

**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ATOMIC SAFETY AND LICENSING BOARD**

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In re: Docket Nos. 50-247-LR; 50-286-LR  
License Renewal Application Submitted by ASLBP No. 07-858-03-LR-BD01  
Entergy Nuclear Indian Point 2, LLC, DPR-26, DPR-64  
Entergy Nuclear Indian Point 3, LLC, and  
Entergy Nuclear Operations, Inc. September 30, 2011  
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**DECLARATION OF DR. JORAM HOPENFELD**

Joram Hopenfeld, hereby declares under penalty of perjury that the following is true and correct:

1. I have been retained by Riverkeeper, Inc. (“Riverkeeper”) as an expert witness in proceedings concerning the application by Entergy Nuclear Operations, Inc. (“Entergy”) for the renewal of two separate operating licenses for the nuclear power generating facilities located at Indian Point on the east bank of the Hudson River in the Village of Buchanan, Westchester County, New York, for twenty years beyond their current expiration dates.
2. I submit this declaration in support of the State of New York and Riverkeeper’s New Joint Contention NYS-38/RK-TC-5, concerning Entergy’s failure to demonstrate that it has all programs that are required to effectively manage the effects of aging of critical components or systems.
3. My professional and educational qualifications are described in the *curriculum vitae* appended hereto as Attachment 1. Briefly summarized, I am an expert in the field relating to nuclear power plant aging management. I am a mechanical engineer and hold a doctorate in mechanical engineering. I have 45 years of professional experience in the fields of thermal-hydraulics, material/environment interaction instrumentation, design, project management, and nuclear safety regulation, including 18 years in the employ of the U.S. Nuclear Regulatory Commission (“NRC”).
4. My extensive professional experience has afforded me with knowledge and expertise regarding the material degradation phenomenon known as “metal fatigue,” that is, the fatigue or “cyclic stress” of metal parts due to repeated stresses during plant operation. Most recently, I was a technical consultant and expert witness for the New England Coalition in the Vermont Yankee license renewal proceeding, where I testified at an adjudicatory hearing concerning metal fatigue.

5. I reviewed the April 30, 2007 License Renewal Application (“LRA”) submitted by Entergy to renew the operating licenses for Indian Point Units 2 and 3, and assisted Riverkeeper with the preparation of Contention TC-1, which challenged Entergy’s aging management plan for addressing metal fatigue at Indian Point during the proposed period of extended operation.

6. I reviewed Entergy’s January 22, 2008 amendment to its original LRA, in which Entergy purported to provide additional information regarding its aging management program for addressing metal fatigue, and assisted Riverkeeper with the preparation of an amended contention (Riverkeeper Contention TC1-A) to articulate the ongoing deficiencies with Entergy’s plan to deal with metal fatigue.

7. I reviewed Entergy’s August 10, 2010 “Notification of Entergy’s Submittal Regarding Completion of Commitment 33 for Indian Point Units 2 and 3,” NL-10-082, as well as Entergy’s revised metal fatigue evaluations dated June 2010, and assisted Riverkeeper with the preparation of a new and amended contention (New York State 26-B/Riverkeeper TC-1B), which articulated various deficiencies with Entergy’s revised analysis, as well as Entergy’s ongoing failure to demonstrate that the affects of metal fatigue would be adequately managed at Indian Point during the proposed period of extended operation.

8. I have now reviewed NRC Staff’s “Request for Additional Information for the Review of the Indian Point Nuclear Generating Unit Numbers 2 and 3, License Renewal Application,” dated February 10, 2011, Entergy’s response thereto (“Response to Request for Additional Information (RAI), Aging Management Programs, Indian Point Nuclear Generating Unit Nos. 2 & 3, Docket Nos. 50-247 and 50-286, License Nos. DPR-26 and DPR-64,” dated March 28, 2011), and NRC Staff’s “Safety Evaluation Report Related to the License Renewal of Indian Point Nuclear Generating Unit Nos. 2 and 3, Supplement 1” dated August 2011 (“SER Supplement 1”), all of which implicate and discuss metal fatigue. After a review of these documents, for the reasons explained more fully below, it remains my professional opinion that Entergy has, to date, failed to demonstrate that the affects of metal fatigue will be adequately managed at Indian Point during the proposed period of extended operation.

