FORTNIGHTLY'S

SPARK

Letter #22
Oct. 2005

The on-line gateway for readers of Public Utilities Fortnightly magazine.

This year's winter meeting of the American Nuclear Society (ANS) will be held Nov. 13-17 in Washington D.C. The co-chairs are Thomas Christopher and Michael Wallace, who are featured in this month's cover story on the resurgence of nuclear power in the U.S. After the passage of the Energy Policy Act of 2005, which is revitalizing the nuclear agenda, expect quite a buzz in the air as ANS attendees look forward to new nuclear plants finally being built in the U.S.

But while the nation waits for emissions-free nuclear plants to come on-line, SAP America's Henry Bailey takes a look at emissions management and how to transform a cost center into a revenue stream. From Europe to the U.S., emissions trading takes center stage.

Lori A. Burkhart
Editor

NUCLEAR RESURGENCE

Reactors Are Back!

By Lori A. Burkhart

The Energy Policy Act of 2005 stands firmly on the side of nuclear power, incentivizing its resurgence in an industry that is recalcitrant to build with good reason. Although some 20% of our nation's energy supply comes from nuclear power, the U.S. has not ordered a new plant since 1973. But that appears to be changing.

On Sept. 15, 2005, U.S.-based Constellation Energy and French nuclear group, Areva Inc., announced formation of UniStar Nuclear, a joint enterprise to provide what it touts as an "unprecedented" business framework to design, license, build and operate new nuclear plants in the U.S. The group's aim is to deploy a fleet of advanced nuclear plants and it hopes that providing a one-stop shop will spur that industry.

UniStar Nuclear will offer this business framework to enable development of joint ventures with Constellation Energy and other energy companies. Those joint ventures in turn would license and construct, then own and operate, nuclear plants as part of a standardized fleet. Constellation Energy would operate the fleet and hold the plant operating licenses.

UniStar Nuclear will market a standard advanced design called the U.S. Evolutionary Power Reactor (U.S. EPR), which is a 1,600-MW power reactor designed for use in the U.S. by Areva. The U.S. version of the EPR is based on AREVA's advanced nuclear power plant, and two such reactors already are scheduled to be built and operated in Europe, with one under construction in Finland and the other slated for France. In the U.S., Areva as prime contractor intends to provide the nuclear »

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reactor, support systems, instrumentation, control system and initial load of nuclear fuel. Bechtel Power Corp. will support the project as architect-engineer and constructor.

But UniStar has competition. Constellation already had been a founding member of the NuStart nuclear consortium, which is testing the Nuclear Regulatory Commission's (NRC) combined operating license procedure (COL). NRC approval of any plant design is needed prior to construction. The 11-member NuStart already has chosen Entergy's Grand Gulf and Tennessee Valley Authority's Bellefonte nuclear plants sites for its COL application for building new nuclear plants. Grand Gulf in Mississippi will use the General Electric ESBWR design, while Bellefonte in Alabama will use the Westinghouse AP1000 design (*for more on nuclear plant designs under consideration, see Box, p. 8*). But while NuStart plans to use some funding from the Department of Energy (DOE) under DOE's Nuclear Power 2010 program for the expensive application process, UniStar plans to be self-funding.

Constellation, upon formation of UniStar, withdrew from consideration by NuStart of use of its Calvert Cliffs and Nine-Mile Power sites to build a nuclear plant. But Constellation intends to remain a NuStart member.

It is against this backdrop that *Spark* turned to the heads of UniStar for more information on the status of the project to build a new nuclear fleet. Interviewed are Thomas Christopher, President and CEO of Areva, Inc. and co-CEO of UniStar Nuclear, and Michael J. Wallace, President, Constellation Generation Group, executive vice president, Constellation Energy and co-CEO of UniStar Nuclear.

SPARK: How important are the incentives in the Energy Policy Act of 2005 in getting the nuclear fleet built?

Thomas Christopher: I think they were critical; they were necessary but not sufficient, if you will. They go a long way towards addressing a number of risks of new nuclear plants, but not all of them. They have taken a significant step.

