UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE SECRETARY

In the matter of

FirstEnergyNuclear Operating Company (FENOC)	)	
Davis-Besse Nuclear Power Station	)	May 20, 2013
License Amendment Steam Generator	)	
Docket No. 50-346	)	
License No. NPF-3	)	

EXPERT WITNESS REPORT OF ARNOLD GUNDERSEN
TO SUPPORT THE PETITION
FOR LEAVE TO INTERVENE AND REQUEST FOR HEARING
BY BEYOND NUCLEAR (TAKOMA PARK, MD), CITIZENS ENVIRONMENT ALLIANCE SW ONTARIO CANADA, DON'T WASTE MICHIGAN (MI), AND SIERRA CLUB OHIO CHAPTER (OH)

I, Arnold Gundersen, declare as follows:

My name is Arnold Gundersen. I am sui juris. I am over the age of 18-years-old.

Beyond Nuclear (Takoma Park, MD), Citizens Environment Alliance SW Ontario Canada, Don't Waste Michigan (MI), and Sierra Club Ohio Chapter (OH) have retained Fairewinds Associates, Inc to issue an expert report in support of the Parties' Petition For Leave To Intervene And Request For Hearing. I have specifically been retained to examine the licensing basis for the First Energy Nuclear Operating Company (FENOC) proposed Replacement Once Through Steam Generator (ROTSG) modification to its Davis-Besse (D-B) nuclear plant.

I earned my Bachelor Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude. I earned my Master Degree in Nuclear Engineering from RPI via an Atomic Energy Commission Fellowship. Cooling tower operation and cooling tower plume theory was my area of study for my Master's Degree.

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 prior to becoming a nuclear engineering consultant and expert witness. I hold one nuclear plant patent. My Curriculum Vitae is Attachment 1.

I have testified as an expert witness to the Nuclear Regulatory Commission (NRC) Atomic Safety and Licensing Board (ASLB) and Advisory Committee on Reactor Safeguards (ACRS), in Federal Court, the State of Vermont Public Service Board, the State of Vermont Environmental Court, and the Florida Public Service Commission.

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

I have more than 40-years of professional nuclear experience *including and not limited to*: Cooling Tower Operation, Cooling Tower Plumes, Consumptive Water Loss, 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, 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, Source Term Reconstruction, Dose Assessment, Whistleblower Protection, and NRC Regulations and Enforcement.

I am employed as the chief engineer for Fairewinds Associates, Inc, an expert witness and paralegal services firm specializing in nuclear engineering, nuclear operations, and nuclear safety analysis and assessment.

My pertinent experience related to the Steam Generator matters being considered by this proceeding include, but are not limited to:

- In my position as the Senior Vice President of Inspection Services, I was responsible for a group of approximately 200-personnel performing ASME III and ASME XI non-destructive piping inspections at nuclear plants throughout the United States. These personnel used inspection techniques identical to those used on steam generator tube inspections.
- As the Senior Vice President of Engineering Services, I was responsible for the development of the first ever modern steam generator nozzle dams that were sold to approximately 40-nuclear reactors in the US and Asia.

My declaration is intended to examine the licensing basis for the First Energy Nuclear Operating Company (FENOC) proposed Replacement Once Through Steam Generator (ROTSG) modification to its Davis Besse (D-B) nuclear plant.

BACKGROUND

There is a dearth of technical data in the Nuclear Regulatory Commission (NRC) Public Document Room (PDR) regarding the First Energy Nuclear Operating Company (FENOC) proposed Replacement Once Through Steam Generator (ROTSG) modification to its Davis Besse (D-B) nuclear plant in Oak Harbor, Ohio. However, from published reports it appears that FENOC placed its order for the Davis Besse replacement steam generators with Babcock-Wilcox of Canada in early December of 2007.

> Nuclear steam generators are critical, highly engineered pieces of equipment that create the steam required for electrical power generation at the nuclear plant. The Davis-Besse ROTSGs will weigh in excess of 450 tons each and require over five years to design and fabricate. The work on these units will be completed at B&W's Cambridge, Ontario facility. [1]

On December 5, 2007, via a Press Release in Reuters, McDermott International, Inc. announced:

[1] Reuters, *B&W Awarded Nuclear Steam Generator Contract by FirstEnergy*, December 2007. http://www.reuters.com/article/2007/12/05/idUS141970+05-Dec-2007+BW20071205

> …that a subsidiary of The Babcock & Wilcox Company ("B&W") has been awarded a contract by FirstEnergy Nuclear Operation Company to design, fabricate and deliver two replacement once-through steam generators ("ROTSG") for the Davis-Besse Nuclear Power Station.[2]

The Press Release in Reuters implies that FENOC made the decision to replace its steam generators at Davis-Besse and then developed a purchase specification and compared bidders sometime in 2007 prior to awarding the contract to B&W Canada late that year.

