UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of Docket # 50-293-LR

Entergy Corporation

Pilgrim Nuclear Power Station

License Renewal Application January 14, 2011

Affidavit of Paul M. Blanch

I, Paul Blanch hereby declare under penalty of perjury that the following is true and correct.

1. I have been retained by Pilgrim Watch to provide expert services in connection with the above captioned matter, an application to add 20 years to the operating license of Pilgrim Station.

Experience

2. Beginning in 1964, I served in the U.S. Navy as both a nuclear reactor operator and electric plant operator on *Polaris* class submarines for seven years. These submarines typically were at sea for extended tours of duty. During my Navy service, I and my fellow crew members

were routinely in close proximity to the submarines' nuclear reactors that powered the vessels whether they were under the sea or on the surface.

3. As a qualified Reactor and Electric Plant Operator, I was responsible for the operation of the reactor and supporting safety systems including, piping, valves, radiation monitoring systems, chemical monitoring systems, reactor protection, instrumentation and control systems, cable and cable termination systems, turbines, generators, power supplies, inverters, breakers, switchgear, battery chargers, motor and steam-powered electric generators (AC and DC), and transformers and other components and systems required to support the safe operation of the submarine's nuclear power plant.

4. During my Navy career and my commercial nuclear power plant efforts I had firsthand experience with inaccessible dry and submerged power, control and instrumentation cables. I conducted testing and replacement of vital cables that were degraded due to submergence and age related degradation. Prior to cable replacement I personally tested potentially damaged cables, replaced damaged/degraded cables and conducted subsequent cable testing under fully loaded (+10%) conditions for the expected duration of needs.

5. Oftentimes we conducted routing electronic testing of cables with satisfactory results, yet when the cable was "fully loaded" and run for a short period of time, cable failures often resulted. One event occurred while on patrol where a cable failure resulted in a fire disabling some safety systems.

6. I graduated from the U.S. Navy Electronics Technician School in 1964; the U.S. Navy Nuclear Power School, in 1966; and the U.S. Navy Submarine School, in 1968.

7. As part of my Navy duties, I was certified as an operator/instructor at the Navy prototype reactor (S1C) in Windsor Locks, Connecticut. I instructed Navy officers and enlisted personnel on reactor operations and maintenance including the subjects of reactor systems and electrical theory related to nuclear systems, power generation, emergency core cooling systems, emergency power systems, diesel generators, water supplies and all other systems required for the operation of the nuclear reactor.

8. I received an honorable discharge from the Navy in 1971. In 1972, I received a Bachelor of Science in Electrical Engineering from the University of Hartford. This curriculum included numerous courses in thermal and mechanical engineering.

9. I have more than 45 years of engineering, design, operations, maintenance, engineering management, and project coordination experience for the construction maintenance and operation of nuclear power plants. This includes positions at Northeast Utilities that involved in the design, construction, operation, and maintenance of Millstone Units 1, 2, and 3 and Connecticut Yankee (Haddam Neck). During this period, I was under the direction of the Nuclear Engineering Department within Northeast Utilities.

10. I have also been employed by Consolidated Edison and Entergy at Indian Point Unit 2 as an advisor to the Chief Nuclear Officer (CNO) at that facility. I served in a similar position at Maine Yankee reporting to the CNO of Maine Yankee Atomic Power Company.

11. My duties at Northeast Utilities included piping system designs and also all Instrument and control systems. I also served as Nuclear Operations Engineer providing liaison services between the NU headquarter and Millstone Unit 2 responsible for coordination of all system design, operation and backfits of operating systems.

12. I am a registered professional engineer in the State of California. Certificate Number 2235 (currently inactive)

13. I have actively participated in industry standards writing activities with the American Nuclear Society (ANS), Instrumentation Society of America (ISA), and the Institute of Electrical and Electronics Engineers, Inc. (IEEE) for use by the nuclear industry.

14. I have been employed as a contractor for the Electric Power Research Institute (EPRI) for the development of computerized monitoring systems for nuclear power plants including monitoring the performance of safety systems and devices including pressure and level monitoring systems.

