Entergy Nuclear Vermont Yankee
Comprehensive Vertical Audit
ENVY CVA

Recommended Methodology
To Thoroughly Assess Reliability and Safety Issues
At Entergy Nuclear Vermont Yankee

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January 30, 2008

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Legislators, ratepayers, environmentalists and concerned citizens from across the State have called for a NRC Maine Yankee (MY) Style ISA (Integrated Safety Assessment). Even the Vermont Legislature called for an ISA, while the Vermont Public Service Board called for a four-vertical-slice inspection. At the same time, due to alleged cost containment efforts and industry pressure, the NRC has vowed it will not conduct another ISA. The NRC maintains that its Reactor Oversight Process (ROP) fulfills all the functions of an ISA, which simply is untrue.

Performance at Entergy Nuclear Vermont Yankee since Entergy bought the plant has had significant identified weaknesses including a transformer fire, lost nuclear fuel, a fire in an electrical fuse cabinet, an un-greased turbine stop valve, and a collapsed cooling tower. This series of incidents lead us to believe that a thorough Audit must occur prior to any consideration of life-extension. The CVA Group Charter as defined by the State Legislature should be to "*find the weakest links the system*". The CVA team shall be required to look at *what parts or systems are most prone to failure, and then seek to identify the particular components, which might be compromised or stressed*. The State Legislature has been given the statutory authority to examine the reliability of Entergy Nuclear Vermont Yankee and in doing so, determine if it should be relicensed for an additional 20 years. Since ENVY was originally designed to operate for only 40 years, and many of the similar-aged plants have already shut down, how will the State Legislature be able to take such action without a Comprehensive Vertical Audit to determine whether or not ENVY is indeed mechanically sound and reliable enough to run for the proposed additional 20-years. In review of literally hundreds of pages of ENVY documents, it is evident that ENVY needs such a thorough Audit.

DPS has repeatedly stated that the NRC does this job, and that Vermonters should not worry. Given that very few NRC personnel actually oversee the operations of its 20,000 licensees, the NRC relies upon each licensee to accurately and honestly report itself every time it violates any aspect of its license. This reliance by the NRC upon the licensee at each of the 100 U.S. nuclear reactors to tell the complete and accurate truth is codified in federal law in 10CFR50.9. Each nuclear utility's responsibility to report non-conforming conditions in a timely manner is codified in 10CFR50.72 and 10CFR50.73. Moreover, NUREG-1022 provides more than adequate guidance by delineating what each nuclear plant must report. This concept of self-reporting by each nuclear power plant of its own violations would be the equivalent of someone in the general population notifying the police each and every time the car they were driving exceeded the speed limit.

It would simply be impossible for such a limited number of NRC inspectors to "police" the more than 250,000 employees and 20,000 licensees under their purview, without the expectancy that licensees honestly self-report their own violations as required in 10CFR50.72 and 10CFR50.73 and 10CFR50.9.

Between 1997 and 1999 the NRC worked on developing new protocols now called the Reactor Oversight Process, which were applied to ENVY's vertical slice examination. During the review of the aforementioned Reactor Oversight Process, NRC senior managers informed the NRC Chairman and the Commissioners that <u>*NRC inspectors audit only about five percent of the daily activities at a typical nuclear power plant.*</u> This gives nuclear licensees an inordinate amount of control to determine on their own how to qualify and quantify any nuclear incident incidents.

ENVY's most recent "significant" plant engineering and operations incidents include:

- Two fires
- Ungreased valves
- Lost nuclear fuel
- Shipping nuclear waste on an open truck to PA
- $400,000,000 Decommissioning Fund Gap
- Two Vermont fines – $51,000 and $82,000
- Collapsed cooling tower
- Uprate – no increase in ENVY staff
- Uprate – has no new reliability or safety features

- Uprate – reduces reliability and safety margins

Reviewing these concerns along with the added engineering and operational pressures from an Uprate that has the plant producing 20% more power than it was ever designed to produce and proves that this nuclear power plant requires a womb to tomb evaluation to adequately assess significant reliability and safety concerns.

CVA (Comprehensive Vertical Audit) Compare and Contrast

We are not proposing a 25,000 man-hour Maine Yankee ISA. The NRC has already opined that it would never support such an exhaustive exam, and truth be told, the ISA did not uncover all the problems facing Maine Yankee, nor did the results of the ISA shut Maine Yankee down. It is time to move beyond the myth of the infallible ISA to an examination and evaluation that will meet the needs of the State of Vermont, its citizens, and ENVY. The evidence collected during the PSB vertical slice option clearly showed that a ROP inspection does not meet the needs of an aged plant like Entergy Nuclear Vermont Yankee. Furthermore, given that Entergy Nuclear Vermont Yankee has had the largest uprate of any plant in the country and now is applying for a 20-year-life-extension beyond its 40-year design, there is more than adequate reason to conduct a Comprehensive Vertical Audit (CVA).

