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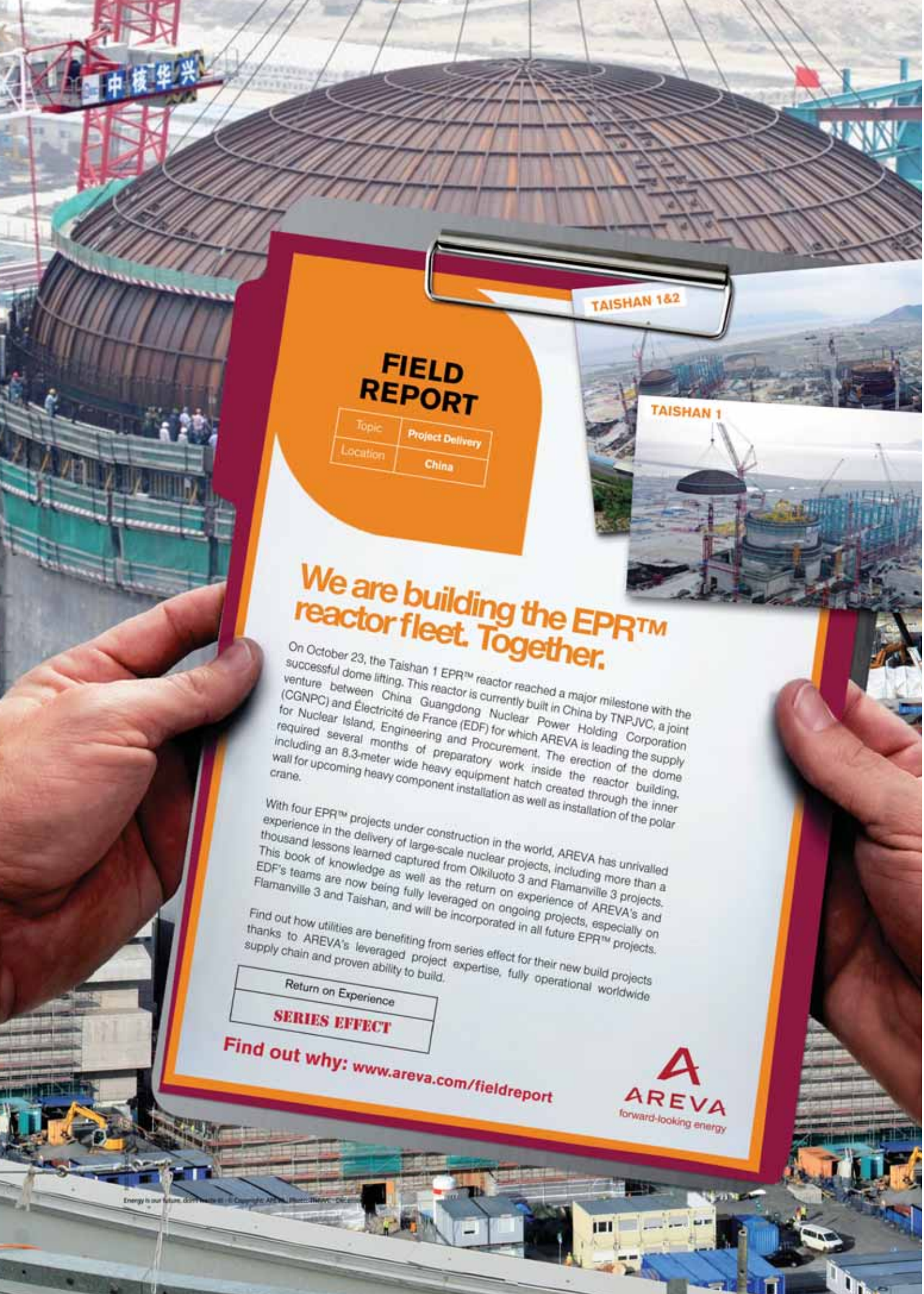
Dresden, United States


中核华兴
TAISHAN 1&2
TAISHAN 1
FIELD REPORT
Topic
Project Delivery
Location
China
We are building the EPR™ reactor fleet. Together.
On October 23, the Taishan 1 EPR™ reactor reached a major milestone with the successful dome lifting. This reactor is currently built in China by TNPJVC, a joint venture between China Guangdong Nuclear Power Holding Corporation (CGNPC) and Électricité de France (EDF) for which AREVA is leading the supply for Nuclear Island, Engineering and Procurement. The erection of the dome required several months of preparatory work inside the reactor building, including an 8.3-meter wide heavy equipment hatch created through the inner wall for upcoming heavy component installation as well as installation of the polar crane.
With four EPR™ projects under construction in the world, AREVA has unrivalled experience in the delivery of large-scale nuclear projects, including more than a thousand lessons learned captured from Olkiluoto 3 and Flamanville 3 projects. This book of knowledge as well as the return on experience of AREVA's and EDF's teams are now being fully leveraged on ongoing projects, especially on Flamanville 3 and Taishan, and will be incorporated in all future EPR™ projects.
Find out how utilities are benefiting from series effect for their new build projects thanks to AREVA's leveraged project expertise, fully operational worldwide supply chain and proven ability to build.
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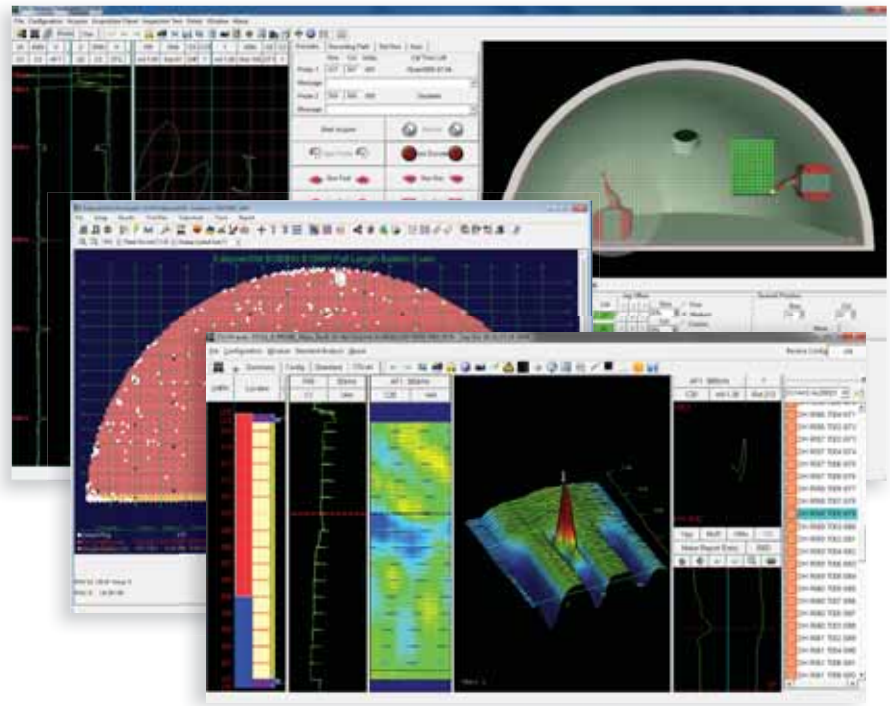

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From the world leader in eddy current steam generator inspection software comes Eddynet on the Windows PC platform. Eddynet now has the flexibility to be operated from a wider array of hardware choices. A new licensing methodology allows users to select from separately licensed acquisition, data management, and analysis modules for ultimate flexibility to match their specific inspection needs.

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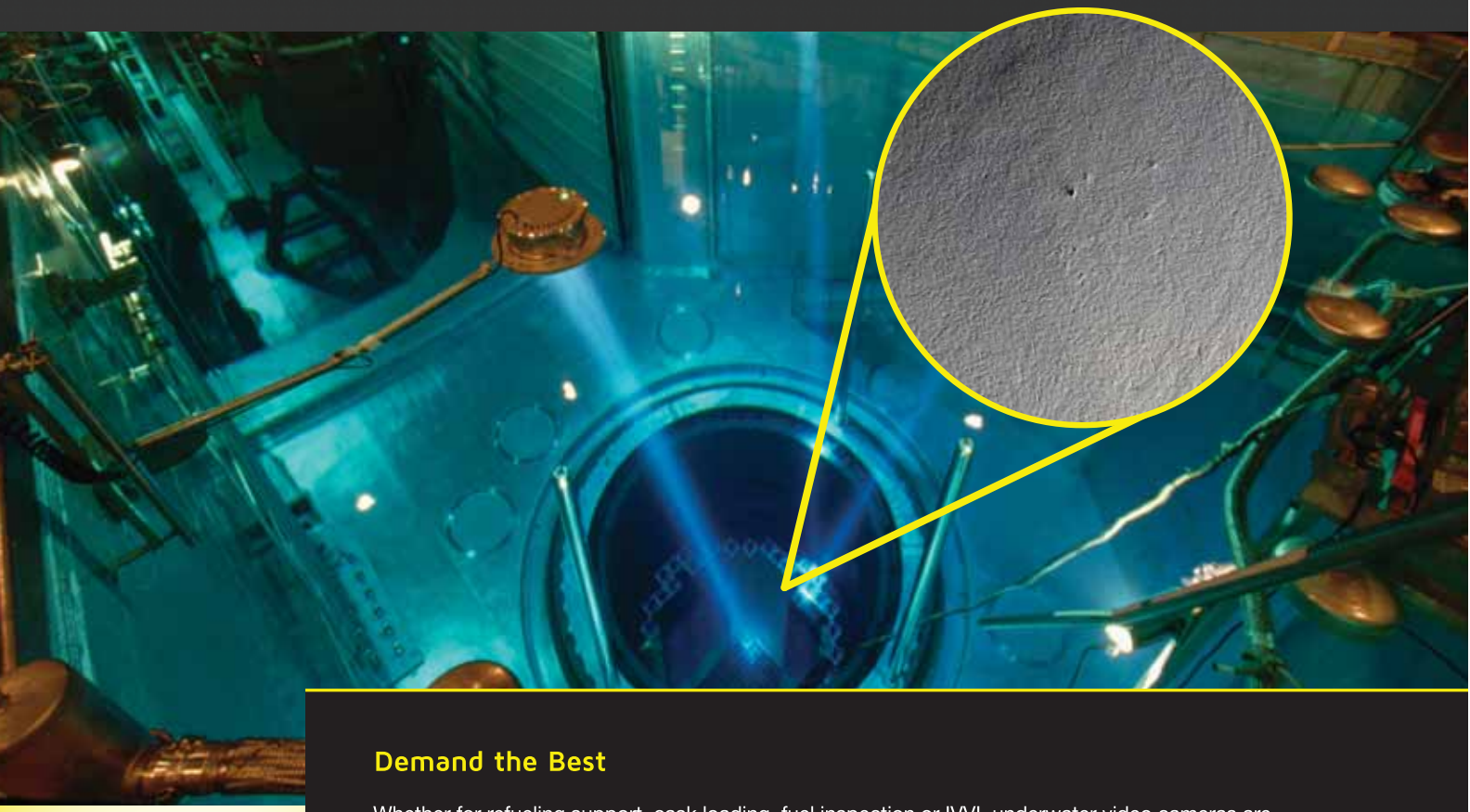

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Nuclear Plant Journal®

March-April 2012, Volume 30 No. 2

30th Year of Publication

Plant Maintenance & Plant Life Extension Issue

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The subscription rate for non-qualified readers in the United States is $150.00 for six issues per year. The additional air mail cost for non-U.S. readers is $30.00. Payment may be made by American Express®, Master Card®, VISA® or check and should accompany the order. Checks may be made payable to "EQES, Inc." Checks not drawn on a United States bank should include an additional $45.00 service fee. All inquiries should be addressed to *Nuclear Plant Journal*, 1400 Opus Place, Suite 904, Downers Grove, IL 60515; Phone: (630) 858-6161, ext. 103; Fax: (630) 852-8787, email: NPJ@goinfo.com.

