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Analyzing the Domestic Nuclear Revival

Presented by Eric P. Loewen, Ph.D.
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Vice President/President Elect, American Nuclear Society

On behalf of the American Nuclear Society – welcome! Thank you to the event organizers for thinking of and inviting me, a representative of the world's premier nuclear science and technology society – the American Nuclear Society – to address this august group. Our 11,000 members seek to promote nuclear science and technology.

These are challenging times. Our economy continues to recover, but is not yet self-sustaining. Economies worldwide have been impacted by one of the most severe and rapid global financial meltdowns in history. We are three years into the global financial crisis, and its effect still dominates the economic outlook. And on top of this, the U.S. is faced with significant energy and environmental challenges. While electricity demand slightly decreased in 2008 and 2009[1] with our contracting economy, long-term demand remains robust. As America's need for energy grows, policy makers are actively developing a portfolio strategy for energy technologies and sources with the objectives of reducing the nation's dependence on imported oil and more importantly in the short term, providing the foundation for economic stimulus and job creation.

A policy alternative is to increase production of electricity from safe and clean nuclear power through construction. Our 104 nuclear power plants provide 20 percent of our electricity[2] and are essential to helping meet America's growing energy needs, as well as maintaining the country's fuel supply and technology diversity. Simply put, nuclear power is a safe, reliable, emission-free technology for base load power supporting U.S. energy security.

We know that advancing nuclear power will require significant investment – not just capital, but also in people and policy. The shifting nuclear landscape – climate change legislation, energy independence, transmission capacity constraints, and tight capital markets – is not a barrier to new nuclear technology but creates an opportunity for the industry.

You're going to hear a lot about the nuclear "revival" in the days ahead. And I'm sure you've read and heard plenty about new nuclear construction in this context. First, let's look at the etymology of the word "revival" itself, and whether, as an industry, we are promoting a flawed definition, or, worse, using the wrong word.

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[1] Annual Energy Outlook 2010 with Projections to 2035, U.S. Energy Information Administration.
[2] Nuclear Energy Institute.

A POOR WORD

The Oxford English Dictionary tells us that revival is (1) an improvement in the condition, strength, or fortunes of someone or something; or (2) an instance of something becoming popular, active, or important again. Both definitions for new nuclear are poor. The former suggests a "restoration to life or consciousness", indicating that nuclear has been in a weakened state, dormant, or in decline. The latter can imply that nuclear has lacked relevance or importance in an economic context. Quite the contrary, nuclear is integral to our economy, standard of living and competitiveness, is financially healthy, is safe and reliable, and delivers environmental benefits.

Granted the U.S. has not constructed a new nuclear plant in some years, but our country has never stopped working on large, complex capital projects throughout the country such as the Boston big dig, pipe lines, bridges, and buildings. We have, however, built about sixteen "virtual" reactors over the past 15 years through an ongoing part of maintaining and refurbishing the 104 existing reactors by power up-rates and improving capacity factors. And the large reactor vendors, AREVA, GE Hitachi Nuclear Energy, and Westinghouse are building now outside the United States.

Thus, as operating licenses are extended and the construction of new nuclear plants ramps up, we should be promoting and improving the industry using a more favorable and simpler term – *new nuclear development.*

INVESTMENT REQUIRED FOR NEW NUCLEAR DEVELOPMENT

The backdrop for new nuclear development in the U.S. portrays a landscape of opportunity, albeit with challenges. Experts forecast that the electric power industry must invest $1.5 to $2 trillion in new electric generating capacity, new transmission and distribution infrastructure, and associated technologies by 2030[3]. This amount of capital represents a significant challenge for the electric power industry. But electric power capacity growth is needed to sustain our trillion dollar economy in the future.

For nuclear developers and operators here today, the challenge is equally significant. Nuclear plants are complex, capital-intensive projects, with construction costs estimated up to $10 billion or $4,000 / kW[4] for a large reactor. The largest electric utility has a market capitalization of approximately $32 billion[5], but most utilities are much smaller. The relatively small electric power companies do not have the balance sheet or financial strength to finance nuclear power construction absent project partners or some form of credit support.