What would a CVA (Comprehensive Vertical Audit) mean for Entergy Nuclear Vermont Yankee?

A CVA does not raise the bar for ENVY, nor does it set up more hoops through which ENVY must jump, *but it does thoroughly examine specific safety and reliability systems to certify that each one of those systems is able to perform its critical reliability and safety function as designed*. A CVA, as some claim, is not a hidden attempt to challenge the old plant to see if it meets newer criteria applied to newer plants. Rather, a CVA is a methodology by which to audit (conduct a methodical examination or review of a condition or situation) specific safety and reliability systems in order to compare and contrast the original plant design with changes in hardware, engineering, and maintenance.

Each nuclear power plant is designed with the real and known risk of atomic energy and awareness that any accident poses a threat to the public. Nuclear power plants are therefore designed with redundant safety systems in place, so that if one safety system fails, a second or third system will function as designed and hopefully protect the public from harmful radiation. In its typical manner, the nuclear industry has applied its amorphic euphemisms to the term redundant safety system and called it *single failure proof*, which in nuclear speak means that a single failure will not disable the plant. Recent NRC rulings in the light of uprated plants have pushed the redundant safety system to the point that it may in fact not be single failure proof. Consequently, a CVA would assess critical safety and reliability systems at Entergy Nuclear Vermont Yankee in order to ascertain whether the plant is more or less reliable when generating electricity following uprate, and to certify that critical safety systems needed to protect the people of Vermont will perform as designed.

The importance of a CVA cannot be over-emphasized.

In order to achieve a Comprehensive Vertical Audit, six key parameters must be established. These parameters are detailed in this Preliminary Analysis recommending this Methodology

1. **Key Audit Instructions**
2. **Systems to be Audited**
3. **Methodology of the Audit**
4. **Duration of the Inspection**
5. **Composition and Size of Inspection Team**
6. **Availability of Documents**

Brief History:

Entergy Nuclear Vermont Yankee (ENVY) was designed more than 40-years ago. When ENVY was newly built, it relied upon General Electric, the nuclear vendor that designed and sold the plant, and Ebasco, Vermont Yankee's Architect Engineer (AE) for its engineering support. As the nuclear industry evolved, and as plants aged, both the nuclear vendor and the AE dropped their engineering support and each nuclear power plant was required to develop its own in-house nuclear engineering department. This was a very costly proposition for a stand-alone plant like Entergy Nuclear Vermont Yankee. While such a step gave ENVY an engineering group that intimately knew the plant and its workings, it also did not give such a small engineering team and corporation the wherewithal to make continuous re-evaluations or to employ arm's length oversight. One of the reasons that Entergy's purchase of VY was seen by the PSB, DPS, and Vermont's utilities as a great option was the anticipation that Entergy had both the financial wherewithal and expertise to manage a nuclear plant. We are talking about nuclear radiation and radioactive waste; it is not like maintaining an old car that if not well maintained may blow an engine which one could replace. An aging nuclear plant like Entergy Nuclear Vermont Yankee needs a well-run and meticulous Aging Management System with which to conduct regular and thorough inspections of every system to look for flaws and weaknesses. When those weaknesses are discovered, then each component, pipe, cable, sensor, actuator, weld and piece of concrete must be promptly repaired, even if such a repair is very costly. Things should not be placed on a "deferred list" to see if they may or may not break. Corrective action for an old nuclear plant should be swift and thorough as real lives are at stake.

Instead, <u>under Entergy's ownership</u>, Entergy Nuclear Vermont Yankee has experienced a transformer fire and a collapsed cooling tower among other things that could have been avoided by proper Aging Management procedures and were seemingly unanticipated by State Regulators and the State Legislature. In light of the fact that ENVY has increased its power output 20 percent above its original design and is now requesting a 20-year license extension beyond the original 40-year designed lifespan, it is imperative that this aged reactor has a complete safety and reliability review. The NRC has repeatedly stated that it is not responsible for reliability issues, only safety issues, but to Vermonters who depend upon ENVY's electric output during Vermont's long, cold winters, reliability is in actuality a safety component of VY's operation. Just as Commission Chairwoman Shirley Jackson ordered an ISA for Maine, the NRC or Chairman Dale Klein has the option to so order a CVA for Entergy Nuclear Vermont Yankee. Moreover, such an

Audit is critical given the facts that ENVY has applied for a 20-year license extension and its Decommissioning Fund is woefully unprepared to dismantle the plant in 2012 as most Vermonters anticipated.