Last 29 year Journal issues are now available online through the Journal website www. NuclearPlantJournal.com (search box on the right-top) for a nominal fee of $25 per issue. Contact: Kruti Patel, email: kruti@goinfo.com

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Utilities:	2,904

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Articles & Reports

Industry Innovations

Plant Profile

Departments

Journal Services

On The Cover

During its 2011 fall outage, Dresden replaced all three of its Unit 2 low-pressure turbine rotors and casings, giving the unit about 40 additional megawatts of electricity, it can now send to the grid. See page 50 for a profile.

Mailing Identification Statement

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Nuclear Plant Journal Rapid Response Fax Form

March-April 2012

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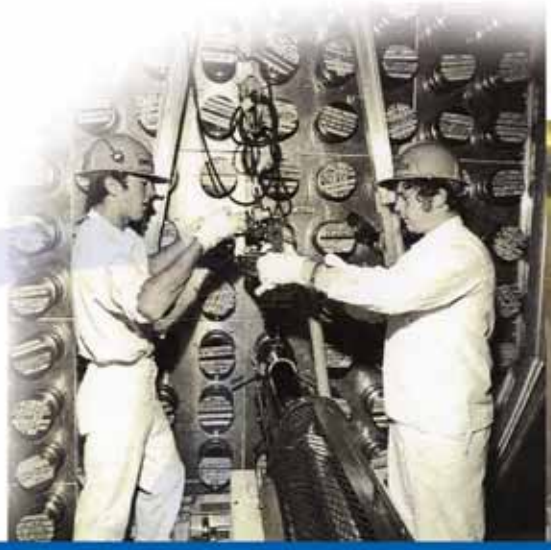

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New Energy

United Kingdom

EDF has demonstrated further progress towards plans to build up to four new nuclear plants in the UK, through signing new agreements at the Franco-British Summit in Paris on February 17, 2012. These agreements, together with others concluded by third parties in relation to safety, engineering and R&D, will support EDF's plans to develop its first new nuclear plants at Hinkley Point with its partner Centrica, England.

The project, the final investment decision for which is expected to be made at the end of 2012, represents a massive investment in UK infrastructure and unprecedented opportunities for the supply chain in France and the UK, employing up to 25,000 people over the course of construction with 5,600 people on site at peak.

The agreements signed include a £100 million–plus contract with Kier BAM, United Kingdom, for site preparation works at Hinkley Point C, a Memorandum of Understanding with AREVA relating to the delivery of the nuclear steam supply system and central instrumentation and control systems for the Hinkley Point C project and confirming the timeframe for completing the negotiation for this contract, and a £15 million investment to establish a world class national training centre in partnership with Bridgwater College in Somerset, United Kingdom.

The agreement with Kier BAM is the first major construction contract for preliminary works at Hinkley Point C, the site of EDF Energy's first two planned nuclear power plants. The initial activities in relation to these works are expected to begin this spring, 2012.

Contact: Jonathan Levy, telephone: 020 7752 2265.

United Arab Emirates

The **Emirates Nuclear Energy Corporation** (ENEC) has been granted approval by the United Arab Emirates (UAE) Federal Authority for Nuclear Regulation (FANR) for additional civil works at the proposed site for the UAE's first nuclear power plants in Barakah, located in the Western Region of Abu Dhabi.

Approval for the additional works has also been provided by The Environment Agency – Abu Dhabi (EAD), the Emirate's environmental regulator.

In October 2011, ENEC requested approval to undertake the preparatory work to ensure delivery of the UAE's first power plant safely by 2017. The additional work includes creation of a smooth, flat surface at the bottom of the excavation using a thin layer of concrete in preparation for the installation of the initial safety concrete, installation of waterproofing material over the leveled concrete, installation of encasement piping, installation of a protective layer of concrete to support installation of reinforcing steel to be performed later.

ENEC is not authorized to pour initial safety concrete until it is granted a Construction License from FANR. ENEC submitted its Construction License Application for Barakah Units 1 and 2 to FANR on December 27, 2010 and the application is currently under review. ENEC's submission also included a Nuclear Environmental Impact Assessment, which requires approval from The Environment Agency – Abu Dhabi.

Contact: Khadija Mohamed Al Marzouki, telephone: 9712 6595 863, email: khadija.almarzouqi@enec.gov.ae.

Vogtle

Construction is set to begin on the nation's first two new nuclear units in 30 years at **Southern Company's** subsidiary, Georgia Power's Plant Vogtle, near Waynesboro, Georgia.

The Nuclear Regulatory Commission (NRC) voted to approve the issuance of the Combined Construction and Operating License (COL) for Plant Vogtle units 3 and 4, the first such license ever approved for a U.S. nuclear plant. Receipt of the COL signifies that full construction can begin.

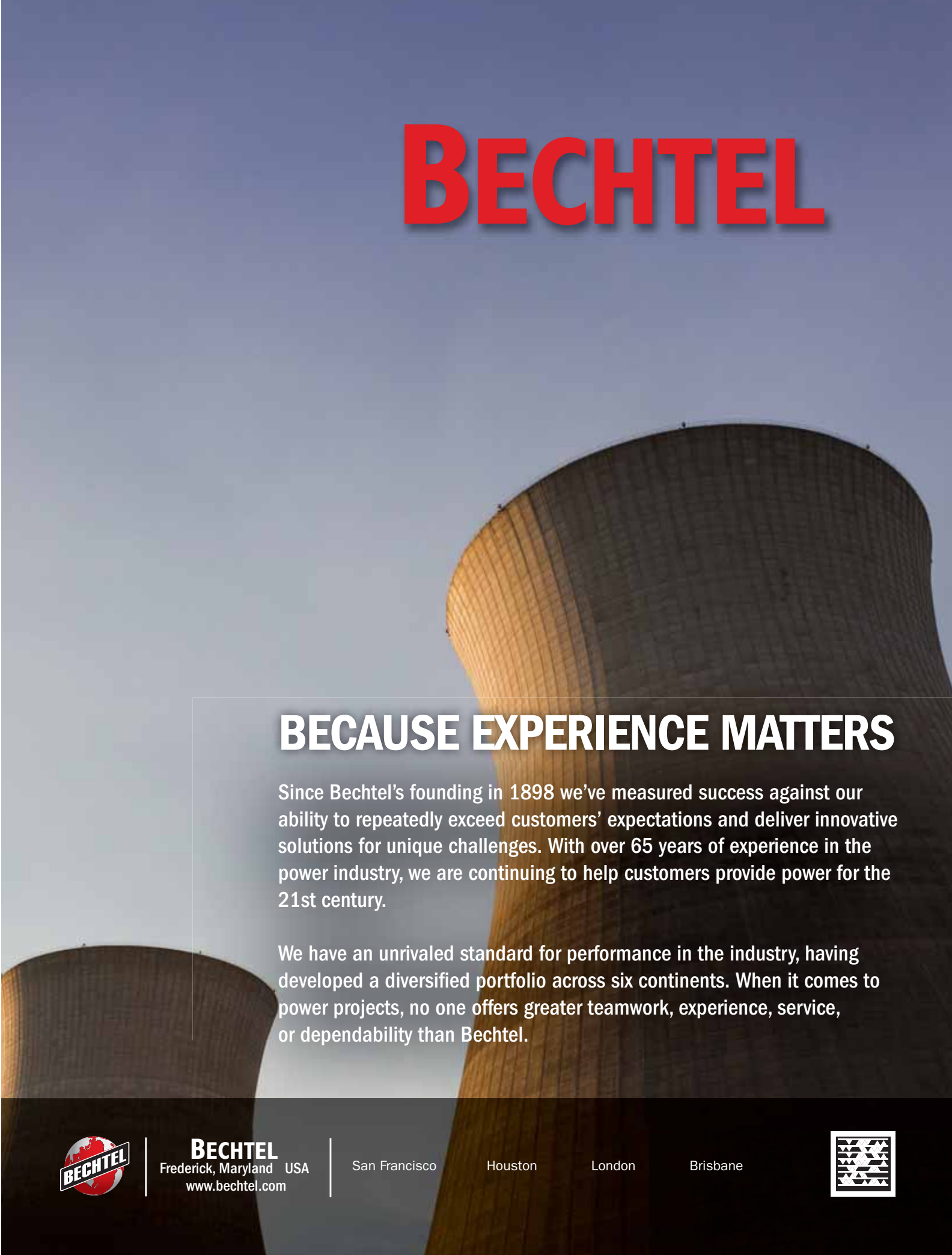
"This is a monumental accomplishment for Southern Company, Georgia Power, our partners and the nuclear industry," said Southern Company Chairman, President and CEO Thomas A. Fanning. "We are committed to bringing these units online to deliver clean, safe and reliable energy to our customers. The project is on track, and our targets related to cost and schedule are achievable."

The company expects to deliver to customers more than $1 billion in benefits from the Department of Energy loan guarantees, production tax credits and recovering financing costs during construction.

Georgia Power expects Unit 3 to begin operating in 2016 and Unit 4 in 2017.