The lack of publicly available technical analysis in the NRC PDR suggests that FENOC made a secret determination under 10 C.F.R. § 50.59 that it was not necessary to apply for a license amendment to replace the Davis-Besse steam generators. The lack of a license application on file with the NRC also implies that Davis-Besse made the determination that the "fit-form-function" of the replacement steam generators fell within the licensing parameters of the original Davis-Besse license.

The first significant description revealing the true extent of the replacement steam generator modifications appears to be in the 74-page PowerPoint entitled *Davis-Besse Steam Generator Replacement Project: Project Overview/Public Meeting: NRC Region III Office: March 20, 2013*, that FENOC submitted to the NRC.

THE DAVIS-BESSE REPLACEMENT ONCE THROUGH STEAM GENERATOR AND 10 C.F.R. § 50.59

According to the PowerPoint presentation, FENOC had performed a 10 C.F.R. § 50.59 analysis that found that the RSG is "similar"[3] to the OSG. Being "similar" to the original steam generators without analyzing the impact so many changes from the original D-B technical specifications is an inadequate criterion by which to determine if 10 C.F.R. § 50.59 has been assiduously applied.

A review by Fairewinds Associates of the critical design information first provided by FENOC at the March 20, 2013 meeting with the NRC shows that the Davis-Besse

[2] Ibid.
[3] *Davis-Besse Steam Generator Replacement Project: Project Overview/Public Meeting: NRC Region III Office: March 20, 2013,* Slides 10 and 31

ROTSG does not meet the criteria of 10 C.F.R. § 50.59. Moreover, the data reviewed shows that FENOC should have applied for a license amendment with the requisite public review six years ago when the ROTSG was originally designed, ordered, and purchased.

Specifically, 10 C.F.R. § 50.59 requires that any licensee performing an experiment at a licensed nuclear power plant must apply for a license amendment and include the requisite public review. FENOC itself had acknowledged that the ROTSG design had significant modifications in comparison to the original OTSG. More specifically, slides 10 through 13 identify the following significant, experimental modifications to the original OTSG design:

1. The tube inspection lane was removed.
2. An additional tube support plate was added.
3. 150 additional tubes were added.
4. The tube alloy was changed.
5. The tube-to-tube sheet junction was modified extensively.
6. The overall design of the steam generator support structure was changed from a cylindrical skirt to a pedestal cone.
7. The thickness of the pressure retaining walls of the ROTSG is two inches thinner than the pressure retaining wall in the Original Once Through Steam Generator.
8. The 180-degree elbow design will be extensively modified.
9. The alloy of the hot leg nozzles was also changed.

Each and every one of these aforementioned changes is significant individually, and when taken together prove that the Replacement OTSG contains many experimental parameters, especially in comparison to the Original OTSG.

Conveniently, the list of experimental changes identified by FENOC does not include the additional modifications applied by FENOC to cut into the Davis-Besse containment for the fourth time since it was constructed. To the best of Fairewinds' knowledge and belief, no other containment structure has been cut open more than twice, yet Davis-

Besse's fourth containment perforation should have been identified by the 10 C.F.R. § 50.59 process as problematic and therefore requiring a license amendment review and application.

Furthermore, 10 C.F.R. § 50.59 requires a formal license renewal application when a license amendment change is required as a result of such a modification. The Atomic Safety and Licensing Board (ASLB) has recently confirmed that Section 50.59 establishes standards for a licensee to request a license amendment before it may make

> … changes in the facility as described in the [updated] final safety analysis report [UFSAR36], make changes in the procedures as described in the [UFSAR], and conduct tests or experiments not described in the [UFSAR]." 10 C.F.R. § 50.59(c)(1). Section 50.59 states that a licensee need not request a license amendment pursuant to section 50.90 if "(i) A change to the technical specifications incorporated in the license is not required, and(ii) The change, test, or experiment does not meet any of the criteria in paragraph (c)(2) of this section." Id. § 50.59(c)(1)(i)-(ii). **Restated, a licensee must request a license amendment if the proposed action requires that existing technical specifications be changed. If a licensee is unable to operate a reactor in strict accordance with its license, it must seek authorization from the NRC for a license amendment (10 C.F.R. §§ 50.59, 50.90 to 50.92), which is a process that triggers a right to request an adjudicatory hearing by persons whose interests may be affected by the proceeding. [Emphasis Added]**[4]

The ASLB decision quoted above stresses that changing technical specifications determine that the 50.59 criteria have not been met, and that a formal license amendment is required. This point is so essential that the ASLB emphasized it by restating the requirement for a formal license amendment review process if a technical specification change were to be required. A review of the FENOC PowerPoint[5] presentation submitted to the NRC contains an extensive list of changes to the D-B Technical Specifications that clearly identifies the necessity for complete technical review by the NRC via the formal 10 C.F.R. § 50.59-license amendment processes. It is evident that the formal license amendment review is required due to the numerous and unreviewed proposed changes to the D-B Technical Specifications.