CVA - Comprehensive Vertical Audit

A Comprehensive Vertical Audit would look at a minimum of four specific systems and preferably seven systems in a comprehensive and in-depth manner. The Audit would look at each system from the time it was designed (womb) through present to end of life (tomb).

The Seven Systems a CVA Would Examine Are:

1. **One electrical system: the diesel generator system**. While the name diesel may sound mechanical, its function is not, because the diesel generator is one of ENVY'S most critical electrical components. The diesel generator makes all the electricity for ENVY in the event of an accident, including power to the control room and every safety related pump.

2. **One safety system: Low pressure safety injection**. The low-pressure safety injection system is the system that cools the nuclear reactor in the event of an accident. There are two pressure safety injection systems: one high pressure and one low pressure. The high-pressure safety injection system runs for only a short period of time, while the low-pressure safety injection system is designed to run for a week or more in order to avoid a meltdown.

   According to nuclear engineer Joseph Gonyeau,

   > "All nuclear power plants have some form of emergency makeup water system in the event that normal makeup is lost and a major break occurs in the reactor cooling system. These emergency systems are called such names as - High Pressure Coolant or Safety Injection, Low Pressure Coolant or Safety Injection, Reactor Core Injection Cooling… The Emergency Core Cooling Systems have 1 major function: Provide makeup water to cool the reactor in the event of a loss of coolant from the reactor cooling system. This cooling is needed to remove the decay heat still in the reactor's fuel after the reactor is shutdown"[1]

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[1] *Joseph Gonyeau, http://www.nucleartourist.com*

Union of Concerned Scientists has noted,

> "Net positive suction head (NPSH) is a key parameter in determining whether the [Emergency Core Cooling System] ECCS pumps will be able to provide the necessary cooling water flow to the reactor vessel. The NPSH depends on factors like the static head (height of water), discharge head, water temperature, flow rate, and length of piping." [2]

Yes, we know this sounds quite technical, but if you have a well, you may know that your well can lose suction in which case the well cannot pump water to your house. NPSH is a similar issue except that the pump might not be able to cool the critical core of the nuclear reactor! According to Union of Concerned Scientists:

> "Some nuclear plant owners, like that for Vermont Yankee, seek to take credit for containment overpressure in order to meet the NPSH requirements for the ECCS pumps at uprated power levels. Containment overpressure is the pressure above atmospheric inside the containment caused by the energy released during the accident. That pressure, when added to the static head, can keep the water pressure inside the pump from dropping below the vapor pressure. The plants were originally built and licensed for static head alone to keep pressure above the vapor pressure. But higher suppression pool water temperature and/or higher ECCS pump flow rates at power uprate levels drop the pressure below the vapor pressure—unless containment overpressure is available… Rather than take credit for containment overpressure and hope that one of these possible scenarios doesn't occur, the NRC should protect the public by insisting that adequate NSPH for ECCS pumps be guaranteed by static head alone." [3]

3. **One mechanical system: the condensate feedwater system, including the condenser. ENVY is a BWR-4 model designed by General Electric**.

> "Water is circulated through the Reactor Core picking up heat as the water moves past the fuel assemblies. The water eventually is heated enough to convert to steam. Steam separators in the upper part of the reactor remove water from the steam.
>
> The steam then passes through the Main Steam Lines to the Turbine-Generators. The steam typically goes first to a smaller High Pressure (HP) Turbine, and then passes to Moisture

[2] *Union of Concerned Scientists (UCS) http://www.ucsusa.org/clean_energy/nuclear_safety/concerns-about-relying-on-containment-overpressure.html*

[3] *Union of Concerned Scientists (UCS) http://www.ucsusa.org/clean_energy/nuclear_safety/concerns-about-relying-on-containment-overpressure.html*

> Separators, and then on to the 2 or 3 larger Low Pressure (LP) Turbines. The turbines are connected to each other and to the Generator by a long shaft (not one piece). The Generator produces the electricity, typically at about 20,000 volts AC. This electrical power is then distributed to a Generator Transformer, which steps up the voltage to either 230,000 or 345,000 volts. Then the power is distributed to a switchyard or substation where the power is then sent offsite.
>
> The steam, after passing through the turbines, then condenses in the Condenser, which is at a vacuum and is cooled by…" water from the Connecticut River. "The condensed steam then is pumped to Low Pressure Feedwater Heaters"… then "the water then passes to the Feedwater Pumps which in turn, pump the water to the reactor and start the cycle all over again…
> …The Condenser has two major functions:
>
> - Condense and recover the steam that passes through the turbine (Condensers are used in all power plants that use steam as the driving force)
> - Maintain a vacuum to optimize the efficiency of the turbine."[4]

4. **One Structure: The Containment itself, including isolation valves, containment spray, and NPSH**.