9. NRC Staff’s February 10, 2011 Request for Additional Information (“RAI”) requested that Entergy “[confirm and justify that the plant-specific locations listed in LRA Tables 4.3-13 and 4.3-14 are bounding for the generic NUREG/CR-6260 components” and “[c]onfirm and justify that the locations selected for environmentally-assisted fatigue analyses in LRA Tables 4.3-13 and 4.3-14 consist of the most limiting locations for the plant (beyond the generic components identified in the NUREG/CR-6260 guidance).” In response, Entergy only indicated that the locations in LRA Tables 4.3-13 and 4.3-14 are the same as those locations provided in NUREG/CR-6260, and, in Commitment 43, promised to determine at some future point in time, though before entering the period of extended operation, whether the NUREG/CR-6260 locations evaluated are the limiting locations for the Indian Point plant configurations. Entergy’s reason for requiring additional time was the need to review “design basis ASME Code Class 1 fatigue evaluations.”

10. Entergy’s RAI responses unacceptably fail to “confirm and justify” bounding and limiting locations for Indian Point. As I have previously stated (and as asserted in admitted

contention New York State 26-B/Riverkeeper TC-1B), it is necessary for Entergy to investigate other components because the  $Cuf_{en}$  values of several components in LRA Tables 4.3-13 and 4.3-14 exceeded unity. See, e.g., Declaration of Dr. Joram Hopenfeld in Support of Petitioners State of New York and Riverkeeper, Inc.'s New and Revised Contention Concerning Metal Fatigue (September 9, 2010), at ¶ 18. Additionally, NUREG-1801, Rev. 2, *Generic Aging Lessons Learned (GALL) Report*, at page X M1-2, states that the sample set for fatigue calculations that consider the effects of the reactor water environment "should include the locations identified in NUREG/CR-6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR-6260." (emphasis added). Now NRC Staff has conceded that there may be more limiting components, and that the  $Cuf_{en}$  values in LRA Tables 4.3-13 and 4.3-14 may not be bounding. NRC Staff's acceptance of Entergy's vague commitments to address these concerns at some point in the future was improper. Like Riverkeeper, the NRC now questions Entergy's claim that LRA Tables 4.3-13 and 4.3-14 (which list the same components as those identified in NUREG/CR-6260) represent limiting conditions for the entire plant. Therefore, according to the guidance of GALL, in order to have an adequate aging management program, Entergy must identify the locations that may be more limiting, and which will be the subject of the  $CUF_{en}$  calculations, now, and not just articulate a plan to determine such locations later.

11. Entergy's response that it "will review design basis ASME Code Class 1 fatigue evaluations" is not confirmation or justification that the locations selected for environmentally-assisted fatigue analyses in LRA Tables 4.3-13 and 4.3-14 consist of the most limiting locations for the plant. Entergy has, to date, not provided any analysis that would support a conclusion that the  $Cuf_{en}$  values in LRA Tables 4.3-13 and 4.3-14 bound all other components at the plant. Entergy has not conducted the analysis that would be required to confirm and justify that the components in LRA Tables 4.3-13 and 4.3-14 are bounding. Nor is this a clearly defined calculation. To the contrary, there are numerous considerations and factors for determining the most limiting locations, and Entergy has demonstrably failed to provide any information about how this analysis will be performed.

12. Such an analysis would require: assessment of experience at Indian Point as well as other pressurized water reactor (PWR) plants; identification of all components that are susceptible to thermal fatigue (including but not limited to nozzles, reducers, mixing tees and bends in feed water lines, surge lines, spray lines, and volume control system lines); component screening in light of the numerous parameters which are known to effect fatigue life (including the ratios of the local heat transfer coefficient the local material conductivity, wall thickness, fluid temperature, delta T, dissolved oxygen levels, flow velocities, number of transients, magnitude and cycling frequency of surface temperatures and loads, and surface discontinuities). Moreover, thermal striping during stratification should be generally considered as these effect fatigue life. NUREG-1801, *Generic Aging Lessons Learned (GALL) Report* requires that environmental effects be included in the calculations and it does not exclude thermal striping from such requirements.

13. This analysis must be performed *before* a determination is made about license renewal. NRC Staff's acceptance of Entergy's commitment in SER Supplement 1 to determine

whether the NUREG/CR-6260 locations evaluated are the limiting locations for the Indian Point plant configurations at some time in the future is not warranted or acceptable.

14. In light of NRC Staff's acceptance of a vague commitment to perform necessary metal fatigue investigation and analyses in the future, Entergy has failed to demonstrate that it has a program to monitor, manage, and correct metal fatigue related degradation sufficient to comply with 10 C.F.R. § 54.21(c), or the regulatory guidance of NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*.