---

[4] *Southern California Edison Co,* (San Onofre Nuclear Generating Station, Units 2 and 3), LBP-13-07, pp. 18-19 (May 13, 2013)

[5] *Davis-Besse Steam Generator Replacement Project: Project Overview/Public Meeting: NRC Region III Office: March 20, 2013,* Slides 15 through 17

INDUSTRY EXPERIENCE

In 2007 Davis-Besse awarded the design and fabrication of its ROTSG to B&W Canada. Since that time, there have been numerous significant problems with other steam generators throughout the United States. FENOC acknowledges these problems in its PowerPoint, *Davis-Besse Steam Generator Replacement Project: Project Overview/Public Meeting: NRC Region III Office: March 20, 2013,* slides 18 through 25. Significant problems have arisen at Oconee (slide 19), ANO (slide 20), TMI (slide 21), and San Onofre (slide 24).

In an effort to avoid the participatory public review aspect of the 50.59 license amendment process, the nuclear power licensees and their parent corporations have made an alleged strategic choice to avoid the license amendment process by manipulating loopholes in the 50.59 processes.

- The last three steam generator replacement projects orchestrated by licensees sought to avoid the 10 C.F.R. § 50.59 license amendment process.
- By avoiding the 50.59 license amendment processes for Crystal River 3 in Florida, and San Onofre 2 and San Onofre 3 in California, the owners, Progress Energy (Crystal River) and Edison (San Onofre Units 2 and 3) caused all three units to experience total mechanical failures.

Moreover, all three major replacement steam generator problems previously discussed and the failures at ANO and TMI described by FENOC in its PowerPoint were not identified at these nuclear power plants until significant damage to both the steam generators and the plants themselves had already occurred. Ratepayers were stuck with millions of dollars in payments for flawed equipment. All five-replacement steam generator equipment failures can be attributed to failure of these licensees to apply the appropriate 10 C.F.R. § 50.59 screening criteria. Evading the 10 C.F.R. § 50.59 license amendment processes allowed design errors to reach through fabrication and into plant operation before regulators even began examining these significant design and fabrication failures.

TIMING OF THE DISCOVERY OF RSG FAILURES AT SAN ONOFRE AND LESSONS TO LEARN FOR DAVIS-BESSE

The timing of the discovery of the failure of the Replacement Steam Generators at both San Onofre Units 2 and 3 is important to review and discuss in order to determine the likelihood of failure for the Davis-Besse ROTSG project. From the reports reviewed, it appears that FENOC most likely completed the new design for the D-B ROTSGs during 2008, and fabrication appears to have begun in 2009. FENOC now claims that lessons learned from the San Onofre failures have been incorporated into the D-B ROTSG design and fabrication. Such a claim is impossible since the San Onofre RSGs failed in 2012, well after the D-B ROTSGs were already in fabrication. Quite simply, the Davis-Besse ROTSG could not have been modified to reflect any lessons learned from the technical failures at San Onofre Units 2 and 3.

SIGNIFICANCE OF DESIGN MODIFICATIONS ON SAFETY[6]

The requirements for the process by which nuclear power plant operators and licensees may make changes to their facilities and procedures as delineated in the safety analysis report and without prior NRC approval are limited by specific regulations detailed in the Nuclear Regulatory Commission's *10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities, Section 50.59, Changes, Tests and Experiments*.

The implementing procedures for the 10 C.F.R. § 50.59 regulations have eight criteria that are important for nuclear power plant safety.

> "(2) A licensee shall obtain a license amendment pursuant to § 50.90 prior to implementing a proposed change, test, or experiment if the change, test, or experiment would:
>
> (i) Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the final safety analysis report (as updated);

[6] *Declaration Of Arnold Gundersen Supporting The Petition To Intervene By Friends Of The Earth Regarding The Ongoing Failure Of The Steam Generators At The San Onofre Nuclear Generating Station, Docket No. 50-361 and 50-362, May 31, 2012*

(ii) Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the final safety analysis report (as updated);

(iii) Result in more than a minimal increase in the consequences of an accident previously evaluated in the final safety analysis report (as updated);

(iv) Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the final safety analysis report (as updated);

(v) Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report (as updated);

(vi) Create a possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the final safety analysis report (as updated);

(vii) Result in a design basis limit for a fission product barrier as described in the FSAR (as updated) being exceeded or altered; or

(viii) Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses."

