOE's first edition Decommissioning Handbook, personnel on my staff authored other sections, and I reviewed the entire Decommissioning Handbook.
- Served on the Connecticut Low Level Radioactive Waste Advisory Committee for 10 years from its inception.
- Managed groups performing analyses on dozens of dismantlement sites to thoroughly remove radioactive material from nuclear plants and their surrounding environment.
- Managed groups assisting in decommissioning the Shippingport nuclear power reactor. Shippingport was the first large nuclear power plant ever decommissioned. The decommissioning of Shippingport included remediation of the site after decommissioning.
- Managed groups conducting site characterizations (preliminary radiation surveys prior to commencement of removal of radiation) at the radioactively contaminated West Valley site in upstate New York.
- Personnel reporting to me assessed dismantlement of the Princeton Avenue Plutonium Lab in New Brunswick, NJ. The lab's dismantlement assessment was stopped when we uncovered extremely toxic and carcinogenic underground radioactive contamination.
- Personnel reporting to me worked on decontaminating radioactive thorium at the Cleveland Avenue nuclear licensee in Ohio. The thorium had been used as an alloy in turbine blades. During that project, previously undetected extremely toxic and carcinogenic radioactive contamination was discovered below ground after an aboveground gamma survey had purported that no residual radiation remained on site.

Additional Education

Basic Mediation Certificate Champlain College, Woodbury Institute
28-hour Basic Mediation Training September 2010

Teaching and Academic Administration Experience

Rensselaer Polytechnic Institute (RPI) – Advanced Nuclear Reactor Physics Lab
Community College of Vermont – Mathematics Professor – 2007 through Spring 2013

Burlington High School
Mathematics Teacher – 2001 to June 2008
Physics Teacher – 2004 to 2006
The Marvelwood School – 1996 to 2000
Awarded Teacher of the Year – June 2000
Chairperson: Physics and Math Department
Mathematics and Physics Teacher, Faculty Council Member
Director of Marvelwood Residential Summer School
Director of Residential Life
The Forman School & St. Margaret's School – 1993 to 1995
Physics and Mathematics Teacher, Tennis Coach, Residential Living Faculty Member

Nuclear Engineering 1970 to Present
Expert witness testimony in nuclear litigation and administrative hearings in federal, international, and state court and to Nuclear Regulatory Commission, including but not limited to: Three Mile Island, US Federal Court, US NRC, NRC ASLB, ACRS, and Petition Review Board, Canadian Nuclear Safety Commission, Diet (Parliament) Japan, Vermont State Legislature, Vermont State Public Service Board, Florida Public Service Board, Czech Senate, Connecticut State Legislature, Western Atlas Nuclear Litigation, U.S. Senate Nuclear Safety Hearings, Peach Bottom Nuclear Power Plant Litigation, and Office of the Inspector General NRC, and numerous Congressional Briefings and Hearings.

Nuclear Engineering, Safety, and Reliability Expert Witness 1990 to Present
- Fairewinds Associates, Inc – Chief Engineer, 2005 to Present
- Arnold Gundersen, Nuclear Safety Consultant and Energy Advisor, 1995 to 2005
- GMA – 1990 to 1995, including expert witness testimony regarding the accident at Three Mile Island.

Nuclear Energy Services, Division of PCC (Fortune 500 company) 1979 to 1990
Corporate Officer and Senior Vice President - Technical Services – Responsible for overall performance of the company's Inservice Inspection (ASME XI), Quality Assurance (SNTC 1A), and Staff Augmentation Business Units – up to 300 employees at various nuclear sites.

Senior Vice President of Engineering – Responsible for the overall performance of the company's Site Engineering, Boston Design Engineering and Engineered Products Business Units. Integrated the Danbury based, Boston based and site engineering functions to provide products such as fuel racks, nozzle dams, and transfer mechanisms and services such as materials management and procedure development.

Vice President of Engineering Services – Responsible for the overall performance of the company's field engineering, operations engineering, and engineered products services. Integrated the Danbury-based and field-based engineering functions to provide numerous products and services required by nuclear utilities, including patents for engineered products.

General Manager of Field Engineering – Managed and directed NES' multi-disciplined field engineering staff on location at various nuclear plant sites. Site activities included structural

analysis, procedure development, technical specifications and training. Have personally applied for and received one patent.

Director of General Engineering – Managed and directed the Danbury based engineering staff. Staff disciplines included structural, nuclear, mechanical and systems engineering. Responsible for assignment of personnel as well as scheduling, cost performance, and technical assessment by staff on assigned projects. This staff provided major engineering support to the company's nuclear waste management, spent fuel storage racks, and engineering consulting programs.

New York State Electric and Gas Corporation (NYSE&G) — 1976 to 1979

Reliability Engineering Supervisor – Organized and supervised reliability engineers to upgrade performance levels on seven operating coal units and one that was under construction. Applied analytical techniques and good engineering judgments to improve capacity factors by reducing mean time to repair and by increasing mean time between failures.

