DOCKET NO. 50-293-LR
ASLBP NO. 06-848-02-LR
PILGRIM WATCH
EXHIBIT ONE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
Before the
ATOMIC SAFETY AND LICENSING BOARD

In the matter of
ENTERGY NUCLEAR GENERATION CO., LLC
and ENTERGY NUCLEAR OPERATIONS, INC.
(Pilgrim Nuclear Power Station)
License Renewal Application

December 19, 2007
Docket No. 50-293-LR
ASLBP No. 06-848-02-LR

DECLARATION OF ARNOLD GUNDERSEN
SUPPORTING
PILGRIM WATCH'S PETITION FOR
CONTENTION 1

I, Arnold Gundersen, declare as follows:

1. My name is Arnold Gundersen. I am sui juris. I am over the age of eighteen (18) years old. I have personal knowledge of the facts contained in this Declaration.

2. Pilgrim Watch has retained me as an expert witness in the above captioned matter.

3. I have a Bachelor's and a Master's Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude.

4. I began my career as a reactor operator and instructor in 1971 and progressed to the position of Senior Vice President for a nuclear licensee. A copy of my Curriculum Vitae is attached.

5. I have qualified as an expert witness before the NRC ASLB relating the proposed uprate at the Entergy Nuclear Vermont Yankee Nuclear Power Station and before the State of Vermont Public Service Board regarding that same matter.

6. I was an author of the first edition of the Department of Energy (DOE) Decommissioning Handbook.

7. My more than 35 years of professional nuclear experience include and are not limited to: Nuclear Plant Operation, Nuclear Management, Nuclear Safety Assessments, Reliability Engineering, In-service Inspection, Criticality Analysis, Licensing, Engineering Management, Thermohydraulics, Radioactive Waste Processes, Decommissioning, Waste Disposal, Structural Engineering Assessments, Cooling Tower Operation, Cooling Tower Plumes, Nuclear Fuel Rack Design and Manufacturing, Nuclear Equipment Design and Manufacturing, Prudency Defense, Employee Awareness Programs, Public Relations, Contract Administration, Technical Patents, Archival Storage and Document Control.

8. My declaration is intended to support Pilgrim Watch's Contention 1 and is specific to issues regarding the integrity of Pilgrim Nuclear Power Station's underground pipes and the ability of Pilgrim's Aging Management Program to determine their integrity.

9. I have reviewed the Aging Management Program (AMP) for Pilgrim Station and conclude that the applicant has not adequately addressed the monitoring of its underground pipes and tanks to assure their integrity if in fact Pilgrim Nuclear Power Station's license to operate is extended by an additional twenty years. The information provided by the AMP is vague and non-specific and cannot be used to conclude that any and all underground piping will ever be examined during the license extension period.

10. Furthermore, I conclude that the applicant has not shown with 95 percent certainty that the proposed AMP will in fact be able to detect any defects in the underground pipes and tanks.

11. Moreover, based upon my review of Pilgrim's AMP, it is my opinion that the applicant has not shown that the proposed AMP is adequate to assess and assure that underground piping and tanks will be able to withstand the stresses of an additional 20-year license extension.

12. Already the record to date in this proceeding supports my conclusion that the AMP may not be adequate to prevent or detect leaks in underground pipes and tanks. The Atomic Safety and Licensing Board (ASLB) has suggested that it is not necessary for the existing AMP to prevent or detect failures in underground pipes and tanks. Accordingly, the ASLB said,

    12.1. "…prevention of leaks per se is not a stated objective of any relevant aging management program. On the other hand, prevention of an aging- induced leak large enough to compromise the ability of buried pipes or tanks to fulfill their intended safety function is a clear goal of an AMP. Thus at issue here is the following fundamental question: Do the AMPs for buried pipes and tanks, by themselves, ensure that such safety-function-challenging leaks will not occur, or must some sort of leak detection devices such as monitoring wells proposed by Intervenors be installed to meet the obligation?" *Memorandum and Order, Docket No. 50-293-LR, ASLB No. 06-848-02-LR, October 17, 2007, P.17*

    Additionally, the ASLB also noted that:

    12.2. "…only issue remaining before this licensing Board regarding Contention 1 is whether or not monitoring wells are necessary to assure that the buried pipes and tanks at issue will continue to perform their safety function during the license renewal period -, or, put another way, whether Pilgrim's existing AMPs have elements that provide appropriate assurance as required under relevant NRC regulations that the buried pipes and tanks will not develop leaks so great as to cause those pipes and tanks to be unable to perform their intended safety functions*." Ibid., P.17*

13. My understanding of NRC regulations is that in operating license proceedings, the licensee bears the ultimate burden of proof.

