BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Nuclear Plant Cost	)	
Recovery Clause	)	**DOCKET NO. 100009-EI**
	)	**FILED: July 8, 2010**
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DIRECT TESTIMONY OF ARNOLD GUNDERSEN

ON BEHALF OF
SOUTHERN ALLIANCE FOR CLEAN ENERGY (SACE)

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IN RE: NUCLEAR PLANT COST RECOVERY CLAUSE

THE SOUTHERN ALLIANCE FOR CLEAN ENERGY

FPSC DOCKET NO. 100009-EI

DIRECT TESTIMONY OF

ARNOLD GUNDERSEN

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name and business address.

A. My name is Arnold Gundersen. My business address is Fairewinds Associates, Inc, 376 Appletree Point Road, Burlington, VT 05408.

Q. Please tell us how you are employed and describe your background.

A. I am employed as a nuclear engineer with Fairewinds Associates, Inc and as a part-time college professor with Community College of Vermont. I have a Bachelor's and a Master's Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude. 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 as Exhibit AG-1. I have qualified as an expert witness before the NRC ASLB and ACRS, in Federal Court, before the State of Vermont Public Service Board and the State of Vermont Environmental Court. I have also given testimony in cases in Canada and the Czech Republic. I am an author of the first edition of the Department of Energy (DOE) Decommissioning Handbook. I have more than 39-years of professional nuclear experience including and 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, Consumptive Water Loss, 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.

II. PURPOSE AND SUMMARY OF TESTIMONY

Q. What is the purpose of your testimony?

A. I have been retained by the Southern Alliance for Clean Energy (SACE) to evaluate the potential for continuing scheduling delays and resulting uncertainty and cost overruns in the licensing of four AP1000 reactors proposed for construction in Florida by Progress Energy Florida (PEF) (Levy Units 1 and 2 or LNP) and Florida Power and Light (FPL) (Turkey Point Units 6 and 7 or TP 6&7), and the effect of these delays and uncertainty on the long-term feasibility of completion of these reactors, as well as the reasonableness and prudence of incurring additional costs on these reactors at this time.

Q. Please summarize your testimony.

A. My review and evaluation of the testimony and other materials filed by PEF and FPL in this docket clearly demonstrates that my previous 2009 testimony to the FPSC in Docket 090009-EI accurately predicted schedule delays and cost overruns that have now occurred at both PEF and FPL in their attempts at licensing and constructing four new nuclear reactors in Florida. I also discuss how the new strategy of delaying possible construction while continuing to attempt to license the proposed reactor sites ("site banking") that is being applied by both PEF and FPL does nothing more than impose additional costs upon the ratepayers in the State of Florida with no end in sight. As a result, I offer my opinion that incurring these site banking costs is unreasonable and imprudent. Next, I offer my opinion that further licensing delays, and resulting cost overruns, are likely for several reasons, including generic AP1000 issues as well as site specific geological issues at both the Levy County and the Turkey Point sites. The ultimate conclusion of my analysis is that neither PEF nor FPL have demonstrated that completion of these reactors is feasible, and as a result incurring additional costs for site banking is unreasonable and imprudent.

Q. Are you sponsoring any exhibits to your testimony?

A. Yes, I am sponsoring the following exhibits:

AG-1.	Arnie Gundersen CV 2010 July
AG-2	Sun Sentinel FPL Olivera
AG-3	FPL Press Release 01-2010
AG-4	NRC to Westinghouse 10-09
AG-5	Westinghouse Schedule 6-21-2010
AG-6	2010-05-28 FPL-TPN-NRC
AG-7	Petition to ACRS re: AP1000

Q. Please describe how your testimony is organized.

A. First, I briefly summarize my testimony in Docket 090009-EI and then evaluate the conclusions that I came to in that testimony in light of recent developments. Next, in the context of the "site banking" approach that both PEF and FPL have resorted to in this docket, I discuss my opinions relating to the long-term feasibility of completing these proposed new nuclear reactors, and the imprudence of incurring additional costs on the proposed reactors at this time given all of the uncertainty surrounding new nuclear generation. I then analyze the potential for further licensing delays and resulting cost overruns for these proposed new nuclear reactors in light of unresolved issues with the generic AP1000 design chosen by PEF and FPL. Next, I briefly discuss geological issues with both the Levy County site and the Turkey Point site and the potential for these geological issues to delay licensing even further. Finally, I offer my conclusions about how the commission should proceed in this docket.

III. TESTIMONY IN DOCKET 090009-EI

Q. Did you provide testimony on behalf of SACE in Docket 090009-EI regarding concerns you held about the potential licensing and construction of PEF's Levy Units 1 & 2 and FPL's Turkey Point Units 6 & 7?

A. I did. I provided prefiled testimony on July 15, 2009, and also testified in-person before the Florida Public Service Commission ("FPSC") in August of 2009 in regards to these proposed four new AP1000 reactors.

Q. Could you briefly summarize the substance of your testimony in Docket 090009-EI?

A. In both my prefiled and in-person testimony, I offered my opinion that there were numerous scheduling obstacles in both the licensing and construction phases of these proposed reactors, and that these obstacles would likely result in significant scheduling delays and great uncertainty, as well as increasing total project costs. Further, I observed that neither PEF nor FPL had adequately acknowledged these obstacles and the resulting delays and uncertainty in their planning processes or in their testimony to the FPSC.

Q. Based on these obstacles and the resulting scheduling delays, uncertainty, and increasing project costs, coupled with PEF and FPL's failure to adequately acknowledge the same, what conclusions, if any, did you reach?

A. First, I reached the conclusion that because PEF and FPL did not adequately address the impact of probable licensing delays and other uncertainties in their planning processes, the licensing and construction schedules proposed by PEF and FPL were overly optimistic and in my opinion impossible to meet. Second, as a result of my conclusion that the proposed licensing and construction schedules were impossible to meet, I concluded that significant project cost overruns would be unavoidable and that the total project cost of these proposed reactors was going to increase significantly. Finally, based upon my construction and licensing analysis, I concluded that neither PEF nor FPL had successfully demonstrated the long-term feasibility of completing construction of the four proposed new nuclear power plants at issue.

Q. Have any of these conclusions been confirmed since the time of your testimony in Docket 090009-EI?

A. Yes. As my detailed analysis predicted, the licensing and construction schedules for both PEF and FPL have been significantly delayed. PEF originally anticipated the issuance of its COL for both Levy Nuclear Plants (LNP) in 2011. However, PEF now concedes that the timeframe for issuance of the COL has been pushed back to late 2012 at the earliest, due to NRC scheduling delays and other uncertainties. I delineated and addressed most of these anticipated scheduling delays in my Docket 090009-EI testimony. Moreover, in May 2010 PEF announced that the soonest possible in-service (operational) dates for the LNP units have been delayed by at least five (5) years to 2021 and 2022 from their original anticipated operational dates of 2016 and 2017. Likewise, FPL now projects that the in-service dates for the Turkey Point 6 & 7 Units will be delayed by at least four (4) years to 2022 and 2023 from their original anticipated operation in 2018 and 2020 due to project uncertainties at the state, national and project levels. In fact, the delays that PEF and FPL address in this current proceeding were identifiable more than one year ago as evidenced by my previous testimony to this Commission.

Q. You noted earlier that you concluded in your Docket 090009-EI testimony that these scheduling delays would cause the capital costs of these potential reactors to increase. Have these scheduling delays affected the cost of these proposed reactors?

A. Yes. As a result of the scheduling delays and uncertainties, the cost of these proposed nuclear reactors has increased dramatically. PEF now projects a cost of at least 22.5

billion dollars to complete the LNP units, as compared to its much lower 2009 estimate of 17.2 billion dollars. Likewise, FPL now estimates a cost increase of at least 1 billion dollars in the total cost of TP 6 & 7 due to scheduling delays and other uncertainties. Again, the significant capital cost increases now acknowledged by PEF and FPL were identifiable more than one year ago as evidenced by my 2009 testimony to this Commission.

Q. In Docket 090009-EI you stated your opinion that PEF and FPL had not demonstrated that completion of these reactors was feasible in the long-term. Has your conclusion changed in light of the recent schedule delays and cost increases acknowledged by PEF and FPL in this current docket?

A. No, my opinion still remains the same in 2010 as it was in 2009 testimony. I continue to believe that neither PEF nor FPL have conducted a realistic analysis that is required in order to demonstrate that completion of these reactors is feasible in the long-term. Although both PEF and FPL now claim to acknowledge all of the uncertainties that both Dr. Mark Cooper and I testified to in Docket 090009-EI, they have in this year's cost recovery docket simply spread out the inevitable cost increases Dr. Cooper and I predicted in Docket 090009-EI. Therefore, the ratepayers of both PEF and FPL are simply spending more money over a much longer period of time.

More specifically, both PEF and FPL are now using an approach which I refer to as "site banking" in an attempt to ensure that both utilities will recover their individual corporate investment costs without having to make a bona fide showing of long-term feasibility in regards to completion of these reactors. In other words, ratepayers will pay for all these investment costs even if none of the reactors are actually constructed and the ratepayers never receive the benefit of this proposed new electric generation.

Q. Explain what you mean by "site banking?"

A. When PEF and FPL announced plans for the AP1000 reactors, it appeared that their goal was to actually construct and operate these proposed nuclear power plants. However, the data in the 2010 PEF and FPL testimony and other submittals indicate that the wrong assumptions have been applied by both PEF and FPL in order to determine the feasibility of licensing and constructing these proposed nuclear power plants. To date, almost every significant schedule milestone has been delayed and every cost estimate has been exceeded by both FPL and PEF. This year, due to both PEF and FPL's belated recognition of all the uncertainties inherent in the licensing and construction of these proposed reactors, PEF and FPL have changed their strategies and now seem entirely focused upon funding only the necessary NRC requirements for obtaining a COL without any real demonstrated commitment to actually constructing these proposed new reactors. I call this "site banking." Quite simply, it is not a foregone conclusion that either PEF or FPL will be able to obtain a COL for the LNP or TP 6&7 utilizing the newly designed AP1000 reactors. I discuss the current problems surrounding the generic AP1000 design, as well as the site viability of the LNP and TP 6&7 for location of these proposed reactors in more detail below. If the NRC does in fact grant a COL to either PEF or FPL for the LNP or TP 6&7, each utility will then decide whether or not it benefits their respective bottom lines to actually construct these proposed new reactors. This possibility once again will leave Florida ratepayers and businesses bearing the unreasonably and imprudently incurred up-front financial burden of these unrealistic projects that may never produce electricity.

Q. How have PEF and FPL reached this point where they are resorting to simply trying to obtain a COL from the NRC without any real demonstrated commitment to actual completion of these proposed new nuclear reactors?

A. There are several reasons why PEF and FPL have resorted to this position. First, the original construction schedules and costs presented by PEF and FPL for these proposed AP1000 nuclear plants have been shown to be dramatically unrealistic, and, as discussed in more detail by SACE witness Dr. Mark Cooper, neither company has attempted to conduct a realistic feasibility assessment that takes into account new additional costs and increased risks, amongst other uncertainties. Second, it is not clear that either site, LNP or TP 6&7, is licensable. Third, it is not clear that the ultimate busbar cost for nuclear power electricity could ever be justified. Fourth, it does not appear that Florida's current load growth even warrants the construction of these plants. And, lastly, it also does not appear that either utility has the financial wherewithal to construct these reactors, even at some point in the distant future. Thus, due to these uncertainties, both PEF and FPL are simply trying to reserve these sites for *possible* construction of new nuclear reactors (site banking), while at the same time ensuring that all costs for this site banking are borne by their Florida ratepayers and no costs are carried by the utilities or passed on to their stockholders/investors.

Ultimately, because neither FPL nor PEF can demonstrate that completion of these reactors is feasible in the long-term, or that expending large sums of capital on these reactors is reasonable and/or prudent at the current time, the utilities have resorted to this site banking approach in an attempt to recover some amount of money from their ratepayers in 2010-2011. However, I do not believe that these site-banking costs are reasonably or prudently incurred, and as a result the FPSC should not award these costs to PEF or FPL.

Q. Given the licensing and construction problems that you identified last year, coupled with events that have occurred since that time, is Florida Power and Light still convinced that the Turkey Point units would ultimately be constructed?

A. No, FPL is not at all convinced that these reactors will ultimately be constructed, and FPL has actually stated so publicly. FPL President Armando Olivera stated as early as January of 2010 in an FPL press release[1] [Exhibit AG-2] that FPL would be immediately suspending all activities on the proposed TP 6&7 reactors beyond what is required to obtain a NRC license due to the fact that the FPSC denied its rate increase proposal. See [Exhibit AG-3] *FPL President addresses criticism of the utility and renewable and nuclear energy.* Further, Mr. Olivera met with the Florida's *Sun Sentinel* editorial board on June 29, 2010, and said in his interview that FPL may never build these new nuclear units due to licensing and economic concerns.[2]

> FPL is moving forward with getting permits for building of two new reactors at Turkey Point as well *but it's unclear if that project will ultimately get done*, Olivera said. "Natural gas prices are down so the economics... are not as attractive," he said. Plus, he noted that the design FPL and other utilities are using hasn't been

[1] *Citing deteriorating regulatory environment, FPL halts dollars in capital expenditures in Florida,* FPL Press Release, 1-13-2010, http://www.fpl.com/news/2010/011310.shtml

[2] *FPL President addresses criticism of the utility and renewable and nuclear energy* http://weblogs.sun-sentinel.com/business/realestate/housekeys/blog/2010/06/fpl_president_armando_olivera.html

approved; the Nuclear Regulatory Commission has concerns about its resistance to hurricanes. [Emphasis Added]

Given that FPL is so uncertain that the Turkey Point reactors will actually ever be constructed, site banking is simply a vehicle by which to transfer costs incurred by FPL for imprudent exploration back to Florida's ratepayers. The FPSC should not allow FPL, or PEF for that matter, to pass on these site banking costs to their respective ratepayers, because, quite simply, the costs clearly are not reasonable and/or prudently incurred especially when their own president says that it is unclear if that project will ultimately be built. The FPSC cannot ignore these comments when considering whether or not completion of these reactors is feasible in the long-term.

Q. Have other energy corporations or utilities expressed doubts similar to Mr. Olivera's regarding the feasibility of building these new AP1000 reactors?

A. During the past two months, the CEO's of two of the largest nuclear operating utilities in the United States have also expressed significant concern about building these new AP1000 reactors**.** In fact, FPL is not the only southern utility to acknowledge that contemplating construction of an AP1000 reactor at this time is not a reasonable business decision. According to Reuters on May 25, 2010, Entergy CEO J. Wayne Leonard said that building new nuclear plants remains too risky.[3]

[3] http://uk.reuters.com/article/idUSTRE64N5S420100524

> Utilities do not want to take that risk," Leonard said at the Reuters Global Energy Summit in Houston. "It's risk we don't control." … New Orleans-based Entergy suspended two license applications filed with the Nuclear Regulatory Commission for proposed new reactors to be built either in Louisiana or Mississippi in 2008 after being unable to negotiate a favorable construction contract. … Nuclear vendors don't want to assume the risk of a cost overrun and have put construction costs too high for most companies, Leonard said. "You have to have a darn good reason at those prices to build," he said. … "Everybody's going to price the risk differently," Leonard said. "When we price the risk appropriately... the numbers just don't work." *"I've wondered how Southern -- how anybody -- makes the numbers work. Sitting on the outside looking in, they have some reason we don't see," he said.* [Emphasis Added].

Another utility Chief Executive Officer, Exelon Chairman John W. Rowe, has reached the same conclusion as Entergy's Leonard. CEO Rowe argued that building new nuclear units was not an economically justified solution to creating additional electric supplies when he said,

> …we must have a market-based solution to the problem. Picking our favorite technologies in 2008 would have led to some good decisions, like energy efficiency and uprates and some very large, very expensive ones, like new nuclear plants and clean coal.[4]

[4] *Fixing the Carbon Problem Without Breaking the Economy* John W. Rowe, Chairman & CEO Exelon May 12, 2010, Resources for the Future Policy Leadership Forum, Washington, DC. Exelon CEO John W. http://www.exeloncorp.com/Newsroom/speeches/speeches.aspx

IV. LICENSING DELAYS

A. GENERIC AP1000 ISSUES

Q. When do PEF and FPL anticipate receiving COLs for the LNP units and TP 6 & 7 units from the NRC?

A. As I anticipated in my 2009 testimony, both PEF and FPL have experienced licensing delays. PEF does not anticipate issuance of a COL for the LNP units until late 2012 at the earliest, and the recently issued NRC review schedule for FPL indicates that the issuance of a COL may not be possible until at least late 2013 for the TP 6 & 7 units.

Q. On a national level, does the potential exist for further licensing delays on the generic AP1000 design due to unresolved issues with the design?

A. Yes, there are several unresolved technical issues regarding the AP1000 design that are currently being assessed by the NRC and which are likely to further delay licensing approval(s). In October 2009 the NRC sent a letter to Westinghouse requiring it to provide more detailed information regarding the AP1000 shield building [Exhibit AG-4]. During the past year, the NRC has asked a series of probing questions relating to the structural integrity of the AP1000 shield building. Responses by Westinghouse to critical NRC information requests were frequently late, thereby further delaying an already problematic and overly optimistic licensing schedule. Finally on June 21, 2010, the NRC issued a letter to Westinghouse stating that the NRC may finally be able to complete the NRC review of the AP-1000 technical design by September of 2011 *if* critical milestones to correct technical and design issues are met in a timely manner by Westinghouse [Exhibit AG-5]. Specifically, the NRC noted the difficulty in meeting these milestones, stating,

> The NRC has established an aggressive goal of completing the AP1000 design certification rulemaking by the end of fiscal year 2011 to support the needs of the Vogtle and Summer combined license (COL) applications and their associated construction plans. Completion of the rulemaking by the end of September 2011 will not be easy. A number of technical issues remain on the application and it will require substantial commitment of resources and the attention of senior management by both Westinghouse and the COL applicants to drive technical issues to closure in a time frame that would support the schedule below. …There is no margin in this schedule that would permit movement of these critical milestones and still achieve the goal of completing the rulemaking by the end of September 2011.

The impact of these generic licensing risks upon the Levy County and Turkey Point AP1000 units were also identified by NRC Director Mathews, of the Division of New Reactor Licensing, to FPL Sr. VP Nazar in a letter[5] dated May 28, 2010 [Exhibit AG-6] that said,

> The Turkey Point Units 6 and 7 COLA incorporates by reference the AP1000 Design Control Document (DCD) submitted by Westinghouse to the NRC on May 26, 2007, as Revision 16 and updated by DCD Revision 17 on September 22, 2008. As allowed by 10 CFR 52.55(c), at your own risk, you have referenced a design certification application that has been docketed but not granted. Therefore, your COLA review schedule is dependent on

[5] *Turkey Point Units 6 And 7 Nuclear Power Plants Combined License Application Review Schedule,* 5-28-2010, Page 1.

> the review schedule for the design certification. In addition, as a subsequent combined license applicant referencing the AP1000 design, your COLA review schedule is also dependent on the review schedule for the Vogtle Electric Generating Plant COLA (the reference COL [RCOL] application for the AP1000 design center). Because it utilizes the standard content contained in the RCOL application, it is incumbent upon FPL to remain cognizant of the resolution of the standard technical issues that will be addressed during the NRC review of the Vogtle Electric Generating Plant RCOL application.

Mathews clearly states the NRC position that any site-specific licensing review for either LNP or TP 6&7 is dependent upon at least two factors. First, approval of the AP1000 generic design, and second, the approval of the reference plant COLA at Vogtle. The NRC letter by the Director of New Reactor Licensing also makes it quite clear that both PEF and FPL are moving ahead with the attempted licensing of the LNP and TP 6&7 <u>at their own risk</u>.

Q. Are there other unresolved issues with the generic AP1000 technology that could further delay the potential licensing of the LNP and TP 6&7?

A. Yes. In addition to the problems with the AP1000 shield building, the NRC is also reviewing a potential and significant safety problem with the AP1000 containment itself. In a letter to the NRC dated April 21, 2010, the AP1000 Oversight Group provided the NRC with a report entitled *Post Accident AP1000 Containment Leakage, an Unreviewed Safety Issue* [AG-Exhibit 7]. As the primary author of that expert report, which was peer reviewed by Dr. Rudolph Hausler, I was invited to appear with Oversight Group counsel John Runkle before the NRC Advisory Committee on Reactor Safeguards (ACRS) on June 25, 2010. The NRC ACRS considers the issues raised in my technical report to be so significant that the ACRS asked me to make a one-hour and fifteen-minute presentation to the ACRS AP1000 subcommittee.

To summarize the key issues of both the Fairewinds Report and the presentation to the ACRS, it is my opinion that there is an unreviewed safety issue associated with the unique passive containment structure that is integral to the AP1000 design. Past nuclear industry experience on steel reactor containment liners and containment vessels shows me that they are susceptible to corrosion and cracking. Neither protective coatings nor ASME XI inspection programs have prevented nor detected these failures. Should a failure of this nature occur in the AP1000 design, the uniqueness of the containment and shield building would cause excessive amounts of radiation to be released in the event of an accident. NRC action on this safety issue may result in design modifications to the AP1000 design that may impact not only its licensing schedule but also the ultimate cost of the reactor.

The presentation to the ACRS was lengthy, lasting one hour and fifteen minutes, an abnormally large amount of time for the ACRS to grant for such a presentation. At the end of the presentation, the ACRS took the comments under advisement. ACRS sub-committee chairman Harold B. Ray, a retired chairman of Southern California Edison, told me that, “Your input to us is helpful in focusing attention.’’ ACRS sub-committee chairman Ray also stated that he believed that the concerns Fairewinds raised related to coatings and ASME inspections should also be addressed as new contentions on each specific AP1000 docket. Additional contentions will undoubtedly also further delay the R-COLA Vogtle licensing process.

Q. What conclusions can you draw due to these unresolved technical issues with the generic AP1000 design that PEF and FPL have chosen for the LNP and TP 6&7?

A. Ultimately, as there are at least two unresolved problems with the technical design of the AP1000, more specifically problems in the Shield Building and in the Reactor Containment, there remains a significant schedule risk of continuing scheduling delays and the likelihood of corresponding cost increases to the generic AP1000 license.

B. SITE SPECIFIC CONCERNS

Q. Based on current circumstances, do you anticipate additional scheduling delays in the licensing of these reactors due to site-specific concerns?

A. Yes. I addressed some unique site-specific licensing issues for both Levy County and Turkey Point in my 2009 testimony. Those issues remain unresolved. Furthermore, it appears that the geologic issue(s) I discussed in 2009 need further evaluation and elaboration in 2010 due to NRC emphasis on specific criteria.

Q. In your 2009 testimony you stated that there were risks associated with the geology of the Levy County site. Did PEF agree with that assessment at that time?

A. No. Less than three weeks before the 2009 hearings, PEF stated that the NRC had no "serious doubts or concerns" about the geology of the Levy County site. Specifically, on pages 15-17 of the "Rebuttal Testimony of Jeff Lyash On Behalf of Progress Energy Florida" dated August 10, 2009, Lyash stated,

> **Q. The intervenors also reference the NRC's statements about the complexity of the site characteristics in this October 6, 2008 letter and the NRC's request for additional information as reasons for concern regarding the Company's LWA request. Do you agree?**
>
> A. No. …the NRC will focus its review of the PEF COLA on the site characteristics to determine how that AP1000 design for the nuclear power plants will actually be built on the Levy site. This review requires the NRC to ask geotechnical questions through RAIs. The fact that the NRC issues RAIs means the NRC is doing its job. It does not mean the NRC has "doubts" or "concerns" --- or that there were problems with the Company's COLA or LWA --- in the way the intervenor witnesses seem to use these words. The mere fact that the NRC was asking geotechnical questions and questions about the site characteristics does not mean that the NRC

> was not going to issue the LWA. …The NRC would not have docketed the PEF COLA if the NRC had "serious doubts" or "concerns" about building the AP1000 nuclear power plants on the Levy site because of the site geology or other site characteristics. The fact that the NRC acknowledged the complexity of the site also does not mean there was a problem with PEF's COLA or LWA.

