

**Summation for 2009 to 2010 Legislative Year**

**For the Joint Fiscal Committee**

**Reliability Oversight**

**Entergy Nuclear Vermont Yankee (ENVY)**

**Fairewinds Associates, Inc  
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July 26, 2010**

## **Contents**

### **Introduction**

### **Executive Summary**

### **Report:**

#### **Section 1. Brief Plant Status**

#### **Section 2. Tritium Leak Status**

**2.1. Five separate problems caused the tritium leak.**

**2.2. Current leak status**

**2.3. NRC Regulatory Information Conference - buried pipes v underground**

#### **Section 3. Slow Progress Toward Developing Action Plans**

#### **Section 4. Decommissioning Issues: Costs and Greenfield**

**4.1. Decommissioning Fund Status with Graph**

**4.2. Fairewinds review of TLG Engineering Services Decommissioning Analysis**

**4.3. July 2, 2010 Testimony by the Department of Public Service to the Public Service Board appears to be incorrect**

**4.4. Possible impact on decommissioning in Enexus aftermath**

#### **Section 5. MLB Report statements made by Department of Health**

#### **Section 6. NPSH (Net Positive Suction Head)**

#### **Section 7. MSIV (Main Steam Isolation Valve) Leakage**

#### **Section 8. The Timeline of Events**

#### **Section 9. Background**

### **Attachments:**

**Attachment 1. Dr. Ahlfeld Letter to Legislature and Biographical Sketch**

**Attachment 2. NY Times Article**

**Attachment 3. Vanags DPS prefiled testimony as filed**

## **Introduction**

Fairewinds Associates, Inc began its contract with the Joint Fiscal Committee (JFC) and the Joint Fiscal Office (JFO) in July 2009 in order to review the progress made by Entergy Nuclear Vermont Yankee (ENVY) toward addressing the challenges identified by Act 189: An Act Relating To A Comprehensive Vertical Audit (CVA) And Reliability Assessment Of The Vermont Yankee Nuclear Facility, and to present ongoing information and analysis regarding reliability issues with Entergy's Vermont Yankee Nuclear Power Plant.

This report is a summation of Fairewinds Associates' oversight of ENVY to the Joint Fiscal Committee for the legislative year 2009 to 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. Our detailed report follows the Executive Summary.

## **Executive Summary**

Many events have unfolded at Vermont Yankee since the previous Fairewinds report was provided to the JFC/JFO. This summation report is a compilation of the six most significant issues that Fairewinds Associates reviewed for the JFC during the 2009 to 2010 legislative year. On July 19, 2010, the Vermont Yankee (VY) Public Oversight Panel (POP) released its separate report to the Vermont State Legislature. There is little if any overlap between this Fairewinds report and the POP report as the VY POP report covers entirely different issues related to the implementation of the Act 189 CVA.

Fairewinds Associates' report, entitled *Summation for 2009 to 2010 Legislative Year For the Joint Fiscal Committee Reliability Oversight Entergy Nuclear Vermont Yankee (ENVY)* discusses the following issues:

- Following the spring 2010 refueling outage, ENVY discovered yet another tritium leak.
- All currently discovered leaks have now been stopped, but groundwater on site remains contaminated and will be for the foreseeable future.
- Progress on addressing the 81-action-items from the 2009 VY Public Oversight Panel report has been slow and additional action items, delineated by NSA, will be added to

address the special in-depth investigation of repairs to the Advanced Off Gas (AOG) system. This data is current to July 1, 2010, and Fairewinds Associates will issue an update on the current status in early October 2010.

- The tritium leak has increased the cost to decommission VY, and that issue in turn is related to the inadequacy of the Decommissioning Fund.
- New Boiling Water Reactor (BWR) applications for power uprates are being put on hold due to NRC and ACRS concerns regarding Net Positive Suction Head (NPSH). The issue of NPSH is also a significant safety concern regarding the Vermont Yankee uprate, but the NRC granted VY a waiver and allowed it to proceed with its 20% power increase (uprate).
- ENVY's Main Steam Isolation Valves (MSIV) are leaking at five times the rate they did prior to the Uprate.

Each of these issues is thoroughly addressed in the body of this report.

## **Section 1. Brief Plant Status**

According to Entergy, Vermont Yankee (VY) has operated for 531-days without shutting down since it was refueled in the fall of 2008 until its refueling outage April 24, 2010. Following its refueling, the plant experienced a rocky start-up with two inadvertent shut-downs as it attempted to reach full power. The first shutdown was due to electrical problems in its switchyard, while the second shutdown was due to yet another previously undetected leak in the Advanced Off-Gas (AOG) system. After resolving these problems, ENVY has been operating at close to full power for almost two months.

The 531 days of continuous operation does not mean that the reactor has been operating at full power for that entire time period. In its second quarterly report, Fairewinds Associates detailed eight critical reliability issues causing ENVY to reduce the power level at the plant in order to make repairs. Probably the single biggest threat to reliability other than the tritium leak went unreported in the media. Last fall, microbiologically induced corrosion (MIC) in one of the plant's emergency diesel generators caused a leak to this safety component. This leak caused one of the two diesels to be removed from service and the plant entered a "Limiting Condition for Operation" (LCO). Under this NRC restriction, the leak had to be fixed within seven days or the NRC would require an immediate shutdown. The diesel was repaired within seven days and the incident was not reported to the press.

Previously Fairewinds Associates was able to assess and report specific individual operating problems to the JFC, however, during the past six-months, it has become increasingly difficult to ascertain operational issues until well after they have transpired. Entergy has restricted the flow of information to Fairewinds Associates, Inc. Entergy has informed us that any request for even basic technical information must be sent in a written and mailed request – no email. That request is then given a technical review and reviewed by attorneys prior to a response to Fairewinds. As an example, it took approximately two-months to receive information from ENVY requested by both DPS and Fairewinds Associates regarding Main Steam Isolation Valve (MSIV) leakage. The MSIV issue will be discussed more thoroughly in Section 8 of this report.

## **Section 2. Tritium Leak Status**

Fairewinds Associates' first quarterly report identified the existence of buried and underground pipes that had not been admitted to by Entergy, even after Mr. Gundersen submitted a specific request for this information. [See *A Chronicle of Issues Regarding the Inspection of Buried Tanks and Underground Piping at Vermont Yankee* presented by Fairewinds Associates to the House Committee on Natural Resources January 27, 2010 on the JFO website or at [www.fairewinds.com/reports](http://www.fairewinds.com/reports)]. Fairewinds Associates' second quarterly report detailed the tritium leak from the previously undisclosed buried and underground pipes, including a status update an outline of our testimony to the Senate Natural Resources Committee, and a map from the Department of Health Vermont Yankee Tritium update website showing the plume of tritiated water extending into the Connecticut River.

The press has called the leak at ENVY a '*tritium leak*', but that is a misnomer as it is neither a single leak nor does it contain only tritium.

### **2.1. In fact five separate problems led to the leak of tritiated water from the plant (tritium leak).**

2.1.1. Two redundant steam traps failed – this is a device used to separate steam and moisture when both items are flowing through pipes.

2.1.2. Two redundant pipes failed – each steam trap had its own pipes and once the steam traps failed, this allowed pipes to corrode faster.

2.1.3. One clogged drain – no one knows how long the drain was clogged, perhaps for a decade or more; the sump pump was not working because no radioactive effluent was flowing into it due to the clogged drain.

Once these five individual components failed, water filled a vault that held the underground pipes. Leakage of radioactive water from this vault occurred at three different crack locations, not just in one location. Moreover, The evidence suggests that this leak existed for at least two years. In his letter to the State Legislature, Dr. David Ahlfeld<sup>1</sup> said that in order for the groundwater to be as saturated by tritium as it was, it is most likely that the underground pipes

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<sup>1</sup> Dr. Ahlfeld is a full professor at the University of Massachusetts in the Department of Civil and Environmental Engineering and has more than 20-years of experience in analyzing environmental engineering issues.

were leaking at least two years. Dr. Ahlfeld's letter to the Legislature and his biographical sketch are Attachment 1. There is additional evidence, including sinkholes that began appearing as early as 2008 above this leak location.

