BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Nuclear Plant Cost Recovery Clause	)	**DOCKET NO. 090009-EI**
	)	**FILED: July 15, 2009**
	)	

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

BY THE SOUTHERN ALLIANCE FOR CLEAN ENERGY

FPSC DOCKET NO. 090009-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 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, 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 scheduling delays and resulting uncertainty in the licensing and construction of four AP 1000 reactors proposed for construction in Florida by Progress Energy Florida (PEF) (Levy Units 1 and 2) and Florida Power and Light (FPL) (Turkey Point Units 6 and 7), and the effect of these delays and uncertainty on the long-term feasibility of completion of these reactors.

Q. Please summarize your findings.

A. In my opinion, there are numerous potential scheduling obstacles and resulting uncertainties, which will be faced by both FPL and PEF in the licensing and construction of their proposed AP 1000 nuclear units at Levy County and Turkey Point. These delays

and uncertainties have not been taken into account by PEF and FPL, and therefore, PEF and FPL have not shown the long-term feasibility of completing these new nuclear units.

Q. What are these obstacles?

A. These obstacles include:

1. Because the 10 CFR Part 52 licensing process for the AP 1000 is brand new and has never been applied before, there is definite scheduling uncertainty due to licensing delays.
2. Hurricanes Katrina and Rita demonstrated that major construction projects are subject to delays due to the worldwide demand for construction materials and skilled labor. It is very likely that those nuclear construction materials in highest demand will face shortages and procurement delays given the great number of nuclear power plants proposed for construction in the Southeastern U.S.
3. The nuclear industry as a whole is facing a labor shortage due to the limited qualified individuals capable of performing this work.
4. Building nuclear power plants is a complicated construction process in which scheduling delays, lengthy construction times, and delayed operation is routine.

Q. Are you sponsoring any exhibits to your testimony?

A. Yes, I'm sponsoring the following exhibits:

AG-1. CV

AG-2. NuStart Letter

AG-3. Moody's 2009

AG-4. Regulatory Risks

AG-5. COMSECY-09-0003

AG-6. NRC Jaczko Speech

AG-7. 2007 ANS Meeting

AG-8. Finnish Nuclear Trouble

III. LICENSING

Q. How does the newness of the 10 CFR Part 52 licensing process for the AP 1000 add to scheduling uncertainty?

A. The first obstacle involves the NRC licensing process itself. No AP 1000 reactor has successfully completed the NRC review and 10 CFR 52 licensing process and has been allowed to begin construction. Therefore there is no road map and clear administrative process for either PEF or FPL to follow during the licensing and construction of either the Levy County or the Turkey Point Units. It was anticipated that the NRC combined construction operating license process would enable the AP 1000 to move more quickly through licensing and construction, but instead the AP 1000 units have suffered numerous scheduling delays. In fact Westinghouse has already submitted 17 amendments to its standard application for the AP 1000 in response to questions from the Nuclear Regulatory Commission. Therefore, it is quite likely that additional amendments will occur before AP 1000's standard application is approved.

Currently there are 14 Westinghouse AP 1000 nuclear reactors planned for construction at seven sites throughout the South. NuStart, a consortium of U.S. utilities and energy companies preparing to build the newly designed AP 1000 reactor, planned for the leading AP 1000 nuclear reactors to be Bellefonte Units 3 and 4; however, NuStart decided to change the Westinghouse reference plant from Bellefonte Units 3 and 4 to

Vogtle Units 2 and 3 on April 28, 2009. This change in reference plant design further slows the NRC decision-making process. On April 28, 2009, NuStart, the AP 1000 Consortium, requested that the NRC use its own procedures to change the reference site. In Exhibit AG-2, NuStart Letter to NRC, NuStart wrote,

> *"We understand that an orderly transition of reference plant activities from Bellefonte to the VDGP will be necessary to fully effect this change in designation while ensuring efficient use of NRC resources please take the steps necessary to implement this change."* [Marilyn K. Ray, President of NuStart Energy, to U.S. Nuclear Regulatory Commission (NRC), Attention Document Control Desk, April 28, 2009]

My review of NRC documentation shows that NRC currently has no internal procedures with which to perform the change of a reference plant site from Bellefonte to Vogtle, thereby introducing additional scheduling uncertainty.

Q. Isn't this problem of licensing delay just an internal problem with the NRC?

A. No, the financial community, which provides the capital investment for the construction of nuclear power plants, is also expressing significant concern regarding the predictability of the NRC licensing process. In a 2009 report, Moody's Financial Services stated that, *"nuclear is a bet the farm risk"*. The Moody report, attached as Exhibit AG-3 Moody's 2009, noted that,

> *"...regulatory risk will persist over the longer term and we increasingly think it unlikely that everything will work out as intended we are concerned with the size of investments being made even before the NRC grants a COL".* [Moody's Global Infrastructure Finance Special Comment, New

Nuclear Generation: Ratings Pressure Increasing, June 2009]

Furthermore, a January 15, 2008 report in Power Magazine entitled "Regulatory Risks Paralyzing Power Industry While Demand Grows", attached as Exhibit AG-4, Regulatory Risks, quotes a 2007 Moody's report as saying that the NRC 42 month COLA (Combined Operating License Application) process *"remains untested"*. Power Magazine also said that, *"...opponents of the nukes are likely to litigate NRC decisions adding time money and doubt to the process."* [Kennedy Maize and Dr. Robert Peltier, Regulatory Risks Paralyzing Power Industry While Demand Grows, Power Magazine, January 15, 2008]

Q. Is the NRC concerned about issues with the COLA (Combined Operating License Application) evaluation process?

A. Yes, concerns about scheduling issues inherent in the COLA process are even evident within the Nuclear Regulatory Commission. The NRC Executive Director of Operations said in a February 4, 2009 memo to the NRC Commissioners, attached as Exhibit AG-5 COMSECY-09-0003:

> *"...the reviews to date have shown that the schedules and activities related to design reviews and COL applications are subject to changes that in turn require the staff to shuffle projects and establish new priorities."* [R. W. Borchardt, Executive Director for Operations to NRC Chairman Klein, Designation Of The Office Of New Reactors As Lead Office For New And Advanced Reactor-Related Rulemakings, COMSECY-09-0003, February 4, 2009]

Moreover, NRC Chairman Gregory B. Jaczko has clearly stated that the process is not fully vetted. In his prepared remarks to the Regulatory Information Conference on

March 11, 2009, attached as Exhibit AG-6, NRC Jaczko Speech, The Honorable Gregory B. Jaczko said,

> *"Finally, I'll touch on an area of new reactors in which I do not think we have fully learned the lessons of the past. The Commission made a strong effort to learn lessons from processes that did not work – so much so that we flipped the application process from 'build first and then license,' to 'license first and then build.' This greatly lessens the financial risk involved but unfortunately applicants have not used this process as intended.*
>
> *At the heart of this change was that the key to success is having completed designs done early. But we are right back into a situation where we have incomplete designs and less than high quality applications submitted for review. The very first application we received was on hold for a year and a half during which time we could only do minimal work on it. In fact, the NRC had to withdraw the hearing opportunity because that applicant was not ready and the agency was only able to re-notice it last month. Even today, almost a fifth (3 of 17) of the COL applications we have received are on hold at the request of the applicants themselves. Vendors are revising four of the new plant designs.*
>
> *The temptation is to plow on anyway and conclude that if plants got licensed in the 1960s and 1970s under less than ideal conditions, it won't be the end of the world if the current process begins to look more and more like that one. But everyone would be better served by focusing on the lesson of all those plants that never got built and concentrating on getting designs completed first. Of course, it is up to licensees to decide which process to*

follow. The Commission made it clear, however, that if licensees choose not to follow the new Part 52 process of referencing an early site permit and a certified design in their applications, they do so 'at their own risk.' I challenge the industry to focus on those projects that are most likely to go forward and get their design and environmental work done, so that success can be used as a model for others to follow."

The fact that the COLA process remains untested further adds to the scheduling and licensing uncertainty for the Turkey Point 6 & 7 and Levy County Units.

Q. Has the NRC elaborated on the issue of scheduling delays with the COLA?

A. No, the NRC has made several public comments, but has not published an overall analysis of the scheduling problems and delays inherent with a generic COLA.

Q. Please delineate any additional site-specific licensing process concerns for either the Levy Units or Turkey Point.

A. On a more specific case-by-case site-licensing basis, the schedule for the Levy County Units received a setback on July 8, 2009 when the NRC Atomic Safety and Licensing Board (ASLB) ruled that it would hear several contentions brought forward by The Green Party of Florida, the Ecology Party of Florida and the Nuclear Information and Resource Service. The ASLB granted standing to the three petitioners who challenged the proposed PEF nuclear power plant in Levy County and will hear petitioners on three of their legal arguments on why the plant should not be built. The arguments, which ASLB accepted for further analysis and review, are the Units' impact on wetlands, waterways, and habitat, and PEF's proposed disposal process for its

hazardous nuclear waste.

In the same way that the NRC ASLB has concerns, there are additional site-specific obstacles which will be encountered at both sites as part of the 10 CFR 52 licensing process. For instance, the generic COLA process has not taken into account the critical emergency planning issues involving other nuclear reactor units that are in close proximity or share the same site. In particular, no assessment has been conducted and no plan has been developed concerning the close proximity of the Levy County Units to the Crystal River reactor. The Levy County site is only 8 miles from the Crystal River reactor and therefore the Levy County Units and its surrounding communities must also be engaged in emergency planning considerations with Crystal River. The two proposed Turkey Point reactors share a site with two other nuclear reactors as well as three coal plants, and the complicated emergency planning issues resulting from so many power plants at one site have not been considered or addressed by the generic COLA process. Such emergency planning will require a lengthy interface with NRC as well as federal, state, and local emergency planning agencies which will necessitate public hearings and public comments before the process is complete.

Q. Are there additional site-specific licensing issues which may delay construction?

A. Yes. PEF requested a Limited Work Authorization at Levy County, meaning that the NRC allows the energy company or utility to begin construction work at the proposed nuclear plant site prior to NRC approval of the corporation's full application. In fact, when it became apparent that there might be unique geological problems associated with the Levy County site, PEF withdrew its Limited Work Authorization request. Currently, it is uncertain whether these geological discoveries may negatively impact the viability of

the Levy County site for operating any nuclear power plant. PEF has formally acknowledged that being unable to do work under its Limited Work Authorization request has already delayed its start up schedule by approximately 20-months, which implies inherent increases in cost, which costs have not yet been addressed in its application.

Q. Are there any additional concerns for delays for the construction of Turkey Point 6 and 7?

A. Yes, there are two significant problems that have already been uncovered at Turkey Point that must be reviewed and analyzed. Indeed, because the Turkey Point application is a more recent application, there may be other unique problems associated with this project, which have yet to be discovered by the NRC or FPL.

Grid stability is the first major problem of concern in evaluating the Turkey Point site, which once again, is an issue that has not been addressed in the generic COLA process. Grid stability is especially critical to nuclear power plants because an unstable grid will cause unanticipated shutdowns (SCRAMS) in operation and therefore challenge safety systems. The NRC has determined that safety systems frequently challenged by grid stability can be a precursor to a nuclear accident.

The Turkey Point site will have seven power plants occupying the same site, which is what presents the unique problems and significant concern regarding grid stability. To be more specific, the transmission corridor from the site is very limited because the ocean bounds the site on one side, which leaves a very narrow corridor through which the power from all seven units must be transmitted. Another major concern is that this narrow transmission corridor is subject to weather related problems that would impact the

availability of seven operating units let alone just one operating nuclear plant. Second, salt-water is currently used to cool the other five operating power plants, and it appears that this cooling canal connected to the cooling towers may be leaking salt-water into local aquifers thereby contaminating the entire area's fresh water supply. This problem is called salt-water intrusion and would most certainly be further compounded by adding two more nuclear power plants to this sensitive environmental area. Unfortunately the problem of possible salt-water intrusion into the ground water near the Turkey Point site has not yet been evaluated in the generic COLA process.

Q. Is there potential for additional delay and uncertainty in the licensing process as the units end the construction phase?

A. Yes, the industry is currently focused on the front end of the licensing process, but when construction nears completion, there are also many opportunities for further licensing delays. Delayed licensing means uncertainty in the form of delayed operation, delayed power generation, and increased costs to Florida's consumers. More specifically, 10 CFR 52.98 allows for new material to be considered after the reactor design has been certified. Every nuclear power plant that has ever been constructed has faced design changes as construction has proceeded; therefore it is completely unrealistic to assume that the initial AP 1000 reactors will not encounter design changes as construction progresses at various sites around the country. Therefore, in my opinion, it is clear that the multiple conditions delineated in Part 52.98, which allow for further delays to consider new information, will apply to these to projects and will introduce additional risk and uncertainty for scheduling delays.

Q. What are your conclusions regarding the Licensing process for FPL Turkey Point Units 6 and 7 and PEF Levy County Units 1 and 2?

A. In my opinion, the licensing process is strewn with obstacles for both Levy County and the Turkey Point projects. Some of these obstacles are generic Westinghouse AP 1000 issues while others are clearly site-specific. Nevertheless, it appears that neither FPL nor PEF have allowed for the impact of significant licensing delays and other uncertainties in either of their applications or in their planning processes for the licensing and construction of Turkey Point Units 6 and 7 and Levy County Units 1 and 2. Therefore, in my opinion, neither FPL nor PEF have shown the long-term feasibility of completing Turkey Point Units 6 and 7 and Levy County Units 1 and 2.

IV. CONSTRUCTION MATERIALS

Q. In your opening summary, you said, "Hurricanes Katrina and Rita demonstrated that major construction projects are subject to delays due to the worldwide demand for construction materials and skilled labor. It is very likely that those nuclear construction materials in highest demand will face shortages and procurement delays given the great number of nuclear power plants proposed for construction in the Southeastern U.S." Please explain how construction materials may cause construction delays and uncertainty.

A. In my opinion, the second major obstacle for FPL and PEF in meeting their proposed construction schedules involves the availability of nuclear grade materials to be used in the construction of these projects. There is already a significant international shortage in quality nuclear grade construction materials, which I believe will be compounded by the need to obtain both quality construction materials, but also to obtain materials that are

nuclear grade American Society of Mechanical Engineering certified.