Q. Has Progress Energy changed its testimony in 2010 to now reflect your 2009 testimony concerning geologic concerns?

A. Yes, PEF completely reverses its 2009 testimony and now in 2010 acknowledges that there are "risks" associated with the geology of the LNP site. Specifically, in his April 30, 2010 testimony on behalf of PEF, Mr. Lyash completely reverses his 2009 testimony and admits that there are "risks" and that not all of the NRC's geologic concerns have been addressed. Furthermore, Mr. Lyash now acknowledges that the both the PEF and the NRC were aware of these "risks" while PEF was testifying before the FPSC in Docket 090009-0EI to the effect that the NRC had no "serious doubts or concerns" about the geology of the LNP site. Specifically, in his April 30, 2010 testimony, Mr. Lyash said,

> Many of the questions the NRC had regarding the site that were discussed during the nuclear cost recovery proceeding last year are being resolved. Following a NRC audit in late September 2009, the NRC staff indicated that new results from field investigations appear to resolve many of their previous geotechnical questions related to karsts and the foundation support at the site. [The NRC] requests for additional information ("RAIs") following that site audit support the NRC staff comments at the audit. The karst

related and other geotechnical site risks are receding. [6]

For the same reasons that I testified about in 2009, it is my current opinion that the LNP site may not even be licensable due to its geologic risks.

Q. Are there potential geologic problems at Turkey Point that can affect licensing?

A. Yes. On May 28, 2010 the NRC highlighted its concerns over seismic risks at Turkey Point in a letter from NRC's Mathews, Director of the Division of New Reactor Licensing to FPL's Sr. VP Nazar [Exhibit AG-6]. In part, the letter said,

> As stated in the staff letter dated September 4, 2009, (ML092380248) we have a concern that we have still not received the additional information related to Final Safety Analysis Report (FSAR) Section 2.5. We cannot initiate our review of Section 2.5 until the information requests identified under the headings of Geology and Seismology and Geotechnical are provided. Therefore, this can introduce uncertainty in the proposed schedule and the schedule may be revised based on the availability of the requested information.

In fact, the generic AP1000 design may not even be licensable for any locations in Florida due to geological considerations.[7] The NRC clearly states that not all geologic locations are capable of accommodating the AP1000 design. Section 2.5.4.2.5 relating to Subsurface Uniformity is but one example of where the generic AP1000 design might encounter geologic problems in certain siting locations.

Section 2.5.4.5 of the DCD states that, although the design and

[6] *Direct Testimony of Jeff Lyash on behalf of Progress Energy Florida*, April 30, 2010, Page 45

[7] NRC generic AP1000 Design Certification Amendment *ADVANCED FINAL SAFETY EVALUATION REPORT FOR CHAPTER 2 TITLED SITE ENVELOPE OF NUREG-1793* (ML101540170-1), page 31, June 29, 2010

> analysis of the AP1000 was based on soil or rock conditions with uniform properties within horizontal layers, provisions and design margins to accommodate many nonuniform sites were also included. The applicant described, in detail, the types of site investigation that would be sufficient for a "uniform" site or a "nonuniform" site. The applicant indicated that the acceptability of a nonuniform site would be based on an individual site evaluation. The applicant concluded that, for uniform sites whose site parameters fall within the site profiles evaluated as part of the DC, no further action will be needed. However, for nonuniform sites, or other sites whose parameters do not fall within the site profiles, a site-specific evaluation will need to be performed. For nonuniform sites, Sections 2.5.1 and 2.5.4.6.1 of the DCD outline the geological investigations for the extended investigation effort to determine whether the site is acceptable for construction of an AP1000 reactor.

Therefore, it is important for the FPSC to take into account the fact that geologic issues may persist for both the Levy County and Turkey Point sites since both sites are not "based on soil or rock conditions with uniform properties within horizontal layers".

Q. Have geologic or seismic conditions ever impacted the construction of a nuclear power plant?

A. Yes. While the record is unclear as to how many reactor sites have been considered and rejected prior to authorization for Construction Permits, at least three reactors in the United States were forced to terminate all activities due to geologic concerns that became apparent after construction had begun. Those reactors were Bodega Bay in California and Midland 1 & 2 in Michigan. Midland 1 was 85% complete when foundation settling caused such severe cracking that the project was terminated at a loss of several billion dollars.

Q. Given the generic and site specific licensing uncertainties, is the 2010 site banking strategy developed by FPL and PEF feasible and prudent?

A. No. It would be more feasible and prudent for FPL and PEF to immediately terminate both the Levy and Turkey Point projects. There is a great risk that the generic or site-specific license will not be approved. Put simply, site banking is an unnecessary expense until all AP1000 issues are resolved. In my opinion, the generic licensing issues that are presently being reviewed on the AP1000 R-COLA design will change the weight, seismic responses, building designs, and costs of the AP1000. Therefore, these changes will adversely impact FPL and PEF seismic and structural analyses and lead to expensive redesign. Furthermore, it is not clear that Florida's unique geologic composition will allow the site-specific licenses to ever be approved due to weight and seismic concerns even when the generic AP1000 design is approved.

Q. Would terminating all activities be costly to the ratepayers of the State of Florida?

A. No. In my opinion, immediately terminating all work on these projects would result in the lowest costs to the ratepayers of the State of Florida. Site banking is considerably more costly than termination. My opinion is confirmed by the April 30, 2010, testimony of Progress Energy, Inc. Vice President of Nuclear Plant Development ("NPD") John Elnitsky (see Confidential version).

IV. CONCLUSION

Q. Please briefly summarize your conclusions.

A. PEF and FPL have belatedly adopted my opinions, as well as those of Dr. Mark Cooper and others regarding the uncertainties surrounding the licensing of new nuclear reactors, and the resulting delays and corresponding cost overruns. However, both PEF and FPL have failed to go far enough and are now simply engaging in site banking in an attempt to recover the costs of licensing from their respective ratepayers while making no real showing of the long-term feasibility of ever completing these proposed reactors. At least three separate utility executives, including FPL's president, have acknowledged the uncertainties surrounding attempts at licensing and constructing new nuclear generation. Furthermore, it is my opinion that there will be additional delays and more cost overruns in PEF and FPL's attempts at licensing these proposed reactors. Therefore, the least cost option would be the immediate cancellation of these units, rather than the site banking approach that the utilities have resorted to. For these reasons, I do not believe that the FPSC should allow PEF and FPL to recover these site banking costs from their ratepayers, as the costs are not reasonably and/or prudently incurred costs given the fact that completion of these reactors is not feasible in the long-term.

Q. Does this conclude your testimony?

A. Yes.

CURRICULUM VITAE
Arnold Gundersen
Chief Engineer, Fairewinds Associates, Inc
June 2010

Education and Training

ME NE	Master of Engineering Nuclear Engineering Rensselaer Polytechnic Institute, 1972 U.S. Atomic Energy Commission Fellowship Thesis: Cooling Tower Plume Rise
BS NE	Bachelor of Science Nuclear Engineering Rensselaer Polytechnic Institute, Cum Laude, 1971 James J. Kerrigan Scholar
RO	Licensed Reactor Operator, U.S. Atomic Energy Commission License # OP-3014

Qualifications – including and not limited to:

- Chief Engineer, Fairewinds Associates, Inc
- Nuclear Engineering, Safety, and Reliability Expert
- Federal and Congressional hearing testimony and Expert Witness testimony
- Former Senior Vice President Nuclear Licensee
- Former Licensed Reactor Operator
- 39-years of nuclear industry experience and oversight
    - Nuclear engineering management assessment and prudency assessment
    - Nuclear power plant licensing and permitting – assessment and review
    - Nuclear safety assessments, source term reconstructions, dose assessments, criticality analysis, and thermohydraulics
    - Contract administration, assessment and review
    - Systems engineering and structural engineering assessments
    - Cooling tower operation, cooling tower plumes, thermal discharge assessment, and consumptive water use
    - Nuclear fuel rack design and manufacturing, nuclear equipment design and manufacturing, and technical patents
    - Radioactive waste processes, storage issue assessment, waste disposal and decommissioning experience
    - Reliability engineering and aging plant management assessments, in-service inspection
    - Employee awareness programs, whistleblower protection, and public communications
    - Quality Assurance (QA) & records

Publications

Co-author — *DOE Decommissioning Handbook, First Edition*, 1981-1982, invited author.

Co-author — *Decommissioning the Vermont Yankee Nuclear Power Plant: An Analysis of Vermont Yankee's Decommissioning Fund and Its Projected Decommissioning Costs*, November 2007, Fairewinds Associates, Inc.

Co-author — *Decommissioning Vermont Yankee – Stage 2 Analysis of the Vermont Yankee*

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Decommissioning Fund – The Decommissioning Fund Gap, December 2007, Fairewinds Associates, Inc. Presented to Vermont State Senators and Legislators.

Co-author — *Vermont Yankee Comprehensive Vertical Audit – VYCVA – Recommended Methodology to Thoroughly Assess Reliability and Safety Issues at Entergy Nuclear Vermont Yankee*, January 30, 2008 Testimony to Finance Committee Vermont Senate

Co-author — *Act 189 Public Oversight Panel Report*, March 17, 2009, to the Vermont State Legislature by the Vermont Yankee Public Oversight Panel.

Author — Fairewinds Associates, Inc *First Quarterly Report to the Joint Legislative Committee*, October 19, 2009.

Co-author — The Second Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding buried pipe and tank issues at Entergy Nuclear Vermont Yankee and Entergy proposed Enexus spinoff. See two reports: *Fairewinds Associates 2nd Quarterly Report to JFC* and *Enexus Review by Fairewinds Associates*.

Patents

Energy Absorbing Turbine Missile Shield – U.S. Patent # 4,397,608 – 8/9/1983

Committee Memberships

Vermont Yankee Public Oversight Panel, appointed 2008 by President Pro-Tem Vermont Senate
National Nuclear Safety Network – Founding Board Member
Three Rivers Community College – Nuclear Academic Advisory Board
Connecticut Low Level Radioactive Waste Advisory Committee – 10 years, founding member
Radiation Safety Committee, NRC Licensee – founding member
ANSI N-198, Solid Radioactive Waste Processing Systems

Honors

U.S. Atomic Energy Commission Fellowship, 1972
B.S. Degree, Cum Laude, RPI, 1971, 1st in nuclear engineering class
Tau Beta Pi (Engineering Honor Society), RPI, 1969 – 1 of 5 in sophomore class of 700
James J. Kerrigan Scholar 1967–1971
Teacher of the Year – 2000, Marvelwood School
Publicly commended to U.S. Senate by NRC Chairman, Ivan Selin, in May 1993 – "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service."

Nuclear Consulting and Expert Witness Testimony

U.S. Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards (NRC-ACRS) AP1000 Sub-Committee
Presentation to ACRS regarding design flaw in AP1000 Containment – June 25, 2010
Power Point Presentation: http://fairewinds.com/node/94

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Second Declaration Of Arnold Gundersen Supporting Supplemental Petition Of Intervenors Contention 15: DTE COLA Lacks Statutorily Required Cohesive QA Program – June 8, 2010

NRC Chairman Gregory Jaczko, ACRS, Secretary of Energy Chu, and the White House Office of Management and Budget
AP1000 Containment Leakage Report Fairewinds Associates - Gundersen, Hausler, 4-21-2010.

This report, commissioned by the AP1000 Oversight Group, analyzes a potential flaw in the containment of the AP1000 reactor design.

Vermont State Legislature House Natural Resources – April 5, 2010
Testified to the House Natural Resources Committee regarding discrepancies in Entergy's TLG Services decommissioning analysis. See *Fairewinds Cost Comparison TLG Decommissioning* (http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm).

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee – February 22, 2010
The Second Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding buried pipe and tank issues at Entergy Nuclear Vermont Yankee and Entergy proposed Enexus spinoff. See two reports: *Fairewinds Associates 2nd Quarterly Report to JFC* and *Enexus Review by Fairewinds Associates*.
(http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm).

Vermont State Legislature Senate Natural Resources – February 16, 2010
Testified to Senate Natural Resources Committee regarding causes and severity of tritium leak in unreported buried underground pipes, status of Enexus spinoff proposal, and health effects of tritium.

Vermont State Legislature Senate Natural Resources – February 10, 2010
Testified to Senate Natural Resources Committee regarding causes and severity of tritium leak in unreported buried underground pipes. http://www.youtube.com/watch?v=36HJiBrJSxE

Vermont State Legislature Senate Finance – February 10, 2010
Testified to Senate Finance Committee regarding *A Chronicle of Issues Regarding Buried Tanks and Underground Piping at VT Yankee.*
(http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm)

Vermont State Legislature House Natural Resources – January 27, 2010
A Chronicle of Issues Regarding Buried Tanks and Underground Piping at VT Yankee.
(http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm)

Submittal to Susquehanna River Basin Commission, by Eric Epstein – January 5, 2010
Expert Witness Report Of Arnold Gundersen Regarding Consumptive Water Use Of The Susquehanna River By The Proposed PPL Bell Bend Nuclear Power Plant In the Matter of RE: Bell Bend Nuclear Power Plant Application for Groundwater Withdrawal Application for Consumptive Use BNP-2009-073.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Declaration of Arnold Gundersen Supporting Supplemental Petition of Intervenors Contention 15: Detroit Edison COLA Lacks Statutorily Required Cohesive QA Program, December 8, 2009.

U.S. NRC Region III Allegation Filed by Missouri Coalition for the Environment
Expert Witness Report entitled: *Comments on the Callaway Special Inspection by NRC Regarding the May 25, 2009 Failure of its Auxiliary Feedwater System,* November 9, 2009.

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Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee
Oral testimony given to the Vermont State Legislature Joint Fiscal Committee October 28, 2009. See report: *Quarterly Status Report - ENVY Reliability Oversight for JFO* (http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm).

Vermont State Legislature Joint Fiscal Committee Legislative Consultant Regarding Entergy Nuclear Vermont Yankee
The First Quarterly Report by Fairewinds Associates, Inc to the Joint Legislative Committee regarding reliability issues at Entergy Nuclear Vermont Yankee, issued October 19, 2009. See report: *Quarterly Status Report - ENVY Reliability Oversight for JFO* (http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm).

Florida Public Service Commission (FPSC)
Gave direct oral testimony to the FPSC in hearings in Tallahassee, FL, September 8 and 10, 2009 in support of Southern Alliance for Clean Energy (SACE) contention of anticipated licensing and construction delays in newly designed Westinghouse AP 1000 reactors proposed by Progress Energy Florida and Florida Power and Light (FPL).

Florida Public Service Commission (FPSC)
NRC announced delays confirming my original testimony to FPSC detailed below. My supplemental testimony alerted FPSC to NRC confirmation of my original testimony regarding licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Supplemental Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy*, FPSC Docket No. 090009-EI, August 12, 2009.

Florida Public Service Commission (FPSC)
Licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Direct Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy*, FPSC Docket No. 090009-EI, July 15, 2009.

Vermont State Legislature Joint Fiscal Committee Expert Witness Oversight Role for Entergy Nuclear Vermont Yankee (ENVY)
Contracted by the Joint Fiscal Committee of the Vermont State Legislature as an expert witness to oversee the compliance of ENVY to reliability issues uncovered during the 2009 legislative session by the Vermont Yankee Public Oversight Panel of which I was appointed a member along with former NRC Commissioner Peter Bradford for one year from July 2008 to 2009. Entergy Nuclear Vermont Yankee (ENVY) is currently under review by Vermont State Legislature to determine if it should receive a Certificate for Public Good (CPG) to extend its operational license for another 20-years. Vermont is the only state in the country that has legislatively created the CPG authorization for a nuclear power plant. Act 160 was passed to ascertain ENVY's ability to run reliably for an additional 20 years. Appointment from July 2009 to May 2010.

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U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Combined Operating License Application (COLA) at North Anna Unit 3 *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions* (June 26, 2009).

U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Through-wall Penetration of Containment Liner and Inspection Techniques of the Containment Liner at Beaver Valley Unit 1 Nuclear Power Plant *Declaration of Arnold Gundersen Supporting Citizen Power's Petition* (May 25, 2009).

U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Quality Assurance and Configuration Management at Bellefonte Nuclear Plant *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions in their Petition for Intervention and Request for Hearing*, May 6, 2009.

Pennsylvania Statehouse
Expert Witness Analysis presented in formal presentation at the Pennsylvania Statehouse, March 26, 2009 regarding actual releases from Three Mile Island Nuclear Accident. Presentation may be found at: http://www.tmia.com/march26

Vermont Legislative Testimony and Formal Report for 2009 Legislative Session
As a member of the Vermont Yankee Public Oversight Panel, I spent almost eight months examining the Vermont Yankee Nuclear Power Plant and the legislatively ordered Comprehensive Vertical Audit. Panel submitted Act 189 Public Oversight Panel Report March 17, 2009 and oral testimony to a joint hearing of the Senate Finance and House Natural Resources March 19, 2009. (See: http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm)

Finestone v FPL (11/2003 to 12/2008) Federal Court
Plaintiffs' Expert Witness for Federal Court Case with Attorney Nancy LaVista, from the firm Lytal, Reiter, Fountain, Clark, Williams, West Palm Beach, FL. This case involved two plaintiffs in cancer cluster of 40 families alleging that illegal radiation releases from nearby nuclear power plant caused children's cancers. Production request, discovery review, preparation of deposition questions and attendance at Defendant's experts for deposition, preparation of expert witness testimony, preparation for Daubert Hearings, ongoing technical oversight, source term reconstruction and appeal to Circuit Court.

U.S. Nuclear Regulatory Commission Advisory Committee Reactor Safeguards (NRC-ACRS)
Expert Witness providing oral testimony regarding Millstone Point Unit 3 (MP3) Containment issues in hearings regarding the Application to Uprate Power at MP3 by Dominion Nuclear, Washington, and DC. (July 8-9, 2008).

Appointed by President Pro-Tem of Vermont Senate to Legislatively Authorized Nuclear Reliability Public Oversight Panel
To oversee Comprehensive Vertical Audit of Entergy Nuclear Vermont Yankee (Act 189) and testify to State Legislature during 2009 session regarding operational reliability of ENVY in relation to its 20-year license extension application. (July 2, 2008 to present).

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U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness providing testimony regarding *Pilgrim Watch's Petition for Contention 1 Underground Pipes* (April 10, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness supporting *Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions Against Dominion Nuclear Connecticut Inc.'s Millstone Power Station Unit 3 License Amendment Request For Stretch Power Uprate* (March 15, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness supporting *Pilgrim Watch's Petition For Contention 1*: *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*. (January 26, 2008).

Vermont State House – 2008 Legislative Session
- House Committee on Natural Resources and Energy – Comprehensive Vertical Audit: *Why NRC Recommends a Vertical Audit for Aging Plants Like Entergy Nuclear Vermont Yankee (ENVY)*
- House Committee on Commerce – Decommissioning Testimony

Vermont State Senate – 2008 Legislative Session
- Senate Finance – testimony regarding Entergy Nuclear Vermont Yankee Decommissioning Fund
- Senate Finance – testimony on the necessity for a Comprehensive Vertical Audit (CVA) of Entergy Nuclear Vermont Yankee
- Natural Resources Committee – testimony regarding the placement of high-level nuclear fuel on the banks of the Connecticut River in Vernon, VT

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
MOX Limited Appearance Statement to Judges Michael C. Farrar (Chairman), Lawrence G. McDade, and Nicholas G. Trikouros for the "Petitioners": Nuclear Watch South, the Blue Ridge Environmental Defense League, and Nuclear Information & Resource Service in support of *Contention 2: Accidental Release of Radionuclides, requesting a hearing concerning faulty accident consequence assessments made for the MOX plutonium fuel factory proposed for the Savannah River Site*. (September 14, 2007).

Appeal to the Vermont Supreme Court (March 2006 to 2007)
Expert Witness Testimony in support of *New England Coalition's Appeal to the Vermont Supreme Court Concerning: Degraded Reliability at Entergy Nuclear Vermont Yankee as a Result of the Power Uprate*. New England Coalition represented by Attorney Ron Shems of Burlington, VT.

State of Vermont Environmental Court (Docket 89-4-06-vtec 2007)
Expert witness retained by New England Coalition to review Entergy and Vermont Yankee's analysis of alternative methods to reduce the heat discharged by Vermont Yankee into the

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Connecticut River. Provided Vermont's Environmental Court with analysis of alternative methods systematically applied throughout the nuclear industry to reduce the heat discharged by nuclear power plants into nearby bodies of water and avoid consumptive water use. This report included a review of the condenser and cooling tower modifications.

U.S. Senator Bernie Sanders and Congressman Peter Welch (2007)
Briefed Senator Sanders, Congressman Welch and their staff members regarding technical and engineering issues, reliability and aging management concerns, regulatory compliance, waste storage, and nuclear power reactor safety issues confronting the U.S. nuclear energy industry.

State of Vermont Legislative Testimony to Senate Finance Committee (2006)
Testimony to the Senate Finance Committee regarding Vermont Yankee decommissioning costs, reliability issues, design life of the plant, and emergency planning issues.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert witness retained by New England Coalition to provide Atomic Safety and Licensing Board with an independent analysis of the integrity of the Vermont Yankee Nuclear Power Plant condenser (2006).

U.S. Senators Jeffords and Leahy (2003 to 2005)
Provided the Senators and their staffs with periodic overview regarding technical, reliability, compliance, and safety issues at Entergy Nuclear Vermont Yankee (ENVY).

10CFR 2.206 filed with the Nuclear Regulatory Commission (July 2004)
Filed 10CFR 2.206 petition with NRC requesting confirmation of Vermont Yankee's compliance with General Design Criteria.

State of Vermont Public Service Board (April 2003 to May 2004)
Expert witness retained by New England Coalition to testify to the Public Service Board on the reliability, safety, technical, and financial ramifications of a proposed increase in power (called an uprate) to 120% at Entergy's 31-year-old Vermont Yankee Nuclear Power Plant.

International Nuclear Safety Testimony
Worked for ten days with the President of the Czech Republic (Vaclav Havel) and the Czech Parliament on their energy policy for the 21st century.

Nuclear Regulatory Commission (NRC) Inspector General (IG)
Assisted the NRC Inspector General in investigating illegal gratuities paid to NRC Officials by Nuclear Energy Services (NES) Corporate Officers. In a second investigation, assisted the Inspector General in showing that material false statements (lies) by NES corporate president caused the NRC to overlook important violations by this licensee.

State of Connecticut Legislature
Assisted in the creation of State of Connecticut Whistleblower Protection legal statutes.

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Federal Congressional Testimony
Publicly recognized by NRC Chairman, Ivan Selin, in May 1993 in his comments to U.S. Senate, "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service." Commended by U.S. Senator John Glenn for public testimony to Senator Glenn's NRC Oversight Committee.

PennCentral Litigation
Evaluated NRC license violations and material false statements made by management of this nuclear engineering and materials licensee.

Three Mile Island Litigation
Evaluated unmonitored releases to the environment after accident, including containment breach, letdown system and blowout. Proved releases were 15 times higher than government estimate and subsequent government report.

Western Atlas Litigation
Evaluated neutron exposure to employees and license violations at this nuclear materials licensee.

Commonwealth Edison
In depth review and analysis for Commonwealth Edison to analyze the efficiency and effectiveness of all Commonwealth Edison engineering organizations, which support the operation of all of its nuclear power plants.

Peach Bottom Reactor Litigation
Evaluated extended 28-month outage caused by management breakdown and deteriorating condition of plant.