2.2. **Current leak status** – While the leak that began receiving public scrutiny in January 2010 has been referred to as leak of tritiated water, the leak also contained other radioactive isotopes of concern to the State and the environment surrounding Vermont Yankee. In Fairewinds Associates' second quarterly report we attached two separate letters regarding the possibility of the tritiated water containing other radioactive isotopes of significant concern to public health and safety. Unbeknownst to each other, both Mr. Gundersen and Dr. Marvin Resnikoff wrote separate letters and contacted State Agencies to specify that analysis of the tritium leaks was ignoring critical monitoring for the radioactive isotope Strontium (Sr-90).<sup>2</sup> Radioactive isotopes are measured by a term called half-life, as described below:

2.2.1. Strontium (Sr-90) has half-life of 29-years, meaning that it will be present *in the environment for 290-years*. It is *water soluble*, so that it will move across the site similar to the tritium plume, but it moves more slowly, similarly to the manner in which a pebble moves slowly in a brook. Strontium 90 is called a *bone seeker* because it is *absorbed into bones like calcium*, placing growing children and women at risk. Strontium 90 *causes leukemia* and other cancers. Accurately testing for Strontium 90 is a very difficult process; one mistake in the testing process will show a reading of no Sr-90.

2.2.2. Cesium 137 has a half-life of 30-years, so it will remain *in the environment for at least 300-years*. It is a *muscle seeker* and in large accident doses it causes the medical disease syndrome known as *Chernobyl heart*.

2.2.3. Cobalt 60 has a 5-year half-life, so it will remain in the environment for 50-years. It emits a high-energy gamma ray that causes cancer and is not water soluble, so it would be expected to be close to the actual leak.

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<sup>2</sup> See *Fairewinds Associates, Inc 2nd Quarterly Report to JFC* attachments to review the letter from Dr. Marvin Resnikoff, a Vermont resident, to Department of Health dated February 10, 2010 and the email from Arnie Gundersen to Department of Public Service dated February 12, 2010.

- 2.2.4. Fairewinds Associates remains concerned that Cesium 137 and Strontium 90 are moving with the tritiated water, only more slowly, which will be discussed in Section 4 on Decommissioning.
- 2.2.5. While digging between the AOG (Advanced Off-Gas) building and the turbine building in their attempt to uncover the leak, Entergy found soil contaminated w/ cesium, tritium, manganese, cobalt, and zinc.
- 2.2.6. The additional overall cost to the clean up leakage of radioactive isotopes is a major concern. Entergy has stopped digging in order not to undermine buildings during the soil excavation process. At this point in time, Entergy will leave the contaminated soil until the decommissioning clean up. To date, 250 cu ft have been removed. ENVY has taken additional soil samples that still show the presence of both cesium and strontium. The impact of radioactive isotopic soil contamination upon ENVY's ultimate decommissioning process and costs is further discussed in Section 4 – Decommissioning Costs and Greenfield, specifically Section 4.4.

Reports by Entergy indicate that while the leak has been repaired, the plume is not contained. While Fairewinds Associates believes that that this leak has been uncovered, contained, and a partial clean up has been completed there still are other major concerns regarding the movement of other radioactive isotopes across the site toward the Connecticut River. Given the age of the plant, condition of the pipes, and the inaccuracies and inconsistencies of Entergy's Buried Pipe and Tank Inspection Program (BPTIP), Fairewinds Associates believes that it is impossible to guarantee that there will not be additional leaks of radioactivity. With a more robust BPTIP and the newly added additional Nuclear Regulatory Commission (NRC) oversight and review, if there are any new leaks we hope they will be uncovered and stopped in a more timely manner.

### **2.3. NRC Regulatory Information Conference March 11, 2010, Washington, DC**

As a result of the tritium leak at Vermont Yankee and at dozens of other nuclear reactors around the country, the Nuclear Regulatory Commission has formed a task force to evaluate methods of preventing leaks and monitoring leaks. At the NRC Regulatory Information Conference in March, Mr. Gundersen was invited to speak at the breakout session on buried and underground pipes regarding issues that should be reviewed by NRC during its regulatory deliberations.



- 2.3.1. The first topic Mr. Gundersen addressed is the need for a common industry-wide definition of buried and underground pipes. *The NRC has agreed that it makes no distinction between the buried and underground pipes.* While there is no distinction between the terminology buried and underground, there are significant differences in how a buried pipe corrodes compared to one that is underground in a vault and is not in direct contact with dirt. The buried pipes in direct contact with dirt usually corrode from the outside inward. However, the pipes that disintegrated at Vermont Yankee were not in contact with dirt because they were inside a concrete vault. The pipes in the vault corroded from the inside out and not from the outside inward so there are two different failure mechanisms. Prior to the problems at Vermont Yankee, the NRC had only been concerned about pipes that corrode from the outside. Mr. Gundersen told the NRC that it should also be concerned about pipes that are not in contact with dirt and fail as a result of internal corrosion.
- 2.3.2. Mr. Gundersen also informed the NRC of the necessity of many more monitoring wells. In Massachusetts a gas station is required to have at least four monitoring wells, yet nuclear plants are only required to have three due to the industry-wide *voluntary initiative*. Mr. Gundersen stated that there is a definite need for more than only three monitoring wells, which Yankee and most of the other nuclear power plants voluntarily install. He also suggested that the nuclear industry initiative on buried and underground pipes is too weak. Experience at Vermont Yankee indicates that three monitoring wells that it had a prior to extensive leak of tritiated water were simply inadequate. Had there been several more monitoring wells, it is most likely that the leak would have been detected as much as six-months earlier.
- 2.3.3. Additionally, Mr. Gundersen discussed the fact that monitoring well samples must be taken more frequently, and that should be a NRC requirement. The current industry initiative allows for samples to be taken every three months (once per quarter). Mr. Gundersen stated that the sample frequency is woefully inadequate and at a minimum should be at least a monthly. Mr. Gundersen also noted that once the sample is drawn from the well, it is important that the sample be analyzed quickly. At Vermont Yankee, a key sample taken from a monitoring well in November 2009 was not analyzed until early January 2010. The net effect of three-

month sample frequencies and a two to three-month delays in analyzing the samples is that a leak may go undetected for six-months after reaching a monitoring well. Such time lags are totally unacceptable for Vermont Yankee and for the nuclear industry as a whole.

2.3.4. Mr. Gundersen also informed the Nuclear Regulatory Commission that monitoring for leaks is not the solution to the problem. Monitoring for leaks frequently allows the leak to contaminate groundwater for months if not years. The industry initiative needs to focus on the fact that pipes should not be allowed to leak in the first place and that adequate monitoring very near to the pipe should be provided to a sure that any leakage will be detected promptly. It is likely that the Vermont Yankee leak existed for at least two years prior to its detection in the monitoring well.

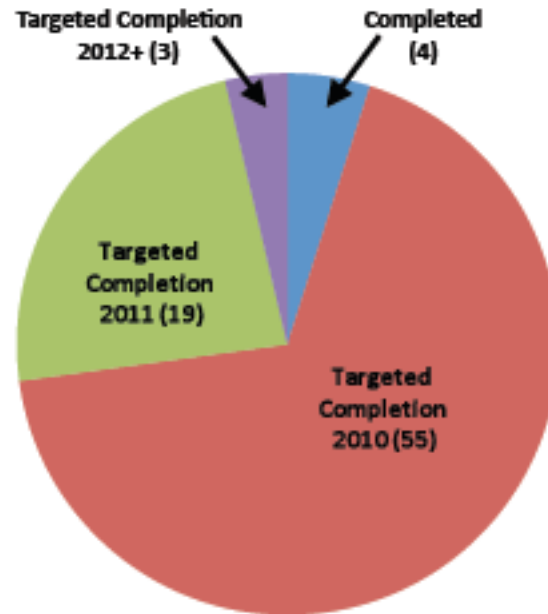
2.3.5. The NRC also held a national teleconference on this issue on April 20, 2010. Mr. Gundersen also spoke at this time and is quoted in the New York Times, a copy of which is Attachment 2.

### **Section 3. Slow Progress Toward Developing Action Plans**

The Joint Fiscal Committee may remember that the 81-action-item list is the result of a combination of the recommendations made by the Oversight Panel and those detailed in the narrative report by Nuclear Safety Associates (NSA). The original 81-action items no longer represent the entire work effort that will be required of Entergy, as NSA has also identified additional corrective action items in their AOG report and the final report of the Public Oversight Panel due to be completed by late July may also highlight additional items.

Of the 81-corrective actions that were created to implement the recommendations of the NSA report in December of 2008, only four items were satisfactorily resolved in 2009. It is possible that another 55-items may be certified as completed by DPS in 2010 and 19 additional items may be approved by DPS in 2011. The remaining 3-items from the 81-item list are the most expensive and long-lead items and will not have been resolved until after 2012, including major repair to the condenser which has been moved further back on ENVY's calendar from 2014 to 2016.