The federal loan guarantee program authorized in Title XVII of 2005 Energy Policy Act should help offset the disparity in scale between the electric utilities and these large nuclear plant projects. There are recent signs, however, that the program is in need of reform shown, for example, with the recent disclosure of the UniStar loan guarantee for

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[3] Financing New Nuclear Power Plants, NEI Policy Brief, March 2010.

[4] Update on the Cost of Nuclear Power, Yangbo Du and John E. Parsons, Center for Advanced Nuclear Systems, Massachusetts Institute of Technology, May 2009.

[5] The Southern Company (NYSE: SO) market capitalization of $31.66 billion as at Oct-21-10.

the 1,700 MWe project at Calvert Cliffs. The Office of Management and Budget has set terms and conditions (with fees set 11.6% based on a calculation of loss given default) which may destroy the project's economics and prevent the project from proceeding[6].

THE DRIVERS OF NEW NUCLEAR DEVELOPMENT – WHY THE PUSH?

Interest in new nuclear development in the U.S. continues to grow, driven by a number of key economic, environmental, and political factors.

From an economic perspective, the demands on natural gas fuels driven by the electric generating needs over the past 10 years has placed an unsustainable demand on natural gas supply, creating volatility in prices. U.S. commercial nuclear reactors, on the other hand, depend on uranium as a fuel source – the cost for which is relatively stable. Nuclear power plants are also a compelling source of job creation – in fact, nuclear plants provide an average of 500 jobs per 1,000 megawatts of generating capacity, compared to 220 jobs in coal, 60 jobs in natural gas, and 90 jobs in wind[7].

Nuclear power plants in the U.S. also operate with a high degree of reliability, with an average capacity factor of 90% since 2000. Currently, our fleet of reactors operates at 91.5% capacity, which is more efficient than coal at 70.8%, combined cycle natural gas at 41.7%, and wind at 31.1%[8]. Let me note this comparison of capacity factors is not totally fair as many natural gas plants are run as peakers and not as base load as a nuclear power plant is, however the numbers give us an idea of magnitude.

The environmental benefits of nuclear power are well documented. Nuclear energy produces 72% of all U.S. emission-free electricity. In 2008, nuclear power prevented nearly 700 million metric tons of carbon dioxide emissions, almost equal to the amount of carbon dioxide emissions from all U.S. passenger cars in a year. Restrictions on sulphur dioxide, nitrogen oxide, and mercury emissions already exist and continue to tighten. Regulatory concerns over carbon dioxide emissions also continue to grow now that the EPA has entered the arena. Nuclear power plants do not have any of these emission issues making them a viable energy source with limited environmental footprint.

A re-emerging topic on many political agendas is security of supply, as we continue to realize how vulnerable we are to interrupted deliveries of oil and gas. The abundance of naturally occurring uranium and the large energy yield of each ton makes nuclear power attractive from an energy security standpoint.

THE STATUS OF NEW NUCLEAR DEVELOPMENT

Though some have suggested that the U.S. is "going nowhere" relative to other countries in nuclear development[9], there has been some promising activity.

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[6] WNA Weekly Digest, 14 October 2010.

[7] Nuclear Energy Institute, "New Nuclear Plants: An Engine for Job Creation, Economic Growth".

[8] NEI

[9] The American Spectator, "Nuclear Renaissance Blossoms – Without the USA", October 2010.

There are currently 22 reactor units under active NRC review, across ten states. Fourteen of these applications are for AP1000 designs, with the balance classified as APWR, ESBWR, and EPR designs. The earliest companies to submit these licence applications have already begun site preparation, and components with long lead times have been ordered.

Based on this information, it is expected that four to eight new reactors will be operational by 2020[10]. Some industry players have explained the limited number of recent new-builds to be a result of the effective maintenance strategies on existing reactors.

Looking internationally in 2009 construction started on twelve new nuclear power reactors, the largest number since 1985! A total of 56 reactors are under construction worldwide, again the largest number since 1992. The interest by countries in starting new nuclear power programs remains high.