A key principle in the design of the nuclear plant is defense in depth. There are intended to be three barriers between the radioactive fission products and the public in order to reduce the likelihood of radioactive releases. These three barriers are - the fuel cladding, the reactor coolant piping, and the containment.

Entergy Nuclear Vermont Yankee is a Mark I Boiling Water Reactor (BWR) and therefore has the traditional torus and inverted light bulb design. This was the first generation of BWR containment, as used in the BWR 1 through 4 designs, and 22 nukes have this style of containment. The design includes:

- The drywell, which surrounds the reactor vessel and recirculation loops,
- A suppression chamber (also known as the torus), which stores a large body of water (suppression pool),
- An interconnecting vent network between the drywell and the

[4] *Joseph Gonyeau, http://www.nucleartourist.com*

suppression chamber, and

- The secondary containment, which surrounds the primary containment (drywell and suppression pool), and houses the spent fuel pool and emergency core cooling systems.

Entergy Nuclear Vermont Yankee originally had 8 relief valves that discharged into the torus. One additional relief valve was added during the uprate. Isolation valves are a critical component of the containment system, including but not limited to the Main Steam Isolation Valve - usually an air operated or motor operated valve used to isolate the steam source from the turbine.

Containment Spray is used to reduce the pressure inside containment after an accident. However, after Uprate, ENVY is required to keep the Containment pressurized in order to provide adequate NPSH suction to the emergency pumps. This means that operators cannot completely mitigate an accident if it were to occur, but rather they must turn the Containment Sprays on and off to keep the pressure high. It is critical to assure that Containment Spray can in fact actually be modulated.

5. **One heat removal system: Cooling Towers**

   Entergy's Vermont Yankee Nuclear Power Plant has a unique cooling tower design unlike any other. ENVY has one single, safety related[5] and seismic[6] related cooling tower, which is attached to a single seismic tower, which in turn is attached to a bank of non-safety, non-seismic cooling towers. ENVY is further unique in that the two seismic cooling towers, one of which is safety related, serve a dual purpose of cooling the plant in its normal

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[5] "In the regulatory arena, this term [safety related] applies to systems, structures, components, procedures, and controls of a [nuclear] facility… that are relied upon to remain functional during and following design-basis events. ["Design Basis Event - A postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to assure public health and safety".]" The *safety related* "functionality ensures that key regulatory criteria, such as levels of radioactivity released, are met." *NRC Glossary, http://www.nrc.gov/reading-rm/basic-ref/glossary.html*

[6] Seismic refers to the "structures, systems, and components that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is sited" and built. *NRC Glossary, http://www.nrc.gov/reading-rm/basic-ref/glossary.html*

operating mode as well as during the critical period in the case of an accident. As a result, the recent failure of a non-safety related tower, and the ongoing concerns regarding missing design basis documents presented during the uprate hearing strongly suggest that the Comprehensive Vertical Audit include the seismic and safety related cooling towers.

6. **One Connecticut River Cooling System: Service Water and Emergency Service Water**

   These systems keep components like the fuel pool from overheating. They also cool the radiator for the diesel generators. In our opinion, the 20% uprate has further strained these systems.

7. **One Generic Issue: Cable Separation – Separation of Safety Systems:**

   Each nuclear power plant has at least two sets of completely redundant safety systems in order to be "single failure proof". In order for safety-related components to be fully redundant, they must be physically separated. Physical separation assures that common events, like a fire or broken pipe, do not simultaneously impair the function of both systems. Therefore, pumps, electrical motors and valves are usually placed in separate rooms to insure that such separation exists, and which is quite easy to inspect. Unfortunately, determining that an actual separation exists between the individual cables (wires), that provide power to the pumps as well as the signals to the sensors, is a much more difficult issue to address.

   For safety reasons, most of the thousands of miles of wires and or cables are wrapped in protective fire retardant blankets. During the original nuclear power plant design phase, these fire retardant blankets were designed to hold only one set of these redundant cables (called a safety train), and in that manner thus assuring the necessary separation of these critically redundant safety systems. The industry has been dismayed to discover that at almost every nuclear plant in the country, both sets of cables where placed together inside the same fire retardant blanket at some point during the construction phase. This error presents serious problems, as a short circuit in one set of cables would then cause a failure in the second set of cables thereby negating the single failure proof design that assures critically redundant safety features.

The ISA at Maine Yankee uncovered numerous situations in which the cables were not physically separated. As a result there was an industry-wide review of this cable separation problem. The industry-review of cable separation uncovered and corrected many instances where these critical safety cables were in fact not installed as designed and were bundled all together. Prior to Entergy Nuclear Vermont Yankee's purchase by Entergy, the cable separation review was ostensibly performed at Entergy Nuclear Vermont Yankee, which claimed to have found separation problems, and corrected all of them. Entergy also claims to have solved this cable separation issue. Yet on more than one occasion since Entergy purchased VY, it has discovered cables in the wrong location and in violation of the cable separation issue. Given that VY previously claimed to have solved this problem, new findings of improperly bundled cable are quite problematic.