Southern Nuclear, a subsidiary of Southern Company, is overseeing construction and will operate the two new 1,100-megawatt AP1000 units for Georgia Power and co-owners Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia and Dalton Utilities. Georgia Power owns 45.7 percent of the new units, with a certified cost of $6.1 billion.

Contact: telephone: (404) 506-5333. ■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Merger

Exelon Corporation and Constellation Energy announced that they have completed their merger, effective today. The merger creates the leading U.S. competitive energy provider with one of the industry's cleanest and lowest-cost power generation fleets, and one of the largest retail customer bases in the nation.

Upon the closing of the merger, Christopher M. Crane became president and CEO of the combined company, and Mayo A. Shattuck III became executive chairman. The new company retains the Exelon name and remains headquartered in Chicago, with significant operations in Maryland, Illinois and Pennsylvania. It will trade on the New York Stock Exchange under the symbol EXC.

Contact: Judy Rader, telephone: (312) 394-7417.

Industry

Small Modular Reactor

The **U.S. Energy Department** and its Savannah River Site (SRS) announced on March 2, 2012, three public-private partnerships to develop deployment plans for small modular nuclear reactor (SMR) technologies at SRS facilities, near Aiken, South Carolina. As part of the Energy Department's commitment to advancing the next generation of nuclear reactor technologies and breaking down the technical and economic barriers to deployment, these Memorandums of Agreement (MOA) will help leverage Savannah River's land assets, energy facilities and nuclear expertise to support potential private sector development, testing and licensing of prototype SMR technologies.

The Energy Department, Savannah River Site and Savannah River National Laboratory (SRNL) have entered into three separate agreements with Hyperion Power Generation Inc.; SMR, LLC, a subsidiary of Holtec International; and NuScale Power, LLC. The agreements will help these private companies obtain information on potential SMR reactor siting at Savannah River and provide a framework for developing land use and site services agreements to further these efforts.

Contact: telephone: (202) 586-4940.

Corporation

ATMEA1

ATMEA received the final report and findings of the review of ATMEA1 reactor safety objectives and options by the French nuclear safety authority (ASN).

The ATMEA1 reactor is an 1100 MWe Generation III+ pressurized water reactor (PWR) developed and already marketed internationally by ATMEA, a joint venture between AREVA and Mitsubishi Heavy Industries Ltd (MHI).

Its safety objectives and principles are based on the latest international standards, requirements and recommendations. The safety features of the ATMEA1 reactor meet the most demanding criteria for protecting systems critical to safety from both internal and external hazards, including earthquakes, flooding and wide-body commercial aircraft crashes, and for severe accident management and mitigation.

In concluding its review, conducted in close cooperation with the French Institute for Radiological Protection and Nuclear Safety (IRSN) and completed at the end of November 2011, ASN stated that the reactor's safety objectives and options are consistent with French regulations, as is the consideration given to internal and external hazards. In addition, ATMEA's assessment of the Fukushima accident, demonstrating that the ATMEA1 reactor's safety options are such that no design changes are needed at this time, was favorably received by ASN.

Contact: Patricia Marie, telephone: 33 (0) 1 34 96 12 15, fax: 33 (0) 1 34 96 16 54, email: press@areva.com.

Robotic Removal

Diakont recently supplied a rad-tolerant manipulator system for the remote robotic removal of Reactor Pressure Vessel (RPV) test specimens.

Test specimens are housed within containers welded to the RPV inner diameter (ID). To retrieve them, it is necessary to perform precision cuts of the welds that fasten the containers to the RPV.

Diakont's new manipulator implements technology that eliminates ingress of welding slag and other foreign material into the RPV. The manipulator is equipped with Diakont D40 radiation tolerant cameras, for monitoring of underwater operations in the very high radiation work area.

This first RPV test specimen removal manipulator has been supplied to the Kalinin Nuclear Power Plant, Russia. Presently Diakont is manufacturing an identical manipulator to be supplied to the Rostov Nuclear Power Plant, Russia.

Contact: Edward Petit de Mange, telephone: (858) 551-5551, email: ejp@diakont.us.com.

Filter System

ENERCON, an engineering, environmental and technical consulting energy company since 1983, has received patents (USPN 8048319 and USPN 8054932) for a filter medium for strainers used in nuclear reactor Emergency Core Cooling Systems (ECCS).

ENERCON's product was developed in response to the Nuclear Regulatory Commission's Generic Safety Issue, GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance."

Eleven nuclear power plants in the United States have the ENERCON Debris Bypass Eliminator installed in their ECCS sump strainers.

Contact: Peggy Striegel, telephone: (918) 740-5584, email: peggy@striegela.com.

MOU

GE Hitachi Nuclear Energy (GEH) continues to expand its presence in the Finland. The company announced it has signed a new project development memorandum of understanding (MOU) with Finnish software and systems engineering firm Space Systems Finland Ltd. (SSF), which specializes in the validation and verification of safety critical software for various industrial sectors, including the aerospace and utility industries.

Under the agreement, the companies will explore potential opportunities to collaborate on future nuclear power plant

projects globally as well as in Finland as the utility Teollisuuden Voima Oyj (TVO) is looking to build a fourth reactor at its Olkiluoto nuclear power station.

As part of the new MOU, SSF will support GEH in making sure that the ESBWR's advanced digital instrumentation and controls (I&C) systems can be licensed in Finland. SSF will review the design, and identify and recommend system architectural modifications necessary, if any, for the ESBWR design to comply with Finland's special regulatory requirements.

In order to meet TVO's project expectations and provide the most competitive bid for an ESBWR project, the MOU with SSF is part of GEH's ongoing strategy to expand its local nuclear supplier network in Finland and complement its proven global supply chain.

Contact: Michael Tetuan, telephone: (910) 819-7055, email: Michael.tetuan@ge.com.

Waste Treatment

NUKEM Technologies GmbH, Alzenau, Germany, has been tasked with turn-key design and supply of processing facilities for a new waste treatment centre to be constructed at Kursk NPP in Russia. This project is NUKEM's contribution to safe and environmentally-friendly disposal of radioactive waste currently stored and still to be generated at Kursk NPP. NUKEM will be subcontracted by Russian NIKIMT-Atomstroy, the successful bidder in an open tender for turn-key construction of the waste treatment centre.

This waste treatment centre will be designed to process all low and intermediate level solid waste as well as ion-exchange resins generated at Kursk NPP. State-of-the-art techniques will be utilized for decontamination of metal waste to release most of the material for unrestricted reuse. The remaining waste volume will be reduced using thermal and mechanical techniques, and then conditioned into a form suitable for final disposal. The engineering concept proposed by NUKEM for waste processing is based on proven technologies.

Contact: Beate Scheffler, telephone: 49 6023 911147, email: beate.scheffler@nukemtechnologies.de.

Westinghouse Canada

Westinghouse Electric Company LLC announced the formation of Westinghouse Electric Canada, Inc. to better serve its Canadian customers, strengthen its ties with Canadian suppliers, and align itself more appropriately with the regulations and requirements in Canada to meet growing business opportunities there. The headquarters will be located in Toronto, Ontario.

Westinghouse currently has more than 150 Canadian suppliers that provide a range of products and services for the Westinghouse product lines of Fuel, Services, Automation, and Nuclear Power Plants. Additionally, by establishing Westinghouse Canada, Westinghouse is further positioning itself for future new nuclear power plant business there. Utilities in Canada are expressing interest in the Westinghouse AP1000® pressurized water reactor (PWR) – widely regarded as the safest, most-advanced PWR technology currently available – and the Westinghouse Small Modular Reactor, a 200 MWe class integral PWR currently under development that is suited for smaller electrical grids, distributed generation, and process heat requirements.

Contact: Scott Shaw, telephone: (412) 374-6737, email: shawsa@westinghouse.com.

Engineering Agreement

Zachry Nuclear Engineering Inc. has been selected as one of the four engineering firms to support the Nebraska Public Power District's Cooper Nuclear Station under a two-year Master Engineering Agreement running through December 31, 2013. Work to be performed includes modifications; analysis and supporting calculations; specifications; project scoping studies; project management; modification work plans; field follow-up; modifications closeout; programs support; owner reviews; and other engineering and professional services. Zachry Nuclear Engineering, a full service engineering firm that provides engineering, design and project management services to the operating nuclear fleet, is an Engineer of Choice at 16 nuclear plants in the United States.

Contact: Lydia Adams, telephone: (210) 588-6795, email: adamslr@zhi.com. ■

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eB Insight Nuclear

eB Insight, part of Bentley Systems, Incorporated's AssetWise platform, provides nuclear operations professionals with a suite of information management applications that ensures the integrity of controlled information by uniquely managing its connectivity to all other relevant information throughout the lifecycle of any nuclear facility. It captures, stores, and manages structured data and unstructured content, including records, specifications, engineering drawings, procedures, reports, emails, design documents, and licensing documents, and identifies and relates this content through object modeling to physical items such as equipment, systems, structures, and components.

eB Insight Nuclear applications comply with nuclear industry guidelines and NRC regulations wherever applicable. Each application is designed and implemented with the support and guidance of nuclear users to ensure they meet industry needs. eB Insight includes nuclear applications for compliance, design engineering, information management, knowledge management, performance improvement, cyber security, and training.

Contact: Leslie Robbins, telephone: (800) 236-8539.

Tubelight

The **BIRNS** TubeLight™ provides more than 10,000 lumens of brilliant underwater drop-light use in confined spaces—perfect for powerfully bright illumination of narrow inspection tubes, or for complete, easy to manipulate 360° lighting of any pool. This unique tungsten halogen lighting system is offered with a wide range of accessories, from a customizable lamp, dome, reflector and mounting options, to tailor it to a variety of demanding nuclear applications. The BIRNS TubeLight is easily suspended by its cable for general-purpose submerged drop light use, and can be mounted singly or in pairs for use with underwater cameras.

With a minute diameter of 48mm (1.9" OD), it's compact and versatile, operating at 100W to 500W at up to 300M, with a sturdy stainless-steel construction. It provides easy decontamination, comprehensive GFCI/ELCB compatibility, and has a unique wire-free design for unmatched safety and performance.

It comes complete with a tool-free mateable subsea-grade electrical underwater connector system, and can be used on 120 or 240V (AC or DC). Relamping is tool-free as well, and can be done in 30 seconds by hand. Despite its intense brilliance, there's no warm-up time needed, and the BIRNS tubelight operates seamlessly with no ballast required.