In the Department of Energy's (DOE) October 22, 2005 report entitled "Nuclear Power Plant Construction and Infrastructure Assessment", DOE states,

> *"The most significant manufacturing concern and the associated construction schedule risk is that reactor pressure vessel fabrication could be delayed by the limited availability of nuclear grade large ring forgings. These forgings are currently available from one Japanese supplier."* [Page iv]

A sole-source supplier of such a critical component presents significant problems and concerns including but not limited to: labor issues, quality issues, and Acts of God. More specifically, given that the only facility in the world to manufacture these forgings is located in Japan, an earthquake or typhoon could hamper the facility's production and delivery of these forgings for months if not years.

An extensive amount of time at the American Nuclear Society (ANS) 2007 convention was spent discussing supply-chain challenges, according to Power Engineering Magazine, attached as Exhibit AG-7 2007 ANS Meeting. For instance, in 1980 *"more than 500 companies in the United States carried N-stamps [Nuclear Stamps]...Today that number is around 100."* [Teresa Hansen Associate Editor, The Nuclear Renaissance's Future, Power Engineering, September 2007, Pages 46 to 50] Additionally, Power Engineering's review of the ANS convention noted that,

> *"Few companies in the United States can provide large complement castings and only one US company can manufacture large nuclear grade components. ...This lack of US-based manufacturing means that constructors/owners of new US nuclear reactor plants will be competing*

with nuclear plant constructors/owners around the world."

The Power Engineering article also emphasized that as compared to 1980, *"Today, the competition and supply chain are international."*

Furthermore, in its summary of the ANS convention, Power Engineering Magazine added that,

> *"Competition from overseas markets and plans to increase nuclear plant building in the United States will cause supply problems in 2013 and 2014. ... the supply of concrete, reinforced steel, large bore piping, small bore piping, structural steel and conduit will be constrained."*

The Power Engineering Magazine analysis also emphasized that, *"... high demand and limited supply will cause material prices to increase."*

Many nuclear grade component and material suppliers have dropped out of the business during the past 30 years due to the stringent manufacturing requirements, the high cost of trained personnel, and the lull in nuclear power plant construction. Now, since there is a broad international demand for these limited resources, I believe that the schedule for these units will be adversely impacted by shortages in nuclear grade materials. In my opinion, PEF and FPL have not considered equipment shortages when considering the long-term feasibility of these reactors.

V. NUCLEAR PERSONNEL

Q. Do you anticipate skilled labor shortages during the time period in which these reactors are being designed and constructed?

A. Yes, the third obstacle to implement the proposed construction schedules involves the availability of trained engineers and construction personnel to support the construction of

these projects. In its October 22, 2005 report entitled "Nuclear Power plant Construction and Infrastructure Assessment" DOE said,

> *"Hiring the highly skilled and highly valued construction workers needed to build nuclear units is expected to be a challenge. Qualified boilermakers, pipefitters, electricians, and ironworkers are expected to be in short supply in local labor markets. The use of workers from other communities and states travelers will be required for these construction trades."*

Given that all of the AP 1000 reactors are presently in the southern states, and that four of the AP 1000 reactors will be in Florida, I believe there will undoubtedly be a regional drain of qualified construction personnel therefore making it challenging to complete any of these projects on time and within budget.

In its September 2007 issue, Power Engineering Magazine had an extensive report on the American Nuclear Society's (ANS) annual conference. Attached as Exhibit AG-7. In regards to skilled labor, the report noted that:

> *"Edward Wick of Shaw Stone and Webster also spoke during the session and said that he believes the challenges faced by companies looking for craft labor are much larger than those faced by companies looking for engineers and scientists ...The labor shortage is very real for the construction industry... not only are there limited numbers of skilled craft workers available, but multiple industries are courting those workers.... The nuclear industry is competing with fossil plants, refineries, manufacturing and other industries for skilled labor."*

Power Engineering also noted that shortages are not only in the crafts but affect engineers and technicians as well. *"During the opening plenary Art Stahl said one of the biggest challenges is finding qualified people -- including craft labor, technicians, engineers and*

scientists -- to support construction and operation ...40% of the current nuclear power plant workers are eligible to retire within the next five years". He also added, "*... only 8% of the current nuclear plant workforce is under 32 years old.*"

My experience as an expert for the State of Vermont leads me to concur with Mr. Stahl's comments above. The Vermont State Legislature appointed me to the Vermont Yankee Nuclear Oversight Panel (VYNOP). The VYNOP was created by the Legislature to assist it in its evaluation of Vermont Yankee's application to extend its license for 20 more years. As a VYNOP member, I determined that shortages in engineering personnel were likely to adversely impact Vermont Yankee beginning as early as 2010.

I believe that the shortage of craft labor within the state of Florida will be a problem in and of itself. However, it is my opinion that this problem is exacerbated due to the simultaneous planned construction of numerous power plants in the Southeastern U.S. Additionally, in my opinion, further pressure will also be added by the ongoing and extensive growth in international nuclear power markets, which may also cause a drain on technical and engineering personnel. Since the international power market pays extensive bonuses and all living expenses to technical and engineering personnel, this may be a unique enticement to a segment of technical and engineering employees who may wish to work outside the U.S. for several years. Furthermore, the 100 nuclear reactors presently in operation are nearing 40 years of operating history and most of their experienced technicians and engineers are nearing retirement. Because these plants are seeking 20-year life extensions, they are recruiting heavily from colleges and drawing heavily on the newly minted engineers and technicians in order to meet staffing requirements. I believe that the addition of several dozen new advanced reactors will place a significant burden on staffing of engineers and technicians for the foreseeable

future. In my opinion, FPL and PEF have not anticipated the shortage of skilled craft, engineering, and technical personnel in their consideration of the long-term feasibility of these Florida units.

VI. CONSTRUCTION DELAYS

Q. Should the COLA's be approved, do you anticipate construction delays?

A. Yes, building a nuclear power plant is an extraordinarily complicated process. During my 38 years of experience in the nuclear industry, I have never seen a nuclear power plant meet its construction schedule without repeated modifications and delays. The corollary to that statement is that I have never seen a nuclear plant be built faster than its schedule anticipated. Since the AP 1000 design is brand new, the evidence from previous radically new designs has shown that delays should be anticipated in the initial units to be built, including Levy County and Turkey Point. These AP 1000 projects will encounter scheduling delays inherent in any large construction project. While some of these problems will be site specific, many others will most likely be due to problems encountered as other AP 1000 reactors are licensed and constructed.

I've been following the problems with new the Generation 3 Finnish reactors in Olkiluoto, Finland for several years. A May 29, 2009, New York Times article entitled In Finland, Nuclear Renaissance Runs into Trouble, encapsulates these problems in a single contemporaneous article attached as Exhibit AG-8 Finnish Nuclear Trouble.

In its report, the New York Times noted that this power plant design "was supposed to be the showplace of a nuclear renaissance... its modular design was supposed to make it faster and cheaper to build. And it was supposed to be safer too." However, the Finish reactors ran into numerous delays. The report noted that construction delays included:

poor concrete, inexperienced contractors, and the lack of professional knowledge by some of the contract personnel. Times reporter James Canter wrote that as a result of these delays the estimated prices climbed by 50% and that the utility is no longer willing to make certain predictions on when or if the plant will ever go online. He added that this Finnish reactor was part of a new fleet of reactors that were to be standardized "down to the carpeting and the wallpaper", and that this "early experience suggests that new reactors will be no easier or cheaper to build than the ones of a generation ago when cost overruns ...ended the last nuclear construction boom."

In this article, Professor Paul Joskow of MIT is quoted as saying that "a number of US companies have looked with trepidation on the situation in Finland... the rollout of new nuclear reactors will be a good deal slower than a lot of people were assuming." "To streamline construction, the Nuclear Regulatory Commission in Washington has worked with the industry to approve a handful of designs. Even so, the schedule to certify the most advanced model from Westinghouse has slipped during the ongoing review of its ability to withstand the impact of an airliner," according to Canter.

The New York Times ended its in-depth expose with two important quotes. First, a Morgan Stanley financial analyst said, "The warning lights now are flashing more brightly than just a year ago about the cost of new nuclear". The second expert, a project manager at the Finnish plant, quoted by The Times said, "We have had it easy. This is at least a geologically stable site... earthquake risk in places like China and the United States or even the threat of a storm surge means building these reactors will be even trickier elsewhere."

I believe there are significant construction risks that will be faced by the proposed new Florida reactors. Based upon these risks, it is my opinion that neither FPL nor PEF have

shown the long-term feasibility of completing the Levy County units or TP 6 and 7.

VII. CONCLUDING TESTIMONY

Q. Are there indications that FPL and PEF are aware of the issues you have identified?

A. Yes, careful reading of documents provided by both FPL and PEF indicate that their executives are aware of the very obstacles I have identified in this report.

PEF executive Daniel Roderick stated, on page 6 line 9 of his Need Docket testimony, that the Levy County schedule "...estimates are based on the best information available to the company at this time." Additionally, he stated that there are a number of factors including but not limited to: permitting and licensing delays, labor and equipment availability, and "imposition of new regulatory requirements" " to name only a few" factors that would adversely "affect the project cost". This testimony suggests that Mr. Roderick is indeed aware of many of the problems I anticipate impacting the Levy County Units. However, despite being aware of the issues, it is my opinion that PEF has not adequately addressed these problems in the information provided to the State of Florida.

In his May 1, 2009 testimony, FPL executive Steven Scroggs said that the construction schedule for the Turkey Point Units was "... the earliest practical deployment schedule." (Page 2, line 14). On page 14, Mr. Scroggs briefly touched upon some of the same cost concerns as Mr. Roderick did in his testimony. Scroggs said, "market forces, such as demand from other international and US nuclear projects, keep the qualified nuclear supply chain highly utilized, maintaining elevated price levels... or changes to the number or capabilities of qualified vendors in the nuclear supply chain will impact pricing". On

page 17 Scroggs also said, "Due to the unique contracting challenges presented in the new nuclear deployment ...FPL may not obtain terms, conditions, scope and payment schedules that represent an acceptable expenditure plan given the economic, legislative, and regulatory environment." It is my opinion that Scroggs is suggesting that FPL's schedule is simply unachievable, as the "earliest practical" schedule does not imply that it is the most likely schedule to be achieved, especially given the international market forces he identifies in his testimony.

In summation, I believe that the scheduling assumptions used for the four AP 1000 reactors proposed to be constructed in Florida are not prudent, as there appears to be no contingency for the obstacles and uncertainty that I have discussed above which are highly likely to occur. Therefore, in my opinion, neither FPL nor PEF have shown the long-term feasibility of completing these reactors, nor have they shown that these very optimistic schedules are even achievable and it is most likely that cost overruns and schedule delays are unavoidable.

Q: Does this conclude your testimony?

A: Yes.

CURRICULUM VITAE
Arnold Gundersen
Energy Advisor
July 2009

Education and Training

ME NE	Masters 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, 1971 Cum Laude, 3.74 out of 4.0 James J. Kerrigan Scholar
RO	Licensed Reactor Operator, U.S. Atomic Energy Commission License # OP-3014

Special Qualifications – including and not limited to:

- Energy Advisor, Fairewinds Associates, Inc
- Nuclear Engineering, Safety, and Reliability Expert
- 38-years of nuclear industry experience and oversight
- Former nuclear industry Senior Vice President
- Federal and Congressional hearing testimony and Expert Witness testimony
- Nuclear engineering management and nuclear engineering management assessment 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
- Former Licensed Reactor Operator
- Systems engineering and structural engineering assessments
- Cooling tower operation, cooling tower plumes, and thermal discharge assessment
- Nuclear fuel rack design and manufacturing, nuclear equipment design and manufacturing, and technical patents
- Radioactive waste processes, storage issue assessment, decommissioning, and waste disposal
- Reliability engineering and aging plant management assessments, in-service inspection
- Archival storage and document control
- Employee awareness programs, and public communications
- Quality Assurance & Records

Publications

Co-author — *DOE Decommissioning Handbook, First Edition*, 1981-1982, Authorship solicited by DOE

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. Presented to Vermont State Senator Ginny Lyons and Vermont State Auditor Tom Salmon.

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

Patents

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

Committee Memberships

ANSI N-198, Solid Radioactive Waste Processing Systems
Founding Member of Connecticut Low Level Radioactive Waste Advisory Committee - 10 years
Three Rivers Community College: Nuclear Academic Advisory Board
National Nuclear Safety Network – Founding Board Member

Honors

James J. Kerrigan Scholar 1967–1971
Tau Beta Pi (Engineering Honor Society), RPI, 1969
(1 of 5 in Sophomore class of 700)
B.S. Degree, Cum Laude, RPI (3.74 GPA) 1971
U.S. Atomic Energy Commission Fellowship, 1972
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."
Teacher of the Year – 2000, Marvelwood School

Energy Advisor: Nuclear Consulting and Expert Witness Testimony

U.S. Nuclear Regulatory Commission
Expert Witness providing testimony on Combined Operating License Application (COLA) at North Anna Unit 3 supporting *Blue Ridge Environmental Defense League's Contentions* (June 26, 2009)

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

U.S. Nuclear Regulatory Commission
Expert Witness providing testimony on Quality Assurance and Configuration Management at Bellefonte Nuclear Plant supporting *Blue Ridge Environmental Defense League's Contentions in their Petition for Intervention and Request for Hearing* (May 6, 2009)

Pennsylvania Statehouse
Formal Presentation and Testimony regarding actual releases from Three Mile Island Nuclear Accident. (March 26, 2009)

Vermont Legislative Testimony and Formal Report for 2009 Legislative Session
As a member of the Vermont Yankee Comprehensive Vertical Audit Oversight Panel spent almost eight months examining the Vermont Yankee Nuclear Power Plant and the legislatively ordered Comprehensive Vertical Audit. Panel submitted written and oral testimony to the Legislature (March 19, 2009)

- Senate Finance
- House Natural Resources

Finestone v FPL (2003 to 12/2008)
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 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, DC. (July 8-9, 2008)

Appointed by President Pro-Tem of Vermont Senate to Legislatively Authorized Nuclear Reliability Oversight Panel – to participate in and 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)

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 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. This report included the review of 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 all 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
Assisted in the creation of State Whistleblower Protection legal statutes.