Therefore it is our opinion that the cable separation issue should be addressed as the "seventh" slice in this Comprehensive Vertical Audit. Determining physical separation is not simply an academic exercise that may be accomplished by reviewing old records. Therefore it is critical in a redundant safety feature of this nature that an actual physical examination of the cables be performed by opening the protective blankets and observing whether all the cables are in the location as designed to assure safe shutdown. Such an exam would be required to occur while the unit is shutdown for refueling. While planning for this critical portion of the Audit requires the expertise of experienced electrical engineers, the actual physical inspection does not. Certified electrical inspector technicians, who are specifically hired for this purpose during an outage, normally perform inspections of this nature. Such certified inspector technicians are available on the open labor market specifically to support nuclear power plant outages.

The difficulty in this part of the Audit is the planning detail, which will take three experienced electrical and control engineers, approximately one month. During the outage, it will take three teams of three certified inspector technicians to do the hands-on effort, reporting to only one manager. These outage inspector team members normally work 60-hour weeks for approximately three to four weeks. The areas of possible cable separation near the control room require special attention. Even during an outage, such an examination requires a unique and timely interface with Entergy because there is fuel on site and in the reactor, thus only one safety train may be examined at a time. The other set of cables must be free to perform its safety function if called upon to manage the fuel, which should be sitting idle. Following the outage, the three initial engineers will be required to reconvene in order to assess the exam and the data and to prepare a report.

While the man-hours for this particular effort are the largest of all the six slices in this Audit, it is important be aware of the fact that most of these additional hours will not require additional NRC resources. The nine certified electrical inspectors used during the outage are not NRC employees, rather they are available through several companies who routinely provide these specifically trained inspector technicians.

At a minimum, a Comprehensive Vertical Audit (CVA) would entail the following and would begin with an Audit of Entergy Nuclear Vermont Yankee's Initial Conditions:

1. What were the codes and standards with which the system was designed to comply?

2. What was the system designed to do? [This is most often called the Design Basis.]
3. Is the design of the system in keeping with the expected initial conditions?
4. Procurement:
    - Do the components match the original design or were items changed during construction?
    - If there were procurement changes, were a new set of review calculations completed for those procurement changes and were those procurement changes compared against the original design and all of its calculations?
5. Installation: [often referred to as As-Built]
    - Was the system installed to match the original design?
    - If not, what was the impact on safety and reliability systems?
    - Were the codes and standards modified to include any changes to the design?
    - Does the As-Built meet the original system design?
    - If not, what are the specific As-Built changes and how do those changes meet codes and standards?
    - Were new computer modeling systems for accident scenarios or for radiation monitoring designed with the As-Built in mind or do they only reflect the original on-paper design?
6. Operation:
    - Has the system operated as the designers had planned and anticipated?
    - What were the unanticipated operations' outcomes?
    - What changes or compensations have been made to accommodate unanticipated operations outcomes?
    - Have those changes, compensations, and accommodations been duly noted in procedure manuals as well as in operation manuals and logs?
    - Has a root cause analysis been conducted to reflect unanticipated outcomes?
    - If a root cause analysis was not conducted, why not?
    - If a root cause analysis was not conducted, presently look for root cause in order to determine if unanticipated system operations outcomes have been

duly compensated for in all safety and reliability operations and procedures.

7. Testing:
   - Has the system undergone periodic tests to prove it is capable of meeting its design basis?
   - If the system has not undergone periodic tests, why not?
   - If the system has undergone periodic tests, have those tests been successful?
   - Are any changes reflected in all documents from Design through As-Built through current operations?
8. Inspection:
   - Has the system undergone periodic inspections to prove it is capable of meeting its design basis?
   - If the system has not undergone periodic inspections, why not?
   - If the system has undergone periodic inspections, have those inspections been successful?
   - Are any changes reflected in all documents from Design through As-Built through current operations?
9. Maintenance: The Aging Management System is one of the most critical aspects of the operation of older nuclear power plants like Entergy Nuclear Vermont Yankee.

> Thorough industry-wide "research conducted under the auspices of the US Nuclear Regulatory Commission's Nuclear Plant Aging Research (NPAR) Program has resulted in a large database of component and system operating, maintenance, and testing information. This database has been used to determine the susceptibility to aging of selected components, and the potential for equipment aging to impact plant safety and availability" [reliability]… The NPAR database also identifies "methods for detecting and mitigating component and system aging."[7]

[7] **Recommendations for managing equipment aging in nuclear powerplants** Gunther, W.E.; Subudh, M.; Aggarwal, S.K. Nuclear Science Symposium and Medical Imaging Conference Record of the 1992 IEEE Volume , Issue , 25-31 Oct 1992 Page(s):754 - 756 vol.2 Digital Object Identifier Issue , 25-31 Oct 1992 Page(s):754 - 756 vol.2 10.1109/NSSMIC.1992.301411 http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel2/1042/7439/00301411.pdf

The NRC has noted that ENVY is not adequately maintaining or reviewing its aging management system. This is of grave concern.