Special Remediation Expertise:

Director of Engineering, Vice President of Site Engineering, and the Senior Vice President of Engineering at Nuclear Energy Services (NES) Division of Penn Central Corporation (PCC)

- NES was a nuclear licensee that specialized in dismantlement and remediation of nuclear facilities and nuclear sites. Member of the radiation safety committee for this licensee.
- Department of Energy chose NES to write *DOE Decommissioning Handbook* because NES had a unique breadth and depth of nuclear engineers and nuclear physicists on staff.
- Personally wrote the "Small Bore Piping" chapter of the DOE's first edition Decommissioning Handbook, personnel on my staff authored other sections, and I reviewed the entire Decommissioning Handbook.
- Served on the Connecticut Low Level Radioactive Waste Advisory Committee for 10 years from its inception.
- Managed groups performing analyses on dozens of dismantlement sites to thoroughly remove radioactive material from nuclear plants and their surrounding environment.
- Managed groups assisting in decommissioning the Shippingport nuclear power reactor. Shippingport was the first large nuclear power plant ever decommissioned. The decommissioning of Shippingport included remediation of the site after decommissioning.

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- Managed groups conducting site characterizations (preliminary radiation surveys prior to commencement of removal of radiation) at the radioactively contaminated West Valley site in upstate New York.
- Personnel reporting to me assessed dismantlement of the Princeton Avenue Plutonium Lab in New Brunswick, NJ. The lab's dismantlement assessment was stopped when we uncovered extremely toxic and carcinogenic underground radioactive contamination.
- Personnel reporting to me worked on decontaminating radioactive thorium at the Cleveland Avenue nuclear licensee in Ohio. The thorium had been used as an alloy in turbine blades. During that project, previously undetected extremely toxic and carcinogenic radioactive contamination was discovered below ground after an aboveground gamma survey had purported that no residual radiation remained on site.

Teaching and Academic Administration Experience

Rensselaer Polytechnic Institute (RPI) – Advanced Nuclear Reactor Physics Lab
Community College of Vermont – Mathematics Professor – 2007 to present
Burlington High School
Mathematics Teacher – 2001 to June 2008
Physics Teacher – 2004 to 2006
The Marvelwood School – 1996 to 2000
Awarded Teacher of the Year – June 2000
Chairperson: Physics and Math Department
Mathematics and Physics Teacher, Faculty Council Member
Director of Marvelwood Residential Summer School
Director of Residential Life
The Forman School & St. Margaret's School – 1993 to 1995
Physics and Mathematics Teacher, Tennis Coach, Residential Living Faculty Member

Nuclear Engineering 1970 to Present

Vetted as expert witness in nuclear litigation and administrative hearings in federal, international, and state court and to Nuclear Regulatory Commission, including but not limited to: Three Mile Island, US Federal Court, US NRC, NRC ASLB & ACRS, Vermont State Legislature, Vermont State Public Service Board, Florida Public Service Board, Czech Senate, Connecticut State Legislature, Western Atlas Nuclear Litigation, U.S. Senate Nuclear Safety Hearings, Peach Bottom Nuclear Power Plant Litigation, and Office of the Inspector General NRC.

Nuclear Engineering, Safety, and Reliability Expert Witness 1990 to Present

- Fairewinds Associates, Inc – Chief Engineer, 2005 to Present
- Arnold Gundersen, Nuclear Safety Consultant and Energy Advisor, 1995 to 2005
- GMA – 1990 to 1995, including expert witness testimony regarding the accident at Three Mile Island.

Nuclear Energy Services, Division of PCC (Fortune 500 company) 1979 to 1990
Corporate Officer and Senior Vice President - Technical Services
Responsible for overall performance of the company's Inservice Inspection (ASME XI), Quality Assurance (SNTC 1A), and Staff Augmentation Business Units – up to 300 employees at various nuclear sites.

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Senior Vice President of Engineering
Responsible for the overall performance of the company's Site Engineering, Boston Design Engineering and Engineered Products Business Units. Integrated the Danbury based, Boston based and site engineering functions to provide products such as fuel racks, nozzle dams, and transfer mechanisms and services such as materials management and procedure development.

Vice President of Engineering Services
Responsible for the overall performance of the company's field engineering, operations engineering, and engineered products services. Integrated the Danbury-based and field-based engineering functions to provide numerous products and services required by nuclear utilities, including patents for engineered products.

General Manager of Field Engineering
Managed and directed NES' multi-disciplined field engineering staff on location at various nuclear plant sites. Site activities included structural analysis, procedure development, technical specifications and training. Have personally applied for and received one patent.

Director of General Engineering
Managed and directed the Danbury based engineering staff. Staff disciplines included structural, nuclear, mechanical and systems engineering. Responsible for assignment of personnel as well as scheduling, cost performance, and technical assessment by staff on assigned projects. This staff provided major engineering support to the company's nuclear waste management, spent fuel storage racks, and engineering consulting programs.

New York State Electric and Gas Corporation (NYSE&G) — 1976 to 1979

Reliability Engineering Supervisor
Organized and supervised reliability engineers to upgrade performance levels on seven operating coal units and one that was under construction. Applied analytical techniques and good engineering judgments to improve capacity factors by reducing mean time to repair and by increasing mean time between failures.

Lead Power Systems Engineer
Supervised the preparation of proposals, bid evaluation, negotiation and administration of contracts for two 1300 MW NSSS Units including nuclear fuel, and solid-state control rooms. Represented corporation at numerous public forums including TV and radio on sensitive utility issues. Responsible for all nuclear and BOP portions of a PSAR, Environmental Report, and Early Site Review.

Northeast Utilities Service Corporation (NU) — 1972 to 1976

Engineer
Nuclear Engineer assigned to Millstone Unit 2 during start-up phase. Lead the high velocity flush and chemical cleaning of condensate and feedwater systems and obtained discharge permit for chemicals. Developed Quality Assurance Category 1 Material, Equipment and Parts List. Modified fuel pool cooling system at Connecticut Yankee, steam generator blowdown system and diesel generator lube oil system for Millstone. Evaluated Technical Specification Change Requests.

Associate Engineer
Nuclear Engineer assigned to Montague Units 1 & 2. Interface Engineer with NSSS vendor, performed containment leak rate analysis, assisted in preparation of PSAR and performed radiological health analysis of plant. Performed environmental radiation survey of Connecticut Yankee. Performed chloride intrusion transient analysis for Millstone Unit 1 feedwater system. Prepared Millstone Unit 1 off-gas modification licensing document and Environmental Report Amendments 1 & 2.

Rensselaer Polytechnic Institute (RPI) — 1971 to 1972
Critical Facility Reactor Operator, Instructor
Licensed AEC Reactor Operator instructing students and utility reactor operator trainees in start-up through full power operation of a reactor.

Public Service Electric and Gas (PSE&G) — 1970
Assistant Engineer
Performed shielding design of radwaste and auxiliary buildings for Newbold Island Units 1 & 2, including development of computer codes.

Public Service, Cultural, and Community Activities

2005 to Present – Public presentations and panel discussions on nuclear safety and reliability at University of Vermont, NRC hearings, Town and City Select Boards, Legal Panels, Television, and Radio
2007-2008 – Created Concept of Solar Panels on Burlington High School; worked with Burlington Electric Department and Burlington Board of Education Technology Committee on Grant for installation of solar collectors for Burlington Electric peak summer use
Vermont State Legislature – Public Testimony to Legislative Committees
Certified Foster Parent State of Vermont – 2004 to 2007
Mentoring former students – 2000 to present – college application and employment application questions and encouragement
Tutoring Refugee Students – 2002 to 2006 – Lost Boys of the Sudan and others from educationally disadvantaged immigrant groups
Designed and Taught Special High School Math Course for ESOL Students – 2007 to 2008
Featured Nuclear Safety and Reliability Expert (1990 to present) for Television, Newspaper, Radio, & Internet – Including, and not limited to: CNN (Earth Matters), NECN, WPTZ VT, WTNH, VPTV, WCAX, Cable Channel 17, The Crusaders, Front Page, Mark Johnson Show, Steve West Show, Anthony Polina Show, WKVT, WDEV, WVPR, WZBG CT, Seven Days, AP News Service, Houston Chronicle, Christian Science Monitor, New York Times, Brattleboro Reformer, Rutland Herald, Times-Argus, Burlington Free Press, Litchfield County Times, The News Times, The New Milford Times, Hartford Current, New London Day, evacuationplans.org, Vermont Daily Briefing, Green Mountain Daily, and numerous other national and international blogs
NNSN – National Nuclear Safety Network, Founding Advisory Board Member, meetings with and testimony to the Nuclear Regulatory Commission Inspector General (NRC IG)
Berkshire School Parents Association, Co-Founder
Berkshire School Annual Appeal, Co-Chair
Sunday School Teacher, Christ Church, Roxbury, CT

Washington Montessori School Parents Association Member
Marriage Encounter National Presenting Team with wife Margaret
Provided weekend communication and dialogue workshops weekend retreats/seminars
Connecticut Marriage Encounter Administrative Team – 5 years
Northeast Utilities Representative Conducting Public Lectures on Nuclear Safety Issues

End

http://weblogs.sun-sentinel.com/business/realestate/housekeys/blog/2010/06/fpl_president_armando_olivera.html

FPL President addresses criticism of the utility and renewable and nuclear energy

> Posted by Julie Patel on June 30, 2010 11:30 AM

Florida Power & Light President Armando Olivera met with the *Sun Sentinel* editorial board Tuesday.

He discussed the utility's plans to ask to pass costs to customers of a new $900 million natural gas-fired power generator in western Palm Beach County that will open next year.

Some of our readers are already fuming about that. "If they want us to pay for this generator, are we going to own it? They want to have their cake and eat it, too. They're increasing their value but trying to pass it on to all of us," said Sam Nusinov, 88, a retired veteran in Boca Raton. "I'm on a very limited income and when I see what these high-living executives are trying to do, it just bothers me."

Olivera touched on a range of other utility and energy issues.

On FPL's rate hike request:

Olivera said he is "clearly disappointed" in the PSC's decision to reject all but 6 percent of the $1.27 billion base rate hike FPL requested. He said he was especially disappointed that in the 9 to 11 percent return on shareholders' investment that the commission set. "We came out of this with the lowest return on equity…even though we have the lowest rates and reliability that's better than the national average," he said.

On the structure of utility regulation in Florida:

The Florida Senate proposed sweeping legislation to bar private conversations between key regulators and utilities and to have commissioners act more like judges. The House proposed studying the idea of creating a new regulatory agency that reports to the Legislature.

"We certainly have talked about that," Olivera said, adding that FPL consultant and former Florida Attorney General "Bob Butterworth and I have talked about what is the right structure."

He said it's important that utility regulation is balanced in how it views utilities and consumers, and add that consumers should feel they "are getting a fair shake."

He said making the PSC an administrative law panel, much like the Division of Administrative Hearings, could work. "If it takes a DOAH process to get there, so be it," he said. But he said there are benefits of the current structure worth considering "before we throw out the proverbial baby with the bath water."

"What we have has worked well," he said. He said FPL customers have the lowest monthly bills in the state, reliability that is higher than the national average and a low greenhouse gas emissions rates compared to utilities its size: "By those measures, it's a pretty good result."

On criticism last year of conversations between FPL and PSC representatives over meals, by phone and via instant messages:

Olivera said FPL reviewed the conversations and found "it is all legal."

"The practice in Florida has been that the parties...can have discussions with the staff," he said.

But he acknowledged that "it seemed inappropriate" so FPL employees are no longer engaging in conversations outside of formal regulatory settings.

"We don't have any conversations" like that, he said. "We don't want to be in that situation again."

On FPL Group's name change:

Olivera said FPL's parent company changed its name to NextEra Energy Resources in part to reflect its reach outside of Florida. It is operating in 26 states and Canada and it's developing a project in Spain.

The name change also highlights the importance of renewable energy to the future of the company, he said.

On FPL's renewable energy projects:

Olivera said FPL's solar projects – a 10-megawatt plant at Kennedy Space Center, a 25-megawatt plant in DeSoto County and a 75-megawatt plant in Martin County that will open this year – are "dear to my heart."

He said the utility could have 10 percent of its energy come from solar power in the next few years. "It's largely dependent on what happens with a few public policy [proposals] and if we can get cost recovery for it," he said.

He said the company is promoting renewable energy legislation at the state and federal level because “from our point of view, it is an insurance for the future.”

He said the company pushed for state legislation this year to allow utilities to recover the costs of renewable energy projects. The legislation – which died in the Senate due to concerns about its cost to customers – would granted higher profit margin to utilities on renewable energy plants but Olivera said that provision is not necessary for FPL to move forward on building new solar plants.

FPL did not advocate legislation supported by environmentalists and non-utility producers of renewable energy that would have required utilities to have a certain percentage of their energy be made up of renewable resources by 2020.

“We didn’t think it had a chance…but we support it,” he said.

He said wind energy is also a “hard sell” in Florida because the wind only blows along the coast where land is expensive and people don’t want to look at large wind turbines.

On nuclear energy:

"Frankly, we wish we had more nuclear," he said. "Our bills would be even lower than they are today."

If said if upgrades at FPL’s Turkey Point and St. Lucie County plants were done five years ago, customers would have saved an estimated $1.2 billion in fuel costs.

FPL is moving forward with getting permits for the building two new reactors at Turkey Point as well but it’s unclear if that project will ultimately get done, Olivera said. "Natural gas prices are down so the economics...are not as attractive," he said. Plus, he noted that the design FPL and other utilities are using hasn't been approved; The Nuclear Regulatory Commission has concerns about its resistance to hurricanes.

On nuclear waste storage:

A panel of Nuclear Regulatory Commission judges ruled on Tuesday that the Obama administration could not withdraw the Energy Department’s application to open a nuclear waste dump at Yucca Mountain in Nevada because Congress required it.

Olivera said “it’s not the best public policy to store the spent fuel” at about 100 locations throughout the country. “Each one needs safeguards,” he said.

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January 13, 2010

Citing deteriorating regulatory environment, FP dollars in capital expenditures in Florida

JUNO BEACH, Fla. – Citing a negative decision on its rate proposal by the Florida Public Service Com deteriorating regulatory and business environment, Florida Power & Light Company said it will immedi approximately $10 billion of investment over the next five years in Florida's energy infrastructure.

The projects would have created an estimated 20,000 direct and indirect construction and related jobs ov

FPL said it will immediately suspend activities on:

- Development of two new nuclear reactors at Turkey Point beyond what is required to receive a lic
- Modernization of the Riviera Beach and Cape Canaveral plants;
- The proposed Florida EnergySecure natural gas pipeline; and,
- Numerous discretionary infrastructure projects targeting improvements in efficiency and reliabilit and distribution units.

FPL will also assess the cost structure of its ongoing operations and review other capital investments fo make further decisions on all of these matters no later than the end of the second quarter.

Historically, FPL has been one of Florida's largest sources of capital investment, generating tens of thou dollars in tax revenues tied to its annual investments in the state's electrical infrastructure.

FPL Group Chairman and CEO Lew Hay issued the following statement:

"We understand that there is never a good time to raise base rates. However, our proposal provided a un while simultaneously investing billions of dollars in our state for upgraded and more efficient electrical significant benefits for our customers. Needless to say, we are very disappointed for our customers and

"This decision was about politics, not economics, and unfortunately it comes at a time when our state u the decision will likely increase customer costs and diminish reliability over the long term because the c providing reliable service to customers.

"Historically, Florida has enjoyed a constructive regulatory environment, which has allowed us to inves while having reasonable confidence that our investors would be allowed to earn fair returns.

"Our past investments have provided FPL customers with bills that are 10 percent lower than the nation utilities, reliability that is 47 percent better than the national average, and a power generation fleet that i country.

"Florida's recent cold weather showed us the benefits of $10 billion in investments over the past five ye allowing us to reliably maintain service even while operating at near-maximum capacity over a period o continue to invest in the electrical infrastructure.

"Unfortunately, today's decision will simply reinforce investor perceptions that the regulatory climate i increasingly hostile to investment. Investments have to be made *in the expectation* of fair regulatory trea money – in this case billions of dollars – already has been spent and sunk. Absent confidence in fair reg will be more reluctant to invest.

"However, the PSC has spoken. Likewise, so have our investors, who have unfortunately seen what we FPL Group stock destroyed over the course of the rate proceeding. As a result, we believe that they do n Florida unless and until the regulatory and business environment improves. Many of those investors are Florida.

"Our business is heavily dependent on the confidence of investors in both the quality of the company an today's decision, we believe that FPL will see an increased cost to attract capital, which in the end will l

FPL Group: Energy Solutions for the Next Era
FPL Group, Inc. (NYSE: FPL) is a leading clean energy company with 2008 revenues of more than $16 generating capacity, and more than 15,000 employees in 27 states and Canada. Headquartered in Juno B are NextEra Energy Resources, LLC, the largest generator in North America of renewable energy from largest rate-regulated electric utilities in the country. Through its subsidiaries, FPL Group collectively o generation fleet. For more information about FPL Group companies, visit these Web sites: **www.FPLG** **www.NextEraEnergyResources.com**, **www.FPL.com**

# # #

Cautionary Statements And Risk Factors That May Affect Future Results

In connection with the safe harbor provisions of the Private Securities Litigation Reform Act of 1995 (R Florida Power & Light Company (FPL) are hereby providing cautionary statements identifying importa actual results to differ materially from those projected in forward-looking statements (as such term is de of FPL Group and FPL in this press release, on their respective websites, in response to questions or oth discussions as to, expectations, beliefs, plans, objectives, assumptions, future events or performance, cli but not always, through the use of words or phrases such as will, will likely result, are expected to, will should, would, estimated, may, plan, potential, projection, target, outlook, predict and intend or words o historical facts and may be forward-looking. Forward-looking statements involve estimates, assumptio statements are qualified in their entirety by reference to, and are accompanied by, the following importa other factors referred to specifically in connection with such forward-looking statements) that could cau materially from those contained or implied in forward-looking statements made by or on behalf of FPL

Any forward-looking statement speaks only as of the date on which such statement is made, and FPL G any forward-looking statement to reflect events or circumstances, including unanticipated events, after t otherwise required by law. New factors emerge from time to time and it is not possible for managemen the impact of each such factor on the business or the extent to which any factor, or combination of facto from those contained or implied in any forward-looking statement.

The following are some important factors that could have a significant impact on FPL Group's and FPL' cause FPL Group's and FPL's actual results or outcomes to differ materially from those discussed or imp

FPL Group and FPL are subject to complex laws and regulations and to changes in laws and regulations regulatory actions. FPL holds franchise agreements with local municipalities and counties, and must re may have a negative impact on the business and results of operations of FPL Group and FPL.

- FPL Group and FPL are subject to complex laws and regulations, and to changes in laws or regul allowed rates of return, industry and rate structure, operation of nuclear power facilities, construct construction and operation of transmission and distribution facilities, acquisition, disposal, deprec recovery of fuel and purchased power costs, decommissioning costs, return on common equity an present or prospective wholesale and retail competition. This substantial and complex framework compliance costs and potentially significant monetary penalties for non−compliance. The Florida authority to disallow recovery by FPL of any and all costs that it considers excessive or impruden restricts FPL's ability to grow earnings and does not provide any assurance as to achievement of e
- FPL Group and FPL also are subject to extensive federal, state and local environmental statutes, r changes in or additions to applicable statutes, rules and regulations that relate to, or in the future r quality, climate change, greenhouse gas emissions, carbon dioxide emissions, waste management, health, safety and renewable portfolio standards that could, among other things, restrict or limit th fuels required for the production of electricity and/or require additional pollution control equipme significant capital, operating and other costs associated with compliance with these environmenta could be even more significant in the future.
- FPL Group and FPL operate in a changing market environment influenced by various legislative a deregulation or restructuring of the energy industry, including, for example, deregulation or restru as well as increased focus on renewable and clean energy sources and reduction of carbon emissic adapt to these changes and may face increasing costs and competitive pressure in doing so.
- FPL Group's and FPL's results of operations could be affected by FPL's ability to negotiate or ren municipalities and counties in Florida.

The operation and maintenance of power generation, transmission and distribution facilities involve sign results of operations and financial condition of FPL Group and FPL.

- The operation and maintenance of power generation, transmission and distribution facilities invol risks, breakdown or failure of equipment, transmission and distribution lines or pipelines, the inab equipment defects throughout FPL Group's and FPL's generation fleets and transmission and distr technology, the dependence on a specific fuel source, failures in the supply or transportation of fu conditions (including natural disasters such as hurricanes, floods and droughts), and performance efficiency. This could result in lost revenues and/or increased expenses, including, for example, l increased expenses due to monetary penalties or fines, replacement equipment costs or an obligati potentially higher prices to meet contractual obligations. Insurance, warranties or performance gu revenues or increased expenses. Breakdown or failure of an operating facility of NextEra Energy may, for example, prevent the facility from performing under applicable power sales agreements termination of the agreement or subject NextEra Energy Resources to incurring a liability for liqu

The operation and maintenance of nuclear facilities involves inherent risks, including environmental, he that could result in fines or the closure of nuclear units owned by FPL or NextEra Energy Resources, an excess of insurance coverage.

- FPL and NextEra Energy Resources own, or hold undivided interests in, nuclear generation facilit subject to environmental, health and financial risks such as on-site storage of spent nuclear fuel, tl ability to maintain adequate reserves for decommissioning, potential liabilities arising out of the c possible terrorist attack. Although FPL and NextEra Energy Resources maintain decommissionin minimize the financial exposure to these risks, it is possible that the cost of decommissioning the the decommissioning trusts, and that liability and property damages could exceed the amount of i
- The U.S. Nuclear Regulatory Commission (NRC) has broad authority to impose licensing and saf operation and maintenance of nuclear generation facilities. In the event of non-compliance, the N down a unit, or both, depending upon its assessment of the severity of the situation, until complia

related to increased security measures and any future safety requirements promulgated by the NR Resources to incur substantial operating and capital expenditures at their nuclear plants. In additi an FPL or NextEra Energy Resources plant, it could result in substantial costs. A major incident a cause the NRC to limit or prohibit the operation or licensing of any domestic nuclear unit.
- In addition, potential terrorist threats and increased public scrutiny of utilities could result in incre which are difficult or impossible to predict.

The construction of, and capital improvements to, power generation and transmission facilities involve s improvement efforts be unsuccessful or delayed, the results of operations and financial condition of FPL

- The ability of FPL Group and FPL to complete construction of, and capital improvement projects facilities on schedule and within budget are contingent upon many variables that could delay com affect operational and financial results, including, for example, limitations related to transmission materials and labor and environmental compliance, delays with respect to permits and other appro are subject to substantial risks. Should any such efforts be unsuccessful or delayed, FPL Group a termination payments under committed contracts, loss of tax credits and/or the write-off of their i

The use of derivative contracts by FPL Group and FPL in the normal course of business could result in collateral that adversely impact the results of operations or cash flows of FPL Group and FPL.

- FPL Group and FPL use derivative instruments, such as swaps, options, futures and forwards, son markets or on exchanges, to manage their commodity and financial market risks, and for FPL Gro FPL Group could recognize financial losses as a result of volatility in the market values of these c to perform or make payments under these derivative instruments and could suffer a reduction in o to post margin cash collateral. In the absence of actively quoted market prices and pricing inform these derivative instruments involves management's judgment or use of estimates. As a result, ch alternative valuation methods could affect the reported fair value of these derivative instruments. be subject to prudence challenges and, if found imprudent, cost recovery could be disallowed by t
- FPL Group provides full energy and capacity requirement services, which include load-following primarily to distribution utilities to satisfy all or a portion of such utilities' power supply obligatio transactions may be affected by a number of factors, such as weather conditions, fluctuating price ability of the distribution utilities' customers to elect to receive service from competing suppliers, results of operations from these transactions.