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).

- 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.
- 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, 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 1990 to Present

- Fairewinds Associates, Inc – Energy Advisor, 2005 to Present
- Arnold Gundersen, Nuclear Safety Consultant and Energy Advisor, 1995 to 2005
- GMA – 1990 to 1995

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.

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 – Ongoing Public Testimony to Committees

Testimony to Vermont State Auditor

Certified Foster Parent State of Vermont – 2004 to 2007

Mentoring former students – 2000 to present – college and employment application questions

Tutoring Refugee Students – 2002 to 2006 – Lost Boys of the Sudan and others

Designed and Taught Special High School Math Course for ESOL Students – 2007 to 2008

Featured Nuclear Safety Expert for Television, Newspaper, Radio, & Internet

Including, and not limited to: CNN (Earth Matters), NECN, WPTZ VT, WTNH, 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

Berkshire School Parents Association, Co-Founder

Berkshire School Annual Appeal, Co-Chair

Christ Episcopal Church, Roxbury, CT – Sunday School Teacher

Washington Montessori School Parents Association Member

Episcopal Marriage Encounter National Presenting Team with wife Margaret

Provided weekend communication and dialogue workshops weekend retreats/seminars

Connecticut Episcopal Marriage Encounter Administrative Team – 5 years

Northeast Utilities Representative Conducting Public Lectures on Nuclear Safety Issues

End

52-14
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52-26

April 28, 2009

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: NuStart COL Project – NRC Project No. 740
Transition of AP1000 Reference Plant COL Application

Reference: Letter from Marilyn Kray (NuStart Energy Development) to NRC Document Control Desk, "Response to RIS 2006-006, New Reactor Standardization Needed to Support the Design Centered Licensing Review Approach" dated July 17, 2006

The NuStart Energy Development, LLC, consortium was formed in 2004 as part of the U.S. Department of Energy's (DOE's) NP-2010 initiative, one of whose objectives is to demonstrate the viability of the U.S. Nuclear Regulatory Commission's (NRC's) process for obtaining a Combined License (COL) with the ultimate goal of constructing a Nuclear power plant. Each of the current and planned COL applicants[1] for the Westinghouse AP1000 reactor design is a member of NuStart, and NuStart was instrumental in the formation of the AP1000 Design-Centered Work Group (DCWG). At the time of initial implementation of the NRC's design-centered review approach, the AP1000 DCWG, through NuStart, designated the Tennessee Valley Authority (TVA) Bellefonte Units 3 and 4 (dockets 52-0014 and-0015) as the AP1000 "reference plant." Since that time, the NuStart-supported Bellefonte 3&4 COL application has been the application reviewed by the NRC for AP1000 "standard content."

In the past several months, the anticipated schedules for the various AP1000 COL applicants have evolved. As a function of business need, NuStart and the AP1000 DCWG (including the TVA) have determined that it is appropriate to align NRC resources for standard content review to an application with specific near-term construction plans. Accordingly, NuStart and the AP1000 DCWG hereby designate the Southern Nuclear Operating Company (SNC) COL application for Vogtle Electric Generating Plant (VEGP) 3 and 4 (dockets 52-0025 and -0026) as the AP1000 reference plant. We understand that an orderly transition of reference plant activities from Bellefonte to VEGP will be necessary to fully effect this change in designation while ensuring efficient use of NRC resources. Please take the steps necessary to implement this change.

[1] AP1000 DCWG members include: TVA for Bellefonte 3&4; Duke Energy for Lee 1&2; SCE&G for Summer 2&3; Southern Nuclear for Vogtle 3&4; Progress Energy for Harris 2&3 and Levy 1&2; and FPL for Turkey Point 6&7.

D063
D085
D092

NuStart understands the transition will be orderly and will include issuance of Safety Evaluation Reports (SERs) with open items on a chapter-by-chapter basis on the Bellefonte docket. These products will then form the basis for reviews by the Advisory Committee on Reactor Safeguards (ACRS) sub-committee. During this transition, NuStart, SNC, and TVA understand the Bellefonte docket will continue to be the vehicle of standard content for these sub-committee reviews. NuStart, through the DCWG, will support closure of standard content related open items on the VEGP 3 and 4 dockets within the same 45-day response period as previously committed. NuStart recognizes that the VEGP Advanced and Final SERs will become the vehicle for documenting the NRC's review of standard material and will work with the DCWG to support this transition.

While NuStart anticipates that the change will result in a more efficient overall schedule for AP1000 applications, and does not expect an adverse impact to the standard-content review, or the Vogtle or Bellefonte site-specific reviews, near-term applicants (i.e., Florida Power & Light Company) may continue to use the Bellefonte COLA as a basis for their COL application. It is anticipated that these near-term applicants will follow the transition of the AP1000 reference COLA to VEGP.

NuStart will continue to support activities associated with the reference application as well as the TVA Bellefonte COL application during this transition. The AP1000 DCWG has been very effective and will remain unchanged as a result of this change in reference plant. Details of the timing of the transition and NRC billing for reference application activities will be the subject of future discussions between the NRC and NuStart staff.

If there are any questions regarding this transition, please contact Richard Grumbir, *NuStart AP1000 Project Manager*, at (256) 308-1770, or Peter Hastings, *AP1000 DCWG Licensing Lead*, at (980) 373-7820. For information regarding Bellefonte, contact Andrea Sterdis, *TVA, Manager, New Nuclear Licensing and Industry Affairs*, at (423) 751-7119. For information regarding Vogtle, contact Chuck Pierce, *Technical Support Licensing Manager*, at (205) 992-7872.

Sincerely yours,

Marilyn C. Kray
President
NuStart Energy Development

cc:

F. M. Akstulewicz, NRC/NRO
R. W. Borchardt, NRC
S. M. Coffin, NRC/NRO
M. R. Johnson, NRC/NRO
B. S. Mallett, NRC
D. B. Matthews, NRC/NRO
T. P. Miller, DOE
L. A. Reyes, NRC/RII
R. F. Smith-Kevern, DOE/HQ
J. A. Bailey, TVA
M. P. Cazaubon, NuStart Project Manager
R. B. Clary, SCE&G
B. J. Dolan, Duke Energy
S. P. Frantz, Esq., Morgan Lewis & Bockius
M. W. Gettler, Florida Power & Light
R. J. Grumbir, NuStart AP1000 Project Manager
P. S. Hastings, NuStart AP1000 DCWG Licensing Lead
W. K. Hughey, Entergy
R. H. Kitchen, Progress Energy
R. May, Detroit Edison
G. D. Miller, Progress Energy
J. A. Miller, Southern Company
C. R. Pierce, Southern Company
G. Serviere, EdF
A. L. Sterdis, TVA

Special Comment

Moody's Global
Infrastructure Finance

June 2009

New Nuclear Generation: Ratings Pressure Increasing

Table of Contents:

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Team Managing Director

Summary

- Moody's is considering taking a more negative view for those issuers seeking to build new nuclear power plants
- Rationale is premised on a material increase in business and operating risk
- Longer-term value proposition appears intact, and, once operating, nuclear plants are viewed favorably due to their economics and no-carbon emission footprint
- Historically, most nuclear-building utilities suffered ratings downgrades—and sometimes several—while building these facilities
- Political and policy conditions are spurring applications for new nuclear power generation for the first time in years
- Nevertheless, most utilities now seeking to build nuclear generation do not appear to be adjusting their financial policies, a credit negative
- First federal approvals are at least two years away, and economic, political and policy equations could easily change before then
- Progress continues slowly on Federal Loan Guarantees, which will provide a lower-cost source of funding but will only modestly mitigate increasing business and operating risk profile
- Partnerships, balance sheet strengthening, bolstering liquidity reserves and "back-to-basics" approaches to core operations could help would-be nuclear utilities maintain their ratings

This Special Comment is an addendum to our prior research reports associated with the credit implications of building new nuclear generation in the U.S. These prior reports, entitled "New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities" published in May 2008 and "New Nuclear Generation in the United States: Keeping Options Open vs Addressing An Inevitable Necessity" published in October 2007 are referenced in the back under the section Moody's Related Research.

Moody's Investors Service

Overview

It has now been three decades since the last, serious nuclear construction cycle. The 1979 accident at Pennsylvania's Three Mile Island nuclear power plant appears to have permanently affected the nation's views about building new nuclear power generation. As a result, substantial new regulatory procedures were implemented. Development and construction costs soared, recovery was challenged, and for many issuers, financial deterioration and ratings downgrades followed. For some, ratings recovery took years.

But while nuclear power remains a thorny political and policy issue today, the concept of building new facilities has gradually reawakened in recent years, offering a buffer against foreign energy dependence, unpredictable commodity prices, and heavily polluting fuel sources. As a result, several of the largest U.S. power companies in recent years have announced plans to pursue new nuclear generation.

This may eventually boost the country's options for power generation. But from a credit perspective, the risks of building new nuclear generation are hard to ignore, entailing significantly higher business and operating risk profiles, with construction risk, huge capital costs, and continual shifts in national energy policy. Project risks are somewhat more clear today than during the last build cycle, in the 1970s, since we now have a track record that measures nuclear power's operating performance; strong plant economics due to low fuel cost; proven efficient and safe operating capabilities; new and refined regulatory procedures; and more certainty over reactor designs before construction begins.

Less clear today is the effect that energy efficiency programs and national renewable standards might have on the demand for new nuclear generation. National energy policy has also begun eyeing lower carbon emissions as a key desire for energy production—theoretically a huge benefit for new nuclear generation—but the price tags associated with these development efforts are daunting, especially in light of today's economic turmoil. It isn't clear what effect such shifts, or changes in technology, will have for new nuclear power facilities.

Credit conditions are yet another question. Few, if any, of the issuers aspiring to build new nuclear power have meaningfully strengthened their balance sheets, and for several companies, key financial credit ratios have actually declined. Moreover, recent broad market turmoil calls into question whether new liquidity is even available to support such capital-intensive projects. (The U.S. Nuclear Regulatory Commission's (NRC) first Construction and Operating Licenses, or COLs, are expected to win approval in roughly 24-36 months, after which investment in these projects could well increase significantly.)

Moody's is considering applying a more negative view for issuers that are actively pursuing new nuclear generation. History gives us reason to be concerned about possible significant balance-sheet challenges, the lack of tangible efforts today to defend the existing ratings, and the substantial execution risk involved in building new nuclear power facilities.

Nuclear's "bet-the-farm" risk

The NRC says about 14 companies to date have submitted COL applications, proposing numerous new nuclear reactors for power generation. The first of these COL's is expected to be approved beginning in mid-2011. Many of the COL license applications include partners, but the next table lists the primary holding company entity behind each project, and our view of the activity level associated with the endeavor.

From a credit perspective, companies that pursue new nuclear generation will take on a higher business and operating risk profile, pressuring credit ratings over the intermediate- to long-term. Even so, we also believe companies will ultimately revise their corporate-finance policies to begin materially strengthening balance sheets and bolstering available liquidity capacity at the start of the construction cycle. In addition, we believe regulators will generally continue to support the long-term financial health of the utilities they regulate, and will authorize recovery of investments and costs over a reasonable timeframe.

Moody's believes there is a significant difference between new nuclear plants located adjacent to existing units from those that are greenfield projects. In our opinion, brown-field projects benefit from the existing infrastructure (including security plans), local political support and historical operating record of the existing units. We believe the U.S. Department of Energy also recognized this as well in the selection of the Southern Company's Vogtle; NRG's South Texas Project, SCANA's Summer and Constellation's Calvert Cliffs / Nine Mile projects. We ascribe a "high" activity level for these projects.

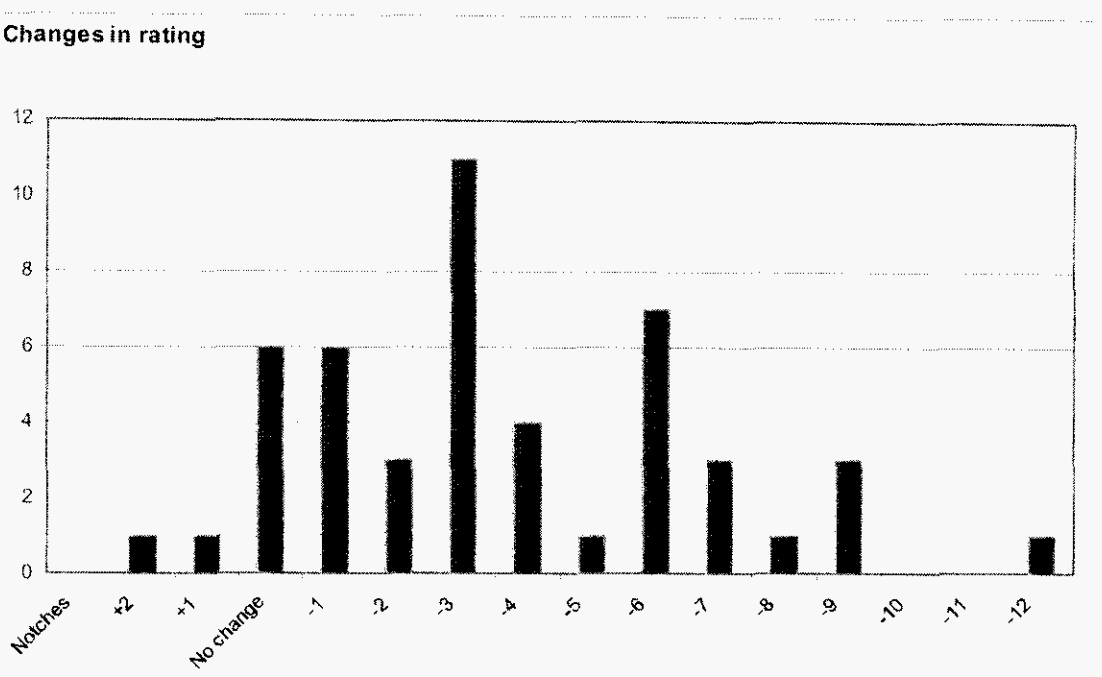
Many of the development plans appear to have been slowed down over the past 6 – 12 months for various reasons. We ascribe a "low" activity level to those projects. Other may have slowed down only modestly. For these projects, we ascribe a "medium" activity level.