15. I have been engaged as a contractor to Nuclear Energy Institute (NEI, previously NUMARC) to attempt to educate Chief Nuclear Officers on the attributes of a Safety Conscious Work Environment (SCWE).

16. In 1993, I was named “Engineer of the Year” by Westinghouse Electric and Control magazine for my efforts in identifying the subtle failures of active electrical devices such as pressure, level, and flow transmitters and indicators. These failures included generic design deficiencies of piping and mechanical systems in reactor level monitoring systems.

17. I am an expert witness for the State of New York for Inaccessible Cables however my comments contained herein do not/may not reflect those of the State of New York.

18. National Electrical Manufacturers Association (NEMA's) position is clearly stated as follows:

> *If it is suspected that the water has unusual contaminants, such as may be found in some floodwater, the manufacturer should be consulted before any decision is made to continue using any wire or cable products.*

19. This is NEMA's position for residential, industrial and commercial facilities and it would be logical to have Nuclear Power plants comply with these minimum standards. I am not aware if the Entergy has consulted with its numerous wire and cable suppliers to receive concurrence with for Entergy's "proven" testing methodology.

20. Wire and Cable exposed to floodwaters should be replaced to assure a safe and reliable electrical system. When wire and cable products are exposed to water or excessive moisture, the components may be damaged due to mildew or corrosion. This damage can result in insulation or termination failures. The problem can be more severe if the components have been subjected to salt water during hurricanes, etc., or inland flooding where there may be high concentrations of chemicals, oils, fertilizers, etc. such as at the Pilgrim location.

> *Wire and cable that is listed for dry locations only, such as NM-B, should be replaced if it has been exposed to floodwater. NM-B cable contains paper fillers that can pull contaminated water into the cable, which can cause premature cable failure. Flood damaged cable should be replaced to assure a safe and reliable installation.*
>
> *Products listed for wet locations, such as THWN and XHHW, may be suitable for continued use if no contaminates are present in the cable. There may be problems that show up later because of corrosion of the conductor. This could result in overheating of the conductor. If the ends of a conductor have been*

exposed to water, the cable may be purged to remove the water. An insulation resistance test should be conducted before the cable is energized.

All wire or cable products that have been exposed to contaminated floodwater need to be examined by a qualified person, such as an electrical contractor, to determine if the cable can be re-energized. Flood damaged cable may not fail immediately when energized. It may take months for the cable to fail due to damage caused by floodwaters

.http://www.southwire.com/support/GuidelinesForHandlingWaterDamagedElecWireAndCable.htm

21. (NEMA) the independent experts for electrical standards including the National Electric Code (NEC) adopted by every State in the USA states the following:

"When any wire or cable product is exposed to water, any metallic component (such as the conductor, metallic shield, or armor) is subject to corrosion that can damage the component itself and/or cause termination failures. If water remains in medium voltage cable, it could accelerate insulation deterioration, causing premature failure. Wire and cable listed for only dry locations may become a shock hazard when energized after being exposed to water. Any recommendations for reconditioning wire and cable in Section 1.0 are based on the assumption that the water contains no high concentrations of chemicals, oils, etc. If it is suspected that the water has unusual contaminants, such as may be found in some floodwater, the manufacturer should be consulted before any decision is made to continue using any wire or cable products.
http://www.nema.org/download.cfm?docId=3719&filename=/Evaluating%20Water-damaged%20Electrical%20Equipment_final.pdf

22. Pilgrim is located adjacent to Cape Cod Bay; therefore the groundwater has very high corrosive salt concentrations in the groundwater which will likely accelerate the degradation of cables in contrast to those nuclear plants located away from coastal areas. The risk of common mode failure of submerged cables at Pilgrim is significantly greater than most US nuclear plants.