As the ANS Vice President I traveled to the International Atomic Energy Agency's (IAEA) fifty-fourth General Conference, met all of the six Deputy Director Generals and listened to many of the countries' statements on nuclear power. What I took away was the growing importance of and international interest in nuclear energy. Briefly, here are some quotes of what some of those countries stated on the world stage:

The United Kingdom stated: "… we will remove any unnecessary obstacles to investments in new nuclear, by continuing to deliver on facilitating measures such as streamlining planning and making a decision about Regulatory Justification of new nuclear reactor designs. The government also wants to provide the long-term certainty needed for clean energy projects, including nuclear, by putting a price on carbon."

France shared: "In order to move towards nuclear energy production, a strong financial commitment is necessary with planning for investment, operation under the best conditions for several decades, followed by facility decommissioning. We call on the international financial institutions to commit to appropriate financing of civil nuclear energy which should be recognized as fully carbon-free form of energy."

Germany stated: "Germany will continue to support its efforts for a nuclear energy that is safe, secure, cost-effective and sustainable."

And a statement delivered on behalf of Pope Benedict XVI sees "… nuclear techniques can in many ways make a significant contribution to responding to the most urgent concerns, for example, the management of drinking water supplies, the production of crops which give an improved yield….. I wish to mention the particular role of radio-nuclides used in the diagnosis and treatment of malignant diseases."

The quote I liked best was from the Director General Mr. Amano: "… I intend to encourage international lending institutions which are reluctant to support nuclear power

[10] World Nuclear Association, "Plans for New Reactors Worldwide", August 2010.

projects to be more open to such projects. Lending institutions should consider a new approach, bearing in mind the fact that a large number of countries recognize nuclear energy as a stable and clean source of energy which they may wish to include in their energy mix."

Take a look at this graph that AREVA provided me showing the average construction time for the 104 reactors of the Generation II type in the U.S. was about nine years – or about 112 months. I think this provides a coherent benchmark for today. Today the nuclear industry is building Generation III reactors quicker than these previous Generation II reactors. We are learning. We are getting better.

I saw this in action when I toured Flamanville on my last ANS official visit. It was a beautiful sight to see a nuclear power plant under construction.

HOW CAN ANS HELP CONSTRUCT NUCLEAR POWER PLANTS?
How can ANS help construct nuclear power plants? Standards. Standards to drive better construction. Let me explain. The mission of the American Nuclear Society (ANS) Standards Committee is to develop voluntary consensus standards to be certified by the American National Standards Institute (ANSI) as American National Standards. ANSI has served as administrator and coordinator of the United States' private sector voluntary standardization system for more than 90 years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations. ANSI's prescribed process for developing standards is set forth in the ANS Standards Committee Rules and Procedures.

The process to produce a standard requires much time, patience, and, most of all, dedication by our members and non-members. The birth of a standard begins with recognizing a need for a particular standard. Right now ANS has over 22 standards that I think will help construction professionals like you to better build a nuclear power plant if you incorporate that wisdom now.

1) ANS-2.25, "Surveys of Ecology Needed to License Nuclear Facilities" to get your project started.

2) Or "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design."

3) Then there is "Design Requirements for New Fuel Storage Facilities at LWR Plants."

Though I only mention those three, I have provided a copy of the pertinent standards as an appendix to this speech.

OUR PATH

We can do this. We can build new nuclear power plants in this great country. New nuclear power development. Why do I think this? We don't have it that bad.

What if you were John Stevens, who was selected by the U.S. to continue building the Panama Canal? Considered the best construction engineer in the country at the age of 52, and of whom President Roosevelt said was "a big fellow, a man of daring and good sense, and burly power," he faced in the creation of the Panama Canal an unprecedented feat of engineering. At its time, the Panama Canal project was the largest, most costly single effort ever mounted on earth. It spanned 40 years! It affected the lives of over 10,000 people. France was rocked to it foundations in its failure to complete the project. It marked a score of advances in planning, engineering and project controls.

A visualization of the volume of earth that was removed is difficult to convey. The total excavation of the Canal would fill an unbelievable number of train cars that would encircle the world four times at the equator. Or with the same volume you could build 63 of the world's largest pyramids. All we're trying to do now is build a power plant.

So what can we learn from the Panama Canal? Courage and tenacity need to be of the highest order to meet unexpected obstacles. We can and will overcome those obstacles.

WHAT NOW?

Remember, this is not the *revival* of our industry, but rather the *development* of it. We are not dormant or in a weakened state. We have been and remain critical to stimulating economic growth, creating jobs, fostering research and innovation, and supplying critical base load electricity generation. And we do so in an environmentally sustainable manner.