- Has the system been maintained to assure it will meet its design basis?
- Is there a track-change system in place to determine what components have been reviewed, repaired or replaced?
- Is there an accurate system in place to record when those reviews and repairs were completed?
- Is there a program of operations or a schedule of operations that specifically delineates what aging management systems, as identified in the industry-wide database, are being reviewed and when?
- Is adequate time allowed in each outage for aging management review, or are those items neglected in order to shorten outage times in an effort to maximize corporate profit?
- Are the aging factors discovered actually being repaired in a timely manner?

10. Repairs:
    - Have repairs been performed which assure the system will operate as expected?
    - Are all repairs completed as soon as possible or are they postponed in an effort to save money and shortage outage times?
    - Are repairs in-depth repairs that really invest in the plant and its operational safety or simply a band-aid approach done in order to save time and money?
11. Modifications:
    - Do all modifications to the system also comply with the system's original design basis?
    - Have all procedure manuals and operations manuals been updated to reflect the impact of any modifications made to any system?
12. Redesign:
    - Have changes made to the plant since original construction been reviewed to ensure that safety margins have not been reduced?
    - Has each component modified for uprate been reviewed to assure that safety margins have not been reduced and to assure that design basis safety

redundancy has not been compromised?

13. Training:
    - Has an adequate review and evaluation of operator training and operating procedures been conducted as a method of determining if the design criterion has been met? In other words:
        - Do the procedures followed meet the As-Built or the Design?
        - If there were changes from Design to As-Built to Modification, have all these changes adequately reflected in the operations procedures?
        - Did the procedural rewrites contain the *<u>necessary reanalysis</u> (as required during Design Basis)* to support the existing As-Built and any Modifications?
    - Have operations personnel been adequately trained in all Modifications to all systems?
    - Are there frequent meetings among operators and engineers for the purpose of uncovering discrepancies or idiosyncrasies in actual operations compared to what engineers and management anticipated?
    - Are operations personnel frequently updated and trained regarding any troublesome issues other plants have uncovered which may compromise operations and safe shutdown?

14. <u>This final step is a critical key to a CVA</u>. The CVA Team must examine all corrective actions programs for each of the systems Audited in order to determine what modifications may have been deferred and why those corrective actions were in fact deferred. Nuclear licensees like Entergy Nuclear Vermont Yankee perform "Operability Assessments" which seek to justify continued operation in accordance with guidance from NRC generic letter 91-18 (Guidance for Engineering Judgment). Reviewing operability assessments after a thorough understanding of all prior criteria, will enable the CVA Inspection Team and the Public to ascertain whether critical systems which require regular inspection and maintenance are not having those inspections or whether that maintenance is

being postponed in an effort to shorten outages and maximize profit.[8]

> **<u>Note:</u>** It should be noted that the draft design criteria to which Entergy Nuclear Vermont Yankee was built no longer exists. Those older design criteria were replaced in the mid-70s by more modern design criteria. The CVA would not Audit to the newer mid-70s design criteria, which would most likely be an impossible hurdle. Instead, the CVA would reflect VY's original design criteria (the Design Basis).

CVA Duration:

We estimate that an Audit of this nature would be completed in less than five months and encompass slightly less than 17,000 man-hours for an Audit of all 7 Systems, with approximately 9,500 man-hours on site, and the remaining hours spent in preparation, establishing criteria, or in report analysis and preparation. The aforementioned 25,000-hour inspection at Maine was due to the identification of many previously uncovered problems. If Entergy Nuclear Vermont Yankee has been paying attention to its Aging Management System, as it has stated, and has regularly updated all procedures and operations manuals, and adequately meets its Design Criteria, approximately only two-thirds (2/3) of the Maine Yankee type ISA man-hours will be required to complete a Comprehensive Vertical Audit.

This Audit must begin at least one to two months prior to the 2008 Outage. At least three of the on-site weeks must take place during the 2008 Outage to allow visual inspection of systems like the Containment Systems and the Safety Injection Systems.

However, if problems are uncovered during the preliminary review, it will be necessary to expand the CVA via an IPA (In-depth Perpendicular Audit) to uncover the root cause of failures and discrepancies and assure all parties that neither the Safety nor the Reliability of Entergy Nuclear Vermont Yankee has been compromised.