## Targeted Action Completion (81 Items)



Graph<sup>3</sup>

**Note:** It is important to note three issues regarding the above graph:

- *First*, the graph does not include any new actions that may be required at the site of the tritium leak from the AOG (Advanced Off Gas) system.
- *Second*, the graph includes *targeted* completion dates as suggested by NSA and the DPS. At this time, ENVY may not meet these dates.
- *Third*, the meeting scheduled to address ENVY's progress on meeting these goals was originally scheduled to be held in June 2010, but was delayed until the end of July 2010, so this new information will be reviewed in Fairewinds Associates' October 2010 report. Entergy anticipated addressing some of these 55-action items during the April 2010 refueling outage.

The approval process created by the DPS and NSA uses the term *satisfactory completion*, but this term does not mean that the task is indeed complete, but rather that the approach to solve a long-term action is satisfactory and is underway. For example, rewriting of operating procedures will not be completed for several years, but according to the DPS plan, the corrective action may

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<sup>3</sup> Vermont State Department Of Public Service Vermont Yankee Reliability Assessment Corrective Actions Monitoring Plan 03/31/10

be eliminated in 2010 if progress toward rewriting the procedures is satisfactory. Such an approach is also true for many of the additional 55-items anticipated to be underway by the end of 2010. Therefore, if progress toward completion is being made then DPS allows those items to be marked as corrected even if the item is not entirely complete.

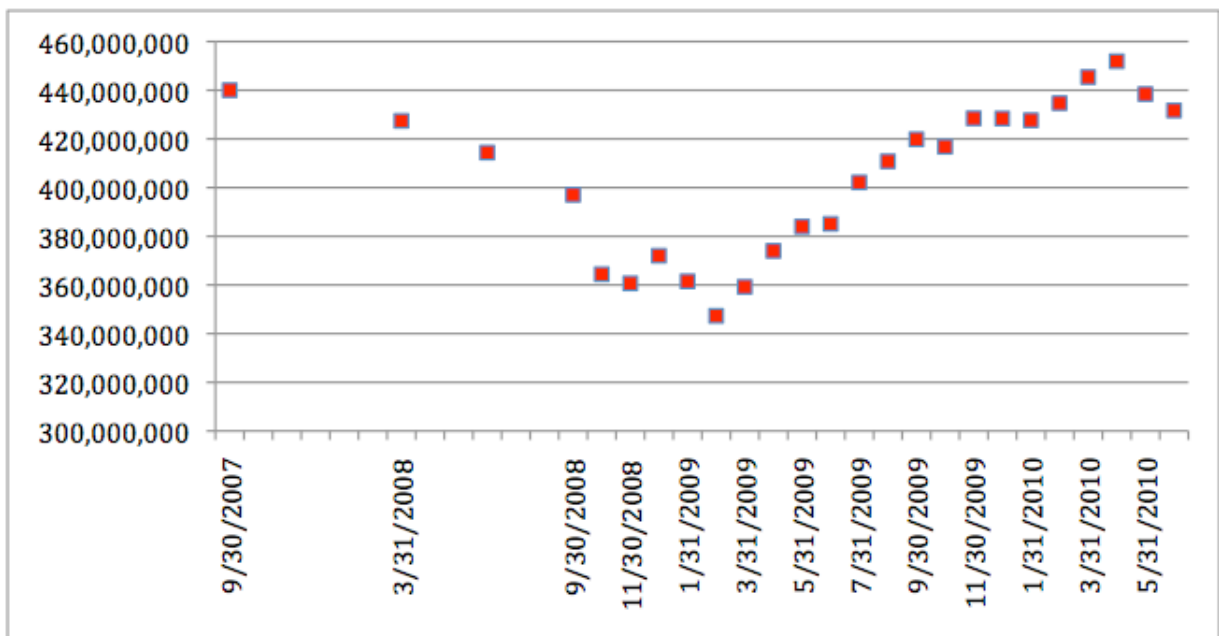
Accordingly, the DPS plans to develop a Memorandum of Understanding (MOU) with continuing milestones to which ENVY must commit prior to the granting of a Certificate for Public Good (CPG) if 20-year relicensure is approved by the legislature. If, however, a CPG is granted, failure to meet a milestone will not result in revocation of the CPG, but rather a remedial request by the DPS to the Public Service Board (PSB).

**Section 4. Decommissioning Issues: Costs and Greenfield**

**4.1. Decommissioning Fund Status with Graph**

The value of the Decommissioning Fund hit a high of \$440 million in September 2007, which was prior to the stock market crash and recession. As of June 31, 2010, 34-months later, the fund is still below its September 2007 high. The graph below is a graphical presentation of the fund values as provided by DPS.

**Decommissioning Fund Value from 9/30/2007 to 6/31/2010**



#### 4.2. **Fairewinds review of TLG Engineering Services Decommissioning Analysis**

Fairewinds Associates' review of TLG Service's decommissioning cost analysis found the data and assumptions to be inaccurate. At the request of the House Natural Resources Committee, Fairewinds looked at the TLG Services decommissioning cost analysis in light of the release of tritiated water and other radioactive isotopes to the site. Our power point presentation regarding the inconsistencies in the TLG decommissioning analysis is entitled *A Comparison of TLG Services Projected Decommissioning Costs for Vermont Yankee April 2, 2010 Testimony*. The complete report is available on the JFO website: <http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm>.

4.2.1. The chart below, entitled Summary of VY Decommissioning Projections from all four studies was extracted from our House Natural Resources testimony.<sup>4</sup>

**Summary of VY Decommissioning Projections from all four studies**

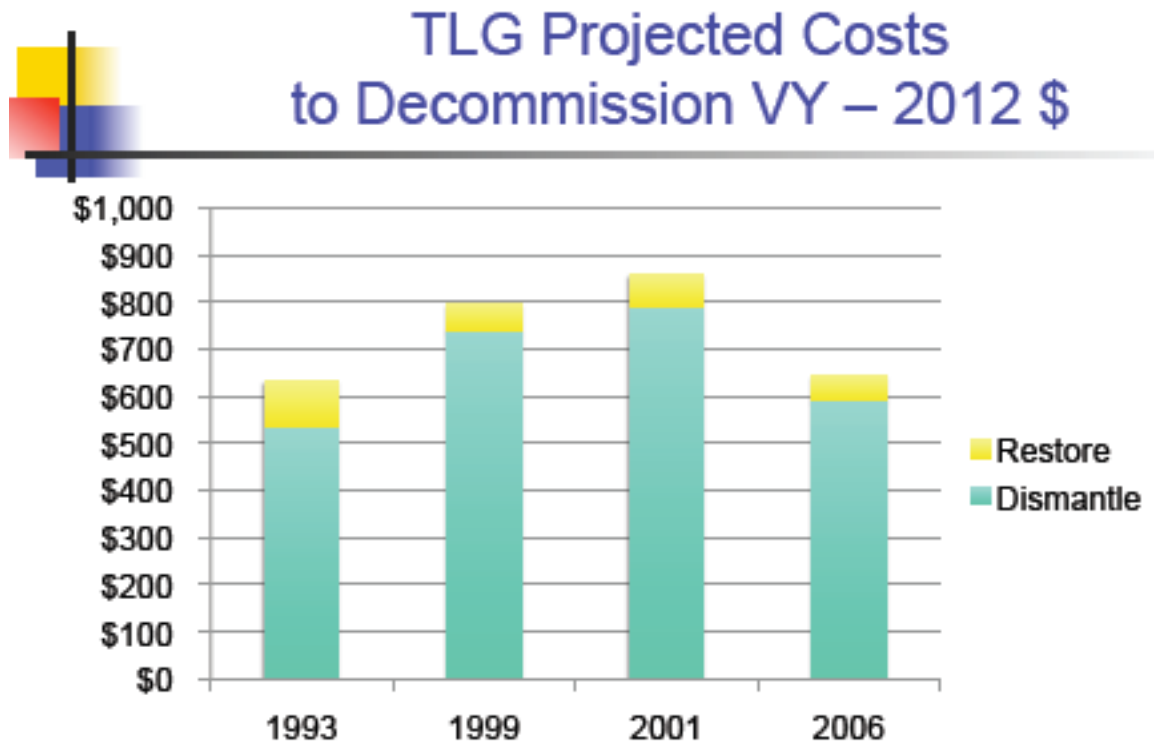
Study Year	Dismantle \$ (,000)	Restore \$ (,000)	Total \$ (,000)	2012 \$ Dismantle (,000)	2012 \$ Restore (,000)	2012 \$ Total (,000)
1993	254,475	44,258	298,733	536,140	93,245	629,385
1999	480,806	37,500	518,306	740,179	57,730	797,909
2001	514,041	43,722	557,763	791,343	67,308	858,651
2006	468,844	40,053	508,897	593,237	50,679	643,916

**Note - Costs escalated at 4% per year**

4.2.2. When TLG Services first analyzed VY's decommissioning plan, TLG was an independent firm. Now TLG is a wholly owned subsidiary of Entergy. Fairewinds Associates remains concerned that the 2006 analysis, which is the latest one given to us to review by the DPS estimates the costs at \$200 million less than the 2001 analysis. \*The Vermont State Legislature might ask DPS to retain a truly independent organization to provide an accurate analysis and recommendation, so

<sup>4</sup> *A Comparison of TLG Services Projected Decommissioning Costs for Vermont Yankee April 2, 2010 Testimony, page 7*

that the State of Vermont might accurately assess its possible liability.