In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on Sept. 30, 2011

  
Joram Hopenfeld

# **ATTACHMENT 1**

**To Declaration of Dr. Joram Hopenfeld  
in support of  
State of New York and Riverkeeper's  
New Joint Contention NYS-38/RK-TC-5  
(September 30, 2011)**

## **Curriculum Vitae for Dr. Joram (Joe) Hopenfeld**

1724 Yale Pl., Rockville, MD 20850

Tel: 301 340 1625

### **A. Professional Expertise:**

- a. **Nuclear Safety and Licensing** (design basis/severe accidents)
- b. **Thermal/Hydraulics** ( Transient Boiling, Jet Mixing, Reentry Heat transfer, molten metal/coolant interactions, pool fires, computer code developments)
- c. **Materials/Environment Interaction** (corrosion, erosion, stress corrosion, fatigue, cavitation, fouling)
- d. **Radioactivity Transport (10 CFR Part 100 )**
- e. **Industrial Instrumentation and Environmental Monitoring.**

### **B. Current Position - CEO, Noverflo, Inc**

### **C. Education - Engineering- University of California at Los Angeles: BS 1960, MS 1962, Ph.D 1967.**

### **D. Summary of Work Experience**

#### **1. Nuclear Plant Related Experience**

I have 45 years of experience in industry and government primarily in the areas of thermal hydraulics, materials, corrosion, radioactivity transport, instrumentation, PWR steam generator transient testing and accident analysis. I have managed major international programs on steam generator performance during steam generator tube ruptures, steam line and feed line breaks. Following a decade of studies and several Advisory Committee on Reactor Safety hearings, the Nuclear Regulatory Commission, ("NRC") adopted my position regarding the safety consequences of operating with degraded steam generator

tubes. In 2001 the NRC initiated a major program on the effects of steam generator tube degradation on plant safety ( see NRC website). I have consulted to law firms and citizen groups regarding Steam Generators, Thermal Hydraulics, Corrosion , and Material Fatigue in connection with license renewals and a power upgrades.

## **2. Non Nuclear Related Experience**

I am the owner and the CEO of a small Maryland company, Noverflo, Noverflo is developing advanced fiber optic sensors for the oil & gas and the environmental monitoring industries. In 2004 Noverflo has completed a three year program which was sponsored by the U.S. Department of Energy. The program produced a new system for automatic tank gauging, which will be presented at the 2006 National Petrochemicals and Refiners Association Maintenance Conference.

In 1994-1996 Noverflo has developed and commercialized a shutoff valve for fuel tanks to comply with new EPA regulations.

## **E. Brief Employment History**

### **A. Recent Consulting**

#### **1. Winston & Strawn , 1400 L St. Washington D.C**

**2001**

Provided assistance in connection with the February 2000 steam generator event at Indian Point.

#### **2. C-10 Research and Education Foundation, Inc. 44Merrimac St. Newburyport, MA**

**2002-2003**

Provided assistance in the preparation of a 2.206 petition to the NRC and other matters in connection with steam generator problems at the Seabrook Station

#### **3. California Earth Corps (Sabrina D. Venskus, Attorney at Law, Santa Monica, CA)**

**2005**



Provided testimony to the Public Utility Commission of the State of California on behalf of California Earth Corps in connection with the San Onofre steam generator replacement project.

**4. New England Coalition ( Raymond Shadis, Edgecomb, Maine 04556)**

**2005-2006**

Technical consultant and expert witness in connection with Vermont Yankee power uprate and life extension hearings before the Atomic Safety and Licensing Board. Prepare contentions and testify before the Board.

**B. Industry and Government Employment**

1962- 1971 –Corrosion testing of materials for the design and operation of liquid metal cooled nuclear reactors. Modeling Transient Boiling in water and sodium. Modeling Sodium Fires. Modeling destruction of SNAP fuel rods on reentry into the earth atmosphere. Atomic International, Canoga Park, Calif.

1971- 1973- Participated in the resolution of design issues as related to material behavior in the Breeder reactor environment. Atomic Energy Commission

1973 – 1978 Project Manager for the safety evaluation and testing of steam generators for liquid metal reactors. Managed the development of thermal –hydraulic computer codes such as COBRA. ERDA/Department of Energy. Responsible for testing material compatibility and cavitation damage in sodium. Development of acoustic leak detection systems for sodium/water reactions.

1978 – 1982 Project Manager for the development of materials and instrumentation for high temperature steam generators for fossil plants. Responsible for the resolution of issues relating to corrosion/erosion and NO<sub>x</sub> /SO<sub>x</sub> emissions, Department of Energy.

1982 – 2001 Program manager for the resolution of various, thermal hydraulics, material corrosion and safety issues primarily in relation to PWR steam generators. Nuclear Regulatory Commission.