Table 1: COL applications received by the NRC

Company	Sr. Unsec.	Reactor Design	Proposed New Reactor	Activity Level
Ameren	Baa3	US EPR	Callaway	Low
Constellation	Baa3	US EPR	Calvert Cliffs	High
Constellation	Baa3	US EPR	Nine Mile Point	High
Dominion	Baa2	ESBWR	North Anna	Low
DTE Energy	Baa1	ESBWR	Fermi	Low
Duke Energy	Baa2	AP 1000	William S Lee	Medium
Energy Future Holdings	B3 CFR	US APWR	Comanche Peak	Low
Entergy	Baa3	ESBWR	Grand Gulf	Low
Entergy	Baa3	ESBWR	River Bend	Low
Exelon	Baa1	ESBWR	Victoria County	Low
NRG Energy	Ba3 CFR	ABWR	South Texas Project	High
PPL	Baa2	US EPR	Bell Bend	Medium
Progress	Baa2	AP 1000	Levy County	Medium
Progress	Baa2	AP 1000	Shearon Harris	Low
SCANA	Baa1	AP 1000	V.C. Summer	High
Southern	A3	AP 1000	Vogtle	High
TVA	Aaa	AP 1000	Bellefonte	Low

Historical rating trends are not good

Historical rating actions have been unfavorable for issuers seeking to build new nuclear generation. Of 48 issuers that we evaluated during the last nuclear building cycle (roughly 1965-1995), two received rating upgrades, six went unchanged, and 40 had downgrades. Moreover, the average downgraded issuer fell four notches. All of these ratings were evaluated on the senior secured or first mortgage bond ratings.



We view new nuclear generation plans as a "bet the farm" endeavor for most companies, due to the size of the investment and length of time needed to build a nuclear power facility. While we continue to view operating nuclear units positively, we increasingly sense that none of the issuers actively pursuing these endeavors have taken any material actions to strengthen their balance sheets. As a result, it has become increasingly likely that the pursuit of new nuclear power projects will lead to some near-term rating actions or outlook changes.

This table highlights the credit metrics some of the issuers that appear most aggressive in their nuclear development plans.

Table 2: Selected utilities actively pursuing new nuclear generation

Company	Sector	Sr. Unsec.	Rating Outlook	2008 Debt*	2008 Revenue*	Debt / Revenue
South Carolina Electric & Gas	IOU	A3	Stable	$3,464	$2,816	123%
South Carolina Public Service Authority (Santee Cooper)	Municipal	Aa2	Stable	$3,715	$1,586	234%
Georgia Power	IOU	A2	Stable	$8,156	$8,412	97%
Municipal Electric Authority of Georgia	Municipal	A1	Stable	$3,390	$772	439%
Power South	Cooperative	Baa1	Stable	$1,398	$750	186%
Oglethorpe	Cooperative	Baa1	Stable	$3,910	$1,239	316%
San Antonio CPS	Municipal	Aa1	Stable	$3,600	$2,200	164%
City of Austin	Municipal	A1	Positive	$1,600	$1,200	133%
NRG Energy	Unregulated	Ba3 CFR	RUR-up	$9,275	$6,885	135%

** in $ millions*

Plant construction can pressure metrics

The sheer size, cost and complexity of new nuclear construction projects will increase a utility's or power company's business and operating risk profile, leading to downward rating pressure. The length of a nuclear construction effort also entails lengthy regulatory reviews and potential delays in recovering investments, changing market conditions, shifting political and policy agendas, and technological developments on both the supply and demand side.

Given these long-term risks, a company's financial policy becomes especially critical to its overall credit profile during construction. In general, we believe a company should prepare for the higher risk associated with construction by maintaining, if not strengthening, its balance sheet, and by maintaining robust levels of available liquidity capacity.

This is crucial, because our preliminary analysis suggests that credit metrics will deteriorate meaningfully without significant mitigating factors or other structural provisions. As cash outflows materially begin to outpace inflows, leverage is expected to increase and metrics related to cash flow are expected to decline. A weakening financial profile, coupled with increasing business and operating risk, should result in credit deterioration.

Precedents offer limited insight

Much has changed since the last major nuclear-generation construction cycle (1965-1995). The industry has learned from experience, including up-front regulatory oversight of development and investment; streamlined federal NRC approval procedures; and enhanced construction cycles and techniques.

In addition, new environmental regulations, specifically those aimed at reducing carbon dioxide emissions; appear well positioned for near-term implementation. These environmental developments should otherwise bolster the case for new nuclear generation, as it is viewed as one of the only large scale generation technology with a no-carbon footprint.

We are not questioning the arguments in favor of new large-scale nuclear generation. We observe, however, that nuclear projects require massive investments, and the long-term recovery of which presents a primary risk factor for issuers actively trying to build new nuclear power plants. Historically, in fact, many of the large nuclear utilities experienced some financial distress while building their plants. Material rating downgrades remain just as distinct a possibility today.

Issuer experience varied during the last U.S. nuclear build cycle, which we define as 1965-1995. This table is not meant to be all-inclusive (it excludes several issuers, such as Portland General and its Trojan nuclear plant. Although almost all issuers experienced rating downgrades to varying degrees, and not all of the downgrades may have been directly related to nuclear development, it was clearly either a primary or contributing factor in most cases.

Table 3: Precedent rating actions for utilities involved in nuclear development

Issuer	Period	Beginning rating	Lowest rating	Notches moved
Alabama Power	1975-1987	A2 FMB	Baa3	4
Arizona Public Service	1981-1993	A2 FMB	Baa3	4
Baltimore Gas & Electric	1974-1979	A2 FMB	A2	--
Cleveland Electric Illuminating	1981-1993	Aa2 FMB	Baa3	7
Commonwealth Edison	1968-1990	Aa2 FMB	Baa1	5
Connecticut Light & Power	1972-1978	Aa2 FMB	A2	3
Consolidated Edison Co of NY	1972-1978	A2 FMB	Baa2	3
Consumers Energy	1969-1974	Aaa FMB	Aa2	2
Detroit Edison	1985-1992	Baa1 SS	Baa2	1
Duke Energy Carolinas	1972-1986	Aa2 FMB	A2	3
Duquesne Light	1974-1988	Aa2 FMB	Baa2	6
Entergy Arkansas	1973-1979	A2 FMB	Baa2	3
Entergy Gulf States	1980-1988	A2 FMB	Ba3	7
Entergy Louisiana	1983-1988	Baa3 FMB	Ba2	2
Entergy Mississippi	1981-1987	A2 FMB	Ba2	6
Florida Power & Light	1972-1984	Aa2 FMB	A2	3
Georgia Power	1975-1990	Baa2 FMB	Baa2	--
Houston Light & Power	1987-1994	A2 FMB	A3	1
Illinois Power	1984-1989	A2 FMB	Baa3	4
Indiana Michigan Power	1973-1979	A2 FMB	Baa2	3
Iowa Electric Light & Power	1973-1977	Aa2 FMB	Baa2	6
Jersey Central Power & Light	1968-1980	A2 FMB	Ba2	6
Kansas Gas & Electric	1982-1986	Baa2 FMB	Baa3	1
Long Island Lighting	1972-1990	Aa2 FMB	B2	12
Metropolitan Edison	1973-1984	A2 FMB	B2	9
New England Power	1971-1992	Aa2 FMB	A1	2
Niagara Mohawk Power	1968-1988	Aaa FMB	Baa2	8
Northern Indiana Public Service	1973-1985	Aa2 FMB	Baa2	6
Northern States Power (MN)	1970-1976	Aa2 FMB	Aa2	--
NSTAR Electric	1971-1990	Aa2 FMB	Baa2	6
Ohio Edison	1975-1988	Aa2 FMB	Baa3	7
Pacific Gas & Electric	1983-1988	A1 FMB	A1	--
Philadelphia Electric Company	1973-1991	Aaa FMB	Baa3	9
PPL Electric Utilities	1982-1986	Aa2 FMB	A2	3
Progress Energy Carolinas	1970-1987	Aa2 FMB	Baa2	6
Progress Energy Florida	1975-1981	A2 FMB	A2	--
Public Service Co of Colorado	1976-1990	Aa2 FMB	A3	4
Public Service Co of New Hampshire	1980-1991	Baa2 FMB	Caa2	9
Public Service Electric & Gas	1973-1987	Aa2 FMB	Aa3	1
Puget Sound Energy	1978-1986	Baa2 FMB	A3	+2
Rochester Gas & Electric	1969-1975	Aa2 FMB	A2	3
South Carolina Electric & Gas	1979-1985	A2 FMB	A1	+1
Southern California Edison	1979-1985	Aa2 FMB	Aa2	--

Issuer	Period	Beginning rating	Lowest rating	Notches moved
Texas Utilities	1989-1995	Baa3 FMB	Baa3	1
Toledo Edison	1977-1988	Baa2 FMB	Baa3	1
Union Electric	1980-1988	A2 FMB	Baa2	3
Virginia Electric and Power	1971-1982	Aa2 FMB	A2	3
Wisconsin Public Service	1969-1975	Aa2 FMB	A2	3

Metrics show no meaningful improvement

Among electric utilities—both non-nuclear and nuclear vertically integrated companies—many key financial credit metrics have remained reasonably steady in recent times. While a stable financial profile reflects our sense of the sector's relative stability and predictability, we are becoming increasingly concerned that the nuclear utilities do not appear likely to see any meaningful improvement over the near to intermediate term.

Because companies that build new nuclear generation will increase their overall business and operating risk profiles, we believe they will need to compensate with near-term financial policies that produce strong financial credit ratios. While a constructive regulatory relationship will help mitigate near-term credit pressures, we will remain on guard for potential construction delays and cost overruns that could lead to future rate shock and/or disallowances of cost recovery. Given the lengthy construction time needed for nuclear projects, there is no guarantee that tomorrow's regulatory, political, or fuel environments will be as supportive to nuclear power as today's.

Table 4: Credit comparisons of nuclear and non-nuclear utilities

	Integrated Utility (non-nuclear) Average of 38 companies in peer group				Integrated Utility (nuclear) Average of 25 companies in peer group			
	7-yr	5-yr	3-yr	2008	7-yr	5-yr	3-yr	2008
Debt / Capitalization	43%	43%	42%	44%	42%	42%	42%	43%
Debt / EBITDA	3.8	3.2	3.3	3.8	3.0	3.0	3.3	3.3
Debt / Revenues	82%	80%	79%	83%	84%	82%	81%	86%
CFO / Debt	23%	22%	22%	18%	26%	26%	26%	24%
(CFO Pre-W/C) / Debt	24%	23%	22%	22%	27%	26%	26%	25%
FFO / Debt	26%	25%	24%	24%	27%	27%	26%	24%
EBITDA / Interest Expense	6.4	6.5	6.4	6.0	6.6	6.7	6.4	6.3
(CFO Pre-W/C + Interest) / Interest Expense	5.5	5.5	5.3	5.3	5.8	5.9	5.9	6.0
(CFO Pre-W/C-Dividends) / Capex	78%	72%	61%	60%	89%	83%	76%	69%
(CFO Pre-W/C-Dividends) / Debt	17%	17%	17%	17%	20%	20%	20%	20%

We can apply the same general financial-profile views to the parent companies that are now pursuing new nuclear construction:

Table 5: Credit conditions of parent companies seeking to build nuclear power generation

	Parent - nuclear Average of 14 companies in peer group			
	7-yr	5-yr	3-yr	2008
Debt / Capitalization	55%	54%	54%	56%
Debt / EBITDA	3.8	3.6	3.2	1.2
Debt / Revenues	131%	121%	123%	126%
CFO / Debt	17%	18%	18%	16%
(CFO Pre-W/C) / Debt	18%	19%	20%	18%
FFO / Debt	19%	20%	20%	19%
EBITDA / Interest Expense	4.5	4.7	4.8	4.3
(CFO Pre-W/C + Interest) / Interest Expense	4.2	4.4	4.4	4.2
(CFO Pre-W/C-Dividends) / Capex	101%	109%	87%	75%
(CFO Pre-W/C-Dividends) / Debt	14%	15%	15%	13%

Benefits of near-term recovery are limited

New nuclear power construction appears to enjoy strong political and regulatory support in a number of jurisdictions, especially in the southeastern states, where there is now legislation afoot to promote it. This support typically involves the regulators in the decision-making process on the business side; regular reviews of the sponsors' capital budgets; and real-time recovery of financing and other charges associated with the construction process.

Nevertheless, regulatory risks will persist over the longer term, and we increasingly think it unlikely that everything will work out as intended. We are concerned with the size of the investments being made even before the NRC grants a COL; the ongoing potential risks from displacement technology developments over the course of the construction period; and the recovery of sizeable sunk costs, should an issuer abandon a project in the future.

These longer-term risks are difficult to quantify today, but the possibility of abandoning a construction project should not be fully dismissed, regardless of the low probability of such an occurrence today. We remain concerned that should an issuer walk away from a nuclear project, for whatever reason, its multi-billion investment may not be fully recovered, or it may be amortized over a long-term period. This could introduce some material financial distress for almost any issuer.

Public Power and Cooperatives are positioned with flexible cost recovery mechanisms but rate pressure is expected

A number of municipally owned and not-for-profit cooperatives are partners in several new nuclear development projects. Several of these issuers have already begun raising significant amounts of debt to finance their share of the up-front development costs associated with these projects.

Public power utilities have begun to take proactive approaches to their participation in these projects to mitigate the burden. The Municipal Electric Authority of Georgia, for example, built a sizable reserve in excess of $700 million and found off takers for some of its initial ownership share to mitigate the financial burden of its ownership in the Vogtle 3 and 4 nuclear project. San Antonio CPS has begun to educate its customer base and to examine its rate process to begin to fund construction in advance of the construction schedule.

Nevertheless, despite their more levered balance sheets, we still consider the municipals and cooperatives better-positioned than the investor-owned utilities, because of their self-regulating rate authorities.

Yet one of the challenges associated with pursuing a new nuclear project is the size of the investment. These entities—like their investor-owned counterparts—risk the prospect that their customers will be unable to absorb steadily increasing rates. Ongoing economic turmoil in the U.S. amplifies this risk over the near to intermediate term and municipals and cooperatives do not have an ability to raise equity capital.