4.2.3. The graph above entitled TLG Projected Costs to Decommission VY – 2012 \$ is from page 8 of the Fairewinds Associates’ testimony.<sup>5</sup>

4.2.3.1. Based upon the 2001 TLG report, the Vermont Yankee Decommissioning Fund contains only one-half the amount of money needed to decommission and dismantle Vermont Yankee. However, for some unknown reason the TLG 2006 estimate is 200 million dollars lower than the firm’s 2001 report for decommissioning VY.

**4.3. July 2, 2010 Testimony by the Department of Public Service to the Public Service Board appears to be incorrect**

It is of significant concern that in our review, we found that the testimony presented by the DPS State Nuclear Engineer Uldis Vanags to the Public Service Board (PSB) on July 2, 2010 is not substantiated by the facts presented on the Department of Health (DOH) website. Specifically,

<sup>5</sup> *A Comparison of TLG Services Projected Decommissioning Costs for Vermont Yankee April 2, 2010 Testimony*, page 8.

in Fairewinds Associates review of the DPS testimony<sup>6</sup>, see Attachment 3, the DPS statement cannot be supported by the data reviewed. DPS said,

"Radiation measurements of the two locations that were remediated showed that the contamination decreased as expected with depth of the soil."

Based upon data at two locations on only one date, DPS opines that the cost of decommissioning Vermont Yankee's will not increase as a result of the recent leaks of cesium, strontium, and cobalt from the AOG system.

Moreover, according to the DOH data reviewed, the concentration of Cesium 137 increases in some site soil samples when the measurements are taken further away from the leak. For example, if one looks at the data for Cesium in the DOH table from the March 17, 2010 soil samples<sup>7</sup>, the data sometimes shows the concentration level of Cesium declines as the samples are further from the contamination. However, in direct contrast to the DPS testimony, *the contamination* in other locations *actually increases* the further away the samples are from the leak. Note that sample sites 6 and 8 of the attached table have higher levels of Cesium further away from the contamination and the Strontium 90 does not diminish at sample site 7.

Furthermore, the DPS conclusion that a decrease was "expected" is not consistent with other decommissioning projects and was certainly *NOT expected* by Fairewinds. The statement is not substantiated by the data from sites 6, 7, and 8, and would lead one to the erroneous conclusion that there will be no increase in decommissioning costs. For example, in a Strontium 90 leak at Entergy's Indian Point Units 2 and 3 in Buchanan, NY near White Plains, Strontium 90 continues to move through the soil in direct contradiction to the DPS testimony to the PSB.

It is important to remember that this leak occurred during a period of at least several years thus enabling both the Cesium and Strontium to gradually move further away from the leak. If the Cesium is not trapped locally, as that data from sites 6 and 8 suggests is not occurring, then there will be a definite increase in decommissioning costs. Since the leak went on for at least two years, there may be a significant amount of cesium migrating across the site that has yet to be uncovered.

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<sup>6</sup> Page 6, lines 4 and 5

<sup>7</sup> [http://healthvermont.gov/enviro/rad/yankee/documents/VY\\_Data\\_soil\\_samples\\_march2010.pdf](http://healthvermont.gov/enviro/rad/yankee/documents/VY_Data_soil_samples_march2010.pdf)

In testimony to the Public Service Board in June 2009, DPS testified that it expected Vermont Yankee's decommissioning costs to be similar to those of Maine Yankee because Vermont Yankee had no underground pipes. This DPS statement is incorrect again, and not just about the underground pipes. Maine Yankee is a Pressurized Water Reactor (PWR), and according to the NRC a PWR is 40% *less expensive* to decommission than a Boiling Water Reactor (BWR) like Vermont Yankee. A BWR like ENVY is much more contaminated than a PWR because the entire turbine hall, and in fact most of the plant is radioactive. Using Maine as an example with or without the tritium leak is not technically justifiable because decommissioning a BWR nuclear plant like Vermont Yankee will cost at least 40% more than a comparable PWR, according to NRC documentation. Thus Vermont Yankee's decommissioning costs will be 40% higher than Maine Yankee's costs and might also be considerably higher due to the on-site leak of radioactivity. Furthermore, it cost *an additional* \$481 million to decommission Connecticut Yankee in Haddam, CT due to an undetected leak of tritium, strontium 90 and other radioactive isotopes.

**Key Recommendation:**

In order to avoid the movement of cesium and strontium in the groundwater where it would progress to the Connecticut River and move through the site water table, it is important for ENVY to continue to extract groundwater from the soil. Keeping regular groundwater separated from the contaminated soil is the only method of preventing the cesium and strontium from moving further away from the leak, spreading out, and increasing the cost to decommission VY. Fairewinds Associates believes that the legislature should recommend that DPS insist on groundwater extraction until the plant is fully decommissioned or statutorily assure compliance with groundwater extraction until the plant is fully decommissioned.

**4.4. Possible impact on decommissioning in Enexus aftermath**

The last Fairewinds Associates report to the JFC discussed the potential problems associated with the Enexus spinoff from Entergy. Since our report was written, both Vermont and New York have rejected the Enexus spinoff.

While this is positive news, Entergy has suggested that it has a legal approach to create a junk-bond holding company without seeking approval of either Vermont or New York. Specifically, Entergy CEO J. Wayne Leonard has suggested that Entergy might keep its corporate name on the six old nuclear assets it had planned to spin off as Enexus while at the same time creating a new



and different corporation that would contain all of Entergy's assets and its newer nuclear plants. Without the corporate name being changed, Vermont and New York State might be unable to intervene. Basically Entergy would strip the assets out of Vermont Yankee and other older nuclear reactors as they planned to do with the Enexus spinoff, but without State involvement.

To our knowledge Entergy has not yet begun the legal process of moving its assets to a new corporation. Our concern should this corporate change occur is that there would not be enough money to ever fully decommission Vermont Yankee unless the State of Vermont paid for the clean-up.

**Section 5. MLB Report statements made by Department of Health**

Fairewinds Associates began making inquiries to the DPS about the existence of underground pipe carrying radioactivity at the Vermont Yankee site in July 2009, while reviewing documents for its JFC contract. In October, Fairewinds Associates presented a written report and testified to the JFC concerning ENVY's misstatements regarding underground pipes carrying radioactivity. Fairewinds' October 2009 presentation at the JFC meeting was the first public forum where the issue of underground pipes was brought to the attention of the legislature. While Fairewinds was informing the legislature, it appears that both the Department of Health (DOH) and the Department of Public Services (DPS) were actively communicating with Entergy in an attempt to discredit the efforts of Fairewinds Associates.

Mr. Gundersen provided the DPS and Entergy with courtesy copies of the October Fairewinds JFC report. According to the Morgan, Lewis, & Bockius<sup>8</sup> (MLB) report, ENVY's Dave McElwee almost immediately contacted the DOH employee Dr. William Irwin with ENVY's concern regarding the Fairewinds report. Again, according to the MLB report, DOH replied in an email October 21, 2010 and said,

"The comments of Mr. Gundersen are hyperbole and, in my opinion, bordering on irresponsibility."

The comments to which DOH refers are those from the Fairewinds report by which Fairewinds Associates notified the JFC that the Public Oversight Panel and not been made aware of any underground pipes containing radioactivity including the plant's storm sewers that DOH already knew to be contaminated.