**Publications**

In addition to numerous reports, I have published 15 papers in peer-reviewed technical journals in the areas of thermal-hydraulics, corrosion/ erosion, steam generator dose releases during accidents, steam explosions, sensors and ECM machining.

#### **Peer Reviewed**

1. "New Fiber Optic Based Technology for Automatic Tank Gauging", *Sensors*, December 2006
2. "Distributed Fiber Optic Sensors for Leak Detection In Landfills", *Proceeding of SPIE Vol 3541* (1998)
3. "Continuous Automatic Detection of Pipe Wall Thinning", *ASME Proceedings of the 9th, International Conference on Offshore Mechanics and Arctic Engineering*, Feb. 1990
4. "Iodine Speciation and Partitioning in PWR Steam Generators", *Nuclear Technology*, March 1990
5. Comments on "Assessment of Steam Explosion Induced Containment Failures" Letter to the Editor, *Nuclear Science and Engineering*, Vol. 103, Sept. 1989
6. "Experience and Modeling of Radioactivity Transport Following Steam Generator Tube Rupture", *Nuclear Safety*, 26,286, 1985
7. "Simplified Correlations for the Predictions of Nox Emissions from Power Plants". *AIAA Journal of Energy*, Nov.-Dec., 1979
8. "Grain Boundary Grooving of Type 304 Stainless Steel in Armco Iron Due to Liquid Sodium Corrosion", *Corrosion*, 27, No.11, 428, 1971
9. "Corrosion of Type 316 Stainless Steel with Surface Heat Flux in 1200 Flowing Sodium", *Nuclear Engineering and Design*, 12; 167-169, 1970
10. "Prediction of the One Dimensional Cutting Gap in Electrochemical Machining", *ASME Transaction, J. of Engineering for Industry*, p100 (1969)
11. "Electrochemical Machining- Prediction and Correlation of Process Variables", *ASME Transactions, J. of Engineering for Industry*, 88:455-461, (1966)
12. "Laminar Two-Phase Boundary Layers in Subcooled Liquids", *J. of Applied Mathematics and Physics (ZAMP)*, 15, 388-399 (1964)

13. "Onset of Stable Film Boiling and the Foam Limit", International j. of Heat Transfer and Mass Transfer, 6; 987-989 (1963) ) (co-author)
14. "Operating Conditions of Bubble Chamber Liquids", The Review of Scientific Instruments, 34, 308-309. (1963); co-author
15. "Similar Solutions of the Turbulent Free Convection Boundary Layer for an Electrically Conducting Fluid in the Presence of a Magnetic Field," AIAA J. 1:718-719 (1965)

**Not Peer Reviewed (Recent Publications Only )**

1. **New Fiber Optic Based Technology for Automatic Tank Gauging ( ATG), NPRA – 2006 Reliability and Maintenance Conference, May 23-26, San Antonio, TX**
2. **Automatic Tank Gauging: A New Level of Accuracy; A New Device Promises Greater Accuracy for Custody Transfer by Combining Fiber- Optic Sensing with a Pressure. Sensors Magazine, 12/01/06**
3. **PlasticOptical Fibers Sensors for Industrial Process Controls and Environmental Monitoring, POF World West 2007, June 25-27. 2007**

**List of Patents**

1. Automatic Shut-Off Valve for Liquid Storage Tanks, 5,522,415
2. Method and Apparatus for Detecting the Presence of Fluids, 5,200,615
3. Sensors For Detecting Leaks, 5,187,366
4. Method for Monitoring Thinning of Walls and Piping Components 4,922,74
5. Method for Monitoring Thinning of Pipe Walls, 4,779,453
6. Looped Fiber Optic Sensor for the Detection of Substances (5,828,798)
7. Coated Fiber Optic Sensor for The Detection of Substances (5,982,959)
8. Method and Apparatus for Analyzing Information of Sensors Provided Over Multiple Waveguides (6,870,607)

### **Honors**

1. **Engineer of Distinction – Published by Engineers Joint Council**
2. **American men and Women in Science**
3. **The Blackwall Award for Machine Tools**
4. **Member Sigma-Xi**

### **Professional Activities**

1. **Reviewed papers for the ASME Journal and the Journal of Sensors and Actuators**
2. **Taught a class on Diesel Engines at Montgomery College, Rockville, MD.**
3. **Served as a member of a Railroad Committee that development a standard for locomotive Fueling**
4. **Funded and sponsored research and development work at the Engineering Department of the University of Virginia. The research produced a novel method of measuring pipe wall thinning from erosion/corrosion**