Mike Wallace: I think it was extraordinarily important that Congress passed, and the President signed, the Energy Policy Act because it dealt with areas of uncertainty and risk that new owners of nuclear plants would have a very difficult time dealing with. As the first new plants come on-line there are more risks to proving out this new licensing process that has never been used, that needs to be dealt with, and the Energy Policy Act provides needed mechanisms to deal with those risks.

SPARK: Isn't it an expensive endeavor to design, build, license and operate new nuclear plants in the United States?

TC: If you look at the last ten nuclear units in the U.S. that were finished, for a variety of reasons their construction costs ranged anywhere between $2,000 per kilowatt (kW) to $4,000 to $5,000 per kW. The reasons are many. But you were left with plants like *(Cont. on p. 5)*

FORTNIGHTLY'S SPARK

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EMISSIONS MANAGEMENT

Transforming a Cost Center into a Revenue Stream

By Henry Bailey

Emissions-producing utilities—such as combustion installations with outputs of more than 20 Mega-Watts (MW), mineral-oil refineries, coke ovens and other energy intensive branches of trade—face heavy industry regulations. In order to remain in business, utilities companies today must comply with legislation, such as the Clean Air Act and the Kyoto Protocol, in addition to a host of other local, regional and environmental emissions mandates set in place to monitor carbon and other outputs with the goal of eventually decreasing air-pollution levels. Because of heavy fines levied when a utility fails to meet emissions standards, compliance is often viewed as a cost center. However, the European Union (EU) has developed an intercontinental trading system, similar to a stock market, which helps utilities companies turn compliance from a revenue drain into a profit-generating business model.

The success of the European emissions trading scheme (ETS) has spurred utility companies in the United States to sit up and take notice. Now, some forward-thinking U.S. utilities are taking the necessary steps to take advantage of this emerging industry trend by implementing robust and flexible technology solutions that help them monitor, measure, document and control emissions data, so they can meet compliance standards and effectively leverage emissions credits in the global marketplace.

The "Cap and Trade" plan, effective January 2005, is a stipulation of the Kyoto Protocol that sets limits on carbon emissions from individual industrial company sites. Under the Cap and Trade Plan, each utility site is allowed a fixed amount of emissions credits, or units of carbon that can be released into the atmosphere. Companies are then charged with monitoring, tracking and reporting emissions levels.

EU officials established the ETS as an incentive for utilities to track and report emissions levels in an efficient manner. The ETS allows utilities that have reached their maximum emissions output levels to buy credits from those that are well below their target levels. Likewise, companies that are below their carbon emission standards can sell remaining emissions credits on the ETS to utilities that have exceeded their emissions levels for a particular price point.

Many companies that have witnessed the value of the ETS—both as a way to safeguard compliance and as a potential revenue generator—justify the investment in technology tools that can help them more effectively track emissions levels. For example, a Dutch utility company might spend €500,000 to implement new technology that cuts carbon emission output by 250,000 tons. Selling those extra tons as emissions credits on the ETS can yield €1.75 million, or a profit of over one million euros. In this way, the ETS offers significant opportunity as a new »

revenue stream for utility companies.

In order to efficiently monitor, record, and report constantly changing emission levels, utilities often turn to sophisticated data analysis tools, integrated business systems and flexible monitoring technology. By investing in advanced data management and analysis technology, E.ON Benelux, a wholly owned subsidiary of E.ON Energie serving markets in Belgium, the Netherlands and Luxembourg, has been able to streamline compliance tasks and gain a clearer view of emissions output levels. With its emissions management solution, E.ON Benelux has better data visibility across all its facilities, which helps increase efficiencies and reduce both the costs of compliance and the risks of noncompliance. Utilizing powerful scenario and analysis management capabilities, E.ON Benelux quickly can describe each site and its emissions-related processes. They also easily can track instances where emissions levels exceed set limits in near real-time, thereby managing incidents and generating the necessary reports in a well-organized manner.