FPL Group's competitive energy business is subject to risks, many of which are beyond the control of F efficient development and operation of generating assets, the successful and timely completion of projec fuel and equipment, transmission constraints, competition from other generators, including those using r capacity and demand for power, that may reduce the revenues and adversely impact the results of opera

- There are various risks associated with FPL Group's competitive energy business. In addition to r specifically affecting NextEra Energy Resources' success in competitive wholesale markets inclu and operate generating assets, the successful and timely completion of project restructuring activi of certain projects, the price and supply of fuel (including transportation) and equipment, transmis tax credits, competition from other and new sources of generation, excess generation capacity and significant volatility in market prices for fuel, electricity and renewable and other energy commod and market risks that are beyond the control of NextEra Energy Resources. NextEra Energy Reso assets or positions against changes in commodity prices, interest rates, counterparty credit risk or FPL Group's future financial results. In keeping with industry trends, a portion of NextEra Energ wholly or partially without long-term power purchase agreements. As a result, power from these term contractual basis, which may increase the volatility of FPL Group's financial results. In addi depends upon power transmission and natural gas transportation facilities owned and operated by disrupted or capacity is inadequate or unavailable, NextEra Energy Resources' ability to sell and c limited.

FPL Group's ability to successfully identify, complete and integrate acquisitions is subject to significant increased competition for acquisitions resulting from the consolidation of the power industry.

- FPL Group is likely to encounter significant competition for acquisition opportunities that may be the power industry in general. In addition, FPL Group may be unable to identify attractive acquis complete and integrate them successfully and in a timely manner.

FPL Group and FPL participate in markets that are often subject to uncertain economic conditions, whic income and expenditures.

- FPL Group and FPL participate in markets that are susceptible to uncertain economic conditions, Because components of budgeting and forecasting are dependent upon estimates of revenue grow uncertainty makes estimates of future income and expenditures more difficult. As a result, FPL G and expenditures but never realize the anticipated benefits, which could adversely affect results of economy also may have a significant effect on the overall performance and financial condition of

Customer growth and customer usage in FPL's service area affect FPL Group's and FPL's results of ope

- FPL Group's and FPL's results of operations are affected by the growth in customer accounts in F Customer growth can be affected by population growth. Customer growth and customer usage ca elsewhere, including, for example, job and income growth, housing starts and new home prices. C influence the demand for electricity and the need for additional power generation and power deliv

Weather affects FPL Group's and FPL's results of operations, as can the impact of severe weather. Wea electricity and natural gas, affect the price of energy commodities, and can affect the production of elect

- FPL Group's and FPL's results of operations are affected by changes in the weather. Weather con electricity and natural gas, affect the price of energy commodities, and can affect the production c including, but not limited to, wind, solar and hydro-powered facilities. FPL Group's and FPL's re of severe weather which can be destructive, causing outages and/or property damage, may affect t be incurred. At FPL, recovery of these costs is subject to FPSC approval.

Adverse capital and credit market conditions may adversely affect FPL Group's and FPL's ability to mee grow their businesses, and increase the cost of capital. Disruptions, uncertainty or volatility in the finan results of operations and financial condition of FPL Group and FPL, as well as exert downward pressure stock.

- Having access to the credit and capital markets, at a reasonable cost, is necessary for FPL Group a capital requirements. Those markets have provided FPL Group and FPL with the liquidity to oper otherwise provided from operating cash flows. Disruptions, uncertainty or volatility in those mar capital. If FPL Group and FPL are unable to access the credit and capital markets on terms that a capital, issue shorter-term securities and/or bear an unfavorable cost of capital, which, in turn, cou businesses, decrease earnings, significantly reduce financial flexibility and/or limit FPL Group's a dividend level.
- The market price and trading volume of FPL Group's common stock could be subject to significan general stock market conditions and changes in market sentiment regarding FPL Group and its su and financing strategies.

FPL Group's, FPL Group Capital's and FPL's inability to maintain their current credit ratings may adve limit the ability of FPL Group and FPL to grow their businesses, and would likely increase interest costs

- FPL Group and FPL rely on access to capital and credit markets as significant sources of liquidity operating cash flows. The inability of FPL Group, FPL Group Capital and FPL to maintain their raise capital or obtain credit on favorable terms, which, in turn, could impact FPL Group's and FP likely increase their interest costs.

FPL Group and FPL are subject to credit and performance risk from third parties under supply and servi

- FPL Group and FPL rely on contracts with vendors for the supply of equipment, materials, fuel ar construction and operation of, and for capital improvements to, their facilities, as well as for busin contractual obligations, FPL Group and FPL may need to make arrangements with other suppliers completion of power generation facilities and other projects, and/or a disruption to their operation

FPL Group and FPL are subject to costs and other potentially adverse effects of legal and regulatory pro changes in or additions to applicable tax laws, rates or policies, rates of inflation, accounting standards, requirements and labor and employment laws.

- FPL Group and FPL are subject to costs and other potentially adverse effects of legal and regulato claims, as well as regulatory compliance and the effect of new, or changes in, tax laws, rates or po securities laws, corporate governance requirements and labor and employment laws.
- FPL and NextEra Energy Resources, as owners and operators of bulk power transmission systems throughout the United States, are subject to mandatory reliability standards promulgated by the N and enforced by the Federal Energy Regulatory Commission. These standards, which previously mandatory in June 2007. Noncompliance with these mandatory reliability standards could result penalties, which likely would not be recoverable from customers.

Threats of terrorism and catastrophic events that could result from terrorism, cyber attacks, or individua Group's and FPL's business may impact the operations of FPL Group and FPL in unpredictable ways.

- FPL Group and FPL are subject to direct and indirect effects of terrorist threats and activities, as v individuals and/or groups. Infrastructure facilities and systems, including, for example, generatio physical assets and information systems, in general, have been identified as potential targets. The but are not limited to, the inability to generate, purchase or transmit power, the delay in developm the risk of a significant slowdown in growth or a decline in the U.S. economy, delay in economic cost and adequacy of security and insurance.

The ability of FPL Group and FPL to obtain insurance and the terms of any available insurance coverag national, state or local events and company-specific events.

- FPL Group's and FPL's ability to obtain insurance, and the cost of and coverage provided by such international, national, state or local events as well as company-specific events.

FPL Group and FPL are subject to employee workforce factors that could adversely affect the businesse FPL.

- FPL Group and FPL are subject to employee workforce factors, including, for example, loss or re qualified personnel, inflationary pressures on payroll and benefits costs and collective bargaining stoppage that could adversely affect the businesses and financial condition of FPL Group and FPL

The risks described herein are not the only risks facing FPL Group and FPL. Additional risks and uncei
FPL Group's or FPL's business, financial condition and/or future operating results

NRC NEWS

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No. 09-173 October 15, 2009

NRC INFORMS WESTINGHOUSE OF SAFETY ISSUES WITH AP1000 SHIELD BUILDING

The Nuclear Regulatory Commission staff has informed Westinghouse that the company has not demonstrated that certain structural components of the revised AP1000 shield building can withstand design basis loads. An NRC letter to Westinghouse states that progress on the shield building review will require the company to provide modifications to the design, as well as testing that demonstrates the building will perform its intended safety function under design basis loads. The staff will continue its review of the remainder of the AP1000 design certification amendment application.

As the name implies, the AP1000 shield building would protect the reactor's primary containment from severe weather and other events. The building's other functions would include providing a radiation barrier during normal operation and supporting an emergency cooling water tank.

"We've been talking to Westinghouse regularly about the shield building since October 2008, and we've consistently laid out our questions to the company," said Michael Johnson, director of the NRC's Office of New Reactors. "This is a situation where fundamental engineering standards will have to be met before we can begin determining whether the shield building meets the agency's requirements."

The impact on the overall AP1000 certification review schedule will be established after the staff and Westinghouse discuss the company's plans to address the NRC's conclusions regarding the shield building design. The impact on related review schedules for Combined License applications referencing the AP1000 will be addressed once the design certification review schedule is better understood.

The staff's letter to Westinghouse will be available on the NRC's electronic documents database, ADAMS, by entering ML092320205 at this address: http://adamswebsearch.nrc.gov/dologin.htm.

###

October 15, 2009

Mr. Robert Sisk, Manager
AP1000 Licensing and Customer Interface
Nuclear Power Plants
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

Dear Mr. Sisk:

By letter dated August 31, 2009, Westinghouse submitted its design methodology report for the AP1000 shield building. The U.S. Nuclear Regulatory Commission (NRC) has completed its review of that report. Based on that report and the body of technical information reviewed to date, the NRC has determined that the proposed design of the shield building will require modifications in some specific areas to ensure its ability to perform its safety function under design basis loading conditions and to support a finding that it will meet applicable regulations (i.e., 10 CFR 50.55a and 10 CFR Part 50, Appendix A (GDC 1 and 2)).

Specifically, the design of the steel and concrete composite structural module (SC module) must demonstrate the ability to function as a unit during design basis events; the design of the connection of the SC module to the reinforced concrete wall sections of the shield building must demonstrate the ability to function during design basis events; the design of the shield building tension ring girder, which anchors the shield building roof to the wall, must be supported by either a confirmation test or a validated (or benchmarked) analysis method.

Progress on the NRC staff's review of the shield building will require that Westinghouse provide modifications to the design and testing that demonstrate the capability of the building to perform its intended safety function under design basis loads. In addition to the issues described above, the NRC staff identified several other issues that need to be addressed; these issues are discussed in the enclosure to this letter.

Based on the above, the NRC considers its review of the shield building, as proposed, to be complete. The NRC will continue to support the resolution of the remaining issues on the AP1000 amendment application while the issues associated with the shield building are being addressed. The impact on the review schedule for the design certification amendment will be established after discussion with Westinghouse about its plans to address NRC's determination.

Pursuant to 10 CFR 2.390, the NRC has determined that the enclosure may contain proprietary information or other categories of information that should be withheld from public disclosure. The NRC will delay placing this document in the public document room for a period of 30 days from the date of this letter to provide Westinghouse with the opportunity to comment on information in the enclosure that should be withheld from public disclosure. If Westinghouse believes that any information in the enclosure should be withheld from public disclosure, please

NOTICE: Document transmitted herewith contains sensitive unclassified information. When separated from the enclosure this cover letter is "DECONTROLLED."

identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.390. Based on Westinghouse's response, sensitive information will be redacted from the version that will be made publically available.

Schedule impacts to the review schedules for the Combined License applications that reference the AP1000 amendment application will be addressed once the schedule for the design certification amendment is better understood.

Please note that the letter and the attached enclosure are proprietary. When the letter is detached from the enclosure, the letter becomes non-proprietary.

Sincerely,

/RA/

David B. Matthews, Director
Division of New Reactor Licensing
Office of New Reactors

Enclosure: As stated.
Docket No. 52-006

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identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.390. Based on your response, sensitive information will be redacted from the version that will be made publically available.

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Sincerely,

/RA/

David B. Matthews, Director
Division of New Reactor Licensing
Office of New Reactors

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Enclosure: As stated.
Docket No. 52-006

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June 21, 2010

Sadler D. "Sandy" Rupprecht
Vice President, Regulatory Affairs and Strategy
Westinghouse Electric Company
Nuclear Power Plants
273A Cranberry Woods Headquarters
1000 Westinghouse Drive
Cranberry Township, PA 16066

SUBJECT: SCHEDULE FOR THE AP1000 DESIGN CERTIFICATION AMENDMENT REVIEW

Dear Mr. Rupprecht:

The purpose of this letter is to communicate the schedule for the AP1000 Design Certification Amendment (DCA) application review and the U.S. Nuclear Regulatory Commission's (NRC's) expectations.

On October 15, 2009, NRC sent a letter to Westinghouse Electric Company (Westinghouse) in response to the August 31, 2009, Westinghouse shield building design submittal. In its letter, NRC said that it had determined that the proposed design of the shield building would require modifications in some specific areas in order to ensure its ability to perform its safety function under design basis loading conditions and to support a finding that would meet applicable regulations. NRC also said that the impact on the review schedule for the DCA review would be established after discussion with Westinghouse about its plans to address NRC's determination.

In response to the NRC's October 15, 2009 letter, Westinghouse submitted a report titled, "Design Report for the AP1000 Enhanced Shield Building, Revision 2" on May 7, 2010. This report included detailed design analyses, the benchmarking analysis, and some test results. With the receipt and preliminary evaluation of Revision 2, and discussions with Westinghouse regarding schedule, the NRC has a better understanding of how Westinghouse plans to address NRC's concerns and is now able to establish the review schedule for the balance of the AP1000 design review.

The NRC has established an aggressive goal of completing the AP1000 design certification rulemaking by the end of fiscal year 2011 to support the needs of the Vogtle and Summer combined license (COL) applications and their associated construction plans. Completion of the rulemaking by the end of September 2011 will not be easy. A number of technical issues remain on the application and it will require substantial commitment of resources and the attention of senior management by both Westinghouse and the COL applicants to drive technical issues to closure in a time frame that would support the schedule below.

There are several critical milestones that Westinghouse must meet in order to achieve the schedule. First, Westinghouse must establish the complete scope of the DCA with defined closure plans for all known issues by the end of June 2010. Second, Westinghouse must provide all necessary licensing documentation to support resolution of known technical issues by the end of July, 2010. If these milestones are met, the staff will work aggressively to complete the technical review by the end of August 2010 and will work with the Advisory Committee on Reactor Safeguards (ACRS) so that it will be able to complete its oversight reviews by December 2010. Further, the staff is implementing additional innovative ways to expedite the rulemaking process to achieve the listed milestones.

The following is the schedule that we have established:

Schedule for Completion of the AP1000 Design Certification Amendment Review

Action	**Completion Date**
NRC finalizes AP1000 DCA review scope and closure strategy for remaining issues	June 30, 2010
NRC receives final Westinghouse DCA submittal	July 30, 2010
NRC technical staff completes Final Safety Evaluation Report (FSER) inputs	August 30, 2010
NRC issues final advanced FSER information issued to the ACRS	October 18, 2010
ACRS holds final subcommittee meeting on AP1000 DCA	November 18, 2010
ACRS holds final full committee meeting on AP1000 DCA	December 2, 2010
NRC receives Westinghouse DCA Revision 18 submittal	Early-December 2010
NRC publishes Federal Register Notice for Proposed Rule	February 2011
Public comment period ends	April 2011
Final Rule	September 2011

There is no margin in this schedule that would permit movement of these critical milestones and still achieve the goal of completing the rulemaking by the end of September 2011. While the staff has increased its attention to meeting the schedule, we will assure that the design meets all applicable NRC regulatory requirements before we proceed to certification rulemaking.

In summary, NRC believes that completion of the AP1000 DCA safety evaluation by the end of calendar year 2010 is aggressive yet achievable with substantial management oversight and commitment from Westinghouse to meet the established milestones with quality submittals that resolve identified technical issues. The staff's review will require Westinghouse management to maintain frequent interactions as recently established. The NRC also expects Westinghouse to maintain a high level of commitment to provide the necessary information to the NRC in accordance with the above schedule. If you have questions regarding these matters, please contact Mr. Frank Akstulewicz at (301) 415-1199.

Sincerely,

/RA/

David B. Matthews, Director
Division of New Reactor Licensing
Office of New Reactors

Docket No. 52-0006
cc: See next page

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Sincerely,

/RA/
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Division of New Reactor Licensing
Office of New Reactors

Docket No. 52-0006
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May 28, 2010

Mr. Mano K. Nazar
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and Chief Nuclear Officer
Florida Power & Light Company
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SUBJECT: TURKEY POINT UNITS 6 AND 7 NUCLEAR POWER PLANTS COMBINED LICENSE APPLICATION REVIEW SCHEDULE

Dear Mr. Nazar:

This letter transmits the Turkey Point Units 6 and 7 Combined License (COL) application review schedule. The environmental review supports the issuance of a Final Environmental Impact Statement (FEIS) in October 2012. The safety review supports the issuance of a Final Safety Evaluation Report (FSER) in December 2012. The COL application review schedule utilizes a four-phase approach for the safety portion of the review. Milestones for the four phases of this review are provided in Table 1 of this letter.

By letter dated June 30, 2009, Florida Power & Light Company (FPL) submitted its application to the U.S. Nuclear Regulatory Commission (NRC) for a COL for two AP1000 advanced passive pressurized water reactors in accordance with the requirements contained in 10 CFR Part 52, "Licenses, Certifications and Approvals for Nuclear Power Plants." By letter dated September 4, 2009, the NRC informed you that we had docketed your COLA for the Turkey Point Units 6 and 7 in the Agencywide Documents Access and Management System (ADAMS), Accession No. ML092380248.

The Turkey Point Units 6 and 7 COLA incorporates by reference the AP1000 Design Control Document (DCD) submitted by Westinghouse to the NRC on May 26, 2007, as Revision 16 and updated by DCD Revision 17 on September 22, 2008. As allowed by 10 CFR 52.55(c), at your own risk, you have referenced a design certification application that has been docketed but not granted. Therefore, your COLA review schedule is dependent on the review schedule for the design certification. In addition, as a subsequent combined license applicant referencing the AP1000 design, your COLA review schedule is also dependent on the review schedule for the Vogtle Electric Generating Plant COLA (the reference COL [RCOL] application for the AP1000 design center). Because it utilizes the standard content contained in the RCOL application, it is incumbent upon FPL to remain cognizant of the resolution of the standard technical issues that will be addressed during the NRC review of the Vogtle Electric Generating Plant RCOL application.

If you determine that it is necessary to resolve a standard issue differently for the Turkey Point Units 6 and 7 COLA, you must notify the NRC immediately so that we may determine the review impact of this standard issue being considered as site-specific. The staff will work with you and the AP1000 design center working group to implement the review of standard content on a stand-alone basis so that the Turkey Point Units 6 and 7 COLA review schedule is minimally affected by the site-specific safety issues that may arise on the RCOLA.

As stated in the staff letter dated September 4, 2009, (ML092380248) we have a concern that we have still not received the additional information related to Final Safety Analysis Report (FSAR) Section 2.5. We cannot initiate our review of Section 2.5 until the information requests identified under the headings of Geology and Seismology and Geotechnical are provided. Therefore, this can introduce uncertainty in the proposed schedule and the schedule may be revised based on the availability of the requested information.

Our review schedules assume that responses to requests for additional information (RAIs) will be complete and provide sufficient information to address the NRC staff's concerns. Our schedules assume that RAI responses will be submitted within 30 days of receipt of safety RAIs related to areas that involve FPL specific information, and within 45 days of receipt of environmental RAIs and safety RAIs related to areas that involve standard content for all AP1000 COL applications.

The review schedule does not model the hearing process. If contentions are admitted, the review schedules in Table 1 of the enclosure may be impacted. The mandatory hearing schedule will be developed by the Commission or the Atomic Safety and Licensing Board; therefore, it is not included in Table 1 of this letter. Both the FEIS and the FSER will be used to support this hearing. As you know, the Commission will not make a determination on whether or not to issue the COL until this hearing is concluded.

The staff will review and re-baseline, if necessary, the Turkey Point Units 6 and 7 safety review schedule around the time the Advance FSER (Phase B) is being prepared. At that point, the staff will have a better idea of what target milestones are achievable given the number and complexity of the potential issues that are to be resolved. Similarly, the staff will review and re-baseline, if necessary, the Turkey Point Units 6 and 7 environmental review schedule soon after the public comment period ends. At that point, the staff will have a better idea if there are any issues that have been identified that could impact the schedule for the issuance of the FEIS. Should any major revisions to the AP1000 Design Certification Amendment or the Vogtle R-COLA occur, we will review and re-baseline schedules as necessary. At any time, feel free to discuss concerns with this schedule or any future proposed schedule with the staff.

Should you have any questions regarding the safety review, please contact the lead project manager, Manny Comar at 301-415-3863 or Manny.Comar@nrc.gov. If you have questions regarding the environmental review, please contact Mr. Andy Kugler, the lead environmental project manager at 301-415-2828, or Andrew.Kugler@nrc.gov.

Sincerely,

/RA/ FAkstulewicz for

David Matthews, Director
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-040 and 52-041

Enclosure:
COL Review Schedule

cc w/encl: See next page

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Sincerely,

/RA/ FAkstulewicz for

David Matthews, Director
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-040 and 52-041

Enclosure:
COL Review Schedule

cc w/encl: See next page

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COL - Turkey Point Mailing List (Revised 04/05/2010)
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Table 1: COL Review Schedule

Phases of Safety Review		Target Completion Date
Phase A	Requests for Additional Information (RAIs) and Supplemental RAIs	May 27, 2011
Phase B	Advanced FSER Without Open Items	May 2012
Phase C	Advisory Committee on Reactor Safeguards (ACRS) Review of Advanced FSER	September 2012
Phase D	Final SER	December 2012

Phases of Environmental Review		
Phase 1	Environmental Impact Statement scoping summary report issued	November 2010
Phase 2	Draft EIS issued to U.S. Environmental Protection Agency (EPA)	October 2011
Phase 3	Final EIS issued to EPA	October 2012

**AP1000 Oversight Group, Bellefonte Efficiency and Sustainability Team,
Blue Ridge Environmental Defense League,
Citizens Allied for Safe Energy, Friends of the Earth,
Georgia Women's Action for New Directions, Green Party of Florida,
North Carolina Waste Awareness and Reduction Network,
Nuclear Information and Resource Service, Nuclear Watch South,
SC Chapter - Sierra Club, Southern Alliance for Clean Energy**

VIA MAIL AND EMAIL

April 21, 2010

Dr. Said Abdel-Khalik, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: PETITION TO INITIATE SPECIAL INVESTIGATION
ON SIGNIFICANT AP1000 DESIGN DEFECT

Dear Chairman:

The above local, regional and national organizations are requesting that the Advisory Committee on Reactor Safeguards ("ACRS") initiate a special investigation on an unreviewed safety issue which fundamentally calls into question the adequacy of the AP1000 reactor design to protect public health and safety in the event of an accident.

The basis for our concern is described in the attached report by Arnold Gundersen, Chief Engineer, Fairewinds Associates, Inc., "Post Accident AP1000 Containment Leakage: An Unreviewed Safety Issue," April 7, 2010 ("Fairewinds Report"). This report is further supported by an affidavit from Dr. Rudolf H. Hausler, Corro Consulta.

As the Fairewinds Report states, one of the design features in the Westinghouse AP1000 reactors is that in a post accident event, radioactive leakage from a containment failure could be deliberately wafted out into the environment. The result of this potential design flaw is that during containment breach, a significant volume of radionuclides will be released into the air with the potential for a significant public health catastrophe.

As the Fairewinds Report states, rather than resolve the real world impacts resulting from this unique design weakness, the Westinghouse analysis relies on several significant and extraordinary assumptions to "minimize" its impact. Westinghouse has failed in its efforts to prove that there is no need to modify the AP1000 containment and shield building in order to eliminate the possibility of releases directly into the environment and to protect public health and safety. In fact, containment failure through only a small hole similar to that at Beaver Valley is likely to exist when the design basis event occurs.

While your committee is investigating the potential defect in the AP1000 design, we have appealed to Chairman Jaczko for the NRC staff to immediately review it also.

We will be glad to meet with the ACRS to assist you in your investigation. Please contact me at the address below and I will inform the organizations that have joined in this petition of the scope of your investigation and what assistance we can provide.

Sincerely,

John D. Runkle
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jrunkle@pricecreek.com

ENC. Fairewinds Report

cc. Chairman Gregory B. Jaczko

Post Accident AP1000 Containment Leakage

An Unreviewed Safety Issue

Fairewinds Associates, Inc, April 21, 2010

A Report by Arnold Gundersen, April 21, 2010
Chief Engineer, Fairewinds Associates, Inc

Affidavit by Rudolf H. Hausler, PhD, Corro-Consulta
Re. Post Accident AP1000 Containment Leakage:
An Un-reviewed Safety Issue

Attachments:

Attachment 1 – Curriculum Vitae
Attachment 2 – Table 1 from *Detection of Aging Nuclear Power Plant Structures*
Attachment 3 – Table 35-4 *Summary Of Release Category Definitions*
Attachment 4 – *Declaration Of Arnold Gundersen Supporting Citizen Power's Petition*
Attachment 5 – *Declaration Of Arnold Gundersen Supporting Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions*

Post Accident AP1000 Containment Leakage
An Unreviewed Safety Issue

A Report by Arnold Gundersen[1]
April 21, 2010

1. Introduction

The AP1000 design has no secondary containment to provide for fission product control following a design basis accident. The purpose of this report is to describe the basis for concerns regarding an apparently unreviewed safety issue raised by the AP1000 containment system design (Revision 18).