23. Another expert expresses his opinion as follows:

"In the normal electrical distribution system, the performance ability of electrical equipment and components is primarily dependent on clean, corrosion-free conductive contact surfaces and by the equipment's dielectric insulation capabilities," explains John Minick, field representative for the National Electrical Manufacturers Association *(NEMA). "Water-damaged equipment, whether through floodwaters or other means, negates that ability and raises the risk of future equipment failure and possibly fire and shock hazards to unknown levels. Expedience and the cost of rebuilding are certainly key factors in helping people regain a sense of normalcy after disasters such as hurricanes and floods, but the possible cost concerning property loss through fire and deaths through shock hazards that may be created as a result of the misuse of water-damaged electrical equipment has to be of equal importance."*

"We see damaged outlets, circuit breaker panels, air conditioning units ruined by water," the contractor says. "All metal items are corroded, including copper and aluminum cables. White jackets of Romex cable have turned black from the brackish waters, and long after water subsided, you can squeeze water from the cable.

"It is absolutely critical that these components be replaced," he emphasizes. "Connecting power to an electrical system containing them poses a serious fire hazard and other risks." *[Emphasis added]*

"Contaminated water that oxidizes metal contact points will increase resistance," he continues. "This resistance will generate heat directly in proportion to the amount of current that flows through the oxidized metal. The more heat that is generated, the more resistance is increased. This 'snowballing' effect can lay dormant until an appliance is used or until loads are increased across a contact point, thereby becoming a fire hazard some time after the electricity is turned on." NEMA and other industry organizations agree that flood-damaged components should be replaced. http://www.lowesforpros.com/always-replace-water-damaged-electrical-components

24. "Entergy Answer Opposing Pilgrim Watch Request For Hearing On A New Contention" states:

The testing must be a proven method for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, or other testing that is state-of-the-art at the time the test is performed. Id. at XI.E-7. Entergy's Application committed to implement these GALL programs, making no exceptions.

25. Implementation of a program consistent with the vague guidance of the GALL revision provides no assurance that the proposed program is in compliance with NRC regulations and industry standards.

26. On January 7, 2011 Entergy submitted completely new information in a supplement to its License Renewal Application addressing a program for a program to monitor the condition of Low Voltage Cables. This new information is pasted below:

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station

Letter Number: 2.11.001
Attachment 1, Page 8

Low-Voltage Cables

Due to industry concerns regarding inaccessible power cables, Entergy is providing the following information enhancing its aging management program for non-EQ inaccessible medium-voltage cables to include low-voltage (400 V to 2 kV) cables, increase the inspection and testing frequencies of these cables, and describe how relevant OE is used to assure program effectiveness.

Inaccessible low-voltage power cables (400 V to 2 kV cables) that perform a license renewal intended function and are potentially exposed to significant moisture will be included in this aging management program (AMP) to address the effects of moisture on the cable insulation.

Entergy will expand the scope of the program described in LRA Section B.1.19 (Non-EQ Inaccessible Medium-Voltage Cable Program) to include inaccessible 400 V to 2kV cables with a license renewal intended function. Inaccessible cables will be tested for degradation of the cable insulation at least once every six years. A proven, commercially available test will be used for detecting cable insulation deterioration for inaccessible low-voltage cables potentially exposed to significant moisture, such as dielectric loss (dissipation factor/power factor), AC voltage withstand, partial discharge, step voltage, time domain reflectometry, insulation resistance and polarization index, line resonance analysis, or other testing that is state-of-the-art at the time the test is performed. Entergy will evaluate unacceptable test results to determine the need for increasing the testing frequency.

Inspections for water in manholes containing inaccessible cables in the scope of this program will be performed at least annually, with more frequent inspections based on evaluation of the inspection results.

27. Entergy has arbitrarily redefined the scope of its cables monitoring programs thereby eliminating the majority of vital cables within the scope of 10 CFR 54.4 and 10 CFR 54.21. There are miles of cables operating at voltages of less than 400 volts that meet the requirements defined

in 10 CFR 54, yet Entergy and the NRC has failed to address any requirements for aging management for these cables and wires.