Some of the key benefits that the E.ON Benelux achieved with an advanced emissions management solution include:

- Meeting regulatory requirements for a 5% decrease from 1990 levels of green-house gases by 2008 to 2012;
- Enhanced performance requirements on corporate and plant levels by effectively measuring environmental Key Performance Indicators (KPIs);
- Meeting international conventions for environmental protection, *e.g.* Kyoto Protocol; and
- Addressing standards and commitments, *e.g.* Global Reporting Initiative, Responsible Care, ISO 14064.

The fact that more than five million tons of carbon dioxide was traded in the month of January alone is testament to the success of the ETS in reducing emissions on a global scale. BP London was testing inner-company green-house gas - trading between 1998 and 2001 and achieving significant results. "With our Emissions Management system we were saving more then 10 million tons of carbon dioxide and 600 million US dollars."[1]

Barclays Capital has predicted the carbon credit market could be worth 40 billion euros a year. The future cost of emissions credits is bound to increase as companies expand and regulations become more stringent. In fact, the cost of carbon credits shot up from €6 per ton in January to €29 in June 2005.

The success of the ETS in Europe has spurred increased interest in an equivalent system among American utility and energy companies. Nine northeastern U.S. states are working out a local cap and trade program similar to the ETS, called the Regional Greenhouse Gas Initiative. Officials in this region have agreed to hold power-plant emissions at their current levels and reduce them by 10 percent by 2020. Revenue from the sale of emission credits should be able to offset any potential rise in energy prices. California, Washington and Oregon are exploring a comparable agreement.

As the idea of an emissions trading market gains popularity in the United States, the Tesoro Corporation, based in San Antonio, Texas, is one energy company poised quickly to take advantage of this emerging revenue stream. Tesoro considers being in compliance with regulations such as the U.S. Clean Air Act a top priority. With six refineries scattered across some of the most ecologically fragile areas of the Western United States and producing nearly 560,000 barrels of oil per day, having complete enterprise-wide visibility is a challenge. Tesoro implemented SAP's xEM solution, through which it created a centralized enterprise portal to be used for the management of all environmental tasks. The portal allows Tesoro employees to access lists of equipment, view emissions output levels and quickly determine the applicable regulation and action required, which helps minimize risk and ensures timely completion of tasks. Tesoro's new technology not only allows for a quicker response time to possible compliance issues, but also provides a clear audit trail that more than meets regulatory requirements.

In order to have the enterprise visibility and data management capabilities necessary to both remain in compliance with regulatory measures and partake in regional trading programs such as the ETS and Regional Greenhouse Gas Initiative, utilities companies should consider technology solutions that can help store, manage, track and analyze all aspects of emissions data. Companies that are looking to automate emissions management processes should consider the following questions when evaluating both a vendor and a solution:

- How are you currently addressing existing emissions management regulations? Do you have various emissions sources, and can you easily estimate, calculate and analyze emissions output levels?
- Do you have an enterprise-wide risk management project (including different subsidiaries acting globally)? How do you manage plant performance, operations planning, and investment decisions?
- Can you support reporting scenarios that facilitate compliance with legal regulations?
- Are you able to create a lifecycle assessment for your processes?

Utilities companies should look for solutions that can completely address all environmental aspects of emissions compliance requirements, including reporting, while providing an opportunity to leverage emerging

emission-trading programs, easily integrate into the process of the utility operations for enterprise-wide visibility, and contain best practices to optimize the environmental health and safety demands to be a best-run utility. ■

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Endnote:

1 Wilhem Bonse-Geuking, CEO, BP Germany

Reactors Are Back!

(Continued from p. 2)

Comanche Peak, Diablo Canyon etc., which began operation with costs on the books of $4 billion or $5 billion per unit. Now, a number of those factors have been improved. But for example, the investment community looks at new nuclear plants through the lenses of their experiences of the 1980s. So while a new loan guarantee might reduce the interest on the construction loan by several hundred million dollars and that is significant—our issue is the billion-dollar overruns. So EPACT is a necessary first step, but not sufficient.