Is size an issue?

One possible solution might be for utilities to create partnerships for building new nuclear generation, thereby diluting this risk through various sharing mechanisms. Even some of the largest utility and power companies in our sector pale in comparison to the largest industrial customers, and to the foreign power companies, some of which could be strong candidates for such partnerships:

Table 6: Relative size comparison of other energy companies

Company	Sr. Unsec.	2008 Debt*	2008 Revenue*	2008 Assets
Large energy companies				
Electricity de France (EdF)	Aa3	$82,985	$87,833	$279,618
Exxon Mobil	Aaa	$56,596	$425,071	$295,024
BP plc	Aa1	$58,862	$361,143	$250,816
U.S. UTILITIES				
Exelon	Baa1	$18,069	$18,859	$48,524
Southern	A3	$20,276	$17,127	$49,380
Duke Energy	Baa2	$16,721	$13,207	$53,968
SCANA Corporation	Baa1	$4,972	$5,319	$11,567
NRG Energy	Ba3 CFR	$9,275	$6,885	$25,071

** in $ millions*

Conclusion

The likelihood that Moody's will take a more negative rating position for most issuers actively seeking to build new nuclear generation is increasing. With only about 24 months remaining before the NRC begins issuing licenses for new projects and major investment begins, few of the issuers we currently rate have taken any meaningful steps to strengthen their balance sheets. Considering these new projects tend to raise an issuer's business and operating risk profiles, the utility's overall credit profile appears weaker.

Most issuers still have some time to revise their financing policies. Even so, we are concerned that the turmoil in the financial markets, continued uncertainty associated with Federal loan guarantees, and the general tenor associated with bank credit facilities and liquidity will make such revisions more difficult in the future.

In order to defend existing ratings, or to limit negative rating actions, we will look for investor-owned utilities to:

- create strategic partnerships, to share costs and risks;
- increase reliance on equity as a component to financing plans;
- moderate their dividend policies to retain cash flow; and
- adopt a "back-to-basics" focus on core electric utility operations, posing less distraction for management

In addition to this "back to basics" focus on core operations and management, we would expect municipal and cooperative utilities to increase up-front rates to consumers, in order to build liquidity cushions and prevent rate shocks.

From a risk mitigation perspective, the prospect of seeking business partners—particularly major multinational energy companies with some experience in the nuclear arena—might also be worth exploring as a good way to preserve liquidity and cash flow, while still reaping the benefits of new nuclear power generation.

Appendix A: Historical rating actions

Issuer	Period	Comment	Reactor
Alabama Power	1975-1987	A2 FMB downgraded to Baa2 in 1976, Baa3 in 1982, followed by multiple rating upgrades in 1983, 1984, 1985, 1986	Farley
Arizona Public Service	1981-1993	A2 FMB downgraded to A3 in 1982, Baa2 in 1984, Baa3 in 1989; upgraded to Baa2 in 1992	Palo Verde
Baltimore Gas & Electric	1974-1979	A2 FMB	Calvert Cliffs
Cleveland Electric Illuminating	1981-1993	Aa2 FMB downgraded to A2 in 1981, A3 in 1984, Baa2 in 1985, Baa3 in 1993	Perry
Commonwealth Edison	1968-1990	Aa2 FMB downgraded to A2 in 1980, A3 in 1984, Baa1 in 1987	Dresden / Quad Cities / Zion / LaSalle / Byron / Braidwood
Connecticut Light & Power	1972-1978	Aa2 FMB downgraded to A2 in 1974	Conn. Yankee / Yankee Rowe
Consolidated Edison Co of NY	1972-1978	A2 FMB downgraded to Baa2 in 1974	Indian Point
Consumers Energy	1969-1974	Aaa FMB downgraded to Aa2 in 1972	Palisades
Detroit Edison	1985-1992	Baa3 Sr. Sec. upgraded to Baa1 in 1985, downgraded to Baa2 in 1987 followed by upgrades to Baa1 in 1990, A3 in 1991	Fermi
Duke Energy Carolinas	1972-1986	Aa2 FMB downgraded to A2 in 1973; upgraded to A1 1982, Aa3 in 1983 and Aa2 in 1984	Oconee / McGuire / Catawba
Duquesne Light	1974-1988	Aa2 FMB downgraded to A2 in 1979, A3 in 1982, Baa1 in 1984 and Baa2 in 1987	Beaver Valley
Entergy Arkansas	1973-1979	A2 FMB downgraded to Baa2 in 1974	Arkansas Nuclear
Entergy Gulf States	1980-1988	A2 FMB downgraded to Baa2 in 1982, Baa3 in 1984, follow by upgrade to Baa2 in 1985 and downgrade to Ba2 in 1986 and to Ba3 in 1987	Riverbend
Entergy Louisiana	1983-1988	Baa3 FMB downgraded to Ba2 in 1985, followed by upgrade to Baa2 in 1986, downgraded to Ba2 in 1988 then upgraded back to Baa3 in 1988	Waterford
Entergy Mississippi	1981-1987	A2 FMB downgraded to A3 and again to Baa2 in 1982, downgraded to Ba2 in 1985, followed by upgrades to Baa2 and again to Baa1 in 1986	Grand Gulf
Florida Power & Light	1972-1984	Aa2 FMB downgraded to A2 in 1974, followed by upgrades to A1 in 1982 and Aa3 in 1984	Turkey Point / St. Lucie
Georgia Power	1975-1990	Baa2 FMB upgraded to Baa1 in 1982, downgraded to Baa2 in 1987	Hatch / Vogtle
Houston Light & Power	1987-1994	A2 FMB downgraded to A3 in 1989, upgraded to A2 in 1993	South Texas Project
Illinois Power	1984-1989	A2 FMB downgraded to A3 in 1986, to Baa2 in 1988 and Baa3 in 1989	Clinton
Indiana Michigan Power	1973-1979	A2 FMB downgraded to Baa2 in 1975	Cook
Iowa Electric Light & Power	1973-1977	Aa2 FMB downgraded to A2 in 1974, to Baa2 in 1975, followed by upgrade to A2 in 1977	Duane Arnold
Jersey Central Power & Light	1968-1980	A2 FMB downgraded to Baa2 in 1972 and Ba2 in 1980	Oyster Creek / Three Mile Island
Kansas Gas & Electric	1982-1986	Baa2 FMB downgraded to Baa3 in 1982, upgraded to Baa2 in 1986	Wolf Creek
Long Island Lighting	1972-1990	Aa2 Sr. Sec. downgraded to A2 in 1979, to Baa2 in 1980, upgraded to Baa1 in 1982, followed by downgrade to Baa3 in 1983, to B2 quickly followed by upgrade to Ba3 in 1984, Ba1 in 1989 and Baa3 in 1990	Shoreham
Metropolitan Edison	1973-1984	A2 FMB downgraded to Baa2 in 1979, B2 in 1980 followed by upgrade to Ba2 in 1984	Three Mile Island
New England Power	1971-1992	Aa2 FMB downgraded to Aa3 in 1982, A1 in 1988	Vt Yankee / Seabrook

Issuer	Period	Comment	Reactor
Niagara Mohawk Power	1968-1988	Aaa FMB downgraded to A2 in 1968, A3 in 1982 and Baa1 in 1984 followed by upgrade to A3 in 1985 and downgrade to Baa1 in 1986, Baa2 in 1987 and upgrade to Baa1 in 1988	Nine Mile Point / Fitzpatrick
Northern Indiana Public Service	1973-1985	Aa2 FMB downgraded to Aa3 in 1982, to A3 in 1983 followed by upgrade to A1 in 1984 and downgrade to A2 and then to Baa2 in 1985	Bailly
Northern States Power (MN)	1970-1976	Aa2 FMB	Monticello / Prairie Island
NSTAR Electric	1971-1990	Aa2 FMB downgraded to A2 then to baa2 in 1974 followed by upgrade to A3 in 1983, A1 in 1984 then downgraded to Baa1 in 1988	Maine Yankee / VT Yankee / Pilgram / Seabrook
Ohio Edison	1975-1988	Aa2 FMB downgraded to A2 in 1976, downgraded to Baa3 in 1981; upgraded to Baa2 in 1987	Davis-Besse / Perry
Pacific Gas & Electric	1983-1988	A1 FMB	Diablo Canyon
Philadelphia Electric Company	1973-1991	Aaa FMB downgraded to aa2 in 1973 to A2 in 1974 to Baa2 in 1981 and Baa3 in 1983 followed by upgrade to Baa2 in 1991	Peach Bottom / Limerick
PPL Electric Utilities	1982-1986	Aa2 FMB downgraded to Aa3 and again to A2 in 1982	Susquehanna
Progress Energy Carolinas	1970-1987	Aa2 FMB downgraded to A2 in 1971 to Baa2 in 1975 followed by upgrade to A2 in 1978	Robinson / Brunswick / Shearon Harris
Progress Energy Florida	1975-1981	A2 FMB	Crystal River
Public Service Co of Colorado	1976-1990	Aa2 FMB downgraded to A2 in 1980, upgraded to A1 in 1983, upgraded to Aa3 in 1985, downgraded to A1 in 1986 and to A2 in 1987 and A3 in 1990	Ft St Vrain
Public Service Co of New Hampshire	1980-1991	Baa2 FMB downgraded to Baa3 then Ba1 in 1982, to B3 in 1984 followed by upgrade to B1 in 1986 then downgrade to Caa2 in 1987 followed by upgrade to Baa2 in 1991 exiting from bankruptcy	Seabrook
Public Service Electric & Gas	1973-1987	Aa2 FMB downgraded to Aa3 in 1982	Peach Bottom / Salem / Hope Creek
Puget Sound Energy	1978-1986	Baa2 FMB upgraded to A3 in 1985	Pebble Springs
Rochester Gas & Electric	1969-1975	Aa2 FMB downgraded to A2 in 1969	Ginna
South Carolina Electric & Gas	1979-1985	A2 FMB upgraded to A1 in 1984	Summer
Southern California Edison	1979-1985	Aa2 FMB	San Onofre
Texas Utilities	1989-1995	Baa2 FMB downgraded to Baa3 in 1990	Comanche Peak
Toledo Edison	1977-1988	Baa2 FMB upgraded to Baa1 in 1982, downgraded to Baa2 in 1983, downgraded to Baa3 in 1984	Davis-Besse / Perry
Union Electric	1980-1988	A2 FMB downgraded to Baa1 in 1980, to Baa2 in 1982, followed by upgrade to A3 in 1985 and A2 in 1988	Callaway
Virginia Electric and Power	1971-1982	Aa2 FMB downgraded to A2 in 1974	Surry / North Anna
Wisconsin Public Service	1969-1975	Aa2 FMB downgraded to A2 1969, upgraded to Aa2 in 1975	Point Beach / Kewaunee

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Special Comments:

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- Moody's Analytical Adjustments for Nuclear Energy Liabilities in EMEA, December 2007 (106604)
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Moody's Investors Service

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January 15, 2008

Regulatory risks paralyzing power industry while demand grows

Kennedy Maize and Dr. Robert Peltier, PE

Nukes face stiff political wind

A new Democratic administration isn't likely to push licensing of new nuclear plants. Indeed, the nuclear industry's worst regulatory nightmare is very much a political possibility: NRC Commissioner Gregory Jaczko becoming the agency's chairman. Jaczko, a very bright and sharp-elbowed political player, is considered "Harry Reid's guy" at the NRC.

A PhD physicist, Jaczko came to Congress as a science fellow working for Rep. Ed Markey (D-Mass.), one of the most anti-nuclear members of Congress over the past 30 years. Jaczko decided he liked Washington and became Reid's chief advisor on nuclear waste issues. Reid has vowed to kill Yucca Mountain, and he may be able to keep his promise come January 2009. Jaczko professes, no doubt honestly, that he is not anti-nuclear power.

But Jaczko has every reason to be anti–nuclear industry. The Nuclear Energy Institute tried, and failed, to block his initial appointment to the NRC when he won a recess appointment—as did Republican Peter Lyons, a former advisor to former Senate Energy and Natural Resources Committee Chairman Pete Domenici (R-N.M.). That was a deal the White House and Reid negotiated, over the objections of the nuclear lobby.

Then the nuke reps tried to derail Jaczko's nomination to fill a full term last year. They failed. Recently, the nuclear lobby tried to abort a second term for Jaczko. They were unsuccessful. Said our lobbyist, "We've tried to screw this guy three different times and failed. How understanding and helpful is he going to be when he runs the NRC?" There's little doubt that if the Democrats reclaim the White House, Jaczko, the only Democrat on the commission, will become its chairman.

The industry's political support in Congress has diminished substantially recently. Domenici, the nuke lobby's leader in the Senate, is a spent force. He's ill and sometimes unfocused, and he's announced he's stepping down at the end of 2008. The second-most-ardent nuke supporter in the Senate is Idaho Republican Larry Craig. His political career is apparently in the toilet. In recent years, the number-three supporter was Wyoming Republican Sen. Craig Thomas, a buddy of vice president Dick Cheney. Thomas died last year. There are no important nuclear stalwarts on the Democratic side of the House or Senate.

The politics of nuclear power will manifest themselves directly in financial markets. It won't matter how badly a utility wants to build new nuclear capacity if it can't convince lenders their investment is a safe one. No one is going to risk $5 billion or more on a new plant without assurance of at least capital recovery plus a return. For most generators, it's a bet-the-company gamble.

So while the politics of new nukes look bad, their short-term financing outlook isn't very promising, either. An October study of the U.S. industry by Moody's Financial Services concluded that "there can be no assurances that tomorrow's regulatory, political or fuel environment will be as supportive to nuclear power as they are currently." The NRC's 42-month COL process, Moody's noted, "remains untested." Opponents of nukes are likely to litigate NRC decisions, adding time, money, and doubt to the process.

Most ominously, Moody's suggests that the current estimate of the average cost to build a reactor and start it up by 2015—around $3,500/kW of capacity—is pie in the sky. A more realistic all-in cost for a new reactor, says the bond rating agency, is in the $5,000 to $6,000/kW range. That's considerably more than conservative estimates for new integrated gasification combined-cycle (IGCC) coal plants. American Electric Power (AEP) estimates its planned 600-MW IGCC plant will cost $3,500/kW.

