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**A Beyond Nuclear Capitol Hill Briefing Paper:
Decommissioning nuclear power stations need an “autopsy”
to verify and validate safety margins projected for operating reactor license extensions**

The Issue

The Nuclear Energy Institute (NEI), the lead organization for the U.S. commercial nuclear power industry, envisions the industry’s “*Bridge to the Future*” through a series of reactor license renewals from the original 40-year operating license; first by a 40 to 60-year extension and then a subsequent 60 to 80-year extension. Most U.S. reactors are already operating in their first 20-year license extension and the first application for the second 20-year extension (known as the “Subsequent License Renewal”) is before the U.S. Nuclear Regulatory Commission (NRC) for review and approval. NEI claims that there are no technical “show stoppers” to these license extensions. However, as aging nuclear power stations seek to extend their operations longer and longer, there are still many identified knowledge gaps for at least 16 known age-related material degradation mechanisms (embrittlement, cracking, corrosion, fatigue, etc.) attacking irreplaceable safety-related systems including miles of electrical cable, structures such as the concrete containment and components like the reactor pressure vessel. For example, the national labs have identified that it is not known how radiation damage will interact with thermal aging. Material deterioration has already been responsible for near miss nuclear accidents. As such, permanently closed and decommissioning nuclear power stations have a unique and increasingly vital role to play in providing access to still missing data on the impacts and potential hazards of aging for the future safety of dramatic operating license extensions.

The NRC and national laboratories document that a post-shutdown autopsy of sorts to harvest, archive and test actual aged material samples (metal, concrete, electrical insulation and jacketing, etc.) during decommissioning provides unique and critical access to obtain the scientific data for safety reviews of the requested license extensions. A Pacific Northwest National Laboratory (PNNL) 2017 report concludes, post-shutdown autopsies are necessary for “*reasonable assurance that systems, structures, and components (SSCs) are able to meet their safety functions. Many of the remaining questions regarding degradation of materials will likely require [emphasis added] a combination of laboratory studies as well as other research conducted on materials sampled from plants (decommissioned or operating).*” PNNL reiterates, “*Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require (emphasis added) harvesting materials from reactors.*” In the absence of “*reasonable assurance,*” it is premature for licensees to complete applications without adequate verification and validation of projected safety margins for the 60 to 80-year extension period.

Decommissioning is not just the process for dismantling nuclear reactors and remediating radioactive contamination for site restoration. Decommissioning has an increasingly important role at the end-of-reactor-life-cycle for the scientific scrutiny of projected safety margins and potential hazards at operating reactors seeking longer and longer license extensions.

The Problem

After decades of commercial power operation, the nuclear industry and the NRC have done surprisingly little to strategically harvest, archive and scientifically analyze actual aged materials. Relatively few samples of real time aged materials have been shared with the NRC. The NRC attributes the present dearth of real time aged samples to *“harvesting opportunities have been limited due to few decommissioning plants.”* However, ten U.S. reactors have completed decommissioning operations to date and 20 units are in the decommissioning process. More closures are scheduled to begin in Fall 2018. A closer look raises significant concern that the nuclear industry is reluctant to provide access to decommissioning units for sampling or collectively share this cost of doing business to extend their operating licenses. Key components including severely embrittled reactor pressure vessels were promptly dismantled by utilities and buried whole without autopsy. Many permanently closed reactors have been placed in “SAFSTOR,” defueled and mothballed “cold and dark” for up to 50 years without the material sampling to determine their extent of condition and the impacts of aging. Moreover, the NRC is shying away from taking reasonable regulatory and enforcement action to acquire the requested samples for laboratory analysis after prioritizing the need for a viable license extension safety review prior to approval. Meanwhile, the nuclear industry license extension process is pressing forward.

David Lochbaum, a recognized nuclear safety engineer in the public interest with the Union of Concerned Scientists, identifies that nuclear research on the impacts and hazards of age degradation in nuclear power stations presently relies heavily on laboratory accelerated aging---often of fresh materials---and computer simulation to predict future aging performance and potential consequences during license extension. Lochbaum explains that *“Nuclear autopsies yield insights that cannot be obtained by other means.”* Researchers need to compare the results from their time-compression studies with results from tests on materials actually aged for various time periods to calibrate their analytical models. According to Lochbaum, *“Predicting aging effects is like a connect-the-dots drawing. Insights from materials harvested during reactor decommissioning provide many additional dots to the dots provided from accelerated aging studies. As the number of dots increases, the clearer the true picture can be seen. The fewer the dots, the harder it is to see the true picture.”*

The Path Forward

- 1) Congress, the Department of Energy (DOE) and the NRC need to determine the nuclear industry's fair share of autopsy costs levied through collective licensing fees for strategic harvesting during decommissioning and laboratory analysis of real time aged material samples as intended to benefit the material performance and safety margins of operating reactors seeking license extensions, and;
- 2) As NRC and the national laboratories define the autopsy's stated goal as providing *“reasonable assurance that systems, structures, and components (SSCs) are able to meet their safety functions”* for the relicensing of other reactors, the NRC approval process for Subsequent License Renewal extensions should be held in abeyance pending completion of comprehensive strategic harvesting and conclusive analysis as requested by the agency and national laboratories, and;
- 3) Civil society can play a more active role in the independent oversight and public transparency of autopsies at decommissioning reactor sites such as through state legislated and authorized nuclear decommissioning citizen advisory panels.

Link to Decommissioning Autopsy Whitepaper and documentation

<http://www.beyondnuclear.org/nuclear-reactors-whatsnew/2018/7/11/captiol-hill-briefing-paper-on-the-need-for-autopsies-at-dec.html>