Please see the estimated CVA hours in the Table below:

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[8] **<u>Note:</u>** The ISA @ MY determined that cost was *in fact* a reason for deferred maintenance.

Estimated Hours for CVA

On Site Hours	People	Weeks	Hours	Total Hours
Diesel Generator	3 x	6 x	50	= 900
LPSI	4 x	6 x	50	= 1200
Feedwater Condensate	4 x	6 x	50	= 1200
Containment/ Isolation Valve	5 x	6 x	50	= 1500
Cooling Tower	3 x	6 x	50	= 900
Service Water	3 x	6 x	50	= 900
Cable Separation NRC Technicians	1 x [9 x	6 x 4 x	50 60	= 300 = 2160]
Team Leader (Administrator)	1 x	6 x	50	= 300
Total Onsite NRC Inspectors[9]	33 people x 24 + 9	For up to 6 weeks		
Total Offsite	26 people x	*3 weeks to set criteria 4 weeks to report For 7* weeks Total x	40	= 3120 = 4160 = 7280
Total Man-hours				= 16,640

In-depth Perpendicular Audit (IPA) Threshold Criteria

In the event that the results from each section of the Comprehensive Vertical Audit begin to show that a specific area contains a disproportionate number of Audit findings, there will be a clearly delineated and predetermined threshold for initializing the In-depth Perpendicular Audit.

[9] NRC offsite personnel exceed NRC onsite personnel because two cable separation experts are not required onsite during the outage while 9 non-NRC technicians perform cable separation inspections.

At what point do the results of the six vertical audits trigger a perpendicular audit of other similar areas in other systems beyond the original scope of the CVA? We believe that an In-depth Perpendicular Audit should be automatically triggered of at least four other systems not originally covered by the initial CVA when a single topic area within any Vertical Audit shows a pattern of either:

- three "green" findings, or
- two "white" findings, or
- two "green" and one "white" finding or
- a single "yellow" finding.*

Note: The Audit Color Code is already defined by the NRC regulations. This broadening of the original scope would be appropriate, given the appearance of a meaningful cluster of Audit findings in a single Audited area.

Composition and Size of Inspection Team

The CVA team assigned to the Audit would consist of 26 NRC inspectors for the complete six-system CVA and at least two specifically-named independent observers who are Vermont residents with nuclear expertise as well as a State and/or Legislative Representative. The two proposed nuclear experts who reside in Vermont are former NRC Commissioner Peter Bradford and Nuclear Safety Expert Arnie Gundersen.

- In addition to his 5-year term as a Commissioner for the NRC, Commissioner Bradford was the Commission Chair on both the Maine and New York State Public Service Boards and teaches nuclear power and public policy at both Yale and Vermont Law School.
- Mr. Gundersen is a nuclear engineer, former nuclear industry senior vice-president, and former licensed reactor operator, who is the only independent nuclear engineer to review most of ENVY's 200,000 pages of documents provided through discovery for ENVY's uprate license application and hearings.

The Vermont Department of Public Service (DPS) may also wish to have its state nuclear engineer added as an observer, and the PSB and/or the State Legislature and/or Windham Regional Commission may also wish to add observers.

NRC Team Composition

- The NRC CVA will report directly to the Commission.
- None of the NRC team members will have previously worked Entergy Nuclear Vermont Yankee in any capacity, either as a NRC employee, VY employee or independent contractor.
- No Region 1 personnel except for one resident inspector as an observer in order to answer ENVY specific questions for all inspectors and observers.
- No personnel from NRR (Nuclear Reactor Regulation)

Availability of Documents:

An important distinction between the ENVY CVA and the MY ISA is that there have been significant improvements in information technology that allow for the rapid access to and the dissemination of documents. This should improve the overall efficiency of the CVA Team effort. These technological improvements will also allow for easy electronic access by the public to the CVA Report after it is completed. The ISA team for MY produced a 70-plus page report that was made publicly available. That report cited dozens, perhaps hundreds, of documents reviewed at Maine Yankee by the ISA team but unable to be viewed by the public.

With the technological changes in information systems, it should be relatively easy for the CVA report, output and inputs to be linked via the NRC website and other websites as a final work product available for public access. Any proprietary documents would be able to have redaction if deemed necessary by the observers and Citizen's Panel in conjunction with the NRC. Too often, the nuclear industry labels documents proprietary in an effort to not allow the public to know what is really going on within the plant. In order to help rebuild public trust, the reviewed documents that are pertinent must be publicly available as they would be if FOIA worked as it was designed to work.