Contact: Amy Brown, telephone: (805) 830-5876, email: abrown@birns.com.

Spent Fuel Storage

Transnuclear, Inc. (TN), an AREVA company, has unveiled an innovative and advanced dry cask system for use in marine environments. The NUHOMS® 32PTH2 system design was submitted to the U.S. Nuclear Regulatory Commission (NRC) for approval and should be available in 2014. It incorporates many lessons learned from previous fabrication, including a more robust corrosion-resistant design, a longer design life for a seaside environments, and can handle wind, salt and water usually associated with coastal locations.

The NUHOMS® system can hold 32 pressurized water reactor (PWR) spent fuel assemblies. Once filled, the canister is moved by trailer and secure transfer cask onto an Independent Spent Fuel Storage Installation (ISFSI), where the loaded canister is stored in a high seismic capacity/passively cooled concrete module.

As one of TN's highest heat rejection capacity canisters/modules, the 32PTH2 system can safely accommodate higher burnup fuel and shorter cooling times to give customers a broader range of used fuel management options.

Contact: Michael French, telephone: (301) 841-1702, email: Michael.french@areva.com.

Services

Professional & Technical

HukariAscendent, Inc. is a provider of professional and technical services. HukariAscendent, Inc. provides in-house recruiting, staffing, program and project management, human resources, finance and accounting, and contract administration in support of several large staff augmentation contracts. HukariAscendent, Inc. currently holds active contracts with several DOE Prime Contractors, providing a broad range of staff augmentation support, including, engineering, regulatory & licensing, designers & drafters, construction & operations, safety analysis, health & safety quality, and environmental/waste management/decommissioning.

Contact: telephone: (303) 384-9079, fax: (303) 277-1458.

Instrumentation & Control

Lockheed Martin is a systems integrator and provider of safety-critical nuclear instrumentation & control systems for commercial and Department of Defense Customers. Their safety critical nuclear instrumentation and control products include safety-critical software, manufacturing services, certified performance, and systems integration.

Contact: Melissa Hilliard, telephone: (407) 356-5351, email: Melissa.hilliard@lmco.com.

(Continued on page 14)

Services...

Continued from page 13

Retube & Feeder

Nuclear Plant Journal issues for the last 29 years are now available online through the Journal website www.NuclearPlantJournal.com for a nominal fee of $25 per issue. This will enable marketing professionals and engineers to search on any specific term of their interest.

Type your word or phrase in the search box in the top right-hand corner. The search results will be displayed. You may review the text and select a specific issue. Follow the guidelines given in the top of the box to purchase your selected issue.

Contact: Kruti Patel, telephone: (630) 858-6161 x 105, email: kruti@goinfo.com.

Contracts

Clean-up

EnergySolutions has been selected by Toshiba Corporation as the technology provider for the clean-up of the large volume of radioactively contaminated water at the damaged Fukushima Daiichi Nuclear Power Plant. Toshiba has previously been selected as a preferred bidder for the work by Tokyo Electric Power Company (TEPCO), the owner of the plant, and EnergySolutions will now support Toshiba in designing and installing the system to decontaminate the water down to levels satisfying the strict safety limits announced by the Japanese Government, which represent a world-leading standard of clean-up.

The water that is to be treated has been utilized in TEPCO's ongoing focus on stabilizing the plant and treatment of the cooling water to date has centered on sufficient decontamination to allow its continued use as a coolant for the reactors. TEPCO has now committed to significantly lower the level of radioactive material in the treated water and EnergySolutions will utilize its world-leading technology, including the Advanced Liquid Processing System (ALPS™), to support Toshiba in removing the wide range of radionuclides present, in addition to the cesium which has been removed to date. The team will also provide the treatment and packaging of secondary wastes resulting from the water decontamination process.

Contact: Mark Walker, telephone: (801) 231-9194, email: mwalker@energysolutions.com.

Simulator Upgrade

L-3 MAPPS has been contracted by DTE Energy to upgrade the Fermi 2 Nuclear Power Plant simulator with L-3's Orchid® simulation environment. The company will also provide DTE Energy with an additional simulator specifically to train field personnel on Emergency Diesel Generator (EDG) operations. The project starts immediately and is slated for completion in the summer of 2012.

In September 2006, L-3 MAPPS successfully performed a comprehensive refurbishment of the Fermi 2 simulator's computers, instructor stations and simulation models to improve the simulator's training effectiveness and long-term performance, while reducing operating costs.

For the current project, L-3 MAPPS will continue to advance the efficiency of the Fermi 2 simulator by updating all of the simulation computers to the latest generation, as well as migrating the models and simulator maintenance tools from the previous generation of L-3 software to its user-friendly, industry-leading Orchid simulation environment. In addition, an EDG simulator will be deployed, with virtual panels based on L-3's Orchid Touch Interface solution.

Contact: Sean Bradley, telephone: (514) 787-4953.

Retube & Feeder

SNC-Lavalin's joint venture with Aecon Industrial has been awarded a major contract by Ontario Power Generation (OPG) to carry out the Definition Phase for the Darlington Retube and Feeder Replacement (RFR) Project.

The overall RFR Project consists of two phases – a Definition Phase from 2012 to 2016 and an Execution Phase from 2016 to 2023. The Definition Phase includes the construction of a full-scale reactor mock-up to simulate key elements of the refurbishment work, and the development, procurement and testing of specialized tooling required for the Project. It further includes the development of a detailed scope, schedule and budget for the Execution Phase, as well as procurement of reactor components for the first unit to be refurbished.

The Execution Phase, which will occur after the OPG Board and the Joint Venture agree to transition from the Definition Phase, will involve the refurbishment of all four reactor cores on a sequential basis using the tools and methods that were developed and tested during the Project's Definition Phase.

Contact: Leslie Quinton, telephone: (514) 390-8000 x7354.

Reflective Insulation

Transco Products Inc. has received contracts from Westinghouse Electric Company LLC for the design, manufacture and installation of metal reflective insulation for the reactor vessel, closure head, primary equipment and piping in the primary containment at the four new AP1000® reactors to be built at the Vogtle site in Georgia and the V.C. Summer site in South Carolina. In a separate transaction, the company also has received contracts from State Nuclear Power Engineering Co., Ltd. (SNPEC) for the design and manufacture of metal reflective insulation to be installed on piping at the four new AP1000® reactors under construction at the Sanmen and Haiyang sites in the People's Republic of China. Westinghouse had previously contracted with Transco for the metal reflective insulation on the reactor vessels at Sanmen and Haiyang. The reactor vessel insulation in particular incorporates advanced features for passive cooling and neutron shielding capabilities. The total combined scope for these contracts covers over 36,000 linear feet of piping and over 72,000 square feet of equipment.

Contact: Pari Patel, telephone: (312) 896-8463. ■

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Sometimes the challenges facing the operation of a nuclear power plant can seem difficult and complex. This is especially true when events outside a plant's design basis occur, like those experienced by operating plants on Japan's East Coast which are resulting in the need for new and additional plant design and engineering evaluations, operational enhancements and emergency planning improvements.

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New Documents

EPRI

1. *Materials Reliability Program: Boric Acid Corrosion Testing.* Product ID: 1022853. Published December, 2011.

A concern associated with primary water stress corrosion cracking (PWSCC) degradation of Alloy 600 reactor vessel top and bottom head nozzles is that if a leaking nozzle is not detected during an inspection, wastage conditions may develop in adjacent low-alloy steel that result in structurally significant loss of material before the next inspection opportunity. Review of plant operating experience shows that visual examinations performed at appropriate intervals are effective at detecting nozzle leakage before such leakage can produce structurally significant wastage.

2. *Materials Reliability Program: Primary Water Stress Corrosion Testing of Alloys 690 and Weld Metals—An Update (MRP-309).* Product ID: 1022854. Published December, 2011.

Primary water stress corrosion cracking (PWSCC) continues to cause increased costs for operation, maintenance, assessment, and repair of thick-walled, pressurized water reactor (PWR) components made of Alloy 600 and its weld metals Alloys 182 and 82. Thick-section Alloy 690 and its weld metals (Alloys 52, or 52M, and 152) are now being widely used, particularly for nozzle penetrations during replacement of RPV heads and for repairs to other components in the primary system. This report describes significant advances made over the last three years and documents the extensive data obtained. These are described both in the context of underlying scientific knowledge with regard to stress corrosion cracking and of recently published results from other laboratories.

3. *Stress-Based Fatigue (SBF) Monitoring.* Product ID: 1022876. Published December, 2011.

This report provides the technical basis for new, multiaxial SBF technology developed to address the NRC concerns. It serves as a requirements specification that can be used for the SBF computations in fatigue monitoring software, and provides detailed discussions about the rationale for various decisions that were made.

4. *Decision Framework for Evaluating Advanced Nuclear Fuel Cycle Options.* Product ID: 1022912. Published December, 2011.

EPRI is working to develop tools to support long-term strategic planning for research, development, and demonstration (RD&D) of advanced nuclear fuel cycle technologies for electricity generation. The development of a decision framework to help guide the eventual deployment of advanced nuclear technologies represents a key component of this effort. This interim report describes the structure of a prototypical EPRI decision framework and illustrates how that framework can be applied to assess nuclear fuel cycle options in order to achieve a defined strategic vision.

5. *Nuclear Maintenance Applications Center: Effective Refueling Outage Preparation and Execution Guidance—Revision to 1014480.* Product ID: 1022952. Published December, 2011.

This report provides updated, current guidance to assist outage managers and teams during preparation and execution phases of a nuclear refueling outage. Included is guidance on how the outage activities support long-range and strategic plans developed by the site or fleet of units.

6. *Plant Engineering: Critical Pump Refurbishment and Procurement —Key Project Phases and Considerations Checklist.* Product ID: 1022960. Published December, 2011.

This report provides tools that can be used to enhance the effectiveness of large pump refurbishment and procurement projects. Individuals with experience overseeing pump procurement and refurbishment projects and supplier representatives determined the major phases of pump refurbishment and component processes. For each major phase, the team identified specific experiences, considerations, and cautions associated with successful results.

7. *Plant Engineering: Predicting Nuclear Plant Output from Performance Losses and Gains.* Product ID: 1022967. Published December, 2011.