My four concerns are:

- Recent experience with the current generation of nuclear reactors shows that containment corrosion, cracking, and leakage are far more prevalent and serious than anticipated by the U.S. Nuclear Regulatory Commission (NRC) in establishing its regulatory program for the safe operation of nuclear reactors.

- By design, the AP1000 containment has an even higher vulnerability to corrosion than containment systems of current reactor designs because the outside of the AP1000 containment is subject to a high-oxygen and high-moisture environment conducive to corrosion and is prone to collect moisture in numerous inaccessible locations that are not available for inspection.

- By design, the AP1000 containment has an even higher vulnerability to unfiltered, unmonitored leakage than the current generation containment system designs, and it lacks the defense in depth of existing structures. While the AP1000 is called an *advanced passive system*, in fact the containment design and structures immediately outside the containment are designed to create a chimney-like effect and draw out any radiation that leaks through the containment into the

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environment. Such a system will also facilitate the more efficient release of unfiltered, unmonitored radiation from any cracks or holes that might develop in the containment.

- Finally, a leakage path exists that is not bounded by any existing analysis and will be more severe than those previously identified by Westinghouse in its AP1000 application and various revisions.

The potential consequences of a radiation release to the environment from a small hole or crack in the AP1000 containment are significant. A containment hole approximately ¾" by ¼", like the one discovered at Beaver Valley in 2009, would create exposure to the public well in excess of the 25 rem limit in 10 CFR 100.11(2) for the entire period of the accident. A hole that is the size of the hole in Beaver Valley's containment is not a low probability event, as several through-wall liner holes have already occurred in existing nuclear containments. Therefore, it is not a concept to be pushed off into the severe accident category. Yet, to my knowledge, neither Westinghouse nor the NRC has adequately analyzed this significant safety issue for the AP1000 design.

2. Background of Containment Design

2.1 General. All nuclear power reactor containment systems are designed to contain the radiation and energy that would be released during a Loss Of Coolant Accident (LOCA). In the absence of a containment system, post accident exposures to the public would be unacceptably high. "A containment building, in its most common usage, is a steel or concrete structure enclosing a nuclear reactor. It is designed to contain the escape of radiation… during any emergency. The containment is the final barrier to radioactive release, the first being the fuel ceramic itself, the second being the metal fuel cladding tubes, the third being the reactor vessel and coolant system."[2]

2.2 Current Reactor Containment Designs. According to H.L. Graves, III, NRC, and D.J. Naus, Oak Ridge National Laboratories, there are two main types of

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[2] http://encyclopedia.thefreedictionary.com/containment+structure

containment designs currently in operation: freestanding containments and concrete containments with liners.[3]

> Freestanding Containments are:
> "freestanding, welded steel structures that are enclosed in a reinforced concrete reactor or shield building. The reactor or shield buildings are not part of the pressure boundary and their primary function is to provide protection for the containment from external missiles and natural phenomena (e.g., tornadoes or site-specific environmental events). Thirty-two of the NPPs licensed for commercial operation in the US employ a metal containment."[4]
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> Concrete Containments With Liner are:
> "metal lined, reinforced concrete pressure-retaining structures that in some cases may be post-tensioned. The concrete vessel includes the concrete shell and shell components, shell metallic liners, and penetration liners that extend the containment liner through the surrounding shell concrete. The reinforced concrete shell, which generally consists of a cylindrical wall with a hemispherical or ellipsoidal dome and flat base slab, provides the necessary structural support and resistance to pressure-induced forces. Leak-tightness is provided by a steel liner fabricated from relatively thin plate material (e.g., 6-mm thick) that is anchored to the concrete shell by studs, structural steel shapes, or other steel products… Seventy-two of the NPPs licensed for commercial operation in the US employ either a reinforced concrete (37 plants) or post-tensioned concrete (35 plants) containment.[5]"

2.3 AP1000 Containment Design. The proposed AP1000 reactors use concepts common to both types of containment system designs to create a wholly *new hybrid containment* that has had no prior operational history. While the AP1000 is a PWR that uses a dry containment system similar to that which most other existing PWRs use, unlike most currently operating PWRs, the AP1000 design proposes to use a freestanding steel containment and no secondary containment.

2.4 Existing freestanding containment systems are normally surrounded by a reactor building that also acts as a filtered enclosure in the case of a design-basis accident. In the AP1000 design, the freestanding steel containment is surrounded by a

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[3] Naus, D.J. and Graves, III, H.L., Detection of Aging Nuclear Power Plant Structures, Proceedings of the OECD-NEA Workshop on the Instrumentation and Monitoring of Concrete Structures, NEA/CSNI/ R(2000)15, Organization for Economic Cooperation and Development – Nuclear Energy Agency, ISSY-les-Moulineaux, France, 2001.
[4] *Id.,* page 3.
[5] *Id.,* pages 3-4.

shield building that is not intended or designed to filter exhaust gases that may leak from the steel containment in the event of an accident.

The AP1000 containment has another unique feature: following an accident it serves a role as a heat exchanger. Unlike any previous containment system ever built, the AP1000 uses a large tank of water above the shield building to pour water directly onto the outside of the steel containment shell. After an accident, the falling water then cools the containment shell, which then cools the radioactive steam inside the containment via two processes known as thermal conduction and convection during which the steel shell evaporates the water that is sprayed from above. As stated in a Westinghouse report:

> "The steel containment vessel provides the heat transfer surface that removes heat from inside the containment and transfers it to the atmosphere. Heat is removed from the containment by the continuous, natural circulation of air. During an accident, air cooling is supplemented by water evaporation. The water drains by gravity from a tank located on top of the containment shield building."[6]

The process of falling water effectively converts the containment into a heat exchanger rather than the passive containment building that is the hallmark of the original PWR containment system design.

2.5 History of NRC Containment Analysis. One of the hallmarks of NRC regulation is that licensees and applicants must apply either *conservative assumptions* or *conservative estimates* in order to meet the NRC's statutory requirement to protect public health and safety. The dictionary defines "*conservative*" *as "Moderate: cautious: a conservative estimate"*. The pattern of recently uncovered weakness in the overall integrity of the current operating containment system design methodology proves that presumptions made for the AP1000 containment system considered in the containment design bases lack the level of prudence and caution as required to protect public health and safety.

3. Discussion

3.1 History of Containment Corrosion and Leakage A recent string of failures in

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[6] W.E. Cummins, et al, *Westinghouse AP1000 Advanced Passive Plant,* Proceedings of ICAPP '03, Cordoba, Spain, May 4-7, 2003, Paper 3235.

the current generation of containment systems strongly indicates that these current containment systems are not as impervious to the post accident environment as was anticipated and calculated by NRC and the nuclear industry in conducting design basis analysis for nuclear reactors. As discussed below in paragraph 3.1.8, this disturbing trend calls for a new analysis of the potential for containment corrosion and leakage. As further discussed in Section 3.2 below, the need for such an analysis is all the more pronounced with respect to the AP1000 design, which appears to invite corrosion through the establishment of a moist oxygenated environment.

For Example:

3.1.1 Beaver Valley. The NRC and the ACRS have received expert witness testimony concerning three pitting indications at Beaver Valley in 2006 and a through-wall hole at Beaver Valley in 2009 as delineated in the April 23, 2009 NRC Event Notification Report 45015. Moreover, the Beaver Valley NRC Event Notification Report clearly shows that visual inspections have proven inadequate to discover leaks before the leaks penetrate the entire metal surface. Below is a picture taken in April 2009 of a through-wall hole in the Beaver Valley containment that was undetected until complete penetration of the liner had occurred.

BEAVER VALLEY UNIT 1 LINER HOLE

3.1.2 European PWRs. Weld anomalies in the containment liner of the latest generation European Pressurized Reactor at Framanville 3 have caused construction delays and setbacks.[7] Weld anomalies may lead to crevices that create through-wall corrosion if they occurred in the unique AP1000 containment design. While there is a significant amount of European data, the data cited in this report is limited to United States nuclear power plants.

3.1.3 Naus and Graves Study. In their treatise, *Detection of Aging Nuclear Power Plant Structures*, Naus and Graves have created a lengthy and comprehensive list of 66 containment system failures beginning as early as 1970 and following through to the end of their published research in 1999. According to their report:

> "As nuclear plant containments age, degradation incidences are starting to occur at an increasing rate, primarily due to environmental-related factors. There have been at least 66 separate occurrences of degradation in operating containments (some plants may have more than one occurrence of degradation). One-fourth of all containments have experienced corrosion, and nearly half of the concrete containments have reported degradation related to either the reinforced concrete or post- tensioning system. Since 1986, there have been over 32 reported occurrences of corrosion of steel containments or liners of reinforced concrete containments. In two cases, thickness measurements of the walls of steel containments revealed areas that were below the minimum design thickness. Two instances have been reported where corrosion has completely penetrated the liner of reinforced concrete containments. There have been four additional cases where extensive corrosion of the liner has reduced the thickness locally by nearly one-half (10)."[8]

Naus and Graves also report that: "Since the early 1970's, at least 34 occurrences of containment degradation related to the reinforced concrete or post-tensioning systems have been reported."[9]

More disturbingly, Naus and Graves chronicled 32 reported incidences of steel containment or liner degradation that are particularly germane to anticipated problems

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[7] Oliver, Anthony and Owen, Ed, *New Civil Engineer Magazine* June 18, 2009
[8] *Id.,* page 5.
[9] *Id.,* page 6.

with the proposed AP1000 containment system. While some of the problems detailed by Naus and Graves are corrosion or pitting that did not completely penetrate the containment system, *their report also uncovered complete containment system failures of either the liner or the steel containment shell*. Table 1, labeled Attachment 2, from Detection of Aging Nuclear Power Plant Structures identifies through-wall containment cracks that occurred in 1984 at Hatch 2,in 1985 at Hatch 1, and in 1999, North Anna 2 also experienced a through-wall hole in its containment.

Naus and Graves also identify significant problems with containment inspections in locations where inspections are difficult due to inaccessibility. It is stated on Page 18 of their report that:

> "**Inaccessible Area Considerations**
> Inspection of inaccessible portions of metal pressure boundary components of nuclear power plant containments (e.g., fully embedded or inaccessible containment shell or liner portions, the sand pocket region in Mark I and II drywells, and portions of the shell obscured by obstacles such as platforms or floors) requires special attention. Embedded metal portions of the containment pressure boundary may be subjected to corrosion resulting from groundwater permeation through the concrete; a breakdown of the sealant at the concrete-containment shell interface that permits entry of corrosive fluids from spills, leakage, or condensation; or in areas adjacent to floors where the gap contains a filler material that can retain fluids. Examples of some of the problems that have occurred at nuclear power plants include corrosion of the steel containment shell in the drywell sand cushion region, shell corrosion in ice condenser plants, corrosion of the torus of the steel containment shell, and concrete containment liner corrosion. In addition there have been a number of metal pressure boundary corrosion incidents that have been identified in Europe (e.g., corrosion of the liner in several of the French 900 MW(e) plants and metal containment corrosion in Germany). Corrosion incidences such as these may challenge the containment structural integrity and, if through-wall, can provide a leak path to the outside environment." [10]

Not only do Naus and Graves identify inspection problems with containments in the United States, but also in Europe. The data they collected, however, only reflect containment problems in the United States. While their report was written in 1999, the

[10] *Id*., Page 18

inspection problems have actually accelerated in severity since that time, with the most recent containment problem reviewed occurring at Beaver Valley in April 2009.

3.1.4 Reports in NRC Information Notice. The 66 incidences of containment system degradation occurring between 1970 and 1999 and reported by Naus and Graves appear to be comprehensive for that specific period of time. While my research to date has not uncovered a comprehensive and all-inclusive list for the current decade from 1999 to present, my review of *USNRC Information Notice 2004-09* identified another eight additional episodes of containment system degradation including a through-wall hole in the containment liner at D.C. Cook in 2001, three through-wall holes through the liner at Brunswick in late 1999, and 60 areas of pitting at D.C. Cook (Ice Containment) in 1998 where the liner was not penetrated but the thickness of the pitting was below the minimum design value[11].

According to the evidence reviewed, at least 77 instances of containment system degradation have occurred at operating US reactors since 1970, including two through-wall cracks in steel containments (Hatch 1 & 2), six through-wall holes in containment liners (Cook, North Anna 2, Beaver Valley 1, and three at Brunswick), and at least 60 instances of liners pitting to below allowable minimum wall thickness (minimum design value).

3.1.5 Citizens Power Report. In its May 2009 filing regarding Beaver Valley's application for a 20-year license extension, Citizen Power recently informed the NRC's Advisory Committee on Reactor Safeguards (ACRS) of the increased likelihood of containment system leakage failures. The expert witness declaration, entitled *Declaration Of Arnold Gundersen Supporting Citizen Power's Petition* and attached herein as Attachment 3 and contained within Citizen Power's filing to the ACRS, identified the *industry-wide* significance of the containment liner hole at Beaver Valley. The declaration detailed potential causes of containment through-wall liner failure and the currently existing weaknesses in inspection techniques on PWR containment systems.

[11] The minimum standard upon which the licensing design of this specific nuclear power plant was predicated and upon which risk assessment data was factored.

The *Declaration Of Arnold Gundersen Supporting Citizen Power's Petition* also addresses United States patents on containment design that clearly state that concrete containment structures are considered porous to radioactive gases and no credit for retention of radiation in concrete may be allowed.[12]

3.1.6 ACRS 2008 Meeting with Connecticut Coalition Against Millstone.

Following my July 9, 2008 testimony to ACRS regarding potential problems with Dominion Nuclear Connecticut Inc.'s Millstone Unit 3's sub-atmospheric *containment system*, the ACRS questioned a *containment specialist staff member of NRC* as to whether the NRC even has the capability to analyze a sub-atmospheric containment. According to the NRC *containment specialist*, the NRC cannot accurately analyze containment systems.

The NRC *containment specialist* and staff member said:

> "It's sort of difficult for us to do an independent analysis. It takes time. We're not really set up to do it. The other thing you have to realize, too, for containment, which isn't as true in the reactor systems area, is that **we don't have the capability**."[13]

To date, the NRC ACRS has met at least twice to discuss Citizen Power's concerns regarding liner failures and the transcripts of those meetings contain key details for containment system failure that should be of concern to the entire nuclear industry.

The most informed discussion of the probability of significant leakage from a PWR containment system may be found in the July 8, 2009 ACRS transcript regarding the Citizen Power petition alerting the NRC to the magnitude and significance of the failure of the containment system. The specific text relating to probability of gross containment leakage is addressed on Page 40 of the July 8, 2009 ACRS transcript:

> "MEMBER RAY: At which point the condition of the concrete can't be taken credit for. So I guess I just think that **the idea that the leakage is**

[12] According to one of Stone and Webster's patents, "A Sub-atmospheric double containment system is a reinforced concrete double wall nuclear containment structure with each wall including an essentially impervious membrane or liner and **porous concrete** filling the annulus between the two walls." US Patent 4081323 Issued on March 28, 1978 to Stone & Webster Engineering Corp. [Emphasis Added]

[13] ACRS Transcript, July 9, 2008, page 88 lines 6-11 [Emphasis added]

> **going to be small from a small hole, from a hole this size, as small as Dan says, in the design-basis conditions isn't logically supportable because the concrete, you can't -- you, yourself said, you can't take credit for the concrete and the reason is because it's condition in the design-basis event can't be predicted, can't be credited. The only thing you can credit is the membrane itself**.
>
> MEMBER SHACK: From a deterministic basis, you're correct. From a probabilistic basis, which is what they use and can take credit based on –
>
> MEMBER RAY: I don't think so.
>
> MEMBER SHACK: Well, that's the way it is.
>
> MEMBER RAY: That's not right."[14]

The July 8, 2009 ACRS discussion between ACRS members Ray and Shack regarding the probability of significant leakage from a PWR containment system occurred after failure of the containment liner at Beaver Valley.

- Ray emphasizes that deterministically the steel containment liner is the only leakage barrier that protects the public.
- Shack implies that the if the liner fails, radiation leaks would be delayed by the concrete containment behind it and therefore a probabilistic risk assessment credit should be given for that reduction in dose release.

My 2008 testimony to ACRS contradicts Shack's assessment and directs one to the original patent delineating the fact that concrete is porous. [See footnote 12]. In the case of the AP1000 design, there is no porous concrete secondary barrier suggested by Shack. Therefore, in regards to the AP1000 design, Ray's position is both deterministically and probabilistically correct.

These ACRS discussions, and further correspondence submitted to the ACRS by Citizen Power indicate that the ACRS has developed an increased awareness of the newly uncovered weaknesses in PWR containment designs. Moreover, a more detailed discussion, including my analysis of the containment issues at Millstone, is detailed within my expert report entitled ***Declaration Of Arnold Gundersen Supporting Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions,*** herewith filed as Attachment 4.

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[14] Transcript, page 40 [emphasis added].

Furthermore, the ACRS wrote a letter to NRC Executive Director for Operation R. W. Borchart on September 21, 2009 entitled _Request By The ACRS For A Future Briefing By NRR On Current Containment Liner Corrosion Issues And Actions Being Taken By The Staff To Address Them_ in which the ACRS said:

> "During the 565th meeting of the Advisory Committee on Reactor Safeguards, September 10-12, 2009, the Committee indicated the need for a future briefing by NRR on the topic of containment liner corrosion. **In recent years liner corrosion issues have been identified on a few of the operating nuclear power reactors. The Committee would like to hear from NRR about current staff efforts to address these issues generically.** Please let us know about a proper date and time for this briefing to take place.[15]

3.1.7 Petrangeli Report. The ACRS is not the only organization expressing concern regarding the overall integrity of PWR containments. In his book Nuclear Safety, Dr. Gianni Petrangeli, a nuclear engineering professor at the University of Pisa in Italy, also reported his concern regarding the likelihood of *containment* breaches *and the probability of severe post-accident leakage from a PWR containment*. In his book, Dr. Petrangeli noted:

> "There is a tendency in the design phase to specify for the containments a figure for the maximum admissible leakage rate which is close to that which is technically obtainable in ideal conditions… In the course of plant operation however, even if at the start the leak rate was the specified one or lower, a certain deterioration in the containment leak rate takes place and then in the case of an accident, the leak rate would probably be higher than that measured in the last leakage test…. In depth studies ... were performed on the deterioration probability of the leak proofing in real containment systems. The picture that emerges is not very reassuring… The probability of overcoming the specification values in the case of an accident is 15 per cent for BWR's and 46 percent for PWRs"[16].

Using US NRC data gathered from 1965 through 1988 and NUREG-1273 on containment leakage from a variety of sources, Dr. Petrangeli presents the probability that a containment system will exceed its technical specification limits during an accident in Table 14-2 reproduced below.

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[15] Meeting Transcript, page 40 [Emphasis Added]

[16] Petrangeli, Gianni, Nuclear Safety, Butterworth-Heinemann, 2006, ISBN 10: 0-7506-6723-0, Page 141.

Table 14-2. Measured containment leaks (USNRC 1988)

Leak measured relative to the specifications	BWRs*	PWRs*
From 1 to 10 times	0.10	0.31
From 10 to 100 times	0.04	0.08
Higher than 100	0.01	0.07

* These columns represent the probability of exceeding the technical specification leakage rates.

In my review of the more comprehensive data from the 1999 Naus and Graves study, as well as significant liner failures between 2000 and 2010 after Naus and Graves collected their data, the leakage rates in Table 14-2 of Dr. Petrangeli's 2006 book may in fact underestimate the post-accident containment system leakage risk.

Dr. Petrangeli further expressed his concerns based on his review of this data as it pertains to the new containment designs including the AP1000 when he said:

> "It is surprising that this issue does not receive much attention in the field of safety studies… This issue has been dealt with here because, for plants now under construction and for future ones, the tendency is to restrict the important consequences of severe accidents to within a very small distance from the plant possibly to avoid the need to evacuate the population. From this perspective, the real leakage of the containment system becomes very important."[17]

Dr. Petrangeli then continues by suggesting as a solution the exact opposite approach to that taken in the AP1000 containment design. Rather than act as a chimney and draw unfiltered gases from the gap between the containment and shield building as the AP1000 does, Petrangeli suggests as a possible solution for severe accident dose mitigation would be "… systems with a double containment with filtering of the effluents from the annulus between the containments…" when a secondary containment can be constructed. I note that the AP1000 shield building is not designed to "contain" any gases, and that Westinghouse has stated, "There is no secondary containment provided for the fission product control following a design basis accident." (AP1000 DCD, Rev. 16, Section 6.5.3.2).

[17] *Id.,* page 142.

3.1.8 Conclusions Regarding Containment Degradation and Leakage. As discussed above, the recent history of nuclear reactor operation shows a disturbing, unanticipated and unanalyzed trend of containment corrosion and leakage. This trend is seen in both standard containments and in containment designs such as the sub-atmospheric design used at Millstone and six other plants, and the ice containment system that has a litany of serious safety related containment failures. And clearly, the newfound containment liner hole at Beaver Valley creates a dilemma for both the industry and regulators in that it shows the increased likelihood of gross leakage by a PWR containment system that would significantly compromise public health and safety.

In my professional opinion, this disturbing trend calls for a new analysis of the potential for containment corrosion and leakage in the existing fleet of operating reactors. As further discussed in Section 3.2 below, the need for such an analysis is all the more pronounced with respect to the AP1000 design, which appears to invite corrosion through the establishment of a moist environment.

3.2 The Unique AP1000 Design Introduces An Unanalyzed Vulnerability

3.2.1 General. In the event the AP1000 containment leaks radioactive material into the annular gap between it and the shield building, the AP1000 is specifically designed to immediately act as a chimney and draw those vapors directly into the environment without filtration. The design of the AP1000 containment also has a greater potential to leak than existing containments with an increased likelihood that the leakage will exceed dose exposure limits at the Low Population Zone.

3.2.2 AP1000 Integrity and Corrosive Attacks. Well before the discovery of pitting (2006) or the through wall leak (2009) at Beaver Valley, the NRC expressed concerns about the integrity of the AP1000 containment to resist a corrosive attack. In 2003 the NRC wrote:

> "The staff's review of the containment shell design identified a concern that the 4.44 cm (1.75 in.) thickness of the cylindrical shell just meets the minimum thickness requirement of 4.4336 cm (1.7455 in.) of the 1998 ASME Code, Section III, Subsection NE, Paragraph NE-3324.3(a), based on a 406.8 kPa (59 psi) design pressure, a 148.9 °C (300 °F) design temperature, allowable stress, S = 182 MPa (26.4 ksi), and a containment vessel radius, R = 1981.2 cm (780 in.). **The staff noted that there is no**

> **margin in the nominal design thickness for corrosion allowance.** Of particular concern is the embedment transition region of the cylinder, which has been prone to corrosion in operating plants. Paragraph NE-3121 specifically requires that the need for a corrosion allowance be evaluated. Consequently, the staff requested the applicant to provide justification for (1) making no provision, in defining the nominal design thickness, for general corrosion of the containment shell over its 60-year design life, and (2) not specifying a corrosion allowance in the embedment transition region. In its response to RAI 220.002 (Revision 1), the applicant submitted the following information to address the corrosion allowance for the AP1000 containment shell:
>
>> The ASME Code of record has been updated to the 2001 Edition including 2002 Addenda. (The applicant has revised the DCD to incorporate this change.) Per the revised Code of record, S = 184.09 MPa (26.7 ksi) and tmin = 4.38 cm (1.726 in.), which provides a nominal margin for corrosion of 0.06 cm (0.024 in.).
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>> The design has been changed to add a corrosion allowance for the embedment transition region, as was provided for the AP600. The nominal thickness of the bottom cylinder section is increased to 4.76225 cm (1.875 in.) and the vertical weld joints in the first course will be post-weld, heat-treated per ASME Code requirements. Design of Structures, Components, Equipment, and Systems
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>> Corrosion protection has been identified as a safety-related function for the containment vessel coating in DCD Tier 2, Section 6.1.2.1.1, "General (Protection Coatings)." The COL applicant will provide a program to monitor the coatings, as described in DCD Tier 2, Section 6.1.3.2, "Coating Program."
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>> On the basis that enough corrosion allowance and proper corrosion protection were provided, the staff found the applicant's response acceptable, pending (1) incorporation of the design change in the cylinder embedment transition region in a future revision, and (2) designation of the "inhibit corrosion" function as "safety" for coatings on the outside surface of the containment vessel in a future revision of DCD Tier 2, Table 6.1-2. This was Confirmatory Item 3.8.2.1-1 in the DSER." [18]

The use of the term *corrosion allowance* refers to situations during which the containment experiences general corrosion over a large area. This general corrosion is a structural problem because it is a broad attack upon the entire structure rather than a pinhole, and therefore the NRC staff concern regarding a general corrosion issue with the

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[18] Page 3-106 AP1000 SER

AP1000 does not address the potential for the through-wall pitting problem reviewed and analyzed in this report. The unique features of the AP1000 exacerbate the likelihood of through-wall pitting corrosion that would increase post accident leakage.