14. In my opinion the factual record submitted by the applicant Entergy does not meet the burden of proof required by a licensee, much less with 95% certainty, that the Aging Management Program will identify leaks, or that any leaks already identified by the AMP will not expand further in the pipes or tanks thereby leaving the Pilgrim Nuclear Power Station and its environs without a critical back-up safety system. For example, the Byron Station Nuclear Power Plant in Illinois recently detected what appeared to be a very small weeping pipe. However, upon closer inspection, the integrity of the pipe was grossly undermined and was in imminent danger of a catastrophic failure.

15. All parties involved in these proceedings to evaluate the viability of a 20-year life extension at the aged Pilgrim Nuclear Power Station are certainly aware that leaks in underground piping and tanks have frequently occurred at other operating nuclear power plants. As recently as November 29, 2007, the presence of Tritium was discovered at the Pilgrim Nuclear Power Plant Site. At the concentrations detected the Tritium undoubtedly came from the plant. Experience in isolating Tritium leaks at other nuclear plants has shown that it will take at least one year to accurately determine the origin of the leak and how broadly it has spread and contaminated surrounding areas. More importantly for this discussion, until the source and magnitude of the leak is uncovered, one cannot determine which system or systems may be compromised.

16. Based upon my professional experience as the Senior Vice-President of an ASME XI In-Service Inspection Division, it is my opinion there are several challenging scenarios in which these unidentified leaks can and will jeopardize the design and

intended function of safety related systems and components at the Pilgrim Nuclear Power Station. More specifically, the recently discovered Tritium releases show that undetected leaks may already have occurred, in Pilgrim's underground pipes and tanks, thereby causing them to malfunction in such a way as to be "*unable to perform the intended safety function"*. Therefore in my estimation, there are at least three possible scenarios that may be the result of the flaws in Pilgrim's AMP.

16.1. In the first scenario, there may be a loss of intended safety function if a leak has occurred and has gone undetected by the Applicant's AMP. If a leak could spontaneously heal itself, we would not need an AMP for pipes and tanks. Unfortunately, leaks, once begun and whether observed or not, will continue to grow as evidenced by the newly discovered Tritium leaks. These leaks may be caused by external abrasion, internal corrosion, galvanic attack or other factors as yet to be uncovered.

16.1.1. Leaks not only continue to increase in flow, but in fact the rate of expansion for leaks actually accelerates once a pinhole has been created in the pipe or tank wall.

16.1.2. After the initial pinhole, water begins to exit the tank or pipe, at an ever-accelerating rate as the hole expands. In fact, mathematically speaking, the leak rate growth is proportional to the square of the hole's radius.

16.1.3. Given that the Aging Management Plan has not detected some underground leaks as suggested in paragraph 12 and by the newly discovered Tritium leaks, it then becomes quite likely that if a safety function is required, the leak may either divert the required water or reduce the required line pressure rendering the pipe and tank system "*unable to perform the intended safety function"*.

16.1.4. Transient flow and pressure changes that would occur if there is a design basis event will exacerbate leak growth and further reduce the ability "*to perform the intended safety function"*. According to the NRC's website, a design basis accident (event) is "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." In my opinion, the recent pipe failures at the Byron Nuclear Power Station in Illinois are the perfect example for this discussion. At Byron, safety-related flanges on pipes were weeping so badly that they certainly would have been unable to have withstand the flow and pressure transient associated with actually requiring the system to operate in its safety mode. Without adequate Aging Management oversight, such a scenario could be mirrored at the Pilgrim Nuclear Power Station.