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<sup>8</sup> Report of Investigation Entergy Nuclear Vermont Yankee, February 22, 2010 by the law firm Morgan, Lewis, & Bockius, which was retained by Entergy to do an internal investigation.

Somehow, the DOH email calling Fairewinds report "hyperbole" and "irresponsible" was marked "For Internal Use Only" and then sent to Vermont Yankee. The email was found by MLB in ENVY's possession and used by MLB to show that even the State of Vermont thought the Fairewinds report was incorrect. Obviously, Fairewinds never received the DOH email. Fairewinds was made aware of the DOH email in Fairewinds' reading of the MLB report.

Fairewinds is dismayed that its attempts to notify the JFC of the existence of underground pipes at Vermont Yankee was belittled by regulators employed by the State of Vermont and shared with Entergy, the very firm the DOH purports to be regulating. This chain of events gives the appearance that the Department of Health and perhaps the Department of Public Service were more willing to belittle the accurate analysis of Fairewinds Associates, Inc rather than investigate the existence of underground pipes at the Vermont Yankee site. *Such inappropriate communication between the agency charged with regulating radiation releases and the industry it purports to be regulating brings into question the credibility of the whole nuclear regulatory process in the State of Vermont and in Fairewinds Associates' opinion may in fact create significant liability regarding attempted enforcement action of ENVY by the State of Vermont.*

#### **Section 6. NPSH (Net Positive Suction Head)**

Net Positive Suction Head (NPSH) is a complicated technical concept regarding the ability of the emergency core cooling pumps to pump water needed to cool the reactor in the event of a nuclear accident. When Vermont Yankee applied for its license to uprate the plant in 2003, the changes made to the plant to facilitate the 20% power increase caused the pumps that cool the nuclear reactor after an accident to no longer perform their safety function in the manner originally designed. While the NRC reviewed this issue, it initially allowed the plants to receive a waiver (the NRC calls it giving a credit, in a sense it is similar to the zoning board granting a variance). Currently the NRC has put the uprate of any additional nuclear plants on hold until the NRC Advisory Committee on Reactor Safeguards (ACRS) has completed a technical review due to ACRS technical concerns.

While it is a complicated concept, NPSH allows the cooling water needed in the event of an accident to it to be pushed toward the cooling pumps. Prior to uprate, VY relied upon gravity in the event of an accident, now however, if there is an accident, there must be adequate containment pressure by which to push the cooling water toward the cooling pumps, as gravity is

no longer strong enough. In actuality, the NRC has two regulations forbidding credit (or a waiver) for NPSH. Yet Vermont Yankee was granted its uprated power license in direct opposition to the regulations in spite of the fact that the Vermont DPS, the Union of Concerned Scientists and Mr. Gundersen, in his role as an expert witness, all wrote to the NRC Advisory Committee on Reactor Safeguards (ACRS) expressing significant concern about the NRC allowing Vermont Yankee to take this NPSH credit (waiver).

During the past several months, three additional BWR's owned by TVA have applied for similar uprate related NPSH credit (waiver) from the NRC. Now, five years after Vermont Yankee was granted its 20% power increase, the NRC ACRS is expressing such significant concern about NPSH that it has put these new license uprate approvals on hold due to NPSH, thus denying uprate licenses to any more reactor operators that claim they need the NPSH credit (waiver). Since Vermont Yankee and several other reactors received their NPSH credit (waiver) prior to the Advisory Committee on Reactor Safeguards expressing its concerns, the NRC has determined that it will continue to allow VY to operate at its 20% uprate (power increase) above the plant's original design capacity until the ACRS has made a firm determination.

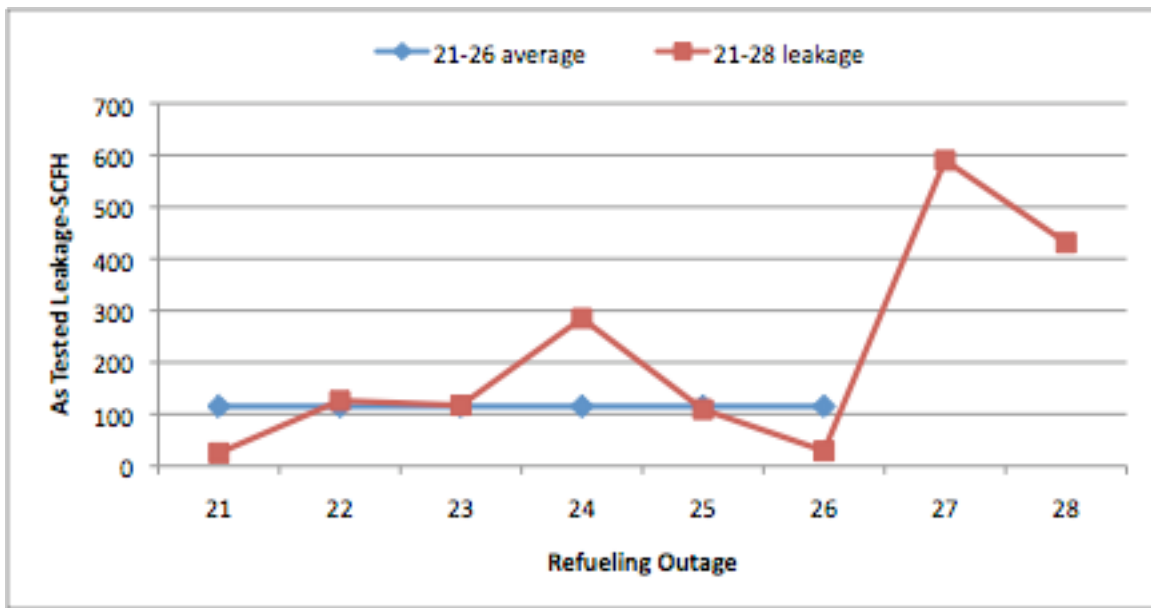
#### **Section 7. MSIV (Main Steam Isolation Valve) Leakage**

Main Steam Isolation Valves (MSIV's) are a safety related component used to stop radioactive steam from leaving the containment in the case of an accident. MSIV testing must take place at every outage. While these Main Steam Isolation Valves are safety related, the *mandatory tests* to make sure they are working properly are a reliability issue, because the testing procedures may increase the length of an outage thereby keeping VY offline for a longer time period. Therefore, the MSIV leakage rate and overview fell under the review of the VY Public Oversight Panel. In late 2008, the Panel identified a disturbing trend that indicated that MSIV leakage had increased dramatically following ENVY's 20% power uprate. This concern was addressed in the March 2009 POP report.

As a follow-up to the VY POP report, during the fall of 2009, ENVY provided MSIV analysis to the DPS, NSA and Fairewinds Associates. The data provided by ENVY indicated that an increase in leakage from the MSIV's would be minimized during the April 2010 outage because ENVY planned to change the way in which the procedure was performed and the manner in which the valves were closed. A Corrective Action Report (CR) was established, as this was one of the 81-items requiring repair and/or upgrade in order to assure reliability if VY were to be

operated for another 20-years. The Corrective Action Report suggested that this problem might be solved in 2010, so the resolution of MSIV leakage was postponed until the 2010 refueling outage. Now that the most recent Refueling Outage (RFO) has been completed, there is one more data point to add to the graph that Mr. Gundersen developed in December 2008 that formed the basis for the Vermont Yankee Public Oversight Panel (VY POP) concern in 2009. Unfortunately, the disturbing trend in MSIV leakage is continuing rather than stabilizing.

The Graph below displays the total MSIV leakage (for all 8-valves) measured at Vermont Yankee during the past 8-outages, which comprised a time period of 12-years. Refueling Outage 27 and 28 were at uprate conditions for the full 18-month cycle. Refueling Outage 21-26 had an average leak rate of 115 Standard Cubic Feet per Hour (SCFH). The RFO cycle 27 & 28 average leak rate was 510 SCFH.



The evidence reviewed shows that in the future these MSIV leakage-testing problems may impact the reliability of Vermont Yankee as predicted by the Public Oversight Panel in its 2009 report.

**Section 8. The Timeline of Events**

The Timeline of Events requested by the JFC had been planned to be a regular feature of Fairewinds Associates’ reports for monitoring technical issues and power reductions that may impact the operational reliability of Entergy Nuclear Vermont Yankee. However, because Entergy is currently restricting access to some of this technical information, Fairewinds is unable

to provide this ongoing feature.