These implementing procedures created for 10 C.F.R. § 50.59 require that the license be amended unless none of these eight criteria are triggered by any change made by a nuclear power plant licensee like FENOC's Davis-Besse. If a single criterion is met, then the regulation requires that the licensee pursue a license amendment process.

By claiming that the steam generator replacements were a *like-for-like* design and fabrication, FENOC, like Edison at San Onofre Units 2 and 3, is attempting to avoid the more rigorous license amendment process. From the evidence reviewed, it appears that the NRC has accepted FENOC's statement and documents without further independent analysis, just as it did for Edison on San Onofre's RSGs.

In the analysis detailed of the Edison RSGs, Fairewinds identified 39 separate safety issues that failed to meet the NRC 50.59 criteria. Any one of those 39 separate safety issues should have triggered the license amendment review process by which the NRC would have been notified of the proposed significant design and fabrication changes.

Now it appears that FENOC is also attempting to skirt the 10 C.F.R. § 50.59 processes on its Davis-Besse ROTSG project. As the NRC guidelines state:

> "(c)(1) A licensee may make changes in the facility as described in the final safety analysis report (as updated), make changes in the procedures as described in the final safety analysis report (as 1.187-A-1updated), and conduct tests or experiments not described in the final safety analysis report (as updated) without obtaining a license amendment pursuant to § 50.90 only if: (i)A change to the technical specifications incorporated in the license is not required, and **(ii) The change, test, or experiment does not meet any of the criteria in paragraph (c)(2) of this section."**[7] [Emphasis Added]

In its previous reports, Fairewinds identified at least 39 *unreviewed* modifications to the original steam generators at San Onofre. Now Fairewinds' preliminary review of the D-B ROTSG shows that FENOC made *at least nine unreviewed technical specification changes to the Systems, Structures and Components (SSC)*. These major design changes are not *like-for-like* and clearly show that FENOC should have applied for a license amendment review of the D-B ROTSG under 10 C.F.R. § 50.59.

Additionally, FENOC has failed to include the Crystal River 3 ROTSG experience in its PowerPoint presentation to the NRC. Like Davis-Besse, the Crystal River 3 steam generator replacement is a Babcock & Wilcox design.

- The Crystal River 3 Containment failed three times in less than one year after being cut open during its ROTSG modification.
- It is important to compare the upcoming Davis-Besse ROTSG modification to the Crystal River 3 RSG, because the Davis-Besse Containment will also be cut open again during this outage.
- Like Crystal River 3, the Davis-Besse design is also a Babcock & Wilcox design, and also the D-B Containment will be cut open for the fourth time since it was constructed according to slides 47 and 51.
- Finally, FENOC's PowerPoint presentation does not address the fact that Davis-Besse's containment integrity issues are compounded by the damage its

[7] *Regulatory Guide 1.187 Guidance For Implementation Of 10 CFR 50.59, Changes, Tests, And Experiments*, 1.187-A-1, ttp://pbadupws.nrc.gov/docs/ML0037/ML003759710.pdf

containment already suffered during the blizzard of 1978, allegedly resulting in all of the cracking that now compromises D-B's containment integrity.

Of all the nuclear plants in the world, the Davis-Besse containment is the only one that has such a complicated history of storm damage and being split open repeatedly. These facts alone require a thorough NRC license application review and public hearing. While FENOC acknowledges that three containment incisions have occurred, it also claims that in this fourth containment incision:

- "Laminar cracking is not expected…"[8]
- And that if the containment were to crack, "Any deficiencies will be documented in the Corrective Action program."

Waiting for cracks to occur and then entering them into the corrective action program is the very definition of a 10 C.F.R. § 50.59-trigger for NRC licensing review. It appears that cutting the Davis-Bessie containment for the fourth time will in fact be an "experiment" as defined under 10 C.F.R. § 50.59.

CONCLUSION

Fairewinds concludes that the Replacement Once Through Steam Generator modifications at Davis-Bessie require a full NRC license application under the rules of 10 C.F.R. § 50.59 because:

1. There are extensive experimental modifications to both the ROTSGs and to the containment structures.
2. There are extensive modifications to the Davis-Besse technical specifications.

In the event that experimental changes are made, or in the event that technical specification changes are required, 10 C.F.R. § 50.59 makes it clear that a formal license amendment with public participation is required. Davis-Besse failed to comply with its responsibility under 10 C.F.R. § 50.59 to file a license amendment request and must do so before replacing its steam generator.

End

[8] *Davis-Besse Steam Generator Replacement Project: Project Overview/Public Meeting: NRC Region III Office: March 20, 2013* Slide 48

Attachments:

Attachment 1 – Curriculum Vitae

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

Executed this 20th day, May 2013 at Burlington, Vermont.

_____/s/_____

Arnold Gundersen, MSNE, RSO
Chief Engineer, Fairewinds Associates, Inc