16.2. The second scenario is similar to the first in that a growing leak remains undetected by an inadequate Aging Management System. However, unlike the first scenario, in which a system failure is caused by allowing water to exit the expanding hole(s), in this scenario rust particles, dirt and other contamination enter the pipe or tank through the hole thereby clogging downstream filters and heat exchangers, or the debris abrades the moving parts thus rendering the system "*unable to perform the intended safety function"*.

16.3. The third scenario acknowledges the presence of the initial leak that may or may not have grown significantly. However, in this scenario, it is the structural weakness created by the hole or holes in the pipe or tank, which render the system "*unable to perform the intended safety function"*.

16.3.1. The hole or holes act as stress risers and increase the likelihood of gross failure under the stress of accident conditions.

16.3.2. Given that the inadequacies of the Aging Management Plan have allowed the creation of a hole or holes, and that the applicant has not structurally analyzed the presence of such holes, it is my opinion that the system would be operating outside its regulatory design basis criteria.

16.3.3. Holes that reduce the structural integrity of pipes are particularly worrisome at elbows and flanges (similar to the aforementioned

Byron incident) and would render the pipe or tank "*unable to perform the intended safety function"* in the event of a Safe Shutdown Earthquake (SSE). As the nuclear industry well knows, the small earthquake at the Perry Nuclear Power Plant in Ohio did cause leaks in plant piping, and this mild earthquake was not at all comparable to a SSE.

16.3.4. According to NRC regulations, all nuclear power stations must have certain structures, systems, and components requisite to safety, designed to sustain and remain functional in the event of maximum earthquake potential. Unidentified holes in safety related underground pipes place those pipes in an unanalyzed condition outside the scope of the regulatory design basis for the Applicant's Pilgrim Nuclear Power Plant.

16.4. In light of the newly discovered Tritium leaks, it may in fact be true that a significant safety system has already been compromised. Moreover, it seems in fact that the applicant Entergy's Aging Management System did not uncover those leaks, or did not do so in a timely manner.

17. It is my belief, as the Expert Witness retained by Pilgrim Watch, that <u>there are at least four solutions available to Entergy and the ASLB to mitigate the serious consequences of undetected leaks</u>. Contention 1, as delineated in this proceeding, is that the frequency of the monitoring proposed by the Applicant is insufficient to ensure that the required safety margins would be maintained throughout any extended

period of operation. The Board appropriately suggested a possible weakness in the Applicant's (Pilgrim Nuclear Power Station) Aging Management Program to detect leaks, and this problem seems to be borne out by the recently discovered on-site Tritium leaks. I suggest that this problem may be minimized by four separate approaches:

- Establish critical Baseline Data;
- Reduce the future corrosion rate;
- Improve monitoring frequency and coverage;
- Increase the Monitoring Well Program to actively look for leaks once they have occurred.

17.1. Establish Critical Baseline Data: In view of the fact that industry as a whole and Pilgrim, specifically, have experienced corrosion and leaks, as evidenced at Pilgrim by the recently discovered Tritium leaks, it is important that critical Baseline Data be collected via a top to bottom examination of the safety-related buried pipes/tanks.

17.1.1. Such an inspection must entail special attention to points of vulnerability – such as at elbows, welds, joints, and at any dead spaces where liquid can sit.

17.1.2. Examinations must include inspection both inside and outside.

17.1.3. Special attention must also be given to those welds located upstream or downstream of a flow disturbance.

17.1.4. Since it is not possible to assess possible damage below the coating in the pipe body, in addition all piping must be pressure tested to at least twice the operating pressure. Inability to perform pressure tests for any reason should not be cause for relief.

17.1.5. Baseline data is critical so that trending is established. NUREG/CR 6876 states, at 32, "…it is evident that predicting an accurate degradation rate for buried piping systems is difficult to achieve…"

17.1.6. After a baseline is established then regular examinations afterwards can better determine the need for mitigation before, not after, a problem develops.

17.2. Reduce corrosion rates: The Applicant can and should implement a thorough Cathodic Protection Program (CPP) on all underground pipes and tanks. I found no reference to such a program in the application submitted by Energy. A CPP would reduce the likelihood of leaks.