**Section 9. Background**

The Vermont Yankee Nuclear Plant, which began operation in 1972, is licensed to run for 40-years until 2012. ENVY has requested a 20-year license extension for its Vermont Yankee Nuclear Plant past its 2012 projected shutdown date. In Vermont such an extension requires a Certificate of Public Good (CPG) and review by the State Legislature. In 2008, the Vermont Legislature enacted the Act 189 Comprehensive Vertical Audit and Reliability Assessment in an effort to give Legislators a more accurate assessment of ENVY's ability to operate its nuclear plant reliably for an additional 20-years. In February 2009 following more than four years of research, review, and receiving testimony in the committees they chair, Senator Ann Cummings, Chair of the Senate Finance Committee, and Senator Virginia Lyons, Chair of the Senate Natural Resources Committee, called for a vote on whether or not to authorized the Public Service Board to complete its review of ENVY's relicensure for 20-more years of operation. The Senate voted against relicensure by a vote of 26 to 4.

In July 2008, following statutory authorization by Act 189, President Pro-Tem of the Vermont State Senate appointed Arnie Gundersen and the Speaker of the House appointed former Nuclear Regulatory Commissioner Peter Bradford to the Vermont Yankee Public Oversight Panel to fulfill a public oversight role regarding the reliability assessment of the Entergy Nuclear Vermont Yankee Power Plant. The Vermont Yankee Public Oversight Panel issued its report to the Vermont State Legislature in March 2009 after which it was disbanded. Following the discovery of a significant tritium leak in allegedly non-existent buried pipes, the Legislature called both the Vermont Yankee Public Oversight Panel (VY POP) and NSA, the Department of Public Service contractor, back into service to review data regarding the apparent source of the leak, the advanced off-gas (AOG) system. NSA released its report April 30, 2010. The VY POP released its report July 19, 2010. The Legislature hoped the VY POP would have completed its assessment and report in March in order for the Legislature to review the report and receive testimony during the Spring 2010 session. However, ENVY was unable to definitively uncover the source of the leak until late March, which delayed both the NSA assessment and the Public Oversight Panel's review and report.



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February 22, 2010

Senator Peter Shumlin, President Pro Tempore of the Senate  
Senator John Campbell, Senate Majority Leader  
Vermont Senate  
Montpelier, Vermont

Dear Senators Shumlin and Campbell:

I am writing in regards to the recent findings of tritium contamination of groundwater at the Vermont Yankee Power Plant (VY). I offer some observations that I believe are important for your deliberations on the continued operation of this Plant. These observations draw upon my 20+ years career in analysis of groundwater contamination that has included the study or review of hundreds of groundwater contamination sites around the world.

The Vermont Department of Health (VTDOH) has done an excellent job of responding to the reported tritium release. I have reviewed the data that has been posted on the VTDOH web site along with the 1991 Battelle site characterization report that I obtained independently.

The emerging data-set on the distribution of tritium suggests that a major contamination event has occurred at VY. When analyzing such an event a number of questions present themselves.

First, what is the source of the observed groundwater contamination? VTDOH reports rapid progress on identifying a likely source in the vicinity of well GZ-10. This apparent source location is several hundred feet from the contaminated wells nearest the Connecticut River (e.g. well GZ-14).

Second, how long has the source been releasing contamination? One feature common to nearly all groundwater contamination sites is the slow travel time of contaminants. Given the apparent geologic conditions beneath the VY site, as detailed in the Battelle site characterization report, it is highly likely that contaminants would require many months to travel the several hundred feet from the source to the current observed location. That

is, the data reported to-date suggests that this is not a short term release, but rather a leak that has gone undetected for perhaps a year or more.

Third, how much groundwater has been contaminated by this event? The spatial distribution of contamination at this site suggests that a plume of tritium contaminated water is present. Using data collected to date and a conservative estimate of plume extent suggests that at least several hundred thousand gallons of groundwater are contaminated with tritium.

The emerging data-set at VY indicates that a long-term, major leak of tritium contaminated water has been discovered at the site. The existence of such a substantial leak raises serious questions about the viability of the infrastructure at this aging plant.

I hope these observations are useful to you in your deliberations on the future of VY. I expect to monitor the ongoing data collection and would be pleased to discuss my thoughts with you regarding the extensive contamination at Vermont Yankee.

Sincerely,

A handwritten signature in cursive script, appearing to read "David Apfel".

Cc: Senator Ann Cummings, Chair of Senate Comm. on Finance  
Senator Virginia Lyons, Chair of Senate Comm. on Natural Resources  
Senator Diane Snelling, Clerk, Joint Fiscal Committee  
Representative Shap Smith, Speaker of the House  
Representative Floyd Nease, House Majority Leader  
Representative Tony Klein, Chair of House Comm. on Natural Resources and Energy  
Representative Michael Obuchowski, Chair Joint Fiscal Committee  
Stephen Klein, Chief Fiscal Officer, Legislative Joint Fiscal Office



## Biographical Sketch

### David P. Ahlfeld

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(413) 545-2681 (office), (413) 545-2202 (fax), email: [ahlfeld@ecs.umass.edu](mailto:ahlfeld@ecs.umass.edu)

### Education

Humboldt State Univ., Arcata, California	B.S. in Environmental Resources Engr,	1983
Princeton University,	M.A. in Civil Engineering,	1985
Princeton University	Ph.D. in Civil Engr. and Oper. Research,	1987

### Academic Appointments

*Professor*, Department of Civil and Environmental Engineering, University of Massachusetts, September 2004 to present.

*Associate Professor*, Department of Civil and Environmental Engineering, University of Massachusetts, January 1998 to September 2004.

*Associate Professor*, Department of Civil and Environmental Engineering, University of Connecticut, September 1994 to January 1998.

*Assistant Professor*, Department of Civil Engineering, University of Connecticut, January 1988 to August 1994.

*Lecturer*, Department of Civil Engineering and Operations Research, Princeton University, Spring semester 1987 and Spring semester 1988

### Selected Publications

D.P. Ahlfeld and Y. Hoque, "Impact of Simulation Model Solver Performance on Groundwater Management Problems", *Ground Water*, Vol 46, no. 5 September-October 2008, pgs 716-726.

D.P. Ahlfeld and G. Baro-Montes, "Solving Unconfined Groundwater Flow Management Problems with Successive Linear Programming", *Journal of Water Resources Planning and Management*, Vol. 134, No. 5, September 1, 2008, pgs 404-412.

Ahlfeld, D.A., Barlow, P.M., and Mulligan, A.E., 2005, GWM-A ground-water management process for the U.S. Geological Survey modular ground-water model (MODFLOW-2000): U.S. Geological Survey Open-File Report 2005-1072, 124 p (refereed).

D.P. Ahlfeld, "Nonlinear Response of Streamflow to Groundwater Pumping For A Hydrologic Streamflow Model", *Advances in Water Resources*, January 2004, Vol 27, pgs 349-360.

Barlow, P.M., D.P. Ahlfeld, and D.C. Dickerman, "Conjunctive-Management Models for Sustained Yield of Stream-Aquifer Systems", *Journal of Water Resources Planning and Management*, January-February 2003, Vol. 129, No. 1, pgs 35-48.

A.E. Mulligan and D.P. Ahlfeld, "Advective Control of Contaminant Plumes: Model Development and Comparison to Hydraulic Control", *Water Resources Research*, Vol. 35, No. 8, August 1999, pgs 2285-2295.

Ahlfeld, D. P., and A. E. Mulligan, 2000, "Optimal Management of Flow in Groundwater Systems", Academic Press, San Diego, CA.



The New York Times

**Green**

**A Blog About Energy and the Environment**

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APRIL 20, 2010, 6:16 PM

## Has Trust Leaked Away With the Tritium?

By [MATTHEW L. WALD](#)

**12:11 p.m.** | *Updated Fixed broken link to Beyond Nuclear report.*

AP/Glenn Russell, Burlington Free Press Workers drilled a well from which water contaminated with tritium would be pumped and stored at the Vermont Yankee nuclear plant last month. Leaks from a pipe there caused an uproar.

A panel of experts convened on Tuesday by the Nuclear Regulatory Commission to discuss how the agency should approach tritium leaks at reactors suggested that the biggest risk that nuclear operators faced was the erosion of public trust.

“Tritium is one of the most benign of radioactive materials that I’ve worked with in my career, and I’ve worked with many of them,” said [Dr. John E. Till](#), a veteran radiation expert who has led studies at several nuclear weapons sites to determine doses. “I’m surprised to be here based on what we know about the science of this material.”