MW: How expensive it is really going to be is a function of the lessons learned, the experiences that we have picked up from the past. That is number one. Number two is how efficiently we can make the design and construction process, once we get through the initial learning curve for the first few. Number three is that the alternative technologies for energy in the country—oil, coal and gas—are not getting any less expensive, and the environmental demands of the future are becoming even clearer. All that favors nuclear. What we have found in the analysis that Constellation has done is that the factors are now coming together to hit a price point at $1,600 to $2,000 per kW for the U.S. EPR overnight construction costs, making that quite competitive with what we expect to be the energy needs and competitive prices that will be demonstrated as we move into the next decade.

SPARK: Are there any projections yet of earning a return and when?

TC: Yes. What you can do—and this is not proprietary information—is you take today's nuclear plants, take the top ten percent of them as a group, and develop the average cost of that group. The average fuel costs, operation and maintenance costs, decommissioning costs, insurance costs etc. Develop a complete cost profile, which you can do as those numbers are available, and escalate them. Say, "OK I am going to have a nuclear plant running in 2015. I am going to escalate this and assume this new plant will run at that level of costs." That is a fairly conservative assumption even though you have taken the top ten percent, as the new nuclear units around the world that have gone on line in the last five or six years typically have had very high performance factors. Take that as your cost base, then assume different pricing curves—also take the current capacity factor availability for that group of plants, which is up above a 90% capacity factor. Then assume a price. I saw one analysis done at $45 a megawatt hour (MWh) average price for the year. What you have got then is a model that will predict income for 30 years of »

Next Month's FORTNIGHTLY

The November *Fortnightly* has a bonus distribution at the annual conference of the National Association of Regulatory Utility Commissioners (NARUC). The focus is on regulatory issues and features interviews with state commissioners from Mississippi, New Jersey, Ohio and California. That Regulators Forum takes a bold look into the *Eye of the Storm.*

Here is more of what you will find:

- **A State Perspective**

  Natural-gas provisions of the Energy Policy Act of 2005 will improve future supply-and-demand conditions, and produce significant benefits to gas consumers in the long run.

- **The Gas Storage Conundrum**

  The Federal Energy Regulatory Commission needs to define when it will carry out its new mandate to review authorized and effective market-based rates.

- **Return on Equity: Gen Sector Issues**

  Our annual review of utility rate cases shows a vibrant—and perhaps growing—interest in rate-of-return regulation, and how public utility commissions are addressing new risks.

- **Utilities and Regulators: A Search for Harmony**

  The single biggest obstacle that must be overcome to manage regulatory uncertainty is the lack of trust between utility leaders and regulators.

- **Rate-Base Cleansings: Rolling Over Ratepayers**

  State PUC regulators must recognize that utilities have collected enormous amounts for future removal costs, and then declare those amounts to be regulatory liabilities for regulatory and ratemaking purposes.

PLUS

- **The Energy Act and Natural Gas**
- **Commission Watch**

the plant against costs and margin that comes off of that, and then you can develop, based on that margin, the present worth of that plant when it starts up. When you do that at $45 per MWh, it says you can afford to spend over $4 billion for the nuclear plants. Somewhere between $4 billion and $4.5 billion is the net present value for that margin. So this play in my mind in the investment community is not so much "alright I can get a bid from the vendor at $2.8 billion for the total plant or $3 billion," it is the potential cost overruns that came out of the actions of the 1980s, that is the biggest issue. The energy bill addressed some of those critical factors, not all of them, but several.

MW: Everybody who is focused on looking at new nuclear has developed sophisticated financial models. The challenge we have had is there are so many variables that affect the outcome of those financial models. The biggest variables have been the uncertainties associated with the regulatory process. Those uncertainties have been well dealt with in the Energy Policy Act. So the assumptions going into our model have been firmed up a little more. We still need to be able to demonstrate, by virtue of plants actually being licensed, that the process will work in an efficient and effective way. Our expectation is that it will. Congress expects it to, the Administration expects it to, and frankly the general public needs new nuclear plants as an environmentally friendly, economic source of power for the future—and one that is less dependent on foreign sources for fuel.