The NRC requirements for increasing the thickness of the AP1000 containment by only one-eighth of an inch and by adding field applied protective coatings do not provide adequate assurance to mitigate potential pitting. The proposed NRC remedies are inadequate in light of industry experience and the unique features of the AP1000 containment design. One needs only to review the 3/8”-thick hole at Beaver Valley which occurred on a field coated surface and other through-wall failures discussed above to conclude that the 1/8 inch corrosion allowance in the AP1000 design is simply not adequate to address pitting.

3.2.3 Vulnerability To Hole Propagation. As discussed in 3.1.3 above, Naus and Graves have already identified the difficulty of thoroughly inspecting inaccessible locations in any containment system. The data reviewed show that such inspections will be more problematic in the AP1000 where abundant air, moisture and corrosive chemicals may allow holes to continue to grow over extended periods of time thereby forming unlimited pockets of corrosion in crevasses at inaccessible locations. This action would likely be especially true in the vicinity of non heat-treated or poorly heat-treated welds of high strength steels. In comparison, the corrosion at Beaver Valley and other existing PWRs has not progressed quite as rapidly as what is projected to occur in the AP1000 because there was no constant replenishment of oxygen and moisture on the outside of the containment liner shell. However, in the event that a corrosion site begins on the outside of the AP1000 containment, unlimited amounts of oxygen, moisture and corrosive chemicals are available for the corrosion to propagate and eventually result in broad weakening of the shell by deep grooves.

The annular gap outside the AP1000 containment is continually subjected to air, is subject to moisture buildup from humidity and condensation in the air, and subject to corrosive chemicals creating the ideal incubator for crack propagation and the creation of holes. The AP1000 containment design effectively continuously "breathes" in air, moisture and contaminants into the annular gap between the shield building and the containment. "Breathing" in this case is what engineers would call natural convection. For example, at Turkey Point and other saltwater sites, that air would also contain salt and other minerals that give ocean air its familiar *ocean smell* and corrosivity of the salt water. On cooling tower sites, the AP1000 would "breath" in cooling tower drift (fine water droplets in the vapor cloud), containing chlorides and biocides and accumulated minerals in the cooling water. The net effect is that these chemicals are corrosive agents traveling immediately next to the outside of the steel containment.

Furthermore, the 800,000-gallon water tank[19] situated above the containment may leak over extended periods of time thereby providing additional moisture to aid in the propagation of holes.

In addition to the possibility of holes or pitting in the wall of the AP1000 containment due to the factors previously discussed, there is also an additional failure mode due to corrosion that must be addressed. Since concrete cannot bond to steel, a gap or pocket will be formed at the interface between the containment wall and the concrete containment floor. History has proven that over time moisture and contamination will enter this gap and cause corrosion to begin. Once again, as Naus and Graves suggest, it is at just such an inaccessible location that pitting can grow to cause either complete failure of the containment system or deterioration of the containment wall thickness to below the Code Allowable.

A second method of containment integrity failure would also be possible at the junction between the concrete floor and steel wall. In this inaccessible location, it is most likely that corrosion would first form as numerous pits ultimately coalescing into a grove that would present a mechanism of loss of structural integrity called *buckling*. If devolved pitting were to occur at the junction between the concrete floor and steel wall, then the low margin of safety for the overall thickness of the AP1000 containment actually becomes a serious structural issue and not just a hole that causes increased leakage.

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[19] The original Gundersen Fairewinds Associates, Inc Report issued March 26, 2010 contained a decimal point error that erroneously stated that the water tank was an 8,000,000-gallon (8-million-gallon) water tank, rather than the correct amount of 800,000 gallons with a weight of 3,300 tons. This typographical error has been corrected in the body of the report and this change has no effect upon the analysis or conclusions contained herein.

The net effect of all these parameters upon the AP1000 design is that through-wall holes or flaws below minimum allowable wall thickness are at least as vulnerable to develop in the new AP 1000 design as compared to the existing PWR containments in which the industry has already witnessed failures.

3.2.4 Inspection Of The AP1000 Containment. Current visual inspections of the containment from easily accessible areas within existing containments have a history of failing to identify any corrosion until the containment barrier itself has been penetrated. Visual inspection on the inside of all containments therefore relies upon a hole fully penetrating the containment in order to be detected.

My experience as a Senior Vice President of an ASME Section XI non-destructive testing division and my review of the AP1000 containment design has led me to conclude that the AP1000 design presents similar obstacles to visual and ultrasonic inspection techniques, and also introduces more locations that are inaccessible to inspection and prone to corrosive attack. Moisture buildup and corrosive agent attack in small crevasses between the containment and the shield building will most likely increase the likelihood of hole-propagation at exactly the locations that are most difficult or impossible to inspect.

3.2.5 Field Welding and Coatings on the AP1000. The AP1000 containment is not a single piece of steel but rather many sheets welded together in the field. These numerous field-welded connections to the containment provide ideal locations both for pitting and crevice corrosion to develop and horizontal surfaces for moisture to collect. In addition, an Idaho National Laboratories Report entitled *Study Of Cost Effective Large Advanced Pressurized Water Reactors That Employ Passive Safety Features* states that, "The containment vessel supports most of the containment air baffle. …Flow distribution weirs are welded to the dome as part of the water distribution system…"[20]

In addition to field-welds, coatings will also be applied to the containment in the field. According to the Idaho National Labs report, "The containment vessel is coated with an

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[20] Pages 2-11 and 2-12 of an Idaho National Laboratories Report entitled Study Of Cost Effective Large Advanced Pressurized Water Reactors That Employ Passive Safety Features (DOE/SF/22170) dated November 12, 2003

inorganic zinc coating".[21] While coatings can provide some protection when properly applied, there is no assurance that field application can be completely successful and will last for the 40 to 60 years of projected operating life. In fact, field quality assurance problems during the construction of existing containments have been determined to be the root cause of many of the containment degradation issues identified earlier in this report. Moreover, there are oil and gas facilities where components have completely corroded even though they were protected by galvanic coatings. A galvanic coating protects only as long as the zinc is present as a metal. For protection, the zinc corrodes and thereby prevents the underlying iron from corroding. However, when the zinc is gone the iron corrodes.

Given that moisture and corrosive chemicals will be drawn into the gap between the shield building and the containment and that various welded connections will provide locations for pit and crevasse corrosion to initiate, it is possible that intergranular corrosion in weldments could propagate at a rate of 0.15inches per year of faster, and in locations that are under stress, cracks could form. In my opinion a small crack could create a hole that would remain undetected and completely penetrate the AP1000 containment in a through-wall leak within approximately ten years or less.

3.2.6 AP1000 Chimney Effect. The AP1000's containment design is uniquely designed to act like a chimney and draw air and moisture out of the annular gap between the containment and the shield building. In the event a containment hole develops, the pressure inside the containment will push any radioactivity into the annular gap and then that radioactivity will immediately be drawn out into the air above the reactor by this chimney effect.

3.2.7 Increased Radiation Exposure From A Leak Into Annular Gap. Based upon my experience in Integrated Leak Rate Testing, the industry expectation is that a ¼ inch hole in the containment will produce leakage in excess of 100 Standard Cubic Feet per Hour (SCFH) resulting in an off-site exposure of approximately 25-rem at the Low Population Zone (LPZ). The hole at Beaver Valley was significantly larger than the aforementioned industry standard and would have resulted in approximately ten times

[21] *Id.,* page 2-12.

that exposure, as leakage increases with the square of the hole diameter. However, as noted earlier in the conversation between ACRS members Ray and Shack, the existing steel liner at Beaver Valley was also backed up by a concrete containment. No such redundancy is incorporated in the AP1000 design. A hole the size of Beaver Valley's would clearly exceed the NRC's Low Population Zone (LPZ) dose limits. Admittedly the AP1000 containment is thicker than Beaver Valley's, but hole propagation is not self-limiting in the AP1000 design as previously described.

3.2.8 Implications To The AP1000 Design. The ACRS concern regarding containment integrity following the discovery of the Beaver Valley hole, Dr. Petrangeli's concern with respect to new containment design leakage rates, and the detailed history of at least 77-containment system failures nationwide, demand a wholly new analysis to determine exactly how the newly proposed AP1000 design accommodates leakage through the wall of its unique hybrid containment system.

Containment system leakage from through-wall holes in steel has already occurred at North Anna, Beaver Valley, Hatch 1, Hatch 2, Cook and Brunswick. However, in each of these circumstances ACRS member Shack articulated the fact that there was another potential barrier by which to collect and filter the airborne radiation that leaked from the containment system. Previous freestanding steel containments with holes were enclosed within a reactor building into which the leakage entered and was controlled. The liner failures appeared to be backed up by a concrete containment building.

In the event of an accident at a proposed AP1000 reactor, leakage through the freestanding steel containment will pass directly into the gap between the steel and the shield building. Therefore, the proposed AP1000 containment design is inherently less safe than current reactors presently licensed and operating.

The following four pages contain accident sequence illustrations.

- Figure 1 – AP1000 in normal operation.
- Figure 2 – AP1000 design basis accident begins.
- Figure 3 – AP1000 containment hole opens as containment fills with radioactive gases.
- Figure 4 – AP1000 chimney effect draws radioactivity directly into the environment.

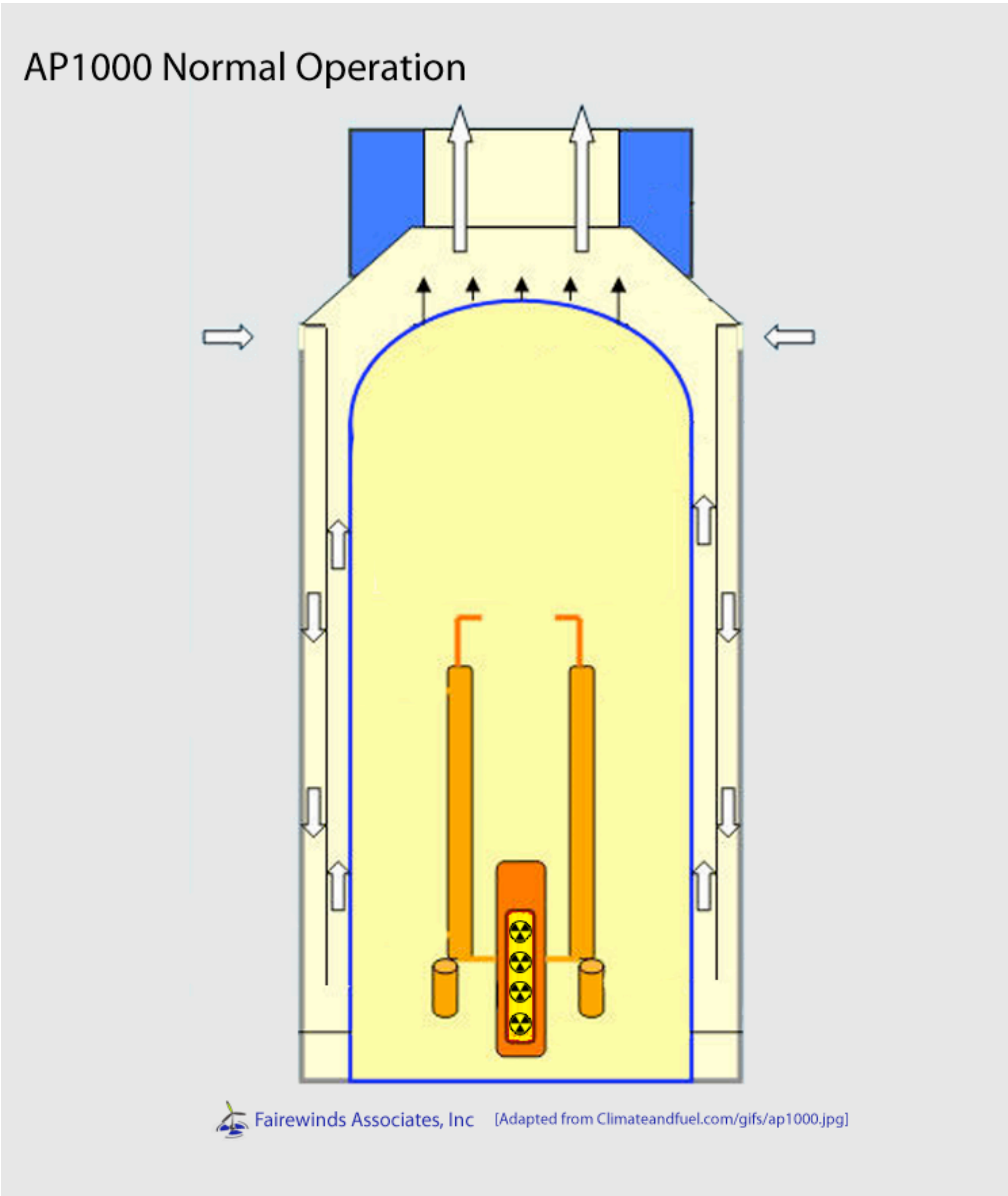
AP1000 Normal Operation
Fairewinds Associates, Inc
[Adapted from Climateandfuel.com/gifs/ap1000.jpg]

Figure 1

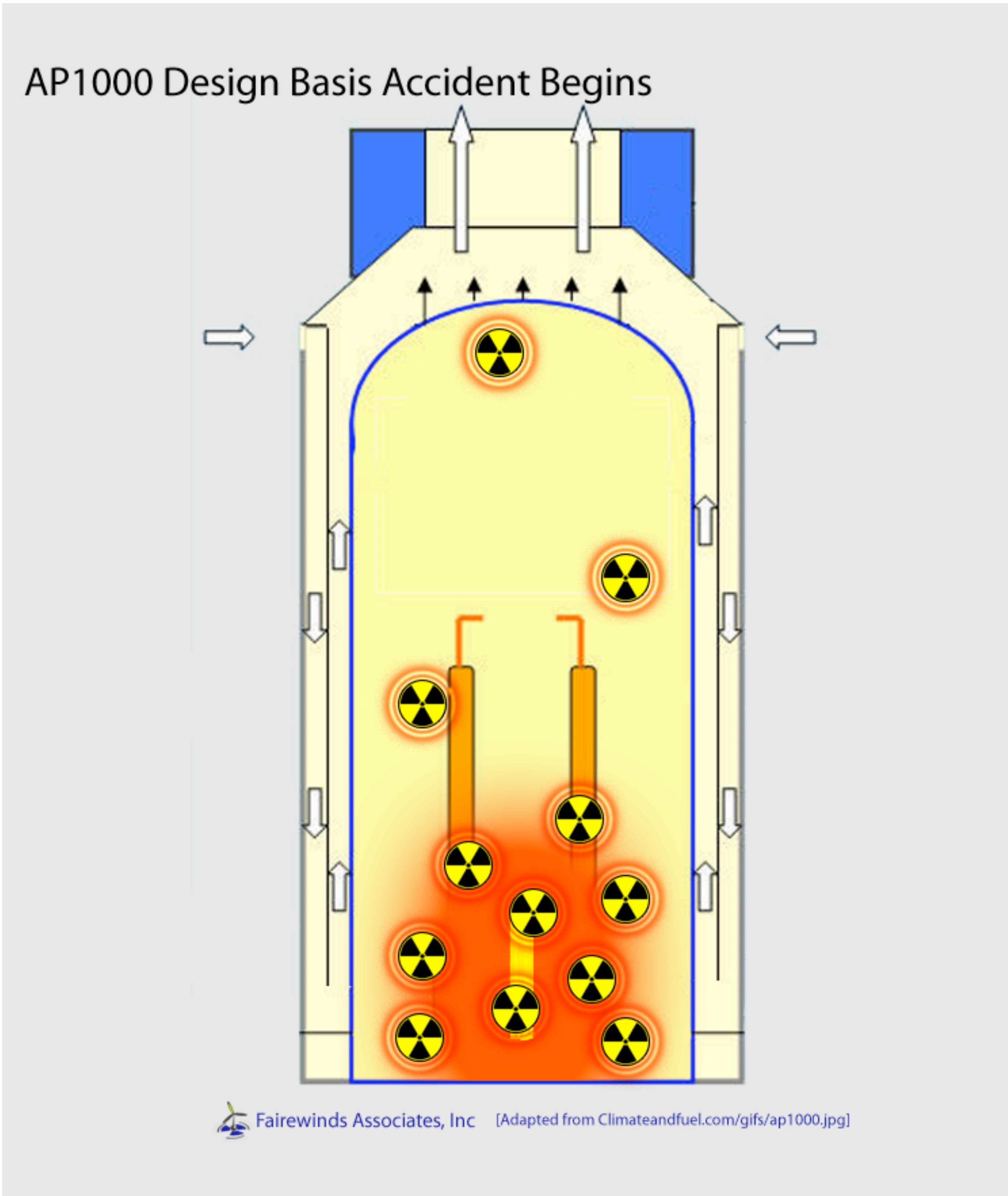
AP1000 Design Basis Accident Begins
Fairewinds Associates, Inc
[Adapted from Climateandfuel.com/gifs/ap1000.jpg]

Figure 2

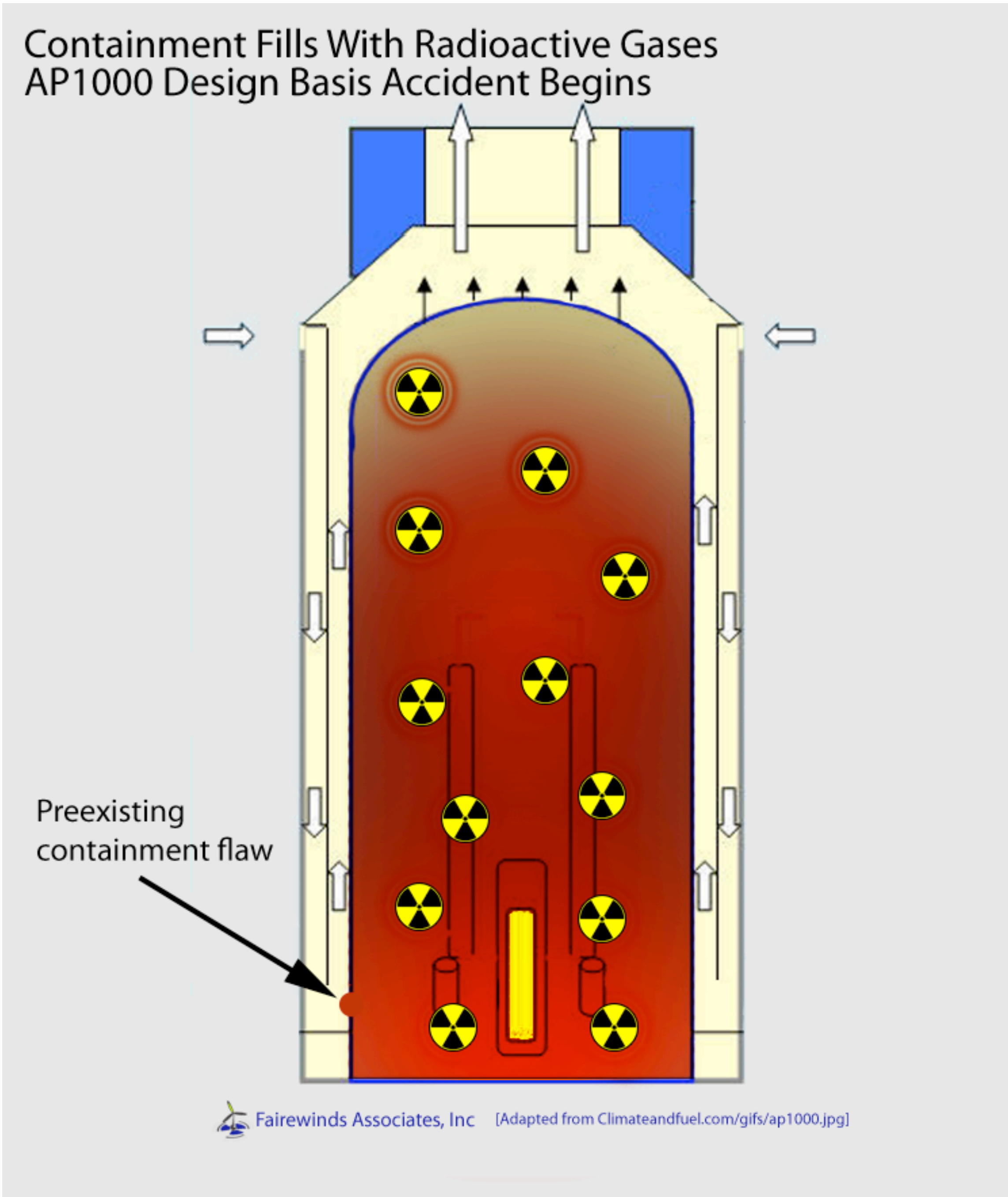
Containment Fills With Radioactive Gases
AP1000 Design Basis Accident Begins
Preexisting
containment flaw
Fairewinds Associates, Inc
[Adapted from Climateandfuel.com/gifs/ap1000.jpg]

Figure 3

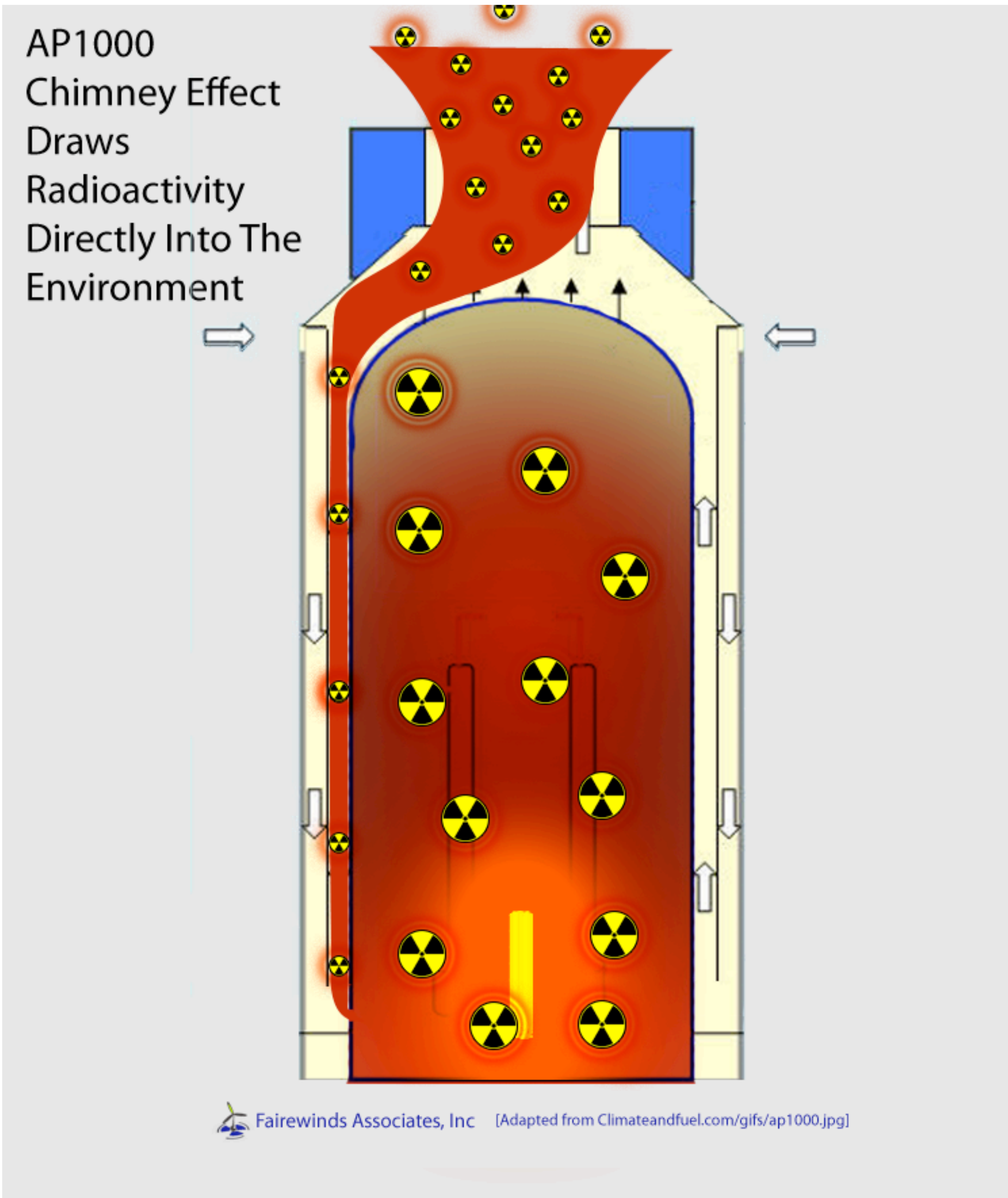
AP1000
Chimney Effect
Draws
Radioactivity
Directly Into The
Environment
Fairewinds Associates, Inc
[Adapted from Climateandfuel.com/gifs/ap1000.jpg]

Figure 4

Concernedly, the hybrid AP1000 containment system appears to lack any of the redundancy or defense in depth[22] in containment system design that was present in earlier designs reviewed in this report and upon which *design bases events* are predicated.