“But on the other hand, the perception of tritium as a potential risk in the environment to the public is huge; it is absolutely huge,” he said. He called it the industry’s biggest problem since the Three Mile Island accident in 1979.

An industry representative on the panel, Alex Marion, a vice president of the Nuclear Energy Institute, said, “We’re facing a policy issue, and that issue is maintaining public trust and confidence.”

The recent discovery of leaks in an underground pipe that allowed radioactive tritium to flow into the groundwater at a nuclear reactor in Vermont has caused an uproar and drawn national attention to the tritium issue.

**Tritium** is a radioactive form of hydrogen that occurs naturally yet is also created in reactors. It is almost always incorporated into a water molecule like an ordinary hydrogen atom and is therefore impossible to filter out, and readily absorbed by the body. But it is also quickly excreted from the body, as ordinary water is, which limits the dose.

In fact, doses ingested appear so far to have been extremely small, even though nearly all reactors have reported leaks. The reason is that very little tritium has reached drinking water.

This is small consolation to critics, who point out that the industry has a history of unintended and sometimes unmonitored releases.

James P. Riccio, a nuclear expert at Greenpeace, says that while nuclear plants have permits that allow them to emit material into surface water and the air, they do not have permits that let them release material to groundwater, which is where the tritium is going.

Public officials also voiced criticism. William Buscher, manager of the hydrology and compliance unit in Illinois's state Environmental Protection Agency, said that part of the problem was with the Nuclear Regulatory Commission's approach, which he said was to wait for leaks and then fix them rather than trying to prevent them, and to leave contaminated soil in place until a reactor was ready to be torn down at the end of its life.

A nuclear plant's neighbors "have a right to put in a well and have it not affected by someone else's dirty nest," he said. Two twin-unit power stations in Illinois have had [tritium problems](#).

"It is my opinion that the regulatory culture of the N.R.C. needs to be reexamined and remolded," he said.

A member of the audience, Paul Gunter, the nuclear expert at a group called Beyond Nuclear, criticized the regulatory commission for having allowed the industry to design and carry out an inspection campaign to look for leaks. "The agency has basically turned over the oversight to the industry," he said. (The group recently produced [a report on leaks](#).)

Joining the meeting by telephone, Arnie Gundersen, a nuclear engineer who is a member of nuclear safety panel [established by the state of Vermont to evaluate Vermont Yankee](#), offered guidelines for a tritium strategy. "The first prong is to keep the horse in the barn, and the second prong is that if the horse gets out, to find it quickly."

Accomplishing either is unlikely, he said, if the pipes in question are underground and hard to inspect, as is the case at Vermont Yankee.

But he added, "It's not about dose, it's not about public health, it's about regaining public trust."



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July 2, 2010

Susan M. Hudson, Clerk  
Vermont Public Service Board  
112 State Street  
Montpelier, VT 05620-2701

Re: Docket 7600 – DPS prefiled testimony

Dear Mrs. Hudson:

Please find enclosed for filing an original and six copies of the prefiled testimony and exhibits of Department witness Uldis Vanags.

Thank you for your assistance in making this filing.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Sarah Hofmann".

Sarah Hofmann, Director for Public Advocacy  
Jeannie Elias, Special Counsel

cc: Attached Service List



**PSB Docket No. 7600 - SERVICE LIST**

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STATE OF VERMONT  
PUBLIC SERVICE BOARD

Docket No. 7600

Investigation into (1) whether Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc., (collectively, "Entergy VY"), should be required to cease operations at the Vermont Yankee Nuclear Power Station, or take other ameliorative actions, pending completion of repairs to stop releases of radionuclides, radioactive materials, and, potentially, other non-radioactive materials into the environment; (2) whether good cause exists to modify or revoke the 30 V.S.A. § 231 Certificate of Public Good issued to Entergy VY; and (3) whether any penalties should be imposed on for any identified violations of Vermont statutes or Board orders related to the releases

DIRECT TESTIMONY  
OF  
ULDIS VANAGS  
ON BEHALF OF  
VERMONT DEPARTMENT OF PUBLIC SERVICE

July 2, 2010

Summary: The purpose of my testimony is to respond to the issues presented in the Board's Order of 3/18/10.

Prefiled Testimony  
of  
Uldis Vanags

1 Q. Please state your name and occupation.

2 A. My name is Uldis Vanags, and I am the Vermont State Nuclear Engineer  
3 with the Department of Public Service ("The Department" or "DPS"). My  
4 responsibilities include oversight of the activities of the Entergy Nuclear Vermont  
5 Yankee nuclear power station in particular, and the nuclear power industry in  
6 general. In addition, I serve as one of two Vermont representatives to the Texas  
7 Low-Level Radioactive Waste Disposal Compact Commission.

8

9

10 Q. Please summarize your educational background and experience.

11 A. I have a B.A. in Physics from the University of Maine at Orono, and an  
12 M.S. in Health Physics from the University of Lowell, Massachusetts. Prior to  
13 coming to the Department, I served as the State of Maine Nuclear Safety Advisor  
14 for 11 years, as Energy Policy Analyst with the Maine State Planning Office for  
15 three years, and as Radiological Engineer at the decommissioning of the Maine  
16 Yankee nuclear power station for three and a half years. I have been with the  
17 Department since August 2007. My resume is attached as Exhibit DPS-UV-1.

18

19 Q. What is the purpose of your testimony?

20 A. In my testimony I provide the Department's response to the three specific  
21 issues outlined in the Board's Order of March 3, 2010, which defined the scope of  
22 this docket. Although the focus of this phase of the docket is on the first issue as  
23 per the Board's Order of 3/18/10, I have included information on the second and  
24 third issues as well.

25

1 Q. Please state the first of those three issues and the Department's response.

2  
3 The Board asked:

4  
5 Should Energy VY be required to cease operations at Vermont Yankee or take  
6 other ameliorative actions, pending completion of repairs to stop unpermitted  
7 releases of radionuclides, radioactive materials, and, other non-radioactive  
8 materials into the environment?  
9

10 A. The Department's response is that Entergy VY should not be required to cease  
11 operation of the Vermont Yankee nuclear station for the following reasons:

12 Since the leak of tritium to the environment was discovered at the station  
13 on January 15, 2010, Vermont Yankee assembled an effective team to locate and  
14 stop the source of the leak to the environment. I have closely monitored the  
15 team's progress and persistence to methodically locate the source of the leak  
16 which they successfully identified and stopped on February 15, 2010. The leak  
17 ceased when the drain in the AOG (Advanced Off Gas System) pipe tunnel was  
18 cleared which then allowed the normal process to resume whereby contaminated  
19 water flows to the AOG drain pit where it is contained and directed to the Rad  
20 Waste System.

21 Prior to the identification of the tritium source my recommendation was  
22 that the station continue to operate while searching for the leak as long as it did  
23 not affect the nuclear safety of the station or public health. There was no evidence  
24 that this leak was affecting systems, structures or components that could impact  
25 the safe operation of the station. The station was operating normally and without  
26 issue at maximum thermal power. In addition, the U.S. Nuclear Regulatory  
27 Commission (NRC) did not order the station shutdown. NRC has full authority  
28 to do so if nuclear safety of the station was impacted. I witnessed Vermont  
29 Yankee following all its procedures to assure there was a thorough engineering  
30 review prior to the drilling of sample wells and any excavation work. It was my  
31 assessment that the effort to locate the source of the leak would be aided and  
32 accelerated by performing the search while the plant was in operation and systems  
33 were pressurized.

1           Also, it was my assessment that continued operation of the station while  
2 searching for the source of the leak would not impact public health as  
3 demonstrated by the radiation dose analysis performed by Areva for Vermont  
4 Yankee and entered as Exhibit EN-JH-6. This dose calculation was performed to  
5 the maximum exposed individual that in this case would be a child who consumed  
6 food products and water from the Connecticut River and products irrigated with  
7 water from the River. The dose is estimated to be 0.000319 mrem in one year.  
8 The average person in the United States receives an average total dose of about  
9 310 mrem in one year from natural sources of background radiation as reported  
10 by the National Council on Radiation Protection and Measurements, Report 160.  
11 This assessment is supported by NRC's review of ENVY's revised dose  
12 assessment of May 9, 2010 where they state in the Vermont Yankee Nuclear  
13 Station – Ground Water Monitoring Assessment Inspection Report  
14 05000271/2010006 "The resultant dose calculation to a child was 0.00026 mrem  
15 in one year. In addition to the above stated exposure pathways, if there was also a  
16 drinking water pathway from the Connecticut River down stream from the  
17 Vernon Dam, the child dose would be 0.00035 mrem in one year."