SPARK: What about siting? Have you chosen sites for the new nuclear plants?

TC: Well, what the industry is doing both through the NuStart operations and through a variety of early site permits is looking at a number of sites. I would say the majority of them are existing nuclear plant sites, which were at one time licensed for more than one nuclear plant. So you see for example, Dominion, is negotiating an early site permit. They have looked at North Anna, which originally was supposed to have four nuclear units and currently has two. Exelon has looked at Clinton, which originally was supposed to have two units and currently has one. Grand Gulf is the same; it was supposed to have four units and currently has two. There are around the U.S., by my estimate, about 15 sites where originally you were going to have multiple nuclear plants and the site infrastructure originally was also built for those, but then the units were cancelled. Those form the primary opportunity for power plants. Another example is Bellefonte for TVA. Some customers are beginning to look at brownfield sites, meaning sites that might have fossil plants on them or were going to have fossil plants. So while I have heard talk of brownfield sites, I would say the higher probability is existing nuclear plant sites.

"At Constellation we believe both our Calvert Cliff site in Southern Maryland and our Nine-Mile Point site in upstate New York are candidates for new U.S. EPRs."

—Mike Wallace

MW: In forming UniStar, the business model we have established with Areva, the goal is to build a fleet of standardized units. We are absolutely committed that the fleet approach will reduce uncertainties the most and bring the greatest savings through synergies for the new plants that come on-line. In our model Areva designs it, Bechtel constructs it and Constellation is the licensee and operator. We then will be continuing discussions with other parties who are owners or potential owners, and those discussions will also determine potential sites. At Constellation we believe both our Calvert Cliff site in Southern Maryland and our Nine-Mile Point site in upstate New York are candidates for new U.S. EPRs. We are evaluating those sites and the economics that would have to come into balance to makes sense. We expect the UniStar model to lead to our working with other energy companies who may well have nuclear sites themselves or sites that at one point were going to be a place for new nuclear plants that they will offer, along with taking a significant ownership interest in an individual site that may be within their territory.

SPARK: Has your relationship with the NuStart nuclear consortium changed now that you are embarking on this endeavor?

TC: Our relationship was never a direct one because at the time NuStart started three years ago we had not made the decision to go ahead and invest in the licensing in the EPR in the U.S. So they went on their own with the two vendors at that time, GE and Westinghouse. We have never been a part of the NuStart initiative, nor privy to any of the DOE funds for the design certification process. Our decision was two years ago to say "all right we missed that train, we think enough of this market to take the risk ourselves," so we stepped in said we will spend the full $140 million to get our unit licensed in the U.S. on our own. »

MW: We are actually quite clear about that. Constellation Energy was one of the founding members of NuStart and we continue to be a full supporter of NuStart. We believe the objectives of the multiple parties who formed NuStart are still valid today, and that is to pursue the ESBWR and the AP1000 through a COL process so as to demonstrate the viability of the New Part 52 licensing. That is important to us as a country, to have those two nuclear products and the U.S. EPR as a third product. It is absolutely appropriate in the marketplace, and the ESBWR and the AP1000 may well prove out the Part 52 process for everybody sooner than any other step that could be taken given how far we have advanced. So we will continue as members of NuStart, including providing our financial support.

SPARK: The EPR reactor, what is the status of construction or operation of them in other countries?

TC: The 50-cycle version of the EPR is being constructed in Finland and it is about 20 percent complete. It is due for start-up—initial hot testing and core loading in the fall of 2008, with full-power operation in 2009. The actual construction cycle on the ground is going to take something like 48 months. There is an order for a second EPR in France in Flamaville, where construction will begin in 2007. So the Finland EPR licensing approvals have been received and they are well into construction. For example, the containment base mat is nearing completion, the containment shell has been delivered and equipment has started to arrive on site.

SPARK: What makes the EPR design the one you have chosen to construct?