The marginal costs of generating electricity, together with the strong emphasis on maximizing production at today's nuclear power generating units, have increased the need for nuclear plant thermal performance engineers (TPEs) to determine the gap between the station's actual performance and its ultimate capability. This report from the Electric Power Research Institute (EPRI) outlines the various items that influence the performance of a nuclear unit and gives the TPE methods to be employed in estimating their effects. The report thus enables the TPE to use performance losses and gains to calculate and predict the output of a nuclear-powered generating unit based on design and operating conditions.

8. *An Assessment of BWR Water Chemistry Control in Advanced Light Water Reactors: Economic Simplified Boiling Water Reactor (ESBWR).* Product ID: 1023002. Published December, 2011.

The Electric Power Research Institute (EPRI) developed the Water Chemistry Guidelines to support industry water chemistry operations. This report reviews the Economic Simplified Boiling Water Reactor (ESBWR) plant design against the current EPRI Boiling Water Reactor (BWR) Water Chemistry Guidelines (BWRVIP-190) to identify gaps and future research activities necessary to close these gaps. It includes a review of water chemistry guidance for the startup and hot functional testing phases.

The above EPRI documents may be ordered by contacting the Order Center at (800) 313-3774 Option 2 or email at orders@epri.com. ■

Meeting & Training Calendar

1. World Nuclear Fuel Cycle 2012, April 17-19, 2012, Helsinki Congress Paasitorni, Helsinki, Finland. Contact: **Nuclear Energy Institute,** telephone: (202) 739-8000, email: conferences@nei.org.

2. Used Fuel Management Conference, May 8-10, 2012, The Renaissance Vinoy, St. Petersburg, Florida. Contact: **Nuclear Energy Institute,** telephone: (202) 739-8000, email: conferences@nei.org.

3. Third International Conference on Nuclear Power Plant Life Management, May 14-18, 2012, Salt Lake City, UT. Contact: **IAEA**, website: www.pub.iaea.org/MTCD/meetings/meetings2012.asp.

4. **Platts** 3rd Annual Small Modular Reactors, May 21-22, 2012, Arlington Virginia. Contact: Ron Berg, Platts, email: ron_berg@platts.com, website: www.smallmodularreators.platts.com.

5. Annual Nuclear Industry Conference and Nuclear Supplier Expo: Nuclear Energy Assembly, May 21-23, 2012, Westin Charlotte, Charlotte, North Carolina. Contact: **Nuclear Energy Institute,** telephone: (202) 739-8000, email: conferences@nei.org.

6. Facility Decommissioning Training Course, June 4-7, 2012, Chicago, Illinois. Contact: Lawrence Boing**, Argonne National Laboratory,** telephone: (630) 252-6729, email: lboing@anl.gov.

7. **ATOMEXPO** 2012 International Forum, June 4-6, 2012, Moscow, Russia. Contact: Anna Belokoneva**,** telephone: 7 495 66 33 821 email: asbelokoneva@atomexpo.com.

8. Emergency Preparedness Forum, June 6-8, 2012, Renaissance Seattle Hotel, Seattle, Washington. Contact: **Nuclear Energy Institute,** telephone: (202) 739-8000, email: conferences@nei.org.

9. 33rd Annual **Canadian Nuclear Society** Conference and 36th Annual CNS/CAN Student Conference. June 10-13, 2012, Saskatoon, SK, Canada. Contact: telephone: (416) 977-7620, email: cns-snc@on.aibn.com.

10. **Electric Power Research Institute/** ASME Radwaste Workshop, June 18-19, 2012, Tucson, Arizona. Contact: Linda Nelson, telephone: (518) 374-8190, email: Lnelson@toplanahead.com.

11. **American Nuclear Society** Annual Meeting 2012, June 24-28, 2012, Chicago, Illinois. Contact: telephone: (708) 352-6611, email: meetings@ans.org.

12. 2012 International Congress on the Advances of Nuclear Power Plants, June 24-28, 2012, Hyatt Regency, Chicago, Illinois. Contact: Organized by: **American Nuclear Society**. Contact: website: www.icapp.ans.org, email: icapp2icapp.ans.org.

13. U.S. Women in Nuclear, July15-18, 2012, Swan and Dolphin Hotel, Orlando, Florida. Contact: **Nuclear Energy Institute**, telephone: (202) 739-8000, email: conferences@nei.org.

14. **Electric Power Research Institute** Boiling Water Reactor and Pressurized Water Reactor Materials Reliability Conference and Exhibit, July 16-19, 2012, National Harbor, Maryland. Contact: Linda Nelson, telephone: (518) 374-8190, email: Lnelson@toplanahead.com.

15. 8th International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies, July 22-26, 2012, The Westin San Diego, San Diego, California. Sponsored by: **American Nuclear Society.** Contact: website: npic-hmit.ans.org.

16. **American Society of Mechanical Engineer's** 2012 International Conference on Nuclear Engineering (ICONE), July 30-August 3, 2012, Anaheim, California. Contact: telephone: (212) 591-7786.

17. Radiation Protection Forum, August 5-8 2012, Westin Waterfront, Boston Massachusetts. Contact: **Nuclear Energy Institute**, telephone: (202) 739-8000, email: conferences@nei.org.

18. Utility Working Conference and Vendor Technology Expo, August 5-8, 2012, Westin Diplomat, Hollywood, Florida. Contact: **American Nuclear Society,** telephone: (708) 579-8282.

19. 2012 **Nuclear Information Management Conference**, August 12-15, 2012, JW Marriott Resort and Spa, Summerlin, Las Vegas, Nevada. Contact: Jane Hannum, telephone: (603) 432-6476, email: nirma@nirma.org.

20. 37th **World Nuclear Association** Annual Symposium, September 12-14, 2012, Central Hall, Westminster, London. Contact: telephone: 44 0 20 7451 1520, fax: 44 0 20 7839 1501.

21. **Electric Power Research Institute** International Decommissioning and Radioactive Waste Management Workshop, October 23-25, 2012, Rome, Italy. Contact: Linda Nelson, telephone: (518) 374-8190, email: Lnelson@toplanahead.com. ■

Research & Development

Enhanced Nuclear Fuel Safety

The Fukushima accident has renewed interest in potentially safer nuclear fuel designs. One option being considered at EPRI is the use of silicon carbide (SiC) as a cladding material. The high-temperature properties of SiC offer many advantages over conventional metal-based fuel materials, especially under loss of coolant accident (LOCA) conditions. The structural and chemical stability of SiC at elevated temperatures offers several benefits, such as the elimination of hydrogen production and maintenance of fuel integrity for longer durations in a LOCA event.

EPRI became involved in SiC research in 2008, initially in a support role to develop a fuel rod end plug seal and to conduct an economic viability evaluation. The sealing of SiC fuel rods represents one of the main obstacles to the development of the technology. Several diffusion and reaction based sealing approaches have been tried with limited success. EPRI is evaluating other variations of diffusion bonds and results are expected some time in 2012. EPRI also has conducted an economic assessment of SiC as a fuel cladding material. The analysis indicates that SiC clad fuel is viable provided that the fabrication cost of SiC-based clad is not significantly different than that of conventional cladding.

One possible nearer-term application for SiC is as a channel material in boiling water reactors (BWRs). Nuclear fuel in BWRs is typically placed inside a long square channel typically made from a zirconium based alloy. The channel functions to hydraulically isolate the fuel and to provide support to control rods. The use of SiC in this application could eliminate a phenomenon called "channel bow" that is currently experienced by metal-based BWR channel boxes. If not detected and addressed, channel bow can potentially lead to control rod insertion issues and reduced shutdown margin. This application may be more promising than SiC cladding because a hermetic seal is not required for proper functioning of the component. EPRI is fabricating several test articles to evaluate fragmentation resistance and properties under irradiation conditions. The irradiation testing is to be conducted in cooperation with the Idaho National Laboratory.

Contact: Ken Yueh, telephone: (704) 595-2613, email: kyueh@epri.com.

Reduced Water Consumption

Innovative technology could significantly reduce water use for closed-cycle steam condensing systems and increase siting flexibility for new nuclear capacity.

EPRI is developing multifunctional nanoparticles that could reduce water consumption in closed cycle steam-condensing systems by as much as 20%. The improved thermal properties of coolants incorporating phase-change nanoparticles could allow power producers to meet increasingly stringent water use restrictions while avoiding or lowering the cost of major cooling system retrofits. Nanotechnology-enabled cooling also could facilitate the siting of new capacity.

While water-efficient air-cooled condensing systems are available as an alternative to once-through and closed-cycle cooling systems, they are associated with high capital costs, energy penalties, and operations and maintenance (O&M) impacts. Based on innovation scouting activities, EPRI has identified a nanotechnology-based cooling concept being developed at Argonne National Laboratory as a potential breakthrough.

Contact: Sean Bushart, telephone: (650) 855-8752, email: sbushart@epri.com.

Fuel Performance Assessments

The revised guidelines, will be issued in April 2012. EPRI is revising guidance for performing nuclear fuel assessments and inspections. The revision will provide technical guidance on the scope and frequency of fuel performance assessments and inspections to support the industry goal of zero fuel failures and operational issues. To achieve this goal, both failed and healthy fuel must be inspected. Such inspections advance understanding of fuel failure mechanisms and unit-specific fuel margins, leading to more robust fuel designs and enhanced operating guidance. Moreover, the revision maintains an emphasis on monitoring of margins following significant changes or anomalous operating events that affect fuel performance.

Revision 1 to the Fuel Surveillance and Inspection Guidelines will implement lessons learned from fuel inspections conducted since issuance of the original guideline in early 2008 – primarily from inspections of "Priority 1 plants" as designated by the major fuel suppliers. The revision includes two main changes:

- A switch in the inspection strategy from priority-based "baseline" fuel inspections for all U.S. plants to one in which the need for baseline inspections is determined via a technical evaluation process.
- Addition of non-intrusive visual fuel inspection programs to monitor for margin impact of cumulative small changes and to help ensure applicable margins are maintained.

Contact: Rob Daum, telephone: (630) 219-3679, email: rdaum@epri.com.

Performance Demonstration Program

Administered by EPRI since its formation in 1991, the Performance Demonstration Initiative has successfully qualified more than 100 procedures and conducted thousands of personnel qualification tests.

Concerns about the reliability of ultrasonic in-service inspections conducted at nuclear power plants led the U.S. Nuclear Regulatory Commission (NRC) to draft a proposed qualification document in October 1984. Representatives from industry, the American Society of Mechanical Engineers (ASME), and NRC agreed that

major improvements in the quality of in-service inspection were needed and that qualification of nondestructive evaluation (NDE) systems might be the answer. Such qualification requirements could be used instead of formal rules established through a regulatory guide. Efforts by the ASME Section XI Subgroup on Nondestructive Examination resulted in the creation of Appendix VIII, which contains the requirements for qualification of ultrasonic procedures, equipment, and personnel. These requirements were approved by the ASME Boiler and Pressure Vessel Standards Committee in early 1989 and by the Board on Nuclear Codes and Standards in mid-1989. Appendix VIII was published as part of the 1989 Addenda to the ASME Code Section XI.