17.3. Improve monitoring frequency and coverage: In an attempt to minimize the size and frequency of leaks, in my opinion, the AMP should be augmented to require more frequent and more comprehensive inspections of all underground pipes and tanks.

17.3.1. Specifically, I believe that a 100 percent internal visual inspection of all underground pipes and tanks must be implemented.

17.3.2. The inspection cycle should be such that all pipes and tanks are inspected every ten years, however, I believe that the Applicant should be required to break the testing interval down such that one sixth of all pipes and tanks are inspected during each refueling outage. (This assumes 18 month refueling outages, or six every ten years.)

17.3.3. Finally, it is my opinion that the Applicant should be required to inspect one sixth of the lineal piping, one sixth of the elbows and flanges, and one sixth of the tank seams at each outage, even if such inspections lengthen the outage time.

17.3.4. For example, when I was reviewing the Aging Management System at Entergy's Nuclear Vermont Yankee (ENVY) Power Station, I noted that the AMP was often neglected in order to assure the outage was not extended. Therefore is my opinion that the Applicant Entergy should certify that each portion of the AMP on the pipes and tanks is accomplished in the order agreed upon and completed at every outage. As an Intervenor with standing on Contention 1, Pilgrim Watch should be allowed to review copies of the certified piping inspection reports prior to the end of each outage to assure that the work was completed as ordered.

17.4. Increase the Monitoring Well Program to actively look for leaks once they have occurred: According to Pilgrim Watch's expert, Dr. David P.

Ahlfeld, in order to meet the minimum criteria for an effective monitoring well program at Pilgrim, such a program should made part of the license going forward so that it is enforceable and not simply voluntary. In the absence of any leaks at the Applicant's Pilgrim Nuclear Power Station, I believe that my recommendations would be necessary to the evaluation of Pilgrim's application for a 20-year extension to its current operating license. However, given the recently discovered Tritium leaks, my recommendations are critical to the continued operation of Pilgrim to the end of its current license, without any consideration of a license extension.

17.4.1. In light of the newly discovered Tritium leaks, it may in fact be true that a significant safety system has already been compromised.

17.4.2. I believe it will most likely take at least one year to trace the path of the unanticipated Tritium releases.

17.4.3. The release of Tritium indicates a leak in a system that in the past was radioactive.

17.4.4. I believe such a leak means that testing should immediately be undertaken that searches for Cesium 134 and Cesium 137, Cobalt 60, and other gamma emitters as well as Strontium 90.

17.4.5. As a nuclear engineering senior vice-president overseeing decommissioning of nuclear sites and an author of the DOE Decommissioning Handbook, I believe it is critical that these

newly discovered Tritium releases be accurately monitored. The evidence I reviewed as an expert witness regarding Florida Power and Light's St. Lucie Nuclear Power Plant, and the documents I have reviewed pertaining to the decommissioning effort at the former Connecticut Yankee Nuclear Power Plant Site, clearly show how far and wide Tritium and other radioactive isotopes may spread before their release is uncovered.

17.4.6. Therefore in my opinion, and given Pilgrim's proximity to the environmentally sensitive Bay and salt marshes, a rigorous and expanded Monitoring Well program should be ordered and immediately undertaken at and around the Pilgrim Nuclear Power Plant Site.

Conclusion:

Based upon my 35-year nuclear safety and nuclear engineering experience, it is my professional opinion that the issues discussed above are serious safety considerations germane to the subject of this ASLB proceeding: Entergy's application to extend the operation of its Pilgrim Nuclear Power Station for an additional 20 years. Furthermore, following my complete review of the facts as delineated in the above discussion, it is my professional opinion that the proposed AMP is inadequate and that several remedies are available to the Applicant that will minimize the probability of a leak occurring, minimize detection of any possible leaks and meet the SSE and design basis accident regulatory criteria by enabling all systems to *"perform the intended safety function*".

I declare under penalty of perjury that the foregoing is true and correct.

Executed this day, December 19, 2007 at Burlington, Vermont.

_____

Arnold Gundersen, MSNE, RO
Fairewinds Associates, Inc