28. There is no "proven, commercially available test" that will assure cables that have experienced submergence for any voltage rating from 0 to 345 KV. This statement by Entergy infers they have a "proven method" for detecting cable deterioration yet neither the NRC, EPRI, Sandia nor Brookhaven have concluded there is any "proven" technology to detect degradation.

29. NUREG/*CR-7000* states:

> *In-service testing of safety-related systems and components can demonstrate the integrity and function of associated electric cables under test conditions. However, in-service tests do not provide assurance that cables will continue to perform successfully when they are* ***called upon to operate fully loaded for extended periods as they would under normal service operating conditions or under design basis conditions****. In-service testing of systems and components does not provide specific information on the status of cable aging degradation processes and the physical integrity and dielectric strength of its insulation and jacket materials.*

30. This statement from the NRC's own research is totally consistent with my personal experience on United States Navy submarines, surface ships, and other commercial and industrial facilities. Entergy's new information makes no reference or commitment to test any cables under normal and/or design basis conditions.

31. "Entergy Answer Opposing Pilgrim Watch Request For Hearing On A New Contention" states:

> *The testing must be a proven method for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, or other testing that is state-of-the-art at the time the test is*

> *performed. Id. at XI.E-7. Entergy's Application committed to implement these GALL programs, making no exceptions.*

32. This statement by Entergy infers they have a "proven method" for detecting cable deterioration yet neither the NRC, EPRI, NEMA, NEC Sandia and Brookhaven have concluded there is not any "proven" technology to detect cable and splice degradation due to periodic submergence in a salt water and otherwise chemically contaminated environment.

33. Entergy further states:

> *Second, although the NRC Regulatory Guide had not yet been issued, Entergy proceeded to develop a fleet procedure, EN-DC-346, Cable Monitoring Program, which it issued on December 31, 2009.*

34. At some time in the future Entergy must substantiate that its program encompasses all cables within the scope of 10 CFR 54 and supply documentation that this is a "proven" test or methodology.

35. Entergy further provides new information in its LRA Supplement:

B.1.19 Non-EQ Inaccessible Medium-Voltage Cable

Program Description

The Non-EQ Inaccessible Medium-Voltage Cable Program at PNPS will be based on and consistent with the program described in NUREG-1801, Revision 2, Section XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements."

Inspections for water accumulation in manholes containing inaccessible low- and medium-voltage cables with a license renewal intended function will be conducted at least annually and trended to determine the need to revise manhole inspection frequency. Additional operational inspections will be performed to verify drainage systems are functional prior to predicted heavy rains or flooding events such as hurricanes. The acceptance criteria includes direct observation that the cables are not wetted or submerged, that cables/splices and cable support structures are intact, and that dewatering/drainage systems are functional.

In this program, periodic actions will be taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit and draining water as needed. In-scope low-voltage and medium-voltage cables exposed to significant moisture will be tested at least once every six years to provide an indication of the condition of the conductor insulation. All in-scope medium-voltage cables will be tested prior to entering the PEO and low-voltage cables will be tested within six years of entering the PEO. The test is to be a proven method for detecting deterioration of the insulation system due to wetting, such as dielectric loss (dissipation factor/power factor), AC voltage withstand, partial discharge, step voltage, time domain reflectometry, insulation resistance and polarization index, line resonance analysis, or other testing that is state-of-the-art at the time the test is performed.

The program will be initiated prior to the period of extended operation.

36. It is my professional opinion that this proposed program fails to meet the requirements of 10 CFR 54 as there is no technical justification for periodicity of inspections and it is not possible to inspect the condition of cable splices that may exist within submerged conduits. Cables that have been exposed to any submergence must be replaced with cabled designed and qualified for underwater operation. This is my professional opinion supported by positions proffered by the electrical industry (NEMA) for commercial and industrial facilities. One would hope to believe that a commercial nuclear power plant would, as an absolute minimum comply with and far exceed these commercial standards and guidelines.