The hole in the Beaver Valley containment confirms Dr. Petrangeli's analysis about the increased likelihood of severe containment leakage. In his analysis, Dr. Petrangeli shows that there is at least a 10-percent likelihood and potentially a 31-percent likelihood of leakage from the AP1000 containment system being 10-times higher than that specified in the AP1000 Design Basis and Technical Specifications. This significant variation in potential leakage corresponds roughly to the size of the hole in the Beaver Valley Containment. See Table 14-2 on Page 12 for comparative chart.

Incongruously, the purpose of *the gap between the steel and the shield building* in the design has ***NOT*** been created to collect and treat radiation as Dr. Petrangeli suggests would be appropriate, but rather to allow air and moisture to cool the containment itself and then to act as a chimney allowing those gases to be siphoned directly out into the environment.

Consequently, the design of the proposed AP1000 containment and its shield building might actually cause the occurrence of a larger leakage rate and a higher probability of a through-wall leakage than the currently existing containment system failures discussed above due to the active role of the AP1000 shield building in acting as a chimney which draws radioactively contaminated air into the environment.

Specifically, the outside of the containment is designed to be wetted and for that reason it has millions of gallons of water suspended above it in order to provide moisture following an accident. More specifically, containment holes and leaks in existing

[22] **Defense in depth** is an approach to nuclear power plant safety that builds-in layers of defense against release of radioactive materials so that no one layer by itself, no matter how good, is completely relied upon. To compensate for potential human and mechanical failures, *defense in depth* is based upon several layers of protection with successive barriers to prevent the release of radioactivity to the environment. This approach includes protection of the barriers to avert damage to the plant and to the barriers themselves. It includes further measures to protect the public, workers, and the environment from harm in case these barriers are not fully effective. *Defense in depth* is a hallmark of nuclear regulation and risk assessment to meet the statutory requirements inherent in the NRC responsibility to protect public health and safety.

containment systems were previously self-limiting because they ran out of moisture and oxygen. Moisture, oxygen and corrosive chemicals would be plentiful in the annular gap surrounding the containment and would promote the propagation of holes in normal AP1000 operational scenarios.

Existing data shows that containment system failures occur with moisture and oxygen. Therefore, it is clear that for the AP1000 design, leakage from the water tank, water from testing the tank, and/or atmospheric moisture due to the condensation on the water tank will create a constant environment of moisture and oxygen that may in fact provoke a through-wall containment failure in locations that are difficult and/or impossible to inspect.

Consequently, by looking at the historical record of containment system failures detailed in NRC records and in this report, and given the lack of a bond between the concrete floor and steel containment wall, and the inspection difficulty within crevasses in the annular gap between the AP1000 containment and the shield building, it is very likely that corrosion will develop that will limit the containment's effectiveness in the event of an accident.

4. Severe Accident Scenario or Design Basis Event?

4.2.1 General. Published reports indicate that the NRC already considers a breach of existing containments to be a plausible accident scenario. Emergency planning exercises at Oyster Creek and Callaway have already been based upon containment failure. My concern is that the potential for a breach of the AP1000 containment as discussed in this report is not a remote probability event, and may in fact occur prior to a design basis accident, and may remain undetected until the accident occurs.

4.2.2 AP1000 PRA. According to Chapter 35 of the Westinghouse AP1000 Probabilistic Risk Assessment on file with the NRC, Westinghouse has not assessed the possibility of radioactive gasses moving through the annular gap between the steel containment and the shield building and then directly out into the environment.

In Chapter 35 of the Westinghouse AP1000 probabilistic risk assessment, which is entitled CONTAINMENT EVENT TREE ANALYSIS, ***none*** of the seven AP1000 accident scenarios assumed containment leaks into the an annular gap of the shield building that would then move radiation out into the environment without filtration.

Moreover, in Table 35-4 entitled SUMMARY OF RELEASE CATEGORY DEFINITIONS on page 35-24 of the report (reproduced as Attachment 5), only seven possible "*Release Categories*" have been defined and identified by Westinghouse as possible candidates for releasing gases into the environment following an accident. None of these release categories identified by Westinghouse include steel containment failure directly into the annular gap created by the shield building.

4.2.3 Severe Accident Mitigation Design Alternatives (SAMDA). As part of the AP1000's *Severe Accident Mitigation Design Alternatives (SAMDA)* analysis, Westinghouse claims to have considered and rejected the need for "Secondary Containment Filtered Ventilation". In its Revision 9 of the AP1000 Design Control Document, Page 1B-6 Westinghouse said:

> **"Secondary Containment Filtered Ventilation**
> This SAMDA consists of providing the middle and lower annulus… of the secondary concrete containment with a passive annulus filter system for filtration of elevated releases. The passive filter system is operated by drawing a partial vacuum on the middle annulus through charcoal and HEPA filters. The partial vacuum is drawn by an eductor with motive flow from compressed gas tanks. The secondary containment would then reduce particulate fission product release from any failed containment penetrations (containment isolation failure). In order to evaluate the benefit from such a system, this design change is assumed to eliminate the CI release category."

I have no understanding of why, in the above quotation, Westinghouse uses the term "*secondary concrete containment*" to refer to the AP1000 Shield Building. The Shield Building is proposed to be of modular construction and will not serve the purpose of containing radiation. It is not designed to contain anything, but rather is designed to disperse air and moisture used to cool the containment. *Westinghouse's use of the term "secondary concrete containment" is a misnomer.*

The starting point (base case) for all the AP1000 containment scenarios is the "Intact Containment". The intact containment is explained as "Release Category IC" on Page 1B-10:

> **"Release Category IC – Intact Containment**
> If the containment integrity is maintained throughout the accident, then the release of radiation from the containment is due to nominal leakage and is expected to be within the design basis of the containment. This is the "no failure" containment failure mode and is termed intact containment. The main location for fission-product leakage from the containment is penetration leakage into the auxiliary building where significant deposition of aerosol fission products may occur."

In addition to this base case scenario, the SAMDA analysis then postulates several extremely low probability events on Pages 1B-10 and 1B-11:

> "**Release Category CFE – Early Containment Failure**
> Early containment failure is defined as failure that occurs in the time frame between the onset of core damage and the end of core relocation. During the core melt and relocation process, several dynamic phenomena can be postulated to result in rapid pressurization of the containment to the point of failure. The combustion of hydrogen generated in-vessel, steam explosions, and reactor vessel failure from high pressure are major phenomena postulated to have the potential to fail the containment. If the containment fails during or soon after the time when the fuel is overheating and starting to melt, the potential for attenuation of the fission-product release diminishes because of short fission-product residence time in the containment. The fission products released to the containment prior to the containment failure are discharged at high pressure to the environment as the containment blows down. Subsequent release of fission products can then pass directly to the environment. Containment failures postulated within the time of core relocation are binned into release category CFE."

> "**Release Category CFI – Intermediate Containment Failure**
> Intermediate containment failure is defined as failure that occurs in the time frame between the end of core relocation and 24 hours after core damage. After the end of the in-vessel fission- product release, the airborne aerosol fission products in the containment have several hours for deposition to attenuate the source term. The global combustion of hydrogen generated in-vessel from a random ignition prior to 24 hours can be postulated to fail the containment. The fission products in the containment atmosphere are discharged at high pressure to the environment as the containment blows down. Containment failures postulated within 24 hours of the onset of core damage are binned into release category CFI."

"**Release Category CFL – Late Containment Failure**
Late containment failure is defined as containment failure postulated to occur later than 24 hours after the onset of core damage. Since the probabilistic risk assessment assumes the dynamic phenomena, such as hydrogen combustion, to occur before 24 hours, this failure mode occurs only from the loss of containment heat removal via failure of the passive containment cooling system. The fission products that are airborne at the time of containment failure will be discharged at high pressure to the environment, as the containment blows down. Subsequent release of fission products can then pass directly to the environment. Accident sequences with failure of containment heat removal are binned in release category CFL."

"**Release Category CI – Containment Isolation Failure**
A containment isolation failure occurs because of the postulated failure of the system or valves that close the penetrations between the containment and the environment. Containment isolation failure occurs before the onset of core damage. For such a failure, fission-product releases from the reactor coolant system can leak directly from the containment to the environment with diminished potential for attenuation. Most isolation failures occur at a penetration that connects the containment with the auxiliary building. The auxiliary building may provide additional attenuation of aerosol fission-product releases. However, this decontamination is not credited in the containment isolation failure cases. Accident sequences in which the containment does not isolate prior to core damage are binned into release category CI."

"**Release Category BP – Containment Bypass**
Accident sequences in which fission products are released directly from the reactor coolant system to the environment via the secondary system or other interfacing system bypass the containment. The containment failure occurs before the onset of core damage and is a result of the initiating event or adverse conditions occurring at core uncovery. The fission-product release to the environment begins approximately at the onset of fuel damage, and there is no attenuation of the magnitude of the source term from natural deposition processes beyond that which occurs in the reactor coolant system, in the secondary system, or in the interfacing system. Accident sequences that bypass the containment are binned into release category BP."

4.2.4 Analysis of SAMDA Assumptions. A brief examination of the SAMDA assumptions Westinghouse applied to the AP1000 containment beyond its design basis (*Intact Containment*) scenario shows many non-conservative assumptions.

- For Release Category CLF (Late Containment Failure), Westinghouse assumes that the postulated containment failure occurs only 24-hours after the accident has begun and that the failure is due to the inability of the containment to remove decay heat. Westinghouse has simply made an arbitrary choice of the 24-hour number and the causative action.

- For Release Category CI (Containment Isolation), Westinghouse first assumes that the containment fails to properly isolate. Secondly, Westinghouse assumes that the isolation failure occurs at a containment penetration from which any additional leakage then enters the auxiliary building. Leakage into another building then provides additional filtration and delay. Westinghouse **does *not* assume** that the failure might occur at a location in the containment that directly exhausts into the annular ring between the containment and the shield building. Any leakage into this annular gap would then leak directly into the environment, which has not been factored into either the Westinghouse assessment or the NRC review of the Westinghouse data.

- For Release Category BP (Containment Bypass) Westinghouse has assumed that the containment is bypassed through an open piping system. Once again, Westinghouse fails to consider or factor in to its analysis that the containment failure might occur at a location in the containment that directly exhausts into the annular ring between the containment and the shield building. Any leakage into this annular gap would then leak directly into the environment. As delineated before, the Westinghouse assessment has not considered all the pertinent data.

Westinghouse has ignored the long history of previous containment and containment liner failures that indicate there is an unacceptably high risk that the AP1000 containment might be in a failed condition at the onset of an accident. Inspection results of existing PWR containments have shown numerous occasions when containment liners have completely failed or experienced holes below minimum allowable wall thickness. Therefore, there is a significant probability that leakage from the AP1000 containment would begin immediately and most likely **will *not* occur** at the site of containment penetration. This potential AP1000 leakage is not related to an extraordinary SAMDA event, but may be anticipated to exist at the beginning of the accident due to uninspected corrosion of the containment as discussed in this report. The leakage problem in the AP1000 design is exacerbated because it is the only containment design that has an annular gap specifically created to act as a chimney and draw air directly into the environment.

4.2.5 SAMDA Summation. In every case Westinghouse chose to analyze, it ignored the likelihood that radioactive leakage would move directly into the annular gap between the containment and the shield building.

Moreover, in the design *features* of the Westinghouse AP1000 reactor, this leakage would *be deliberately* wafted out into the environment. Furthermore, there are several significant and extraordinary assumptions within the Westinghouse analysis that has the net effect of minimizing the AP1000's unique design weakness.

These non-conservative SAMDA assumptions include:

- The likelihood of containment failure is minimized.
- The timing of the failure is delayed, hence reducing radionuclide concentrations.
- The location of the failure is chosen to avoid the annular gap.
- The likelihood of significant leakage is minimized.
- And, the dose consequences are therefore also minimized.

With these five erroneous assumptions, Westinghouse has failed in its efforts to *prove* that there is no need to modify the AP1000 Containment and Shield building in order to eliminate the possibility of releases directly into the environment and to protect public health and safety. In fact, containment failure through only a small hole similar to that at Beaver Valley should not be a SAMDA event, but is likely to exist when the design basis event occurs.

5. Conclusion

Given the newly discovered Beaver Valley containment system failure and a litany of other containment failures identified throughout this report, the facts show that it is unreasonable to assume that the AP1000 containment design for the proposed AP1000 reactors will not leak radiation directly into the annular gap created by the shield building.

In conclusion, the potential for containment leakage directly through holes in the steel shell creates an unanalyzed safety risk to the public from the proposed AP1000 containment design. Releases from this potential leakage path are not bounded by any existing analysis and will be more severe than those previously identified by Westinghouse in its AP1000 applications and various revisions.

Four contributing factors will increase the consequences of an accident in which the containment leaks radiation directly into the annular gap.

- First, more radiation is likely to be released than previously analyzed.
- Second, radiation will be released sooner than in other scenarios because the hole or leakage path exists prior to the accident.
- Third, radioactive gases entering this gap are not filtered or delayed.
- Fourth, moisture and oxygen, routinely occurring between the containment and the shield building in the AP1000 design, exacerbates the likelihood of larger than design basis containment leaks.

Filtration of the air leaving the annular gap between the containment and the shield building was previously rejected by Westinghouse's SAMDA analysis. However, in my opinion, this issue should be reconsidered because it is a design basis event and not a low probability SAMDA occurrence. Finally, because the NRC and Westinghouse have not analyzed the containment system for the design of the proposed AP1000 reactors in light of these flaws, the public is presented with an *unreviewed safety issue* that creates a potential accident with much more severe consequences than previously analyzed.

Attachments:

Attachment 1 – Curriculum Vitae

Attachment 2 – Table 1 from *Detection of Aging Nuclear Power Plant Structures*

Attachment 3 – Table 35-4 *Summary Of Release Category Definitions*

Attachment 4 – *Declaration Of Arnold Gundersen Supporting Citizen Power's Petition*

Attachment 5* – *Declaration Of Arnold Gundersen Supporting Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions* – *This attachment is a separate document due to email and PDF size constraints. All reports are posted on www.fairewinds.com/reports.

Note: See footnote 19 for typographical change notation also pasted below.

> The original Gundersen Fairewinds Associates, Inc Report issued March 26, 2010 contained a decimal point error that erroneously stated that the water tank was an 8,000,000-gallon (8-million-gallon) water tank, rather than the correct amount of 800,000 gallons with a weight of 3,300 tons. This typographical error has been corrected in the body of the report and this change has no effect upon the analysis or conclusions contained herein.

CORRO-CONSULTA
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Affidavit

Re.

Post Accident AP1000 Containment Leakage: An Un-reviewed Safety Issue

By
Arnold Gundersen, March 26, 2010

I, Rudolf H. Hausler, Corrosion Engineer, NACE Corrosion Specialist, recipient of the NACE Technical Achievement Award, and NACE Fellowship, dipl. Chemical Engineer and PhD in Technical Sciences, hereby assert that I have read subject report in detail.

I agree with the assessment that the construction of the containment building of the AP1000 leaves the reactor containment (carbon steel shell) subject to various modes of corrosion attack. Even though both the inside and the outside of the containment may be coated for corrosion protection (it is not clear that they are because heavy protective paint coat layers will reduce the necessary heat transfer rate) there are always pinholes in any paint layer where corrosion processes may be initiated. Inaccessible areas will be most vulnerable to defects and hence corrosion.

In recent years coatings for applications in nuclear energy plants have been given much attention. However, with all the testing in salt spray cabinets supplemented by irradiation, there are no manufacturers who will give assurances beyond the life expectancies based on intuitive extrapolations.

It turns out that the paint manufactures develop paints and perform test procedures according to industry standards but leave the final selection of a paint schedule to the operating engineer at the respective generating plants. Clearly in this case the blind are leading the seeing.

Because of the impossibility of ruling out defects in the protective coating, the uncertainty of the fitness for purpose of coatings beyond the customarily guaranteed 10 years, the further uncertainty of the performance of the natural convection cooling scheme of the AP-1000, it would appear extremely risky to deny and rule out need for secondary containment.

I therefore agree with Arnold Gundersen's assessment in its entirety.

Signed

March 29, 2010

Attachment 2
Table 1 from Detection of Aging Nuclear Power Plant Structures

Table 1. Instances of containment pressure boundary component degradation at commercial nuclear power plants in the United States.

Plant Designation (Occurrence Date) Plant Type (Source)*	Containment Description (No. of Similar Plants)	Degradation Description	Detection Method
Vermont Yankee (1978) BWR/4 (Ref. 52)	Mark I Steel drywell and wetwell (22)	Surface cracks in the overlay weld-to-torus base metal heat-affected zone	Visual examination (As part of modifications to restore the originally intended design safety margins)
Hatch 2 (1984) BWR/4 (Refs. 53, 54, and 55)	Mark I Steel drywell and wetwell (22)	Through-wall cracks around containment vent headers within the containment torus (Brittle fracture caused by injection of cold nitrogen into torus during inerting)	Visual examination of torus interior
Hatch 1 (1985) BWR/4 (Ref. 55)	Mark I Steel drywell and wetwell (22)	Through-wall crack in nitrogen inerting and purge line (Brittle fracture caused by injection of cold nitrogen during inerting)	In-service inspection testing using magnetic particle method
Monticello (1986) BWR/3 (Ref. 56)	Mark I Steel drywell and wetwell (22)	Polysulfide seal at the concrete-to-shell interface became brittle allowing moisture to reach the steel shell	Visual examination (A small portion of the drywell shell was excavated as a part of a life extension study)
Dresden 3 (1986) BWR/3 (Ref. 57)	Mark I Steel drywell and wetwell (22)	Coating degradation due to exposure to fire with peak metal temperatures of 260°C (500°F) and general corrosion of metal shell by water used to extinguish fire	Visual examination (Polyurethane between the drywell shell and concrete shield wall was ignited by arc-air cutting activities producing smoke and heat)
Oyster Creek (1986) BWR/2 (Refs. 58, 59, and 60)	Mark I Steel drywell and wetwell (22)	Defective gasket at the refueling pool allowed water to eventually reach the sand cushion region causing drywell shell corrosion	Visual examination of uncoated areas and ultrasonic inspection
Fitzpatrick (1987) BWR/4 (Refs. 56 and 61)	Mark I Steel drywell and wetwell (22)	Degradation of torus coating with associated pitting	Visual examination of uncoated areas and ultrasonic inspection (Technical specification surveillance performed during outage)
Millstone 1 (1987) BWR/3 (Ref. 61)	Mark I Steel drywell and wetwell (22)	Degradation of torus coating	Visual examination of uncoated areas and ultrasonic inspection (The torus had been drained for modifications)
Oyster Creek (1987) BWR/2 (Ref. 61)	Mark I Steel drywell and wetwell (22)	Degradation of torus coating with associated pitting	Visual examination of uncoated areas and ultrasonic inspection

Table 1. Instances of containment pressure boundary component degradation at commercial nuclear power plants in the United States (cont.).

Plant Designation (Occurrence Date) Plant Type (Source)*	Containment Description (No. of Similar Plants)	Degradation Description	Detection Method
Brunswick 1 (1987) BWR/4 (Ref. 62)	Reinforced concrete with steel liner (9)	Corrosion of steel liner	General visual examination of coated areas
Nine Mile Point 1 (1988) BWR/5 (Ref. 63)	Steel drywell and wetwell (22)	Corrosion of uncoated torus surfaces	Visual examination of uncoated areas and ultrasonic inspection
Pilgrim (1988) BWR/3 (Ref. 61)	Steel drywell and wetwell (22)	Degradation of torus coating	Visual examination of uncoated areas and ultrasonic inspection (Licensee inspection as a result of occurrences at similar plants)
Brunswick 2 (1988) BWR/4 (Ref. 62)	Reinforced concrete with steel liner (9)	Corrosion of steel liner	General visual examination of coated areas
Dresden 2 (1988) BWR/3 (Ref. 64)	Steel drywell and wetwell (22)	Coating, electrical cable, and valve operator component degradation due to excessive operating temperatures	Visual examination of uncoated areas and ultrasonic inspection (Ventilation hatches in the drywell refueling bulkhead inadvertently left closed)
Hatch 1 and 2 (1989) BWR/4 (Ref. 65)	Steel drywell and wetwell (22)	Bent anchor bolts in torus supports (due to weld induced radial shrinkage)	Visual examination
McGuire 2 (1989) PWR (Ref. 66)	Ice Condenser Reinforced concrete with steel liner (4)	Corrosion on outside of steel cylinder in the annular region at the intersection with the concrete floor	General visual examination prior to Type A leakage rate test
McGuire 1 (1989) PWR (Ref. 66)	Ice Condenser Reinforced concrete with steel liner (4)	Corrosion on outside of steel cylinder in the annular region at the intersection with the concrete floor	General visual examination (Inspection initiated as a result of corrosion detected at McGuire 2)
Catawba 1 (1989) PWR (Refs. 66 and 67)	Ice Condenser Steel cylinder (5)	Corrosion on outside of steel cylinder in the annular region	General visual examination (Inspection initiated as a result of corrosion detected at McGuire 2)
Catawba 2 (1989) PWR (Ref. 66)	Ice Condenser Steel cylinder (5)	Corrosion on outside of steel cylinder in the annular region	General visual examination (Inspection initiated as a result of corrosion detected at McGuire 2)

Table 1. Instances of containment pressure boundary component degradation at commercial nuclear power plants in the United States (cont.).