COMSECY-09-0003

February 4, 2009

MEMORANDUM TO: Chairman Klein
Commissioner Jaczko
Commissioner Lyons
Commissioner Svinicki

FROM: R. W. Borchardt ***/RA Bruce Mallett Acting for/***
Executive Director for Operations

SUBJECT: DESIGNATION OF THE OFFICE OF NEW REACTORS AS LEAD OFFICE FOR NEW AND ADVANCED REACTOR-RELATED RULEMAKINGS

Purpose:

The purpose of this memorandum is to request that the Commission approve the designation of the Office of New Reactors (NRO) as lead office for design certification (DC) and other rulemaking activities related to new and advanced reactors.

Background:

NRO was formed following the Commission decision documented in the staff requirements memorandum (SRM) dated July 21, 2006, related to SECY-06-0144, "Proposed Reorganization of the Office of Nuclear Reactor Regulation (NRR) and Region II," dated June 24, 2006. When SECY-06-0144 was proposed, it was not readily apparent that NRO would require several concurrent rulemakings for DCs in addition to work on Title 10 of the *Code of Federal Regulations*, Part 52 (10 CFR Part 52), "Licenses, Certifications, and Approvals for Nuclear Power Plants," supplemental rulemakings and possibly establishing technical bases for a risk-informed and performance-based approach for licensing advanced reactors. Consequently, SECY-06-0144 stated that NRO would rely upon the established infrastructure within NRR for rulemaking as well as other areas such as generic communications. In addition to approving the staff's proposal, including NRR support for new reactor rulemakings, the SRM for SECY-06-0144 also directed the staff to perform self-assessments to promote continued improvement and ensure the reorganization resulted in the level of accountability and effectiveness envisioned by the Commission.

CONTACT: George M. Tartal, NRO/DNRL
301-415-0016

Discussion:

The staff has assessed possible improvements in the assignment of rulemaking tasks for NRO and NRR determined that the organizations could be more effective if NRO assumed full responsibility for all rulemaking activities related to new and advanced reactors. As the process is currently structured, NRO is responsible for preparing the technical basis (the majority of the work in developing the rulemaking package) for design certification rulemakings (DCRs) and other rulemakings for new and advanced reactors. NRR is responsible for providing project management support, administrative support, and assistance in selected parts of the rulemaking package such as regulatory analyses. While this arrangement was successful in the recent development of the rule requiring consideration of aircraft impacts for new nuclear power reactors, the process and assignments resulted in some duplication of efforts and introduced additional coordination issues for both offices. For example, staff and managers in both offices needed to review preliminary drafts, participate in meetings and briefings, and track the progress and issues associated with the rulemaking. Both offices also needed to reassign personnel and revise priorities for other projects when the Commission directed the staff to proceed with the aircraft impact assessment rulemaking.

In addition to the aircraft impact assessment rulemaking, the staff has assessed, as part of the agency's lean six sigma program, the process for the upcoming DCRs and determined that dedicated project management support within NRO for those rulemakings would be a more effective process than the current division of responsibilities between offices. DCRs are referenced in, and affect the schedules of, combined license (COL) applications that are being reviewed by NRO concurrently with the design reviews that will form the basis for the related DCRs. As a result, it was determined that a dedicated, focused approach by NRO, with dedicated rulemaking staff working with the staff completing the reviews of the DC and COL applications, would enhance the DC and COL licensing processes. The reviews to date have shown that the schedules and activities related to design reviews and COL applications are subject to changes that in turn require the staff to shuffle projects and establish new priorities. NRO can appropriately manage the resources needed for these processes and thereby avoid other project offices needing to adjust priorities and assignments to support changing DC and COL application reviews and DCR schedules or introducing conflicting priorities between offices.

NRO is currently scheduled to lead a number of agency rulemaking activities. Within the next several years, the staff is expecting to promulgate six rulemakings in support of new DCs, amendments to DCs, and a renewal of a DC. The staff is also planning on proposing a supplementary rule to 10 CFR Part 52 and possibly other rulemakings to support new reactor licensing actions. Further, the U.S. Nuclear Regulatory Commission may receive petitions for rulemaking to 10 CFR Part 52 based on increased public interest in new reactor licensing activities. Finally, NRO has recently taken over project management of advanced reactor programs. The agency may, in the longer term, wish to pursue changes to its regulations to facilitate the licensing process for advanced reactors. Thus, there are a sufficient number of significant rulemaking activities, either planned or anticipated, for new and advanced reactors, to warrant the designation of NRO as a lead rulemaking office.

The designation of NRO as a lead rulemaking office and the assignment of project management responsibilities to NRO is consistent with the SRM dated September 16, 1997, issued in response to SECY-97-167, "DSI 22 Implementation," dated July 30, 1997. In the SRM, the Commission directed the staff to "expeditiously transfer all rulemaking functions and responsibilities to the program offices." NRO has demonstrated that it has the necessary technical, licensing, and project management expertise to perform the rulemaking function for

new and advanced reactors. Examples include NRO leading recent activities such as the 10 CFR Part 52 rulemaking, the limited work authorization rulemaking, the aircraft impact assessment rulemaking, and the lean six sigma evaluation of the DCR process. NRO is currently preparing an office instruction similar to NRR's LIC-300, "Rulemaking Procedures," as well as preparing templates and other documents needed for its rulemaking activities. The staff determined that this infrastructure is needed to support NRO's current role of being responsible for the technical bases for rulemakings related to new reactors and otherwise leading efforts for new and advanced reactors. To minimize development efforts and to ensure consistency, the NRO staff is adopting existing procedures and processes and will continue its participation in the interoffice rulemaking coordinating committee (RCC), which is led by the Office of Administration (ADM).

The staff has discussed the designation of NRO as a lead rulemaking office in forums such as the RCC and reached a consensus that the assignment of rulemakings to NRO is appropriate under the current circumstances and work loads. Some support offices (e.g., the Office of General Counsel and the ADM) may experience some additional needs to determine priorities if rules from different offices are simultaneously coordinated with those support offices. Such issues can, however, be anticipated and managed through close communication among offices and routine meetings of the RCC. The staff has concluded that this realignment of rulemaking functions would have no significant effect on overall agency resources for promulgating rules, including resources for program, coordinating, and support offices.

Approval of NRO as a lead office for new and advanced reactor rulemakings would not reduce or negate the coordination of rulemakings between NRR and NRO. The coordination of NRO rulemakings with NRR, and vice versa, is essential to ensuring that both offices have a clear understanding of changes to regulatory requirements that impact each other's programs. Therefore, the NRR and NRO rulemaking staff would maintain a close working relationship and coordinate reviews of rulemakings. NRO would continue to attend meetings of the RCC, amending its role from a support/technical office to a lead office.

For Fiscal Year (FY) 2009, NRO's budget of 2.2 FTE includes resources to develop the infrastructure for and to manage all currently anticipated DCR projects, manage 10 CFR Part 52 petitions for rulemaking (if submitted), and support other agency rulemaking activities. NRO has requested 2.2 FTE in its FY 2010 budget, unchanged from FY 2009, and will shift its focus from rulemaking infrastructure and support to work on NRO's highest priority rulemakings. Resources for FY 2011 and beyond will be requested through the Planning, Budgeting, and Performance Management Process. NRR has reprogrammed its rulemaking resources from including support to NRO for new and advanced reactor rulemakings to supporting other reactor-related rulemaking activities.

SECY, please track.

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Prepared Remarks for
The Honorable Gregory B. Jaczko
Commissioner
U.S. Nuclear Regulatory Commission
at the
NRC Regulatory Information Conference
March 11, 2009
"Learning the Right Lessons"

This is my fifth opportunity to address our Regulatory Information Conference. Each year I use this talk as an opportunity to address big themes and how they apply to the specific challenges of nuclear safety regulation.

This year I would like to focus on the most important lessons we need to learn from past success to meet our mission of providing an adequate assurance of public health and safety. I would like to begin with an example of how we use information, and as Cambridge, Massachusetts, is a center of reason and thought, I will begin there today, even though that is hard for me to acknowledge as a graduate of an Ivy League institution located in a different city.

I am not sure how many of you listen to that unique source of wisdom known as the NPR's Car Talk radio show, but yes, it is produced in Cambridge. Each week the show features a thought experiment known as the 'puzzler.' Last month's logic puzzle was set during wartime and went something like this:

An air force flight operations chief begins a debriefing by asking airmen who just returned from a costly mission in which many planes were lost, "From what direction were you attacked?" Without hesitation, the reply was, "From above and behind." The flight operations chief hastily scribbles the information on the back of top secret maps, and hands it to a junior officer with the instructions, "Get this information to the departing air crews. It may save their lives!" As the officer turns to leave, a more senior officer from the back of the room booms out: "Hold that order. The information you're about to give may not save any lives at all."

What did the senior officer know that the flight operations chief didn't? The surviving airmen answered that they were attacked from above and behind. But they survived. They were taking evidence of past success – the pilots who got home safely – and trying to predict future success. Why doesn't this approach work? Because the pilots who made it back successfully dealt with the attack on them. Those weren't the fatal attacks. The fatal attacks were from some other direction, and those pilots didn't have any advice to offer because they did not make it back.

The point of this story is that evidence of past success should not necessarily be used as a basis for predicting future performance. The successful pilots thought they had all the information they needed to help their colleagues be successful, when in fact they did not. The result of this type of thinking – using evidence of past success to try to predict future success – is a type of complacency that can be found throughout the history of nuclear power, from Three Mile Island to Davis Besse.

I think it is important to set the stage for today's discussion by looking at the status of the NRC. So before further elaborating on this theme of complacency, let me talk about the NRC's best weapon against it – the NRC staff. There has been dramatic change at the agency during the last four years, including a ramp-up in staff, budget, and office space. I mentioned some of these statistics in a speech last month but I think it is important to revisit them for this audience.

When I first joined the Commission four years ago, the NRC had a smaller staff, a much smaller budget, and headquarters consisted of two buildings. Since then, we have seen a dramatic twenty-five percent growth in the number of employees, the size of our budget has grown by fifty percent, and we have created two new offices. We have also been forced to rent space in four new interim buildings around Montgomery County. Even more dramatic, almost half of our workforce has been at the agency for five years or less.

Why is that significant? In concrete terms it means that most of our staff joined the agency after September 11, 2001. Most were not at the NRC when the Davis Besse vessel head cavity was discovered in 2002, let alone during the Three Mile Island accident in 1979. This makes knowledge management tremendously important.

Now, I do not want anyone to get the wrong impression. We have excellent and dedicated staff. The people who come to the NRC have top-notch educations and diverse and impressive professional backgrounds in industry, government, and science.

Take one small branch in our security office that assesses threat information for the agency as an example. These seven folks have well over one hundred years of combined experience in military, intelligence, and law enforcement fields. They have worked at the U.S. Secret Service, the Army, the Defense Intelligence Agency, the U.S. Coast Guard, the CIA, and the newest member of the office served in Iraq. Such staff is selected and hired for the expertise they bring to help the agency ensure nuclear materials are adequately

secured. Similar levels of expertise are repeated in offices around the NRC by staff with both agency and external experience.

The demographic changes we have gone through present us with the challenge of taking advantage of the ability these new employees have to look at issues from a fresh perspective to make us even better, while making sure all our staff continues to understand the lessons that were learned from the past. This makes it crucial to have written documentation for use in our safety work – clear regulations and guidance documents. This is important not just for the public and for licensees to clearly understand the requirements, but also for the NRC staff who are asked to oversee and enforce them.

I would note the good work the staff has done over the last four years after the Commission directed them to update guidance documents and standard review plans. The staff has updated 248 sections in all 19 chapters of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants or NUREG-0800, with less than 20 sections left to go. We have also updated all of the agency's regulatory guides needed to support applicants' new reactor licensing efforts, but more than 200 other regulatory guides are not yet completed and the schedule to finish those has slipped. These updated tools are even more important now, and we need to prioritize the resources for that work.

So what should our staff be doing to stay focused on safety? Not be complacent. Not take false comfort in calculations. Not ignore seemingly unlikely events.

This is the real lesson of the puzzler I began with. This is also the real lesson of Davis Besse, which took the NRC and industry by surprise. The NRC and industry had previously recognized the potential for nozzles to experience some cracking but in spite of that knowledge, Davis Besse happened anyway. That is partially because we were resting on past evidence to tell us it could not be an immediate safety concern and we got complacent. Unforeseen events with potentially very bad consequences ***are*** always possible and ***could*** happen over time.

When we think about the lessons learned from Davis Besse, we think of incremental improvements to ensure we do a better job of inspecting and ensuring regulatory compliance. But the real lesson of Davis Besse or even TMI is that we must never get complacent. Neither event was thought to be probable, or significant, until the very moment when they happened. This reinforces the importance of doing our jobs, not relying on past evidence of success and always being on the lookout for new problems.

One specific area where we can make additional progress is the Reactor Oversight Process, which is a good oversight tool. We can do so by improving performance indicators. When we look at performance indicators and see more and more 'green' results, we can draw one of two conclusions: either everything is working well and there are no issues to be worried about, or, alternatively, that the usefulness of specific indicators is declining. I think we have a duty as regulators to consider both possibilities. We have an obligation to make sure performance is consistently high and not just that it is being tuned more finely to the indicator itself. If actual performance is being maintained, then a whole host of indicators should show that. To ensure that is the case, we should develop a new set of performance indicators. They should include a spectrum of indicators used on a rotating basis to give us a better understanding of actual plant performance.

An example of what I think we should do involves the Mitigating Systems Performance Index indicator, which went into effect in early 2006 as a new way to measure the availability of mitigating systems. This indicator has provided more than triple the greater than green findings in the two years after implementation, compared to the same cornerstone two years before – 68 vs. 20 findings. This indicator provides an example of the value of meaningful performance indicators to help make sure we aren't making the wrong conclusions about the successes of past performance.

A broader solution to the fight against complacency is to focus on safety culture and I am glad to see the Commission making progress. This is a topic I have been focused on for a long time. In fact, regular RIC attendees may note that it has featured prominently in all four of my RIC speeches, including the first one in 2005 when I called for the integration of security into the safety culture concept.