37. Entergy states in footnote 27:

[27] It is not clear whether Mr. Blanch's statement means that he is averring to the accuracy of all of the statements in Pilgrim Watch's Request. Pilgrim Watch's Request includes statements that any competent and experienced nuclear engineer would know to be wrong, such as Pilgrim Watch's assertion that "Pilgrim Nuclear Power Station (PNPS), like all other nuclear plants, has thousands of submerged electrical cables throughout the plant." See PW Request at 7. Similarly, Pilgrim Watch's assertion that "[m]ost electrical cables at [Pilgrim] have been exposed to significant moisture over the past 40 years since initial construction in the 1960's" (PW Request at 14) is unfounded. The plant is a sealed structure and most cables are inside that sealed structure. In the same vein, Pilgrim Watch's assertion that "[w]ater travels downward from leaks inside the reactor following along wires to collect below" (PW Request at 15) is unsupported and inaccurate. The Pilgrim reactor is contained in an ASME certified and tested pressure vessel that is continuously monitored to ensure that there is no leakage. There are no wires that penetrate the reactor pressure vessel or communicate physically with the reactor internals and its coolant.

38. It should be noted that Mr. Blanch does not claim to be a **competent and experienced nuclear engineer** however I am competent and experienced electrical engineer with many years of Navy and commercial nuclear operational experience. It is unclear what is meant "The plant is a sealed structure and most cables are inside that sealed structure." Very few, if any, of the cables within the scope of 10 CFR 54 are contained within an ASME certified and tested pressure vessel that is continuously monitored to ensure that there is no leakage."

39. Entergy states:

> *Further, Mr. Blanch's Declaration does not identify any special expertise with cable monitoring programs at commercial nuclear power reactors.*

40. This is an accurate statement however Mr. Blanch has extensive hands on experience with cable maintenance on US Navy nuclear power plants in addition to extensive experience related to 50.49 Environmental qualification of electric equipment important to safety for nuclear power plants. See paragraphs #4 and #5.

41. Entergy states:

> *Pilgrim Watch asserts (without any support) that "corrosion/degradation is a rate process and the rate is not constant with time" (PW Request at 21, ¶ 32a), but corrosion is not even an aging effect applicable to cable insulation; and Pilgrim Watch provides no information that would support the claim of accelerating aging or the need for more frequent testing.*

42. Corrosion is a factor due to submergence. Cables may be degraded due to manufacturing defects, installation, splices allowing contaminated and brackish water to come in contact with the metallic conductors, splices and other connections thereby resulting in corrosion and overheating due to ohmic effects.

43. Entergy states:

> *PW also quotes SAND96-0344 as stating that "[n]o currently available technique was identified as being effective in monitoring the electrical aging of medium-voltage power cables." PW Request at 22, 32d. This statement in a 14-year old report does not demonstrate any genuine dispute with Entergy's AMP for non-EQ inaccessible cable, or the current recommendations in the GALL Report, particularly since both the GALL Report and NUREG/CR-7000 have now both identified specific types of tests capable of monitoring the condition of cable insulation. Pilgrim Watch provides no information indicating that these specified tests are inadequate.*

44. While this Sandia document may be 14 years old, however its conclusions have **not been superseded** by additional research including extensive EPRI and NRC studies. None of these documents conclude that any testing has been proven to detect degraded cables. Entergy makes no explicit commitment to any of these research studies.

45. Entergy states:

> *First, Pilgrim Watch provides no information indicating that the AMP will be ineffective. Further, that a program is new does not mean that it is inadequate. Clearly, the NRC Staff has been giving careful consideration to the development of an effective cable monitoring program for a number of years,*

> *including commissioning studies like NUREG/CR-7000 to study the effectiveness of available techniques. The GALL Report itself indicates that the recommended AMP for non-EQ inaccessible cable builds off these studies. This AMP considers the technical information and generic communication guidance provided in NUREG/CR-5643; IEEE Std. 1205-2000; SAND96-0344; EPRI 109619; EPRI 103834-P1-2; NRC Information Notice [IN] 2002-12; NRC GL 2007-01; NRC GL 2007-01 Summary Report; NRC Inspection Procedure, Attachment 71111.06, Flood Protection Measures; NRC Inspection Procedure, Attachment 71111.01, Adverse Weather Protection; RG 1.211 Rev 0; DG-1240; and NUREG/CR-7000. GALL Rev. 2 at XI.E3-4. In light of this identified and substantial basis for the AMP, Pilgrim Watch's bald, unsupported assertion raises no genuine dispute.*

46. Entergy's statement: "Pilgrim Watch provides no information indicating that the AMP will be ineffective." Is not necessary to support at this time. Neither the NRC nor Entergy have demonstrated compliance with accepted industry and NRC studies, NRC regulations and the positions of NEMA and NEC.