Plant Designation (Occurrence Date) Plant Type (Source)*	Containment Description (No. of Similar Plants)	Degradation Description	Detection Method
McGuire 1 (1990) PWR (Ref. 68, 69, and 70)	Ice Condenser Reinforced concrete with steel liner (4)	Corrosion on inside surface of coated containment shell under the ice condenser and between the floors near the cork filler material	Visual examination and ultrasonic inspection (Degradation possibly caused by moisture from the ice condenser or condensation)
Quad Cities 1 (1991) BWR/3 (Refs. 71, 72, and 82)	Steel drywell and wetwell (22)	Two-ply containment penetration bellows leaked due to transgranular stress-corrosion cracking	General visual examination (Excessive leakage detected)
Quad Cities 2 (1991) BWR/3 (Refs. 71 and 72)	Steel drywell and wetwell (22)	Two-ply containment penetration bellows leaked due to transgranular stress-corrosion cracking	General visual examination (Excessive leakage detected)
Dresden 3 (1991) BWR/3 (Ref. 72)	Steel drywell and wetwell (22)	Two-ply containment penetration bellows leaked due to transgranular stress-corrosion cracking	General visual examination (Excessive leakage detected)
Point Beach 2 (1992) PWR (Ref. 73)	Post-tensioned concrete cylinder with steel liner (35)	Liner plate separated from concrete	General visual examination
H. B. Robinson (1992) PWR (Ref. 73)	Post-tensioned concrete cylinder (vertical only) with steel liner (35)	Degradation of liner coating	General visual examination
Cooper (1992) BWR/4 (Ref. 73)	Steel drywell and wetwell (22)	Corrosion of interior torus surfaces and corrosion stains on exterior torus surface in one area	General visual examination
Beaver Valley 1 (1992) PWR (Refs. 73 and 74)	Subatmospheric Reinforced concrete cylinder with steel liner (7)	Corrosion of steel liner, degradation of liner coating, and instances of liner bulging	General visual examination prior to Type A leakage rate test
Salem 2 (1993) PWR (Ref. 75)	Reinforced concrete cylinder with steel liner (13)	Corrosion of steel liner	General visual examination prior to Type A leakage rate test

Table 1. Instances of containment pressure boundary component degradation at commercial nuclear power plants in the United States (cont.).

Plant Designation (Occurrence Date) Plant Type (Source)*	Containment Description (No. of Similar Plants)	Degradation Description	Detection Method
Sequoyah 1 (1993) PWR (Ref. 76)	Ice Condenser Steel cylinder with concrete shield building (5)	Degradation of moisture barriers resulting in corrosion of the steel shell	General visual examination and visual examination of coated areas
Sequoyah 2 (1993) PWR (Ref. 76)	Ice Condenser Steel cylinder with concrete shield building (5)	Degradation of moisture barriers resulting in corrosion of the steel shell	General visual examination and visual examination of coated areas
Brunswick 2 (1993) BWR (Refs. 62 and 77)	Reinforced concrete drywell and wetwell with steel liner (9)	Corrosion of steel liner	General visual examination and visual examination of coated areas (Follow-up inspection based on conditions noted in 1988)
Brunswick 1 (1993) BWR/4 (Ref. 77)	Reinforced concrete drywell and wetwell with steel liner (9)	Corrosion of steel liner	General visual examination and visual examination of coated areas (Inspection initiated as a result of corrosion detected at Brunswick 2)
McGuire 1 (1993) PWR (Ref. 78)	Ice Condenser Reinforced concrete with steel liner (4)	Main steam isolation line bellows leakage	Leakage testing conducted on bellows following successful Type A leakage rate test
Braidwood 1 (1994) PWR (Ref. 79)	Post-tensioned concrete cylinder with steel liner (35)	Liner leakage detected but not located	Type A leakage rate test
North Anna 2 (1999) PWR (Ref. 80)	Subatmospheric Reinforced concrete with steel liner (7)	6-mm-diameter hole in liner due to corrosion	General visual examination and visual examination of coated areas
Brunswick 2 (1999) BWR/4 Ref. 81)	Reinforced concrete drywell and wetwell with steel liner (9)	Corrosion of liner ranging from clusters of surface pitting corrosion to a 2-mm-diameter hole	General visual examination and visual examination of coated areas (Inspection initiated as a result of corrosion detected at Surry)

Table 35-4

SUMMARY OF RELEASE CATEGORY DEFINITIONS

Release Category	Definition	Release Category Description	Release Magnitude	Release Timing
IC	Intact Containment	Containment integrity is maintained throughout the accident, and the release of radiation to the environment is due to nominal leakage.	Normal Leakage	-
BP	Containment Bypass	Fission products are released directly from the RCS to the environment via the secondary system or other interfacing system bypass. Containment failure occurs prior to onset of core damage	Large Release	Time Frame 1
CI	Containment Isolation Failure	Fission-product release through a failure of the system or valves that close the penetrations between the containment and the environment. Containment failure occurs prior to onset of core damage.	Large Release	Time Frame 1
CFE	Early Containment Failure	Fission-product release through a containment failure caused by severe accident phenomenon occurring after the onset of core damage but prior to core relocation. Such phenomena include hydrogen combustion phenomena, steam explosions, and vessel failure.	Large Release	Time Frame 2
CFV	Containment Venting	Fission-product release through a containment vent line during intentional depressurization of the containment	Controlled Release	Time Frame 3
CFI	Intermediate Containment Failure	Fission-product release through a containment failure caused by severe accident phenomenon, such as hydrogen combustion, occurring after core relocation but before 24 hours.	Large Release	Time Frame 3
CFL	Late Containment Failure	Fission-product release through a containment failure caused by severe accident phenomenon, such as a failure of passive containment cooling, occurring after 24 hours.	Large Release	Time Frame 4

DOCKET NOS. 50-334 and 50-412
CITIZEN POWER
EXHIBIT ONE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of

FirstEnergy Nuclear Operating Co.	)	May 25, 2009
Beaver Valley Power Station Unit 1	)	Docket No. 50-334 and 50-412
License Renewal for Beaver Valley Units 1 and 2	)	

DECLARATION OF ARNOLD GUNDERSEN
SUPPORTING CITIZEN POWER'S PETITION

I, Arnold Gundersen, declare as follows:

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

2. Citizen Power has retained me as an expert witness in the above captioned matter, and my declaration is intended to support the Petition of Citizen Power.

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. (*Exhibit 3*)

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

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

7. I have more than 35-years of professional nuclear experience including and 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, Consumptive Water Loss, 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, Quality Assurance and Records, Configuration Management, Whistleblower Protection, and NRC Regulations and Enforcement.

8. My declaration is intended to support the Petition by Citizen Power and is specific to issues regarding FirstEnergy Nuclear Operating Company's application to extend Beaver Valley Unit 1 Power Station's operating license for an additional 20 years.

9. Beaver Valley Unit 1 is a Westinghouse three loop Nuclear Steam Supply System with a Stone & Webster designed "sub-atmospheric containment." It received its operating license to generate electricity on July 2, 1976.[1]

10. According to NUREG/CR 5640, the *Nuclear Power Plant System Sourcebook*:

    "Sub-atmospheric containments are only found at seven Westinghouse PWR plants, six 3-loop plants, and one 4-loop plant."

11. Stone & Webster Engineering Corporation designed all sub-atmospheric containment systems. The six three-loop sub-atmospheric units are Beaver Valley 1 and 2, North Anna 1 and 2, and Surry l and 2. Stone & Webster's last sub-atmospheric containment is at Millstone Unit 3, a Westinghouse four-loop unit.

12. As a former Northeast Utilities employee who worked on the Millstone Unit 3 engineering, design, and construction, I have personal knowledge of Stone &

[1] http://www.nrc.gov/info-finder/reactor/bv1.html

Webster's sub-atmospheric design. Moreover, in 2008, I provided written testimony to the NRC regarding Millstone Unit 3 sub-atmospheric containment. *(Exhibit 2)*

13. Furthermore, I briefed the NRC ACRS on the problems and contradictions associated with the NRC's analysis of sub-atmospheric containments.

14. As the lead licensing engineer for Northeast Utilities' Millstone Power Station Unit 3 during the 1970's, I was responsible for coordinating the analysis for the PSAR (Preliminary Safety Analysis Report), which formed the original design basis of the Millstone Power Station Unit 3 including its Containment. This interface was among Millstone's structural mechanical, electrical, construction, and operations personnel as well as the architect Stone & Webster and the NSSS vendor Westinghouse. Millstone Power Station Unit 3 was originally designed to be a "Sub-Atmospheric Containment." [In this instance my testimony is that of a fact witness[2] in addition to my overall testimony as an expert witness in my Millstone Unit 3 Declaration (Exhibit 2).]

15. In my 2008 expert witness report to the NRC ACRS, I identified generic issues with sub-atmospheric containments. The issues of critical concern to both the engineering and operations staff regarding the Sub-Atmospheric Containment were:

    15.1. Members of the operations staff, who worked within the Containment, were repeatedly subjected to the adverse effects of high temperature and low oxygen.

    15.2. The small size of the Containment Building severely limited space for equipment and also complicated accident analysis.

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[2] According to the Department of Justice United States Attorneys' Manual Title 3, Chapter 3-19.111 An expert witness qualifies as an expert by knowledge, skill, experience, training or education, and may testify in the form of an opinion or otherwise. (See Federal Rules of Evidence, Rules 702 and 703). The testimony must cover more than a mere recitation of facts. It should involve opinions on hypothetical situations, diagnoses, analyses of facts, drawing of conclusions, etc., all which involve technical thought or effort independent of mere facts. And according to Chapter 3-19.112 Fact Witness A fact witness is a person whose testimony consists of the recitation of facts and/or events, as opposed to an expert witness, whose testimony consists of the presentation of an opinion, a diagnosis, etc
http://www.usdoj.gov/usao/eousa/foia_reading_room/usam/title3/19musa.htm#3-19.111

15.3. Significant construction problems relating to the placement of concrete and rebar were caused by the Containment's small size.

15.4. Minimal analytical data regarding the long-term strength of the building's concrete and its continual exposure to the combination of high temperatures, low pressure, and low specific humidity within its sub-atmospheric Containment as it has aged has led to doubts and questions regarding the strength of this critical safety-related structure in the event of a nuclear accident.

16. Following my ACRS testimony, the ACRS questioned a *containment specialist* staff member of NRC as to whether the NRC even has the capability to analyze a sub-atmospheric containment. According to the NRC *containment specialist*, the NRC cannot accurately analyze Containment systems.

The NRC staff member *containment specialist* said,

> "It's sort of difficult for us to do an independent analysis. It takes time. We're not really set up to do it. The other thing you have to realize, too, for containment, which isn't as true in the reactor systems area, is that **we don't have the capability**." (Page 88, ACRS Transcript, July 9, 2008, lines 6-11.) [*Emphasis added*]

17. From 1976 until 2002, Beaver Valley Unit 1 (BV1) was operated with a sub-atmospheric containment building. In my opinion, Stone & Webster's similar patents[3] provide two important considerations that apply directly to Beaver Valley's design. Those two considerations are that concrete is considered

[3] According to one of S&W's patents, "A Sub-atmospheric double containment system is a reinforced concrete double wall nuclear containment structure with each wall including an essentially impervious membrane or liner and porous concrete filling the annulus between the two walls. The interior of the structure is maintained at sub-atmospheric pressure, and the annulus between the two walls is maintained at a sub-atmospheric pressure intermediate between that of the interior and the surrounding atmospheric pressure, during normal operation. In the event of an accident within the containment structure the interior pressure may exceed atmospheric pressure, but leakage from the interior to the annulus between the double walls will not result in the pressure of the annulus exceeding atmospheric pressure so that there is no net outleakage from the containment structure. US Patent 4081323 Issued on March 28, 1978 to Stone & Webster Engineering Corp.

porous and all boundaries leak to some extent. On page 1 of the footnoted patent, Stone & Webster considers the concrete to be "***porous***", and on page 8 of the cited patent, Stone and Webster stated, "…***all boundaries leak to some extent***…".

18. In a sub-atmospheric containment, the air pressure in the containment is approximately 4 psi[4] below the pressure outside the containment liner.

19. During the past four years the evidence I reviewed shows that several age related corrosion problems have impacted BV1's containment system.

20. According to Beaver Valley Senior Resident Inspector David Werkheiser[5], May 19, 2009, the first documented containment liner problem at BV1 was uncovered during the BV1 2006 steam generator replacement outage.

    20.1. Specifically, NRC Senior Resident Inspector Werkheiser said that when the containment liner was cut and removed to allow the steam generator replacement, Beaver Valley personnel noticed three locations or pockets on the "outside" of the cut portion of the liner where significant corrosion was present.

    20.2. According to Werkheiser, FirstEnergy's BV1 attributed these "pockets" to construction problems dating back to the early 1970's. Werkheiser also noted that in FirstEnergy's analysis, the "pockets" or voids appear to have been caused by improper vibration of the concrete as it was being poured.

    20.3. Furthermore, Werkheiser noted that FirstEnergy's analysis showed that over time these "pockets" had allowed moisture to accumulate and gradually corrode the "outside" of the liner.

    20.4. Finally, Werkheiser confirmed that the three corrosion locations were analyzed and repaired prior to start-up in 2006 in accordance with:

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[4] pounds per square inch

[5] Telephone conversation between Beaver Valley Senior Site Resident Inspector David Werkheiser and Arnold Gundersen, expert witness nuclear engineer, May 19, 2009 12:33 pm.

- Duquesne Light Company Calculation 8700-DSC-156W, 2/26/91;
- Liner Minimum Wall Thickness S&W Calculation 11700-EA-41, 11/3/71;
- Duquesne - Beaver Valley Unit 1 – Reactor Containment Liner Stress Analysis and repaired before the Unit started up in 2006.

21. In my opinion, the data I reviewed from the FirstEnergy BV1 SER and outage report indicates problems with the BV1 inspection techniques. For more than 30-years, BV1's visual, ultrasonic and integrated leak-rate inspection techniques were unable to detect these three voids and their associated corrosion until 2006, though the voids and corrosion clearly existed well before then.

22. When the steam generator was replaced in 2006, the 17' x 21' piece of liner which was removed represents, according to my calculations, approximately three percent of the total containment liner.

    22.1. Given that the voids are randomly positioned, when I applied a ratio of the containment surface area to the piece removed, a basic statistical analysis showed that if three voids were found behind a 17'x 21' section, there may be as many as 99 (ninety-nine) more voids that are similarly impacted by corrosion, but remain hidden behind the residual containment liner.

    22.2. By failing to reexamine the full liner in 2006 after detecting three corrosion sites, I believe that FirstEnergy and the NRC made analytical errors by not analyzing whether the sampling density is sufficient to make a reasonably valid conclusion. By not inspecting for more corrosion, in other words, not looking for evidence of the corrosion problem does not prove that corrosion does not exist and that the containment system is sound.

23. BV1 documented a second containment liner problem on April 23, 2009, when the company filed event report 45015 with the NRC. According to BVI event report 45015 *Damaged Area In Containment Liner*:

> "On April 21, 2009 during the Beaver Valley Power Station Unit No.1

(BEAVER VALLEY PS-1) refueling outage, an ASME XI Section IWE General Visual examination was performed on the interior containment liner. A suspect area was identified at the 738 foot elevation level of containment. This area was approximately 3 inches in diameter and exhibited blistered paint and a protruding rust product. At approximately 1015 hours on April 23, 2009 after cleaning the area and removal of the corrosion products, a rectangular area approximately 1 inch (horizontal) by 3/8 inch (vertical) was discovered that penetrated through the containment steel liner plate (nominal .375 inch thickness). The BEAVER VALLEY PS-1 containment design consists of an internal steel liner that is surrounded by reinforced concrete."

"With the plant currently shutdown and in Mode 6, the containment as specified in Technical Specification 3.6.1 is not required to be operable. The cause of this discrepancy is currently being evaluated.

"This is reportable pursuant to 10 CFR 50.72(b)(3)(ii)(A) as a condition of the principal safety barrier (i.e., containment) being seriously degraded."

23.1. In my opinion, it is important to note once again that all visual, ultrasonic and integrated leak-rate inspection techniques at BV1 *failed to detect the incipient passive failure of a key safety structure before the full perforation of the steel liner.*

24. FirstEnergy claims that the "root cause" of both the BV1 2006 containment liner corrosion and the 2009 gross containment liner failure may be related to construction problems that occurred more than 33-years ago. However, the evidence I examined shows that this purported *root cause* analysis is simplistic for several reasons:

24.1. In the National Association of Corrosion Engineers (NACE) book[6] *Corrosion Basics,* Pierre R. Roberge defines the electrochemistry of corrosion as resulting "from the overwhelming tendency of metals to react electrochemically with oxygen, water, and other substances in the aqueous environment".

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[6] *Corrosion Basics: An Introduction*, 2nd Edition, by Pierre R. Roberge, 2006 by NACE Press Book, 364 pages, 77 tables, 292 figures hardbound, ISBN: 1-57590-198-0

24.2. Therefore, in order for any corrosion to occur, there must be both moisture and oxygen present during which the corrosion reaction would occur. In my expert opinion, if this corrosion issue were solely due to construction problems that occurred more than 33-years ago, there would not have been enough oxygen to cause the identified corrosion. Thus, there must be a secondary source of oxygen.

24.3. Neither the construction voids between the liner and the concrete, which was the purported BV1 2006 reason for containment corrosion, nor BV1's 2009 claim, that a block of wood left from construction, is the *cause* of this recent gross containment failure, because neither accounts for the significant oxygen and moisture buildup that must have occurred. I believe that both FirstEnergy and the NRC have failed to address the underlying issue, which is how did the accumulated moisture and oxygen infiltrate the containment system for such an extensive period of time as to perpetuate a serious corrosion reaction.

25. No root cause analysis to date has addressed moisture and oxygen buildup behind the liner, or why such a buildup occurred at only four very specific locations. The failure to conduct a root cause analysis implies that the four sites of corrosion identified during the past three years may be an anomaly. Rather, I believe that a root cause analysis must investigate in an in-depth fashion the possibility of systemic corrosion issues which may be even greater than 99 corrosion "pockets" on the "outside" of the containment liner rather than limited to these four recently discovered random sites.

26. As discussed above, BV1's sub-atmospheric containment design is unique. In my opinion, it is possible that the pressure differential between the outside moist air and the sub-atmospheric conditions within the containment could act as the driving force to draw moisture and oxygen through the porous concrete into construction voids and wood adjacent to the liner. Therefore, I believe this sub-atmospheric design may be the *root cause* of the oxygen and moisture buildup behind the liner. A thorough *root cause analysis* must consider what impact the sub-atmospheric containment had upon the accumulation of oxygen and moisture between the liner and the porous concrete.

27. In summation, I found the incomplete analytical evidence in the FirstEnergy BV1 and the NRC assessments of BV1's containment failures to be simplistic and believe such incomplete analysis puts an undue risk on public health and safety. In my opinion, an in-depth analysis of the corrosion problems that exists between the liner and the porous concrete may uncover systemic failure mechanisms.

28. Moreover, I believe the breach of this containment liner with no prior warning following repeated and various types of containment inspections which occurred for more than 33-years has broad nuclear policy and safety ramifications, for BV1, Beaver Valley Unit 2 and the other sub-atmospheric containments nationwide.

29. The evidence I reviewed also shows significant problems, therefore, I believe that corrective actions are appropriate, including, but not limited to:

    29.1. The prompt 100% ultrasonic inspection of the entire liner at BV1 due to the fact that more than 33-years of visual inspection and fractional ultrasonic testing failed to detect the 2009 corrosion until the liner failed.

        29.1.1. In my opinion, the liner failure implies that visual and partial ultrasonic techniques are inappropriate for liner inspections under any conditions.

        29.1.2. In my assessment, the Beaver Valley liner degradation and/or failures of both 2006 and 2009 indicate a gross breakdown in Quality Assurance (QA) procedures during the construction phase of BV1.

        29.1.3. Based upon my knowledge of the construction processes involved in pouring a sub-atmospheric containment, the QA process applied during the BV1 construction repeatedly missed opportunities for this piece of wood to have been discovered and removed.

        29.1.4. If the failure discovered in 2009 existed in 2006, an Integrated Leak rate Test in 2006 failed to detect incipient failure implying that slow, controlled pressurization of the containment in that test is inadequate to detect incipient failure.

29.2. It is my position that the 20-year life extension of the Beaver Valley Units 1 and 2 should be put on hold until these significant programmatic Aging Management problems have been analyzed and resolved.

29.2.1. The visual, ultrasonic and integrated leak test inspection failures show programmatic weakness in the aging management systems upon which FirstEnergy has relied upon for its Beaver Valley Units' license extensions.

29.3. In my opinion, if the 100% UT inspection process discovers other construction voids, then the containment liner should be reanalyzed to determine the operability BV1 in order to ascertain any overall weakening of the liner.

29.3.1. An analysis of the Containment liner will ascertain its ability to withstand seismic stress and limit radiation releases, and the NRC has informed the ACRS of its inability to perform a containment analysis, I believe that an independent National Lab should perform this analysis.

29.4. Likewise, I believe that Beaver Valley Unit 2 (BV2) should also be inspected using 100% ultrasonic techniques, given that BV1 and BV2 have the same design, were built by the same contractor, have the same inspection program, and the same Aging Management Program.

30. Furthermore, it is my conclusion that these events at BV1 also have critical ramifications for the entire U.S. nuclear industry, but especially for PWRs.

30.1. In my opinion, the Containment Breach at BV1 in 2009 was the *Passive Failure* of one of the most important safety barriers in a nuclear power plant.

30.1.1. The nuclear industry has heretofore considered such containment liner failures virtually impossible.

30.1.2. NRC Risk Informed Decision Making does not take the likelihood of

Passive Failure of the Containment into consideration.

30.1.3. Given the generic nature and risk to public health and safety due to *containment breach*, I believe that the NRC should order 100% Ultrasonic Testing of all PWR containment liners.

31. In my opinion, FirstEnergy's inability to detect the most recent failure (2009) of the containment liner prior to perforation, as well as its inability to detect three other corrosion sites discovered in 2006, may indicate one of two possible failure scenarios.

31.1. If the 2006 and 2009 corrosion events grew slowly and began during construction, I believe this implies that during the 35-years since construction, neither the visual, ultrasonic, nor integrated leak rate testing have been adequate to detect incipient containment liner failure.

31.2. The second possibility is that visual, ultrasonic and integrated leak rate testing do indeed work, but that through wall liner failure can propagate much more quickly than anticipated between inspection intervals.

31.3. Both of these scenarios are equally troubling to me, as one indicates that ANY existing inspection regime has been inadequate, and the second indicates rapid failures are possible between inspections whose corrosion growth mechanisms have yet to be determined.

32. Given either scenario, it is my professional opinion that the NRC must modify the Beaver Valley SER and AMP to include a full ultrasonic inspection and root cause analysis prior to license extension.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed this day, May 25, 2009 at Burlington, Vermont.

Arnold Gundersen, MSNE

STATE OF VERMONT)
COUNTY OF CHITTENDEN) ss.

I HEREBY CERTIFY that on this 25th day of May 2009, personally appeared Arnold Gundersen resident of Burlington Vermont, who is personally known to me or who produced the following identification, and he swore, subscribed, and acknowledged before me that he executed the foregoing as his free act and deed as an expert witness of said case, for the uses and purposes therein mentioned, and that he did take an oath.

In witness whereof, I have hereunto set my hand in the County and State aforesaid:

OFFICIAL NOTARY Joanna E. Cole

NOTARY PUBLIC STATE OF VERMONT

MY COMMISSION EXPIRES: 2/2010