Contact: Carl Latiolais, telephone: (704) 595-2638, email: clatiola@epri.com.

Atom Probe Tomography

EPRI is gaining greater understanding of micro structural behavior through atom probe tomography – information that will aid the identification and management of materials susceptible to irradiation-assisted stress corrosion cracking.

Atom probe tomography (APT) is revealing details at the microstructure level that will enable the development of better models for assessing the susceptibility of BWR and PWR internals to irradiation-assisted stress corrosion cracking (IASCC). Such understanding, in turn, will lead to improved management and mitigation strategies, contributing to greater safety and higher equipment reliability, and potentially avoiding or reducing the billions of dollars in costs incurred by the nuclear power industry over the past 30 years to address the related phenomena of environmentally assisted cracking.

Neutron irradiation over time (or fluence, measured as displacements per atom) causes damage to vessel internal materials, predominantly stainless steels, that makes them more susceptible to IASCC. In addition, variations in IASCC susceptibility among heats of nominally the same alloy, at comparable fluence, are equally significant. Because the micro structural contributions to heat-to heat variations are not well understood, bounding curves have been used to guide life assessment evaluations.

Contact: Peter Chou, telephone: (650) 855-2137, email: pchou@epri.com.

Instrument Channel Performance

A new EPRI guideline illustrates how on-line monitoring can improve safety, strengthen equipment reliability, and reduce costs compared to conventional instrument channel surveillance techniques.

A new EPRI report provides guidelines for implementing a nuclear plant online monitoring program on instrument channel surveillance that offers significant benefits compared to conventional techniques such as field-executed instrument calibration. The report, Guideline for On-Line Monitoring of Nuclear Power Plant Instrument Channel Performance (EPRI report 1022988), consolidates technical guidance from 34 EPRI reports on instrument channel calibration and monitoring and also discusses the licensing aspects of implementing an on-line monitoring program.

While implementing online monitoring technologies can be challenging, the safety and economic benefits can be significant. For example, the report describes the opportunity to reduce 75% of the technical specification transmitter field calibrations during refueling outages, which would reduce the number of outage maintenance activities, the potential for human error during maintenance activities, and the amount of radiation exposure to maintenance personnel.

Contact: Rick Rusaw, telephone: (704) 595-2690, email: rrusaw@epri.com.

Source: Electric Power Research Institute's (EPRI) Nuclear Executive Update. ■

Fukushima Update

Public Information

President Takuya Hattori of the **Japan Atomic Industrial Forum, Inc**. (JAIF) recently visited Warsaw, Poland, to make a presentation at a conference on Public Information Materials Exchange (PIME 2012) staged by the European Nuclear Society (ENS).

While there, Hattori met with key persons involved in introducing nuclear generation in Poland, including Commissioner for Nuclear Energy Hanna Trojanowska and Acting President Witold Drożdż of PGE Energia Jądrowa SA. Hattori explained to them about the aftermath of the accident at the Fukushima Daiichi Nuclear Power Station of the Tokyo Electric Power Co., Inc. (TEPCO).

The JAIF chairman also met Director General Jean-Pol Poncelet of FORATOM and agreed to establish cooperative relations between the two organizations, including exchanging information in the wake of the accident at Fukushima.

On February 13, 2012, Hattori, as the first speaker of the day, spoke under the title "What exactly happened in Fukushima? What was communicated, and how?" He talked mainly on the four following points: (1) how information was conveyed overseas, (2) the effects of the accident on public opinion and energy policy, (3) JAIF's public information activities, and (4) the lessons learned.

Contact: website: www.jaif.or.jp/english.

Safety Standards

The Japan-France committee on nuclear energy met for the first time, in Tokyo. Included among the attendees were French Minister Eric Besson of Industry, Energy and the Digital Economy and Japanese Parliamentary Senior Vice-Minister Ryuji Yamane of Foreign Affairs. The co-chairpersons of the committee are Chairman Bernard Bigot of the French Atomic Energy and Alternative Energies Commission (CEA) and Director-General Makio Miyagawa of the Disarmament, Nonproliferation and Science Department in Japan's Ministry of Foreign Affairs (MOFA).

Following the opening statements, in which France and Japan declared that they would cooperate to promote nuclear power meeting the world's highest safety standards, the committee discussed efforts related to the accident at the Fukushima Daiichi Nuclear Power Station (NPS), owned by the Tokyo Electric Power Co., Inc. (TEPCO). The Japanese side explained its recovery roadmap, among other matters, and the French side introduced technology and know-how considered useful for solving related problems.

Contact: ***Japan Atomic Industrial Forum****, website: www.jaif.or.jp/english.*

Rehabilitation Programs

With the co-operation of the **NEA**, the International Commission on Radiological Protection (ICRP) organized a dialogue with residents of Data City, Japan on February 25-26, 2012. This meeting was the second in a series of ICRP seminars that foster discussions among affected stakeholders in order to help identify priorities and to initiate rehabilitation programs in follow-up to the Fukushima Daiichi nuclear accident. The agenda focused on past accomplishments, current challenges and future initiatives to improve the radiological situation and living conditions for local inhabitants. About 50 representatives of civil society as well as central, prefectoral and local governments attended along with 50 residents of Fukushima prefecture. Data City is a community that has been significantly affected by contamination from the Fukushima accident. During the meeting, ways to help improve the situation were identified, including common agreements on radiological criteria (e.g. food contamination levels), waste management approaches and criteria for successful remediation.

NRC Response

The NRC continues to evaluate and act on the lessons learned from the March 2011 nuclear accident in Japan to ensure that appropriate safety enhancements are implemented at nuclear power plants in the U.S. In accordance with Commission directions, the NRC's activities are being led by a steering committee comprised of senior NRC management. Additionally, the NRC established the Japan Lessons Learned Project Directorate, a group of over 20 full-time employees focused exclusively on implementing the lessons learned.

On March 12, 2012, the NRC issued the first regulatory requirements for the nation's 104 operating reactors based on the lessons-learned at Fukushima Daiichi. The NRC issued three orders requiring safety enhancements of operating reactors, construction permit holders, and combined license holders. These orders require nuclear power plants to implement safety enhancements related to (1) mitigation strategies to respond to extreme natural events resulting in the loss of power at plants, (2) ensuring reliable hardened containment vents, and (3) enhancing spent fuel pool instrumentation. The plants are required to promptly begin implementation of the safety enhancements and complete implementation within two refueling outages or by December 31, 2016, whichever comes first. In addition, the NRC issued a request for information, requesting each reactor reevaluate the seismic and flooding hazards at their site using present-day methods and information, conduct walkdowns of their facilities to ensure protection against the hazards in their current design basis, and reevaluate their emergency communications systems and staffing levels.

The NRC staff provided the Commission with its technical and regulatory basis for issuing the orders and requests for information in a paper dated February 17, 2012 (SECY-12-0025,). The Commission approved issuance of the orders on March 9, 2012. (SECY-12-0025).

Contact: telephone: (301) 415-8200, email: opa.resource@nrc.gov.

Impact Report

One year after the nuclear accident at Fukushima Daiichi, the **World Energy Council** (WEC) published a study on March 9, 2012 analyzing the impact of the accident on national nuclear energy plans worldwide.

The report is titled 'World Energy Perspective: Nuclear Energy One Year After Fukushima'.

The report highlights that currently about 50 countries are operating, building, or considering nuclear power as part of their energy mix. About half of these countries are newcomers to nuclear. More than 60 nuclear plants are under construction, mainly in China, Russia, India and South Korea.

The growth in the utilization of nuclear power is mainly driven by non-OECD countries - the very countries that are seeing ever rising energy demand.

Contact: Florence Mazzone, telephone: 44 0 2072922090, email: mazzone@worldenergy.org. ■

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An Industry Leader

By Susan Landahl, Exelon Nuclear.

Susan Landahl

Susan Landahl is the Chief Operating Officer and Senior Vice President at Exelon Nuclear. Landahl is responsible for oversight of the Exelon Nuclear organization, which operates a fleet of 10 nuclear stations with 17 reactors that generate more than 17,000 megawatts of electricity annually.

Landahl's career spans more than 25 years in the nuclear power industry. Prior to her current role, Landahl was Exelon Nuclear's Senior Vice President - Midwest Operations.

Landahl received a Bachelor of Science degree in Nuclear Engineering/Fission Reactor Technology and a Master of Science degree in Nuclear Engineering/ Health Physics, both from the Massachusetts Institute of Technology. Landahl is a member of several professional societies including the American Nuclear Society, the Society of Women Engineers, Women in Nuclear, and the North American Young Generation in Nuclear (NA-YGN). She is also a member of the Executive Advisory Committee for the North American NA-YGN.

In October 2011, Landahl was awarded a Nuclear Excellence Award by the World Association of Nuclear Operators.

An interview by Newal Agnihotri, Editor of Nuclear Plant Journal at Exelon's Headquarters in Warrenville, Illinois on March 1, 2012.

Fukushima

1. *A concern has been expressed in the industry regarding the quality assurance and quality control of the work being done by the sub contractors. What is Exelon's guidance to other utilities in assuring quality control and quality assurance of sub contractor's work?*

- Exelon takes a graded approach to quality assurance for the materials and services associated with the maintenance and modification of our plants.
    - For our most critical Nuclear Safety applications in the plant, also known as Safety-Related: The audits used to qualify vendors to provide safety-related products and services to Exelon look extensively at sub-contractor controls.
    - The vendors must have robust programs for auditing their sub-contractors to ensure that their quality programs are effectively implemented.
    - The vendors must also inspect the products they receive from their sub-contractors to ensure that it meets the specified requirements and as a final check, the vendors must provide final tests, inspections or certifications for the product or service Exelon has purchased ensuring that it complies with the specified technical and quality requirements."
- For other commercial materials required to ensure reliable plant operations, we have implemented a "Parts Quality" process where Exelon performs additional testing at the time of receipt to ensure the quality of these materials. In some cases the testing is performed by the supplier at their facility with oversight by Exelon (e.g. large motors). This is done whether the supplier utilizes a sub-contractor or not.
- For all Services, Exelon has a robust Contract Administration and Contractor Oversight program that is in place to ensure our contractors and their sub-contractors are performing work in accordance with contractual requirements as well as Exelon's procedures and processes.