Citizen Review Panel

Finally, as many of the issues discussed herein relate to public confidence, the final report from the Comprehensive Vertical Audit will be submitted to a Citizen Review Panel for comments. The Citizen Review Panel's comments would be submitted to the State Legislature along with the CVA for review in preparation for ENVY's license extension. The Citizen Review Panel's comments would be available to the general public and meet the legislature review timetable. Accordingly, a Legislative Task Force would be designated to create this Citizen Review Panel which at a minimum would include one member from each of the citizen interest groups, one member from each group that has been an intervenor in the process, key legislators who are part of the ENVY oversight process via regulatory review, finance, or the environment, and VY citizen technical experts.

ISA History for Comparison with CVA:

The ISA conducted by the NRC at the Maine Yankee Nuclear Power Plant did not begin as a 25,000-man-hour effort. Instead, the Maine Yankee ISA started out small and was planned for three weeks on site followed by two weeks back in the office writing reports and completing the overall assessment. Please remember that the political climate was rife with nuclear safety concerns.

According to Ray Shadis in his 2003 remarks to VSNAP:

> "Prior to the ISA, Maine Yankee received a regimen of routine and special inspections"… and "Maine Yankee received the very highest performance and safety ratings.
>
> Were it not for the chance of whistleblower allegations that Yankee Atomic Electric Company had knowingly performed inadequate analyses to support a 10 percent uprate, the ISA would likely never have happened.
>
> The 1996 NRC ISA report has it that this single " issue raised a question of whether similar problems existed in other areas. In order to address this question, as well as to respond to concerns by the Governor of Maine about the safety and effectiveness of regulatory oversight of Maine Yankee, the NRC Chairman initiated an independent safety assessment of Maine Yankee."

> It is also fair to say that the Maine Yankee ISA was triggered by an uprate; although in that case it had already erroneously been granted.
>
> The NRC did not shut Maine Yankee down as a result of the ISA.
>
> In fact the ISA found Maine Yankee safe to operate though not at uprated power. Plant owners and the Governor crowed at the plant's designation as, "*safe*" [emphasis added]…
>
> …However, the projected costs of remedying the long list of safety defects uncovered by the ISA and under NRC "watch list" scrutiny following ISA, proved too much for Maine Yankee's owners and the plant was permanently closed. Topping the list of "high ticket" items was the failure to maintain safe electrical cable and circuitry configuration. (Perhaps this is what ENVY fears.) Cable separation is a perennially emerging problem at Entergy Nuclear Vermont Yankee and spelled out in the most recent, July 30th inspection report."[10]

When the initial three-week ISA uncovered no significant issues or concerns, NRC Commission Chairwoman Shirley Jackson, who had ordered the in-depth analysis, sent the inspectors back to Maine Yankee to look again from a different vantage point. Restructuring the assessment for the second three-week investigation, led the NRC inspectors to uncover more than 75-pages worth of concerns. By this point in time, significant problems had been identified and a 75-page report was written with most of the remaining 25,000 man-hours spent, not on identifying problems, but rather on working to see if resolution was possible.

It is myth that the ISA shut down Maine Yankee. Finances shut down Maine Yankee. After the NRC had given Maine Yankee permission to restart, the company discovered cable separation issues that would cost more than $1 Million to repair. Since then, one former NRC Commissioner has even postulated that if Maine Yankee's owners had known how lucrative the New England power generation market would become, the corporation might have opted to keep Maine Yankee open and simply invest the money needed to upgrade the plant.

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[10] *Ray Shadis, New England Coalition, NEC ISA Remarks B4 VSNAP, 8/20/2003.*

ISA Group Charter:

What changed in the Maine Yankee ISA from inception to finish? From the evidence we have reviewed, it is clear that Commissioner Jackson changed the hypothesis. When the inspection team began the ISA, the team assumed that all the systems worked as designed. However, when sent back to look at Maine Yankee a second time, Commissioner Jackson had charged the inspectors to look at the entire plant from a different vantage point. Instead of automatically assuming that all systems worked or functioned as designed, the inspection team looked at *what parts or systems were most prone to failure, and then sought to identify the particular components, which might be compromised or stressed.* Put another way, the first time the team went on site, their charter was to count the links in the chain, while the second time the team went on site, their charter was to *find the weakest links in the system*. That change in focus enabled the inspection team to gain an entirely different perspective. Problems were uncovered, and corrective action steps were taken by MY so that the plant was given a green light by the NRC. Again, the ISA did not shut down Maine Yankee.

In conclusion:

The CVA Group Charter should be to "*find the weakest links the system*". The CVA team shall be required to look at *what parts or systems are most prone to failure, and then seek to identify the particular components, which might be compromised or stressed.* Given that this Legislature has the statutory authority to review the reliability of the operation of ENVY, it is in the best interest of the Governor, Legislature, Congressional Delegation, NRC, Vermont's Citizens, and most of all ENVY to embrace and welcome a CVA (Comprehensive Vertical Audit).