18           As to ameliorative actions that would apply to preventing future leaks,  
19 Entergy VY should follow through on the Buried Pipe and Tank Inspection  
20 Program (BPTIP) and the Ground Water Protection Initiative. I have attached the  
21 Supplemental Report to the Comprehensive Reliability Assessment as Exhibit  
22 DPS-UV-2. This document was prepared for Docket 7440, but it provides  
23 background on the AOG (Advanced Off Gas System) leak investigation as well as  
24 an assessment of the BPTIP. The recommendations of the SR CRA should be  
25 followed through on by EntergyVY.

26  
27



1 Q. What was the second issue outlined by the Board and your response?  
2

3 Whether good cause exists to modify or revoke the  
4 Certificate of Public Good (“CPG”) that the Board  
5 issued to Entergy pursuant to 30 V.S.A. § 231 on June  
6 13, 2002, in Docket No. 6545 as a result of those  
7 releases?  
8

9 A. The Department’s response is that while it does not believe that cause  
10 exists to revoke the CPG issued to Entergy, the Board should impose a condition  
11 upon that incorporates the timely completion of the “*Groundwater Protection*  
12 *Initiative*”<sup>1</sup> as a condition of either the CPG or as a result of this docket for the  
13 following reasons:

14 The Board’s issuance of the CPG to Entergy was granted in part, on the  
15 basis of a finding that the nuclear station, if operated reliably, would result in an  
16 economic benefit to ratepayers. Throughout the tritium investigation undertaken  
17 by Entergy VY the nuclear station operated at 100% power except for two power  
18 reductions to make equipment repairs and required rod pattern adjustments. The  
19 unit capability factor for Vermont Yankee during January through May 2010 was  
20 97.75%, 98.68%, 99.01, 94.25, and 78.22, respectively. There was a short power  
21 reduction in mid-January due to insulator damage in the switch yard and a  
22 recirculation pump oil level alarm, both not related to the tritium leak event. A  
23 decrease in the capability factor in May was due to power down for the scheduled  
24 refueling outage. The tritium investigation did not impact the electrical power  
25 production of Vermont Yankee.

26 However, if the voluntary GPI had been completed on schedule this  
27 program would very likely have identified the tritium leak sooner. While three

---

<sup>1</sup> The Groundwater Protection Initiative(GPI) was developed and finalized by the Nuclear Energy Institute in August 2007 (NEI 07-07 (Final)). The purpose of this initiative was to address the inadvertent release of radioactive plant-related materials to the subsurface soils and groundwater which had occurred at multiple nuclear stations throughout the Nation. The GPI identifies those actions necessary for implementation of a timely and effective ground water protection program. This is a voluntary program that all nuclear power owners have agreed to implement. The Nuclear Regulatory Commission is monitoring the progress of the implementation of this program.

1 ground water wells were installed in the fourth quarter of 2007 by the river bank,  
2 the GPI was to be fully implemented by August 2008 which would have resulted  
3 in the development of a site specific hydro-geological model and installation of  
4 additional monitoring wells. This was not done as identified in Entergy VY's  
5 Root Cause Evaluation Report dated 6/16/10 and submitted to the Board by  
6 Entergy VY's counsel with a cover letter dated 6/22/10. It is estimated that the  
7 tritium leak may have progressed for 2 years prior to it reaching one of the  
8 sampling wells at the river bank. Had Entergy VY implemented the GPI on  
9 schedule it is highly likely that the leak would have been identified in its early  
10 stages.

11 While Entergy VY has recently communicated its intention to complete  
12 the voluntary GPI quickly, making it a mandatory condition would ensure that it  
13 does so and would also give the Board authority to monitor progress with  
14 compliance.

15 It is also relevant for the Board to determine whether the contamination  
16 related to the tritium leak at the Vermont Yankee site is likely to have an impact  
17 on the decommissioning cost for the plant, and whether a condition should flow  
18 from that information. Entergy VY provided its assessment of the impact to the  
19 cost of decommissioning from the AOG System leakage event to the Windham  
20 Regional Commission in Docket 7600, June 15, 2010, A.WRC:EN.1-11. Here  
21 Entergy VY stated that it was not possible for them to determine at this time if  
22 there would be any additional expenses borne by the VY Station's  
23 decommissioning trust funds. The Department agrees that at this time Entergy VY  
24 does not have all the analysis completed to determine if there will be any residual  
25 contamination from this event that may require remediation and costs from the  
26 decommissioning fund. However, considering the known contamination to date,  
27 it is unlikely that there will be any significant remediation requiring additional  
28 costs to decommission fund from either soil or groundwater contamination.

29 The AOG System event resulted in contamination of soils in the  
30 immediate vicinity of the leak source. The soil contamination from the leak

1 resulted in the removal of about 240 cubic feet of contaminated soil. The cost of  
2 this removal was from operational funds. No decommissioning funds to date are  
3 being used for this AOG contamination event.

4 Radioactivity measurements of the two locations that were remediated  
5 showed that the contamination decreased as expected with depth of the soil.  
6 Entergy VY has explained to the Department that the concentrations of nuclides  
7 remaining in the soils are at activity concentrations that can remain and still meet  
8 decommissioning radiation dose regulations for unrestricted use of the property.  
9 However, I would expect this area where the leak occurred and the pipe tunnel  
10 concrete structure (250 feet long and about 15 feet deep) which is contaminated  
11 will all be removed in entirety during decommissioning. In addition, I am aware,  
12 from the experience of mitigating radioactive soils at the Maine Yankee  
13 decommissioning project, that it is also true that contaminated soils can be  
14 effectively removed in bulk at costs that do not impact the cost of the  
15 decommissioning project. Thus, it is highly unlikely that any remaining soil  
16 contamination from this AOG System leak will have any significant impact on the  
17 decommissioning funds.

18 The AOG System leak has contaminated ground water on a portion of the  
19 site of the Vermont Yankee station. Entergy VY has taken measures to mitigate  
20 the ground water contamination by pumping out contaminated water from one  
21 extraction well. The company's plan is to pump out approximately 300,000  
22 gallons of the tritium contaminated water which will ultimately be used as  
23 makeup water for the nuclear station over several years. The nuclear station  
24 requires makeup water as it operates and the purified water in the systems and  
25 spent fuel pool are already tritiated so utilizing the extracted water is an efficient  
26 means to disposition it. Since the AOG System leak was located and stopped,  
27 overall concentration of tritium in most test wells is decreasing. In general, wells  
28 close to the source of the leak and the extraction well are decreasing in tritium  
29 concentration. The most outer wells, especially toward the river bank have  
30 experienced increases in concentration due to the plume moving toward these

1 wells. However, the concentrations are expected to begin declining once reaching  
2 a maximum concentration. At present, Entergy VY has GZA GeoEnvironmental,  
3 Inc. developing a computer model of the ground water flow at the VY site. This  
4 model will enable GZA to reasonably predict the tritium concentration decline  
5 overtime and will provide information to the Department if the ground water  
6 tritium concentrations will present any restrictions to the land use when Vermont  
7 Yankee is eventually decommissioned.

8 The bottom line is that it is unnecessary for the Board to add a condition to  
9 the CPG regarding decommissioning costs. First and foremost, the Docket 6545  
10 Order makes clear that the decommissioning risk is squarely on Entergy VY's  
11 shoulders whatever the cost may be so such a condition would be redundant.  
12 Second, although the Department does not believe that decommissioning costs  
13 will be significantly increased because of the leaks, this issue is better reviewed in  
14 the context of Docket 7440.

15  
16 Q. What was the third issue outlined by the Board and your response?  
17

18 Whether any penalties should be imposed on  
19 Entergy VY for any identified violations of Board  
20 orders related to those releases, or any statutory  
21 violations that are within the Board's jurisdiction  
22 for imposing sanctions?  
23

24 A. The Department at this time is unaware of any violations of Board orders  
25 or CPG conditions related to the releases. Accordingly, the Department does not  
26 believe that penalties can be imposed under the criteria of Title 30 of the Vermont  
27 Statutes Annotated. However, the Department defers to and supports any  
28 recommendations on this question made by the Vermont Agency of Natural  
29 Resources for matters related to conditions or criteria related to environmental  
30 issues.

31  
32 Q. Does this conclude your testimony?

33 A. Yes.