So now it's time to do our part. As you share information at this meeting to improve our industry, let's remember the larger audience outside these walls. Remember your neighbors. Let's help them put fear aside and embrace the knowledge that nuclear power is the safest, large-scale energy source on earth.

Good luck, enjoy the summit, and I wish you all very successful and rewarding careers.

ACKNOWLEDGEMENT

I wish to acknowledge the contributions of Richard Simm and Ernst & Young to this speech.

ANS Standards:
Standards Related to Construction/Design of Nuclear Facilities

*Standards in development

ANSI/ANS-2.2-2002, "Earthquake Instrumentation Criteria for Nuclear Power Plants"

*ANS-2.3, "Determining Tornado and Other Extreme Wind Characteristics at Nuclear Facility Sites"

*ANS-2.15, "Criteria for Modeling and Calculating Atmospheric Transport of Routine Releases from Nuclear Facilities"

*ANS-2.17, "Evaluation of Radionuclide Transport in Ground Water for Nuclear Facilities"

*ANS-2.25, "Surveys of Ecology Needed to License Nuclear Facilities"

ANSI/ANS-2.26-2004 (R2010), "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design"

ANSI/ANS-2.27-2008, "Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments"

ANSI/ANS-2.29-2008, "Probabilistic Seismic Hazard Analysis"

*ANS-2.30, "Assessing Capability for Surface Faulting at Nuclear Facilities"

ANSI/ANS-3.11-2005, "Determining Meteorological Information at Nuclear Facilities"

*ANS-40.21, "Siting, Construction, and Operation of Commercial Low Level Radioactive Waste Burial Grounds"

ANSI/ANS-40.37-2009 "Mobile Low-Level Radioactive Waste Processing Systems"

*ANS-41.5, "Verification and Validation of Radiological Data for Use in Waste Management and Environmental Remediation"

ANSI/ANS-51.1-1983; R1988; W2000, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor "

ANSI/ANS-52.1-1983; R1988; W2001, "Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants"

*ANS-53.1, "Nuclear Safety Criteria for the Design of Modular Helium-Cooled Reactor Plants"

*ANS-54.1, "Nuclear Safety Criteria and Design Process for Liquid-Sodium-Cooled-Reactor Nuclear Power Plants"

ANSI/ANS-55.1-1992; R2000; R2009, "Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants"

ANSI/ANS-55.4-1993; R1999; R2007, "Gaseous Radioactive Waste Processing Systems for Light Water Reactor Plants"

ANSI/ANS-55.6-1993; R1999; R2007, "Liquid Radioactive Waste Processing System for Light Water Reactor Plants"

ANSI/ANS-57.1-1992; R1998; R2005, "Design Requirements for Light Water Reactor Fuel Handling Systems"

*ANS-57.2, "Design Requirements for Light Water Reactor Spent Fuel Facilities at Nuclear Power Plants"

*ANS-57.3, "Design Requirements for New Fuel Storage Facilities at LWR Plants"

ANSI/ANS-57.5-1996; R2006, "Light Water Reactors Fuel Assembly Mechanical Design and Evaluation"

ANSI/ANS-57.9-1992; R2000, W2010,"Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)"

*ANS-58.2, "Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture"

ANSI/ANS-58.8-1994; R2001, R2008, "Time Response Design Criteria for Safety-Related Operator Actions"

ANSI/ANS-58.9-2002, "Single Failure Criteria for Light Water Reactor Safety-Related Fluid Systems"

ANSI/ANS-58.11-1995; R2002, "Design Criteria for Safe Shutdown Following Selected Design Basis Events in Light Water Reactors"

*ANS-58.14, "Safety and Pressure Integrity Classification Criteria for Light Water Reactors"

*ANS-58.16, "Safety and Pressure Integrity Classification for Non-Reactor Nuclear Facilities

ANSI/ANS-59.3-1992; R2002, "Nuclear Safety Criteria for Control Air Systems"

ANSI/ANS-59.51-1997; R2007, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators"

ANSI/ANS-59.52-1998; R2007, "Lubricating Oil Systems for Safety-Related Emergency Diesel Generators"