Lead Power Systems Engineer – Supervised the preparation of proposals, bid evaluation, negotiation and administration of contracts for two 1300 MW NSSS Units including nuclear fuel, and solid-state control rooms. Represented corporation at numerous public forums including TV and radio on sensitive utility issues. Responsible for all nuclear and BOP portions of a PSAR, Environmental Report, and Early Site Review.

Northeast Utilities Service Corporation (NU) — 1972 to 1976

Engineer – Nuclear Engineer assigned to Millstone Unit 2 during start-up phase. Lead the high velocity flush and chemical cleaning of condensate and feedwater systems and obtained discharge permit for chemicals. Developed Quality Assurance Category 1 Material, Equipment and Parts List. Modified fuel pool cooling system at Connecticut Yankee, steam generator blowdown system and diesel generator lube oil system for Millstone. Evaluated Technical Specification Change Requests.

Associate Engineer – Nuclear Engineer assigned to Montague Units 1 & 2. Interface Engineer with NSSS vendor, performed containment leak rate analysis, assisted in preparation of PSAR and performed radiological health analysis of plant. Performed environmental radiation survey of Connecticut Yankee. Performed chloride intrusion transient analysis for Millstone Unit 1 feedwater system. Prepared Millstone Unit 1 off-gas modification licensing document and Environmental Report Amendments 1 & 2.

Rensselaer Polytechnic Institute (RPI) — 1971 to 1972

Critical Facility Reactor Operator, Instructor – Licensed AEC Reactor Operator instructing students and utility reactor operator trainees in start-up through full power operation of a reactor.

Public Service Electric and Gas (PSE&G) — 1970

Assistant Engineer – Performed shielding design of radwaste and auxiliary buildings for Newbold Island Units 1 & 2, including development of computer codes.

Media

Featured Nuclear Safety and Reliability Expert (1990 to present) for Television, Newspaper, Radio, & Internet – Including, and not limited to: CNN: JohnKingUSA, CNN News, Earth Matters; DemocracyNow, NECN, WPTZ VT, WTNH, VPTV, WCAX, RT, CTV (Canada), CCTV Burlington, VT, ABC, TBS/Japan, Bloomberg: EnergyNow, KPBS, Japan National Press Club (Tokyo), Italy National Press Club (Rome), The Crusaders, Front Page, Five O'Clock Shadow: Robert Knight, Mark Johnson Show, Steve West Show, Anthony Polina Show, WKVT, WDEV, WVPR, WZBG CT, Seven Days, AP News Service, Houston Chronicle, Christian Science Monitor, Reuters, The Global Post, International Herald, The Guardian, New York Times, Washington Post, LA Times, Miami Herald, St. Petersburg Times, Brattleboro Reformer, Rutland Herald, Times-Argus, Burlington Free Press, Litchfield County Times, The News Times, The New Milford Times, Hartford Current, New London Day, Vermont Daily Briefing, Green Mountain Daily, EcoReview, Huffington Post, DailyKos, Voice of Orange County, AlterNet, Common Dreams, and numerous other national and international blogs

Public Service, Cultural, and Community Activities

2009 to Present –Fairewinds Energy Education Corp 501(C)3 non-profit board member

2005 to Present – Public presentations and panel discussions on nuclear safety and reliability at University of Vermont, Vermont Law School, NRC hearings, Town and City Select Boards, Legal Panels, Local Schools, Television, and Radio.

2007-2008 – Created Concept of Solar Panels on Burlington High School; worked with Burlington Electric Department and Burlington Board of Education Technology Committee on Grant for installation of solar collectors for Burlington Electric peak summer use

Vermont State Legislature – Public Testimony to Legislative Committees

Certified Foster Parent State of Vermont – 2004 to 2007

Mentoring former students – 2000 to present – college application and employment application questions and encouragement

Tutoring Refugee Students – 2002 to 2006 – Lost Boys of the Sudan and others from educationally disadvantaged immigrant groups

Designed and Taught Special High School Math Course for ESOL Students – 2007 to 2008

NNSN – National Nuclear Safety Network, Founding Advisory Board Member, meetings with and testimony to the Nuclear Regulatory Commission Inspector General (NRC IG)

Berkshire School Parents Association, Co-Founder

Berkshire School Annual Appeal, Co-Chair

Sunday School Teacher, Christ Church, Roxbury, CT

Washington Montessori School Parents Association Member

Marriage Encounter National Presenting Team with wife Margaret
Provided weekend communication and dialogue workshops weekend retreats/seminars
Connecticut Marriage Encounter Administrative Team – 5 years

Northeast Utilities Representative Conducting Public Lectures on Nuclear Safety Issues

Personal

Married to Maggie Gundersen since 1979. Two children: Eric, 35, president and founder of MapBox and Development Seed, and Elida, 32, paramedic in Florida. Enjoy sailing, walking, swimming, yoga, and reading.

End