TC: We did a market test, if you will. In the sense that four years ago Finland came out for bids for new nuclear plants. They got bids from the Russians, they got bids from my colleagues in France on the EPR and they got bids from GE. They did a detailed evaluation for many months. At the same time we gave them an alternate bid for a simplified boiling water reactor, which had been developed by our colleagues in Germany—the former Kraftwerk Union Nuclear, which merged with Framatome several years ago. As a result of almost nine months of evaluations, the Finns came back and said the EPR wins hands down. It was quite a test in the sense that it was a fixed-price, turnkey contract. We then took that in the U.S. and began to look at what it would take to make a U.S. EPR, meaning one that didn't run on 50-cycle electricity, but one that would run on 60 cycles, with the design and engineering base here in the U.S. We had just completed the acquisition of Duke Engineering and Services and had a sufficient engineering resources base that could take that on. What came out of the market test was that we thought this was a slightly different concept than our competitors' models in the sense that it doesn't introduce new passive systems; it stays with the existing systems. It advances the components; it is more like a series of customized improvements rather than totally new systems. So as you look at each of the components you can see that each one of them through the German/French knowledge, the European knowledge, was advanced substantially. For example, eliminating cooling requirements or improving operational characteristics. And then the fundamental issue we had to face was the unit was designed to the very severe European standards, which are currently more restrictive than the U.S. standards. But it was our feeling that rather than waste the money to try and redesign, it is better to stay with what we have as it is proven, and the design is complete, even though it is something of a fortress. Contrary to our competitors, this is a double containment, bunkered, reinforced concrete structure that can take an airplane crash of certain size anywhere in the plant. It is extremely rugged and it has very high margins of safety, much greater water volumes and things like that. Many of those things are not required in the U.S., but we felt when you talk about a new plant in the U.S. that might be running say 70 years from now, assuming that it would start up in 2015, taking that extra step for the design measures is a prudent thing.

"This is a double containment, bunkered, reinforced concrete structure that can take an airplane crash of certain size anywhere in the plant."

—Thomas Christopher

MW: The U.S. EPR is appropriately how we refer to it because it is an evolutionary design that really has its roots in 40 years of pressurized water reactors in the U.S. and then further development of those reactors in Europe. Now that design actually is being constructed in Finland, which is an extraordinary fact for us, because that brings a new technology nuclear plant with significantly enhanced security and safety features to the real world. It is physically being built, it already has been designed and the design »

approved by the Finnish regulatory authorities. So we are taking that design and we are converting it to a U.S. design—we have to go from 50 cycles to 60 cycles—and then conform to U.S. code standards and regulations including those of the Nuclear Regulatory Commission. When we have done that, we will have a U.S. EPR. In fact, the design work is being done principally in Lynchburg, Virginia among the various Areva facilities, with Constellation Energy, our team, providing oversight from an operations, maintenance and construction point of view. So we are creating the U.S. EPR from the Finnish plant being built in Finland, which itself evolved from over 40 years of global PWR technology.

So why pick it? We believe the U.S. EPR provides the greatest degree of certainty in the design and in construction because we are evolving into a U.S. form of a plant that already has been licensed and is under construction and reflects significant improvements in safety and security.

SPARK: What is the status of the application process at the Nuclear Regulatory Commission?

TC: We filed the initial set of documents. The actual design certification application itself should go in in another 18 months. We are in the process now of going through all of the detailed design information from Finland, converting those things that need to be converted to the U.S. standards, finishing the analysis and getting ready for the submittals. That process is going to take us about 15 months. It's a little different from other design certifications in that we are basing ours on an actual plant that already exists.

MW: We have had discussions just since the formation of UniStar, Tom Christopher and I, with the NRC about our intentions to convert the design to a full U.S. design. That work is ongoing now in preparation of filing for design certification, which Areva will do, and in preparation for filing for a COL, which UniStar will expect to do with parties we are in dialogue with as we seek to firm up locations for the first

Nuclear Plant Designs at the NRC

(June 2005)

The review process for new reactor designs involves the certification of standard reactor designs by a rulemaking process. Currently there are three certified reactor designs that can be referenced in an application for a combined license. They are:

- **Advanced Boiling Water Reactor** design by GE Nuclear Energy (May 1997);
- **System 80+** design by Westinghouse (formerly ABB-Combustion Engineering) (May 1997); and
- **AP600** design by Westinghouse (December 1999).