2. *Is Exelon taking advantage of any new data being developed after March 11, 2011 to protect its plants against earthquake, flooding, and tornadoes?*

- Exelon is fully engaged with industry organizations and the NRC in using new information to develop and apply new guidance in assessing the impacts of external events.
- In anticipation of this new guidance Exelon has begun external flooding evaluations at four of its sites and is beginning to collect the site specific data needed to support seismic evaluations.
- Exelon Nuclear plants have multiple physical barriers and layers of backup safety systems to ensure safe operations even in extreme events, including floods, hurricanes, tornadoes and earthquakes.

3. *Is Exelon doing any analysis to ensure prevention of risk from potentially dangerous industries such as chemical process, liquid natural gas storage, chemical industries, or petrochemical refineries?*

- Assessment of hazards posed by nearby industrial facilities is part of establishing initial plant design requirements.
- The impact of chemical sources on control room habitability is periodically re-evaluated.
- Offsite surveys of stationary and mobile sources of hazardous chemicals in the five mile radius of the site shall be re-assessed every six (6) years.
- The six years frequency is considered adequate based on past experience of hazardous chemical use within 5 mile radius of the Exelon plants. Hazardous chemical surveys should

(Continued on page 24)

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HITACHI

An Industry...

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be performed more frequently if any of the following apply:

- A new significant source of hazardous chemical (per Regulatory Guide 1.78) is identified within a five mile radius of the plant.
- There is an industry/facility using or producing significant quantities of hazardous chemicals within a 5 mile radius of the plant.
- The quantity of chemicals is significantly greater than previously assumed.
- The License Basis commits to more frequent surveys.

4. *What are Exelon's plans to bring in and reinforce onsite and offsite power supply sources by additional portable diesel generators?*

- Exelon will store onsite portable diesel generator(s) with sufficient capacity to provide power to maintain key safety functions during an extended loss of AC power.
- These on-site diesel generator(s) will be supplemented by additional diesels staged offsite that will provide additional electrical power for equipment needed to support longer term recovery from the event.
- Last week, NRC staff recommendations on additional portable safety equipment purchases in 2012 were agreed to by the entire U.S. nuclear energy industry.

5. *How is Exelon ensuring the reliability of cooling functions of spent fuel pools under beyond design basis events?*

- Exelon has already strengthened programmatic controls associated with Spent Fuel Pool equipment to maximize its availability under all conditions of normal plant operation.
- For beyond design basis events, Exelon will provide portable equipment that is independent of installed plant equipment that will maintain Spent Fuel Pool Cooling capability.
- All Exelon plants have "Severe Accident Mitigation Guidelines." The guidelines prescribe actions beyond normal emergency operating procedures and address severe challenges to the reactor core of the kind seen in Japan. These systems are constantly tested, challenged or simulated to ensure proper operation when needed.

6. *What is being done by Exelon to ensure the short term and long term cooling of the reactor pressure vessel and the primary containment vessel in case of a beyond design basis event?*

- Exelon, in conjunction with the industry, is developing a strategy called FLEX which integrates a number of the current regulatory activities to provide for short and long term cooling of the reactor and maintains primary containment integrity.
- This strategy includes use of portable equipment for core cooling and improvements in containment venting capability to maintain these key safety functions.

7. *How is Probabilistic Risk Assessment approach being applied to have an effective accident management of a nuclear power plant in an emergency situation?*

- Exelon maintains updated PRAs for all of its nuclear power plants.
- The insights from these studies are used to identify key safety considerations to each site, including key operator actions related to accident management.
- In addition, Exelon is in the process of expanding the scope of these PRAs to support decision-making on plant enhancements relative to external hazards.

8. *What are the results of analyzing the safety of multi unit sites to ensure that an accident at one unit does not adversely affect the other?*

- Previously established design requirements ensured separation of key safety systems between trains of components on the same unit and between systems on different units.
- Some events can impact multiple units on a site and the strategies now under development will address an event that occurs simultaneously on multiple units.

9. *Have any portable cooling measures been taken to cool down the reactor pressure vessels and the fuel pool in case of a beyond design basis event condition?*

- U.S. Nuclear plants employ a safety in depth process for plant operations that includes stationary and portable safety.
- Portable equipment that can maintain cooling to the reactor and spent fuel pool for one unit was available at US sites prior to the Fukushima event.
- Procurement of additional equipment to support providing these functions for multiple units at multi-unit sites is in progress.
- Exelon recently placed a second set of core and fuel pool cooling portable equipment at its dual unit sites.

10. *What measures have been taken by Exelon in case of an accident to ensure that hydrogen explosion does not occur?*

- Exelon is focused on actions that will prevent the generation of hydrogen by strengthening reactor core cooling capabilities and strategies that maintain containment integrity.
- Exelon is also evaluating improvements that can be made to ensure any hydrogen that is generated is contained and will not result in an explosion.

11. *What instrumentation enhancements are being planned for the reactor and the primary containment to ensure accuracy of indicated parameters in a severe beyond design basis event?*

- A substantial number of instruments are already in place to provide monitoring of key reactor and containment parameters.
- The current focus is on developing strategies that will maintain electrical power to these instruments so that they can be used by the operators under beyond design basis conditions.

(Continued on page 26)

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An Industry...

Continued from page 24

- These strategies involve supplying power from portable equipment and establishing procedures that will allow the instruments to be read locally even if power is not available.
- The industry has also recognized that instrumentation for monitoring spent fuel pool parameters is inadequate and will be installing plant modifications to improve spent fuel pool monitoring capability.

12. *How does Exelon ensure effective communication within its organization, with other utilities, and agencies in the U.S. and abroad in case of a major accident?*

- Exelon has pre-established, dedicated communication systems at each nuclear plant and the corporate headquarters that ensures prompt notification to company emergency responders, state/local agencies, federal agencies, INPO, and American Nuclear Insurers (ANI) in the event of a major accident.
- INPO (internationally, WANO) assists utilities by applying the resources of the nuclear industry to meet the needs of the emergency.
- INPO/WANO assists affected utilities by coordinating the flow of media and technical information about the emergency and aids in locating sources of emergency personnel and equipment.

13. *What is the mechanism of implementing owner's group recommendations for Exelon plants?*

- Exelon is participating and contributing in the development of additional severe accident guidance within both the PWR and BWR Owner's Groups.
- The collective knowledge of the representative utility participants is leveraged with the lessons learned from Fukushima to provide enhanced procedural guidance to utilities.
- These generic enhancements are translated using plant-specific design and operating information into procedures or guidance for control room and emergency response organizations.

14. *What is Exelon's plan for implementing tier one and tier two U.S. NRC staff recommendations as provided in SECY-11-0137 dated October 3, 2011?*

- Exelon is fully engaged working in developing the industry response through participation in NEI activities at all levels of the organization (Chip Pardee, COO, Exelon Generation – NEI Fukushima Steering Committee, Jim Meister, vice president, Operations Support, Exelon Nuclear – NEI Fukushima Regulatory Response Working Group, and participation at the working level in the individual task forces) and at INPO (Chuck Behrend, director, Severe Accident Management, Exelon Nuclear – INPO Executive Advisory Group).
- Exelon has ALSO established a new organization to coordinate implementation of Fukushima related activities.
- This organization known as the Severe Accident Management group is integrating the industry approach developed through NEI and INPO and the NRC regulatory requirements to apply them at Exelon.

15. *The commissioners have recommended inclusion of "filtration of containment vents" into the tier one items included in U.S. NRC's SECY-11-0137 dated October 3, 2011. What are Exelon's plans for implementation of these at its Mark 1 and Mark 2 containments?*

- Exelon is currently focused on activities to improve reliability of containment vents at its Mark I and Mark II BWRs.
- This will likely require modification of existing hardened vents for Mark I containments and installation of hardened vents for Mark II containments.
- Exelon is also currently working with the industry to better assess the impact of filtration of containment vents.

Safety Culture

1. How do you train your employee to follow "Safety Culture"?

Exelon has always been passionate about nuclear safety. When the term "safety culture" started to be used, the workforce at large thought of it more as industrial safety and we had to devote more time and discussion to what nuclear safety is and how it affects every task on every shift in each of our plants.

The behaviors of a strong nuclear safety culture were even more ingrained throughout the last decade, supported by INPO in the publication of "Principles for a Strong Nuclear Safety Culture." We constantly emphasize nuclear safety in the training that new employees receive, in their continuing training, and in the training that we give to folks who come in as temporary workers during our outages. It's about clearly understanding that nuclear technology is special and that each of us has a role in assuring nuclear safety is always our top priority.

Why are things different in nuclear? From a leadership prospective, it's not just talking about nuclear safety but it's making sure we make the right decisions, using nuclear safety as a guide above all else. We invite the people at all levels of the organization to share their opinions even if their opinions may be different. We have a lot of healthy debate and that's important.

2. *How do you implement Safety Culture?*

One of the key programs that supports a strong Nuclear Safety Culture is the corrective action program: the whole system of identifying issues, getting them documented, getting responses, doing the right thing to fix the problem. The program is also about getting back to the person who raised the issue, saying thank you and here is what we did to address and correct the problem. It is a requirement for every nuclear plant to have such a program. I think our program is robust and we get a lot of value from it. We get literally thousands of issue reports generated by our employees. Anybody can write an Issue Report and all employees are strongly encouraged to do so.

We have an electronic database of information and any concern can be

documented in the corrective action program and is addressed with a set of actions to resolve the concern. Every one of our employees has to feel free to raise an issue. I believe that transparency is a foundation of our safety culture as well.

3. *How do you assess safety culture?*

As an industry we've all committed to do periodic safety culture assessments where we actually bring in teams of people who don't necessarily work at the station to assess the state of our nuclear safety culture. It's a combination of internal and external participants. That team will go and watch meetings and look at how the leadership communicates. Does the leadership really encourage everybody in the room to participate in the meeting? We ask questions of the workforce. We look at corrective action documents and how well are we answering those. That assessment program is another key part to making sure we don't start getting too overconfident. The NRC is very interested in these assessments as well, so they will monitor the assessment and review the results.