Referring back to the puzzler for a moment, the individual who expressed concern about the value of the information the returning pilots possessed demonstrated a healthy safety culture. The NRC has a number of initiatives underway to strengthen this type of culture. We have added attributes of safety culture to the ROP, and more broadly, we are now developing a policy statement that will lay out our expectations for a healthy safety and security culture at all NRC licensees. The staff has worked with a broad group of stakeholders on this, as well as on the internal NRC safety culture initiative I strongly believe in, and I am pleased with the progress so far. These safety culture exercises will come together to give us a definitive understanding of what the NRC should be doing in the area of safety culture oversight.

Of course, I could not give a RIC speech without talking about fire protection at nuclear power plants. In fire protection, we have an example of actual evidence of past problems back all the way to the Browns Ferry fire in 1975, that are still in need of a transparent solution.

I am sometimes asked why the Commission cares about this issue, and my simple answer is 'because according to our analysis, fire is a significant contributor to the overall risk of core damage at a plant.' To stretch my opening analogy even further, fire protection is like the plane that got shot up very badly and barely limped back to base. It can actually teach us lessons about ***failure*** that can be useful, and fire protection has many of those lessons to share about challenges that need to be resolved.

We have made some progress on the fire barrier issues, we are working on a database of exemptions to be completed this year, and the staff has a fire protection closure plan in the works. We have even discovered what I believe is the ultimate solution but we have not yet given the order to implement it. Therefore, we need to all recognize the reality that NFPA-805 is the only way to finally resolve the fire protection issue. It is the only possible success path to fully resolve issues associated with operator manual actions and fire induced circuit failures. I am glad to see that many licensees have recognized this but unfortunately not all have.

In fact, I often hear about the industry's interest in more performance based, risk-informed regulations. Yet, NFPA-805 is a performance based, risk-informed rule and yet 56 out of 104 plants are not pursuing it. Part of the issue is that probabilistic risk assessment models for fire are not complete. This is one of the lessons of NFPA-805 – we must have the PRA tools in place first. I do not believe it is the most effective use of agency resources to focus on risk informing our regulations when there is more work to be done on that risk assessment infrastructure.

This brings me to a few items in the area of new reactors I would like to discuss. One tremendous success in this area is the Commission's recent decision to provide clear direction about how new plant designs have to deal with the threat of a commercial aircraft crash. With this new rule, I believe the Commission has resolved most concerns the aircraft threat poses for both the existing reactors, which had a focus on mitigation, and any new plants which will have to focus on design improvements. The Commission that was in place following September 11, 2001, especially Chairman Meserve and Chairman Diaz, deserves credit for ensuring the agency developed the technical information that made these policy decisions possible.

Finally, I'll touch on an area of new reactors in which I do not think we have fully learned the lessons of the past. The Commission made a strong effort to learn lessons from processes that did not work – so much so that we flipped the application process from 'build first and then license,' to 'license first and then build.' This greatly lessens the financial risk involved but unfortunately applicants have not used this process as intended.

At the heart of this change was that the key to success is having completed designs done early. But we are right back into a situation where we have incomplete designs and less than high quality applications submitted for review. The very first application we received was on hold for a year and a half during which time we could only do minimal work on it. In fact, the NRC had to withdraw the hearing opportunity because that applicant was not ready and the agency was only able to re-notice it last month. Even today, almost a fifth (3 of 17) of the COL applications we have received are on hold at the request of the applicants themselves. Vendors are revising four of the new plant designs.

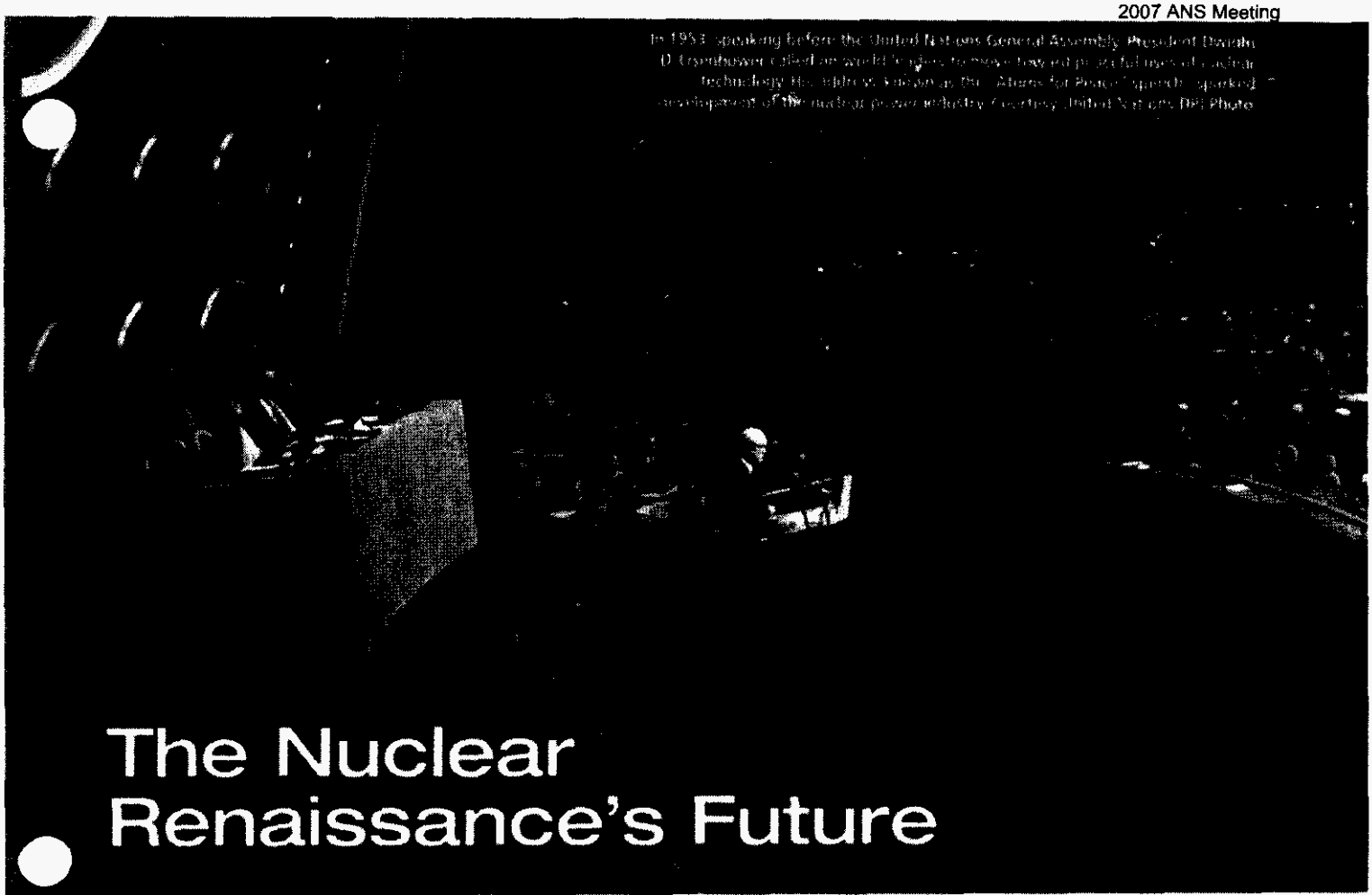
The temptation is to plow on anyway and conclude that if plants got licensed in the 1960s and 1970s under less than ideal conditions, it won't be the end of the world if the current process begins to look more and more like that one. But everyone would be better served by focusing on the lesson of all those plants that never got built and concentrating on getting designs completed first. Of course, it is up to licensees to decide which process to follow. The Commission made it clear, however, that if licensees choose not to follow the new Part 52 process of referencing an early site permit and a certified design in their applications, they do so 'at their own risk.'

I challenge the industry to focus on those projects that are most likely to go forward and get their design and environmental work done, so that success can be used as a model for others to follow. And in that context, I would like to acknowledge our staff who have shown dedication and flexibility in responding to this rapidly changing new reactor environment.

The challenge I would issue for everyone in this room going forward is to continue to work to minimize risks, never rest on success, and always be on the lookout for new information and for the unexpected. Each of us should be focused on both the safety issues we know about today as well as the search for tomorrow's safety issues we have not yet discovered. What safety issues will we be talking about at next year's conference? Will it be something new in digital instrumentation and control? Materials degradation? BWR sump screens? We must think about these things now and not get complacent. We must not assume we know everything there is to know.

For the NRC, we should recognize that we will continue to have to make hard – and sometimes unpopular – decisions. When we deliberate about those decisions, we should do so by transparently engaging all members of the public. We must understand society's current level of acceptable risk to ensure our adherence to the agency's mission. Once we have done that, we have a responsibility to decisively implement and enforce safety standards.

Thank you, and I look forward to answering your questions.



In 1953, speaking before the United Nations General Assembly, President Dwight D. Eisenhower called on world leaders to move toward peaceful uses of nuclear technology. His address, known as the "Atoms for Peace" speech, sparked development of the nuclear power industry. Courtesy: United States Info Photo

The Nuclear Renaissance's Future

Growing demand for electricity coupled with concern about global warming are promoting the idea of new nuclear power plant construction worldwide. Like other countries, the United States is looking at nuclear power as a solution to its growing need for energy. Early this summer, during a visit to the newly restarted Browns Ferry Unit 1 nuclear power plant, President Bush said there is no single solution to climate change, but there is no viable solution that does not include nuclear energy. Yvo de Boer, the Executive Secretary of the United Nations, also said recently that he has never seen a realistic solution to climate change that did not include nuclear energy.

Based on these statements and others like them from various world leaders, it appears that a nuclear renaissance is inevitable. However, to date no company has broken ground on a new nuclear power plant in the United States; for that matter, no company has even committed to breaking ground. Participants in the American Nuclear Society's (ANS) 2007 Annual Meeting held in Boston this summer pointed out that a nuclear renaissance is far from a sure thing.

Art Stall, FP&L's senior vice president and chief nuclear officer, co-hosted the ANS meeting's opening plenary. He told attendees that the euphoria surrounding the nuclear renaissance has been dampened somewhat by the realities of the challenges involved in building new nuclear power plants. Stall and other speakers at the annual meeting spoke about the obstacles that must be cleared before a new nuclear power plant will be built in the United States. These include issues such as supply chain constraints, radioactive waste disposal, public policy, public support and workforce shortage.

Supply Chain

Supply chain challenges received much attention at this year's ANS meeting. Carol Berrigan, the Nuclear Energy Institute's (NEI's) Director of Industry and Infrastructure, provided an overview of NEI's Nuclear Manufacturer's Study. In 1980, more than 500 companies in the United States carried N-stamps. Today that number is around 100, Berrigan said. In addition, during the first nuclear plant construction period, most suppliers to U.S. plants were domestic and competition was limited to companies within the United States. Today, competition and the supply chain are international.

Currently, Japan is the only country that can supply ultra-heavy forgings to the nuclear industry. There are two companies in the world that can provide heavy forgings and rigging (neither of which is in the United States). Few companies in the United States can provide large component castings and only one U.S. company can manufacture large nuclear-grade components, Berrigan said. This lack of U.S.-based manufacturing means that constructors/owners of new U.S. nuclear power plants will be competing with nuclear plant constructors/owners around the world.

David Barry of the Shaw Group said not only will there be global competition for nuclear components, but that the nuclear

industry will also be competing against many other industries for materials and supplies. "The nuclear portion is minuscule compared to other industries," Barry said. To make matters worse, most bulk commodities must be qualified to nuclear standards.

Given the small number of existing U.S. suppliers and the dual facts that ultra-heavy forgings are not available domestically and the availability of heavy forgings in the United States is limited, it becomes clear that the nuclear power industry is not a domestic industry, said Tom Sanders, vice president, Council on Global Nuclear Competitiveness and manager of Sandia National Laboratory's Global Nuclear Futures Initiative. Most components "except the concrete" are imported, he said. The United States has little to contribute to the world's emerging nuclear power markets, Sanders said. "The United States and its national security interest hardly have a seat at the table when it comes to providing anything to the emerging markets."

By ordering long-lead-time components before committing to build a plant, companies are positioning themselves to avoid a possible supply issue.

Although nuclear component suppliers have been reluctant to invest in related manufacturing infrastructure without confirmed orders in hand, a few companies are stepping up their capability in the United States. For example, BWX Technologies, a long-time producer of nuclear components, reopened its forging facility in Indiana in 2005. The facility was originally built in the 1960s to support the commercial nuclear industry, but was placed in "standby" mode in the 1970s. It is the only facility in the United States certified by ASME to manufacturer large, heavy nuclear components. In addition, GE is expanding its manufacturing facility in Wilmington, N.C., and recently announced it will partner with Hitachi to better compete in the global nuclear energy market.

In anticipation of moving forward with new nuclear plant construction, a couple of generation companies have recently submitted orders for some long lead-time nuclear components. Entergy Nuclear in early August signed a project development agreement with GE-Hitachi Nuclear Energy that includes a major reactor component order. Large forgings as well as fabrication of several schedule-critical nuclear and turbine components required for GE's ESBWR design are a part of the order. In addition, just days earlier, Ameren UE placed its second order with AREVA Inc. to procure the second set of heavy forgings. (Ameren UE placed an order with AREVA for the first set in 2006.) Both Entergy and Ameren UE were careful to say that these orders do not represent decisions to build new nuclear plants, but merely preserve the companies' options to do so.

By ordering long-lead-time components before committing to build a plant, these companies are positioning themselves to avoid another possible supply issue. Berrigan predicted that competition from overseas markets and plans to increase nuclear plant building in the United States will cause supply problems by 2013 and 2014. She expects the supply of concrete, reinforced steel, large-bore piping, small-bore piping, structural steel and conduit to be constrained. It is important for the industry to increase its outreach to nuclear component manufacturers and potential manufacturers, Berrigan said. "Many companies that had N stamps and let them expire are still making the same components. We need to reach out to these companies to get them back (in the nuclear business)."