Reactor Design Review Status

The status of advanced reactor applications for both active and inactive design reviews is provided below in alphabetical order.

ACTIVE REVIEWS

- **ACR-700** - Atomic Energy of Canada, Limited Technologies, Inc. requested pre-application review of its ACR-700 design in a letter to the NRC dated June 19, 2002. The NRC expects to complete its pre-application review in 2007 and to receive an application for design certification in late 2007.
- **AP1000** - Westinghouse requested a design certification review of its AP1000 design, by letter dated March 28, 2002. The NRC issued the Final Design Approval and Final Safety Evaluation Report on Sept. 13, 2004. The AP1000 design certification rule is expected to be issued by Dec. 2005.
- **ESBWR** - General Electric requested pre-application review of its design in a letter to the NRC dated April 18, 2002. The NRC expects to complete its pre-application review in 2005 and expects GE to submit an application for design certification at the end of the summer 2005.
- **EPR** - Framatome ANP has initiated pre-application discussions with NRC staff, outlining its plans in a February 8, 2005, letter. Framatome expects to submit a design certification application in late 2007.
- **IRIS** - In an Aug. 12, 2003, letter, Westinghouse outlined its expectations for the near term review of the IRIS design. Westinghouse stated that its goal is to begin design certification review in 2006, and to deploy the first IRIS module in the 2012-2015 timeframe.
- **PBMR** - A South African firm, Pebble Bed Modular Reactor (PBMR) Pty. Ltd. notified the NRC in a Feb. 18, 2003 letter of its intention to apply for design certification and requested discussions with the NRC to plan scope and content of the preapplication review. On Nov. 3, 2004, NRC staff held a public meeting with PBMR Pty Ltd. to discuss its activities and plans to begin pre-application interactions. (*Cont. on p. 9*)

units of the standardized fleet. We talked with the NRC about the design certification timeline and we have talked with the NRC about our expected timeline for COL, both of those applications will be filed in 2007 and 2008—as we presently contemplate it.

SPARK: What is the long-term plan for nuclear waste?

TC: We, like everyone else, believe that we need Yucca Mountain long-term. This plant can run safely and economically even if it has to have dry-fuel storage, which are the dry fuel canisters stored above ground, such as many of the nuclear plants do today. In terms of operations and performance, we don't see any limits imposed by that. We are assuming economically that that would be the case, having the spent fuel in a spent fuel pit. The base option is it would be stored in dry storage canisters on site, that is, within the secured boundaries of the site. You are talking about a plant that if its starts operating in 2015, you wouldn't ship waste off site until 2020. Over the next 15 years it is our hope both that Yucca Mountain gets accelerated, and if it turns out to be economically useful, that reprocessing gets re-introduced. All of those things can go to improve costs substantially.

MW: We need a solution to the nuclear waste issue in this country for the sake of 103 operating nuclear rectors today. That need exists whether or not new nuclear plants are built. That is point one. Point two is as we go forward with the U.S EPR and move closer to the stage of construction, we will take cognizance of how things have evolved in this country, as we have several alternatives. We would hope there is a federal waste depository that is established so we have a defined process to take the fuel from the U.S. EPR and move it to a federal repository. Should there be stumbling blocks in the road of that happening in the future then we can—like we do with today's 103 operating units—use wet storage in pools or dry storage on site. So we will make the decision with respect to dry storage much further down the path as we see how things have evolved, but solution of the issue is not an ultimate barrier to moving forward. It is just one factor that will help us determine how to deal with the fuel. It is critical though that this country solves the spent fuel storage problem. »

Nuclear Plant Designs

(*Cont. from p. 8*)

PBMR expects to submit a design certification application in 2007.