47. NUREG/CR-7000 is the most comprehensive study on cable degradation. The recommendations of this NRC sponsored study heavily rely on "baseline" inspections of cables. Entergy has failed to provide any commitment to establishing any baseline inspections for safety related inaccessible cables.

48. The NRC does not have the expertise to totally understand cable manufacturing, installation and operation. The organizations with the most detailed knowledge of this subject are ***National Electrical Manufacturers Association*** **(**NEMA) and the National Electric Code (NEC). These organizations are consistent and clearly require that cables be replaced after exposure to any type of submergence.

49. On January 7, 2011 the NRC submitted a document titled "NRC staff's answer in opposition to Pilgrim Watch request for hearing on new contention"

50. A cursory review of this document mentions that the submerged cables are of "very low safety significance" more than 14 times.

51. While a single event of a submerged cable failure may b***e of low safety significance*** this is a problem that may result in common mode failures of multiple redundant safety systems. Information Notice 2010-26 cites failures of 269 cables with the frequency increasing with plant aging. If the NRC believes Entergy's program is a "proven" program then it should be endorsed by the entire industry including NEMA, EPRI, Sandia, INPO, NEI, Brookhaven and the NRC itself. With a "proven" program one would expect the cable failure rate to be decreasing rather than increasing as reported by numerous industry data and studies.

52. The 269 reported failures in the Information Notice may only be the "tip of the iceberg" as many of the cables may not be normally energized and many other cables may fail when energized during a design basis event. According to many industry studies including NUREG/CR-7000 and EPRI studies have concluded that there is no proven technology to detect incipient cable failures. While not confirmed by the Information Notice, most of these failures likely occurred after the cable was required to perform its designated safety function.

53. Page 13 of the NRC's response states:

> *Pilgrim's AMP contains provisions for testing the cable insulation, inspecting for submergence and deterioration of the cable surface, and draining of water.*

54. This is a meaningless statement as it makes no claim to be able to detect incipient failures of cables that have aged for 40 years and exposed to environmental conditions, may be damaged/degraded and for which they were not designed to operate. This bald statement provides no assurance that the cables will remain functional throughout their proposed extended 20 lifetime.

55. Page 16 of the NRC response states:

> *Mr. Mathew explains that 10 C.F.R. Part 50 requires licensees to test and maintain safety-related electric cables to ensure that they can perform their intended functions, and the NRC's ongoing oversight of licensee operations verifies licensee compliance.*

56. I agree that 10 CFR 50 Appendix A and B require testing and corrective actions however the fact that these failures are increasing with age indicates that proper corrective actions are not being implemented by the licensees. There is no recognized testing that can provide reasonable assurance that these cables can perform "their intended functions."

57. Page 16 continues to state:

> *Thus, Pilgrim Watch's Request for Hearing does not raise a significant safety issue and should thus be denied.*

58. It is my expert opinion that this is a grave safety issue that may result in common mode failures increasing the probability and possibly challenging:

- The integrity of the reactor coolant pressure boundary;
- The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- The capability to prevent or mitigate the consequences of accidents

59. This risk will increase with continued age unless the NRC is willing to implement the recommendations of industry studies and independent organizations including NEMA and NEC.

60. I have read and reviewed the enclosed proposed contention from Pilgrim Watch and fully support all technical and regulatory aspects of this contention on Inaccessible cables.

Executed in Accord with 10 CFR 2.304 (d),

Paul M. Blanch
January 14, 2011
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