Experts who spoke at the ANS meeting predicted that high demand and limited supply will cause material prices to increase, as they have been for the past three years or more. Berrigan predicted that most commodity prices will stabilize, except for seamless piping and high alloy steel. Don Bowers, Velan Valve Corp.'s Director of Sales and Power Products, said carbon steel casting prices have risen by 25 percent in the past three years, while the price of stainless steel castings has doubled. He expects this trend to continue and warned that cost estimates for new plants calculated two or three years ago are likely to be much too low in today's materials market.

Public and Political Support

Dana Mead, chairman of MIT Corp., the Massachusetts Institute of Technology's governing body, spoke at the ANS meeting's plenary session and presented what she termed the "opinion of an industry outsider." Mead said that formidable challenges to a nuclear renaissance include the public's and politicians' failure to understand nuclear power's important role. He said that few people outside the industry realize that nuclear power represents not only 20 percent of the nation's generating capacity and 25 percent of the generating capacity worldwide, but 70 percent of the non-carbon generating capacity worldwide. "The story is there is no story," Mead said.

To emphasize his point, Mead presented data compiled from public opinion surveys conducted by MIT's political science department. In 2002, nuclear power was the least-liked energy source in the United States. By 2007, however, the public's opinion of nuclear power improved and now is approaching the same status as natural gas-generated electricity. Mead cautioned, however, that even though public opinion is rising, industry leaders must be aware of the "danger of being lulled into complacency and assuming that nuclear energy will be a part of the energy future." He said nuclear power faces competition from other forms of energy and it must have not only public support and approval, but also support and commitment from government. He said laymen set policies, make laws, provide financing and report on and write about the nuclear industry; therefore, it is important for the industry to convince "outsiders" that it is a viable, necessary energy form.

Mead said the industry must focus on two main issues to garner public and political support. First, the industry must show early progress once construction begins on the initial plant. Second, the industry must address concerns and perceptions, especially about nuclear waste. A repository at Yucca Mountain will require nuclear waste to be transported through as many as 40 states. Mead pointed out that those 40 states are represented by 80 U.S. senators and well over 100 congressmen and most of these individuals will have to buy into Yucca Mountain. He also noted that nuclear power generates the most varied public opinion of any power generation type.

According to MIT studies, 39 percent of those polled feel it should be reduced, 35 percent feel it should be increased and 11 percent don't believe it should be used at all—this is the highest fraction of people who do not want it around of any generation type. Mead said many more would support nuclear power if the nuclear waste issue was resolved.

Utility Perception

Individuals who work for utilities that plan to build new nuclear plants discussed the challenges they foresaw coming in the next few years. Dale Lloyd, Southern Generation's Director of Plant Vogtle's Units 3 and 4, said potential new plant owners "must go out and talk about new nuclear with confidence." They must convince the regulators, financiers, policy makers and public that the new generation of units will be built in a much different culture than the first generation. Lloyd discussed how during the first build-out of nuclear power plants, all the companies—owner, constructor and A/E contractor—were involved in the plants' designs. He cautioned that a repeat of this would be a recipe for failure. "We must leave the design to the A/Es," he said. Owners must be supportive of the constructor, but not get too involved," Lloyd said.

Randy Vigor of Duke Energy agreed with Lloyd, saying that utility boards want predictability and are looking for a level of confidence when it comes to schedule and construction. "We need regulatory stability from the NRC and public utility commissions to determine how we will recover costs," he said. In addition, the owners must form supportive and collaborative partnerships with A/Es, constructors, vendors and others. "If the early projects are not successful, we will have to find power from another generation source," Vigor said.

Lloyd also said that most nuclear power plant owners have become much more effective at dealing with the public, the media and the NRC since the early days. He said the owners are more approachable and willing to provide much more information to outside entities. They are also better at dealing with employees and building teams.

Workforce

The looming workforce shortage was another topic that received much attention at this year's event. During the opening plenary, Art Stall said one of the biggest challenges is finding qualified people—including craft labor, technicians, engineers and scientists—to support construction and operation. He said that 40 percent of the current nuclear power plant workers are eligible to retire within the next five years. He said only 8 percent of the current nuclear plant workforce is under 32 years old. While the number of technical and engineering college graduates is increasing, Stall said much competition exists from other industries for these graduates and the nuclear industry must become creative to entice grads to enter and remain in the nuclear field.

"The labor shortage is very real for the construction industry," said Edward Wick of Shaw Stone and Webster

Tyrone Tonkinson, president of consulting firm Simple Approach Inc., spoke during a breakout session about the power generation industry's traditional culture and how that culture needs to change to fit the needs and wants of potential employees. Tonkinson said many workers during the first nuclear power plant buildout came from the Atoms for Peace program and the Navy's nuclear division, resulting in a military-like, authoritarian culture. In this culture, directives were issued from higher ranking managers, much emphasis was placed on rules and micro-management was common. This culture included a chain of command where advancement opportunities were often limited. Chain of command, promotions and rank were based on years of service, a culture that is not attractive to today's workforce, Tonkinson said.

The new generation of workers is driven by more than money and position, Tonkinson said. This generation considers personal life to be as important as professional life. Some of the work characteristics this new generation requires include flexible work hours, free time, job satisfaction, freedom to aggressively pursue goals and think independently, advancement based on results rather than years in service, freedom to be creative, empowerment and life-long use of modern technology.

To successfully recruit and retain this new generation of workers, many companies must change their culture. He said that converting some senior managers to coaches is a good way to train new employees and initiate them into the company. He also recommended that companies create a [illegible] that allows rapid development of leaders.

Edward Wick of Shaw Stone and Webster also spoke during the session and said he believes the challenges faced by companies looking for craft labor are much larger than those faced by companies looking for engineers and scientists.

"The labor shortage (caused by an aging workforce) is a myth for most industries that don't require heavy labor," Wick said. Older engineers and other technical workers whose jobs are mostly knowledge-based and can be performed at a desk may be able to postpone retirement because they are not required to perform manual labor. In addition, many desk jobs can be moved offshore. Older workers in construction jobs face a different story, however.

"The labor shortage is very real for the construction industry," said Wick.

Not only are there limited numbers of skilled craft workers available, but multiple industries are courting those workers. Many industries are currently expanding their facilities and infrastructures so the demand for skilled craft is high. The nuclear industry is competing with fossil plants, refineries, manufacturers and other industries for skilled labor.

Edward Sullivan, the AFL-CIO's Building and Construction Trade President, told ANS meeting attendees that 200,000 to 250,000 new craft workers are needed in the United States each year. Sullivan said the Bureau of Labor Statistics predicts that 1 million new craft workers will be needed in the next six years and 2.5 million will be needed by 2015.

Overcoming craft labor shortages will require a multi-pronged approach. Contractors, utilities and educational institutions must work together to attract qualified individuals, Wick said. He said it is important to begin encouraging children as early as middle school to enter the construction industry. Sullivan agreed, stressing that the industry must target parents and teachers to encourage young people to train for craft jobs.

Wick said that developing faster training programs, rewarding individuals for skill and performance and putting less emphasis on time in grade will also help attract new craft labor to the industry. High wages must also be a part of the mix.

Sullivan pointed to what he said was some good news in the nuclear industry when it comes to craft labor.

"The nuclear industry already has a skilled training infrastructure in place," he said. "The industry must use this infrastructure and make sure an appropriate apprentice structure is also in place." pe

The New York Times

May 29, 2009

In Finland, Nuclear Renaissance Runs Into Trouble

By JAMES KANTER

OLKILUOTO, Finland — As the Obama administration tries to steer America toward cleaner sources of energy, it would do well to consider the cautionary tale of this new-generation nuclear reactor site.

The massive power plant under construction on muddy terrain on this Finnish island was supposed to be the showpiece of a nuclear renaissance. The most powerful reactor ever built, its modular design was supposed to make it faster and cheaper to build. And it was supposed to be safer, too.

But things have not gone as planned.

After four years of construction and thousands of defects and deficiencies, the reactor's 3 billion euro price tag, about $4.2 billion, has climbed at least 50 percent. And while the reactor was originally meant to be completed this summer, Areva, the French company building it, and the utility that ordered it, are no longer willing to make certain predictions on when it will go online.

While the American nuclear industry has predicted clear sailing after its first plants are built, the problems in Europe suggest these obstacles may be hard to avoid.

A new fleet of reactors would be standardized down to "the carpeting and wallpaper," as Michael J. Wallace, the chairman of UniStar Nuclear Energy — a joint venture between EDF Group and Constellation Energy, the Maryland-based utility — has said repeatedly.

In the end, he says, that standardization will lead to significant savings.

But early experience suggests these new reactors will be no easier or cheaper to build than the ones of a generation ago, when cost overruns — and then accidents at Three Mile Island and Chernobyl — ended the last nuclear construction boom.

In Flamanville, France, a clone of the Finnish reactor now under construction is also behind schedule and overbudget.

In the United States, Florida and Georgia have changed state laws to raise electricity rates so that consumers will foot some of the bill for new nuclear plants in advance, before construction even begins.

"A number of U.S. companies have looked with trepidation on the situation in Finland and at the magnitude of the investment there," said Paul L. Joskow, a professor of economics at the Massachusetts Institute of Technology, a co-author of an influential report on the future of nuclear power in 2003. "The rollout of new

nuclear reactors will be a good deal slower than a lot of people were assuming."

For nuclear power to have a high impact on reducing greenhouse gases, an average of 12 reactors would have to be built worldwide each year until 2030, according to the Nuclear Energy Agency at the Organization for Economic Cooperation and Development. Right now, there are not even enough reactors under construction to replace those that are reaching the end of their lives.

And of the 45 reactors being built around the world, 22 have encountered construction delays, according to an analysis prepared this year for the German government by Mycle Schneider, an energy analyst and a critic of the nuclear industry. He added that nine do not have official start-up dates.

Most of the new construction is underway in countries like China and Russia, where strong central governments have made nuclear energy a national priority. India also has long seen nuclear as part of a national drive for self-sufficiency and now is seeking new nuclear technologies to reduce its reliance on imported uranium.

By comparison, "the state has been all over the place in the United States and Europe on nuclear power," Mr. Joskow said.

The United States generates about one-fifth of its electricity from a fleet of 104 reactors, most built in the 1960s and 1970s. Coal still provides about half the country's power.

To streamline construction, the Nuclear Regulatory Commission in Washington has worked with the industry to approve a handful of designs. Even so, the schedule to certify the most advanced model from Westinghouse, a unit of Toshiba, has slipped during an ongoing review of its ability to withstand the impact of an airliner.

The Nuclear Regulatory Commission has also not yet approved the so-called EPR design under construction in Finland for the American market.

This month, the United States Energy Department produced a short list of four reactor projects eligible for some loan guarantees. In the 2005 energy bill, Congress provided $18.5 billion, but the industry's hope of winning an additional $50 billion worth of loan guarantees evaporated when that money was stripped from President Obama's economic stimulus bill.

The industry has had more success in getting states to help raise money. This year, authorities permitted Florida Power & Light to start charging millions of customers several dollars a month to finance four new reactors. Customers of Georgia Power, a subsidiary of the Southern Co., will pay on average $1.30 a month more in 2011, rising to $9.10 by 2017, to help pay for two reactors expected to go online in 2016 or later.

But resistance is mounting. In April, Missouri legislators balked at a preconstruction rate increase, prompting the state's largest electric utility, Ameren UE, to suspend plans for a $6 billion copy of Areva's Finnish reactor.

Areva, a conglomerate largely owned by the French state, is heir to that nation's experience in building nuclear plants. France gets about 80 percent of its power from 58 reactors. But even France has not

completed a new reactor since 1999.

After designing an updated plant originally called the European Pressurized Reactor with German participation during the 1990s, the French had trouble selling it at home because of a saturated energy market as well as opposition from Green Party members in the then-coalition government.

So Areva turned to Finland, where utilities and energy-hungry industries like pulp and paper had been lobbying for 15 years for more nuclear power. The project was initially budgeted at $4 billion and Teollisuuden Voima, the Finnish utility, pledged it would be ready in time to help the Finnish government meet its greenhouse gas targets under the Kyoto climate treaty, which runs through 2012.

Areva promised electricity from the reactor could be generated more cheaply than from natural gas plants. Areva also said its model would deliver 1,600 megawatts, or about 10 percent of Finnish power needs.

In 2001, the Finnish parliament narrowly approved construction of a reactor at Olkiluoto, an island on the Baltic Sea. Construction began four years later.

Serious problems first arose over the vast concrete base slab for the foundation of the reactor building, which the country's Radiation and Nuclear Safety Authority found too porous and prone to corrosion. Since then, the authority has blamed Areva for allowing inexperienced subcontractors to drill holes in the wrong places on a vast steel container that seals the reactor.

In December, the authority warned Anne Lauvergeon, the chief executive of Areva, that "the attitude or lack of professional knowledge of some persons" at Areva was holding up work on safety systems.

Today, the site still teems with 4,000 workmen on round-the-clock shifts. Banners from dozens of subcontractors around Europe flutter in the breeze above temporary offices and makeshift canteens. Some 10,000 people speaking at least eight different languages have worked at the site. About 30 percent of the workforce is Polish, and communication has posed significant challenges.

Areva has acknowledged that the cost of a new reactor today would be as much as 6 billion euros, or $8 billion, double the price offered to the Finns. But Areva said it was not cutting any corners in Finland. The two sides have agreed to arbitration, where they are both claiming more than 1 billion euros in compensation. (Areva blames the Finnish authorities for impeding construction and increasing costs for work it agreed to complete at a fixed price.)

Areva announced a steep drop in earnings last year, which it blamed mostly on mounting losses from the project.

In addition, nuclear safety inspectors in France have found cracks in the concrete base and steel reinforcements in the wrong places at the site in Flamanville. They also have warned Électricité de France, the utility building the reactor, that welders working on the steel container were not properly qualified.

On top of such problems come the recession, weaker energy demand, tight credit and uncertainty over future policies, said Caren Byrd, an executive director of the global utility and power group at Morgan Stanley in New York.

"The warning lights now are flashing more brightly than just a year ago about the cost of new nuclear," she said.

And Jouni Silvennoinen, the project manager at Olkiluoto, said, "We have had it easy here." Olkiluoto is at least a geologically stable site. Earthquake risks in places like China and the United States or even the threat of storm surges mean building these reactors will be even trickier elsewhere.

Matthew L. Wald contributed reporting from Washington.