INACTIVE REVIEWS

- CANDU 3U - NRC terminated its review at the request of AECL, in March 1995.
- GT-MHR - There have been no formal interactions between General Atomics (GA) and the NRC staff regarding the GT-MHR in the last 12 months. GA informally indicated it plans to terminate the GT-MHR.
- MHTGR - NRC discontinued its review in early 1996 at request of DOE.
- PIUS - The NRC documented its pre-application review of ABB-CE's Process Inherent Ultimate Safety design in April 1994 and terminated all other activities until an application for design certification is submitted.
- PRISM - The DOE submitted the conceptual design for the Power Reactor Innovative Small Module for pre-application review in Nov. 1986. DOE amended the design document in 1990 and NRC completed its review in Feb. 1994. (*NUREG-1368*, dated Feb. 1994)
- RESAR SP/90 - The NRC published its final safety evaluation report (*NUREG-1413*) for Westinghouse's advanced pressurized water reactor design in April 1991 and issued a preliminary design approval. RESAR SP/90 was the first "evolutionary" light-water reactor.
- SAFR - The NRC's pre-application safety evaluation report (*NUREG-1369*) for the Sodium Advanced Fast Reactor design, sponsored by DOE, was published in Dec. 1991.
- SBWR - GE Nuclear Energy submitted an application for final design approval and design certification in Aug. 1992. The NRC in May 1993 determined it was acceptable for review. In March 1996, GE announced the cancellation of the design certification application with an intent to shift the focus of its SBWR programs to plants of 1000 MWe (megawatts electric) or larger. At GE's request, NRC closed its review in early 1997.
- SWR-1000 - There have been no recent interactions between Framatome and the NRC staff regarding the SWR-1000 reactor design. Framatome has been interacting with the NRC staff only related to the EPR design.
- Toshiba 4S - On Feb. 2, 2005, NRC staff met with the city manager of Galena, Alaska to discuss and answer questions on the city's plans to build a Toshiba 4S reactor. To date, Toshiba has not contacted the NRC regarding possible licensing of the 4S.

(*Source—Nuclear Regulatory Commission*)

SPARK: What should our readers know about the future of nuclear power in the U.S.?

TC: There are a couple of key points. In the U.S., fuel costs are rising dramatically—coal, natural gas and oil. For example, Illinois Basin and Eastern Appalachian coal prices have doubled in two years, and where people thought at one time it was going to be a spike, now the general consensus is that people are beginning to think $45 to $55 a ton is going to be where coal prices settle. That is going to have a substantial impact on the U.S. economy. Same thing for natural gas. And, although you hear stories about uranium prices going up, which in fact they have, the uranium price is only about 20 percent of the price of the fuel for the nuclear reactor. The other pieces of it have not gone up, so in terms of fuel-cost stability, there are many customers looking at nuclear solely from that standpoint. They say, "I need to have a source of power that is stable, and not subject to these tremendous fluctuations in fuel costs." So when you talk about nuclear fuel, U-308, the yellow cake that comes out of the ground is one cost, the second cost is the processing to convert it into gas, the third cost is the cost to enrich it, the fourth cost is then to take that gas, turn it into powder and make fuel assemblies. Those last three steps are in fact showing price compression, not price increases. So on balance, even if you were to double the price of uranium coming out of the ground, you probably would see a three or four percent increase in the total cost of the nuclear plant. It is very small. So the time for nuclear plants has come, and because of the rising prices of electricity, a balanced fuel portfolio is needed. As you look at the numbers now, especially if you double the price of coal, you're looking at a nuclear plant that realistically can run ten years from now at $35 a MWh to $38 MWh, and coal plants are going to be well above $50 MWh at that time.

MW: The surveys that have been conducted through independent parties, through NEI, indicated that today roughly 70 percent of the American public believes nuclear power will be a predominant energy generating source in the future. The public is very focused appropriately on environmentally friendly technologies for the future. The public is very focused on safety. The public is very focused since 9-11 on security and the public I believe is very focused on the need for energy independence in America. Nuclear power plants serve all those needs, and therefore are the best solution for generation of large amounts of electricity in the future. They should know that companies like UniStar are working hard, along with the federal government—Congress and the Administration and the NRC—to bring all of the factors together that will make that a reality as soon as possible. ■

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