By bringing in people who don't see your operation every day, they can raise blind spots we might not see. For example, one area of assessment feedback found that we talk a lot about nuclear safety but when we write our written communications out to supervisors, we miss opportunities to explicitly reinforce decisions and actions that tie directly to nuclear safety. To close this gap, we've actually worked with our Nuclear Communications team to put together a more formal nuclear safety communication plan for our fleet. We want to really be consistent and overt in our safety culture messaging. Exelon has been an active participant in helping to lead the industry to a greater emphasis on communicating the importance of a healthy nuclear safety culture.

4. *How has the industry benefitted from the Exelon program?*

Exelon played an active role in working with Nuclear Energy Institute (NEI) to develop the safety culture guidance document. We volunteered Braidwood Generating Station to be a pilot for one of these assessments.

The Nuclear Regulatory Commission came and observed because they wanted to see how healthy the process was. This is a case where the NRC gave the industry an opportunity to see that we were serious about nuclear safety and the feedback we've gotten so far has been pretty positive. Obviously it's a big focus area for the NRC and they are always observing, challenging when events do happen. As part of their investigations they may ask some safety culture questions.

When a plant has some serious regulatory issues, an independent safety culture assessment is now required as part of the NRC process. If a plant has a lot of serious performance issues, I think that it's always possible that something's not right in the underlying culture of the organization, and an external assessment of your safety culture may reveal that. Or, it could confirm that a plant's safety culture is healthy but that there are gaps in other areas of plant operations.

(Continued on page 34)

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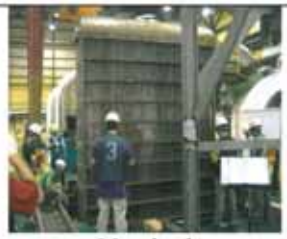

Vertical

Horizontal

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Vertical
Plant "B"

Horizontal

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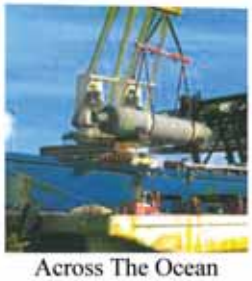

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Vertical
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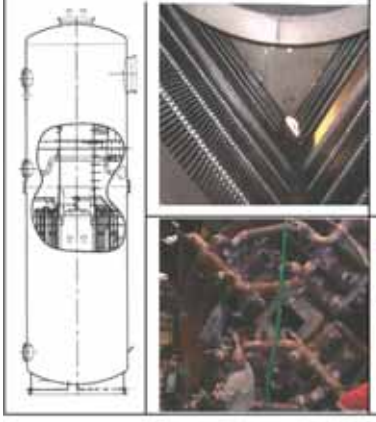

Horizontal
Configuration

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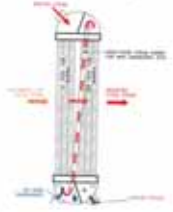
4-pass
(Horizontal)

dual-pass
(Vertical)



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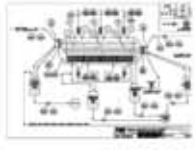
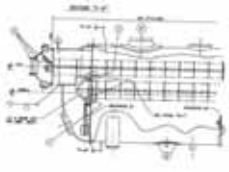
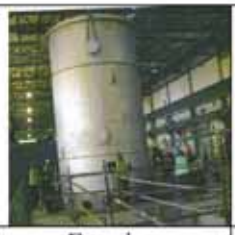




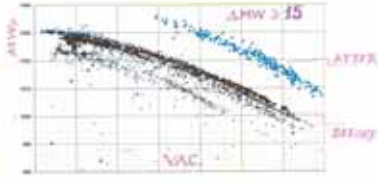
Engineering

Manufacturing



Erecting

Commissioning



Resulting MWe Output

From: Virtual

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To: Real

Strong Safety Culture

By CHEN Hua, CNNC.

China National Nuclear Corporation, China (CNNC) currently operates eight units and has another ten units are under construction. The past year witnessed record performance for the eight operational reactors, and the average load factor exceeded 90% for the first time. In the past four years, the operational units experienced continued performance improvement, mainly due to the collective efforts made to build a strong nuclear safety culture.

"A strong nuclear safety culture is the manifestation of the senior leadership team's commitment to continuous improvement. By practicing what we preach, the behavior and attitude that supports a strong nuclear safety culture is encouraged and promoted. Our business success in nuclear power is largely due to the safety culture we have developed," according to CHEN Hua, Assistant President of CNNC.

Continuous Gap analysis and benchmarking

In the last couple of years, CNNC's fleet of operational reactors has received various external and internal peer reviews, including IAEA OSART reviews and follow-up missions; WANO peer reviews and follow-up peer reviews; Chinese domestic peer reviews and corporate focus area reviews (including outage observations and human error prevention observations). All the opportunities for improvement identified during these reviews were examined in depth before actions were taken and tracked to closure. Benchmarking visits to high performing stations were arranged to assist with the resolution of areas for improvement (AFIs), resulting in the timely closure of pending issues.

CNNC promotes one of the key elements of WANO's mission by encouraging its fleet members to share their experience and learn lessons from other operational nuclear power plants across the world.

Improvement initiatives

CNNC has attached great importance to the building of a strong nuclear safety culture. In the past year, several high level nuclear safety culture training sessions were arranged for the plant senior leadership team. The content included Gap analysis of top performers, attributes of nuclear safety cultures, a methods to promote nuclear safety culture at the plant level (during both the operation and construction phases).

CHEN Hua, Assistant President of CNNC.

Several initiatives have been launched, including a discussion of the Principles for a Strong Nuclear Safety Culture (PSNSC) in the daily meetings at each nuclear power plant, a reward and recognition system closely tied to the PSNSC, management observation and coaching in the field, and promotion of human error prevention tools on a fleet-wide basis.

Daily meetings

All fleet members are encouraged to initiate a short discussion preceding all the meetings in the nuclear power plant, focusing on safety culture related events, activities and feedback. Findings from management coaching and observation should be used as examples to reinforce the staff's understanding of PSNSC. The eight principles for a strong nuclear safety culture are rotated on a weekly basis. At year end, each and every member of the plant should be well exposed to the PSNSC attributes and principles. By doing this, the PSNSC becomes well known to the plant personnel and ingrained into the daily conduct of plant activities.

Reward and recognition system

The design of the reward and recognition system reflects its focus on nuclear safety culture-related topics such as near-miss events avoided by the use of human error prevention tools and "good catches" by plant personnel of potential consequential events. The company's internal communications (newsletters, e-mail, large screen displays, posters etc.) are widely used to reinforce positive behavior. By doing this, the employees can easily understand the behaviors and attitude that are aligned to the PSNSC.

Management observation and coaching

Management observation and coaching in focused areas is planned and carried out on a regular basis. One of the key areas for observation and coaching is the assessment of how well employees have taken on board the company's safety culture principles. A focus area is developed, either weekly or monthly, based on plant performance trends and management priorities. This is a very effective approach. The results of these observations influence management's decision-making and the development of future focus areas. The plant has seen plant personnel behavior and attitudes change with the management in the field. They felt more aligned with the company goals and objectives, which in turn helped motivate them to improve the quality of their work and overall performance.

Use of human error prevention tools

A special task force on human performance was organized by CNNC in 2009. After more than two years' work, a comprehensive human performance improvement program is in place, the main content of which includes: human performance fundamentals, technical

Credit: World Association of Nuclear Operators "Inside WANO" newsletter, V20-N01-2012.

guidelines for setting-up a human performance organization in nuclear power plants, human error prevention tools tailored to Chinese culture, instruction videos for using human error prevention tools, technical guidelines for using human error prevention tools and the set-up of human error mock-facilities. All of these measures have helped to improve the human performance of CNNC's fleet. The fleet also witnessed a chronological reduction in human error-induced events. The threshold for identifying low-level events has been lowered since the broad use of human error prevention tools was introduced.

Post-Fukushima Actions

The Fukushima Daiichi accident, triggered by the earthquake and tsunami on March11, 2011 in Japan, has attracted significant attention from the global community, particularly focused on the safety of nuclear power plants. CNNC conducted comprehensive inspections of all its nuclear power plants immediately following the Fukushima Daiichi accident, with the main focus on the plants' capabilities in severe accident prevention and mitigation. An action plan has been developed with short-, medium- and long-term objectives and prompt corrective actions have been taken for short-term items.

Cooperation with nuclear utilities from other countries was sought, with the aim of seeking an efficient resolution to all the common issues that were identified. The company is also monitoring the developing situation with regards to the lessons learned from the accident and the joint efforts being taken by the international nuclear community. It is clear that nuclear safety is the responsibility of all involved, and only through the collective improvement of safety can the industry sustain the continuous development of nuclear power.

The vision for future development

With CNNC's fleet performance having reached a plateau, management realized that there was still a gap in the company's performance based on benchmarking against the top performers in the world. A decision was made to re-organize the company's nuclear power assets. CNNC nuclear power company (CNNP) was established to represent CNNC to the investors backing all the company's nuclear power plants. CNNC operation and management company (CNNO) was also established in the past year to manage the nuclear power fleet. With the re-organization of the nuclear power asset, the company is now geared toward a more professional and streamlined management model, a model that is more supportive of the Principles for a Strong Nuclear Safety Culture.

"Our journey along the road to nuclear excellence is one that will never end. The bar will continue to rise, and the only option for staying competitive in the nuclear power business is through the pursuit of excellence in our daily endeavors," CHEN Hua concluded.

Reference: http://www.wano.info/wp-content/uploads/2012/03/iw-v20-1-Eng-web.pdf. ■

Incremental Innovation

By Keith Moser, Exelon Nuclear.

Keith Moser

Keith Moser has over 30 years experience designing, manufacturing, constructing and operating nuclear power plants. Currently Keith Moser develops and manages the Innovation Process at Exelon Nuclear. Since introducing the Innovation Process in 2006, Exelon Nuclear has developed over 170 innovations that represent 1080 person-rem of radiation exposure savings, over $796 million in cost savings and a record 27 Nuclear Energy Institute Top Industry Practice Awards.

Mr. Moser has either been the Team Lead or Team Member on 8 Nuclear Energy Institute Top Industry Practice Awards. In 2005, Mr. Moser was honored by the World Association of Nuclear Operators (WANO) as the recipient of the Nuclear Excellence Award for his innovative approaches in resolving equipment degradation problems in Budapest Hungary.

Mr. Moser received his Bachelor of Engineering from LeTourneau University in 1980 and Masters of Business from Olivet University in 1990.

"*Hitting lots of singles is better than hitting a few home runs*."- Famous Baseball Proverb

Sometimes, a single innovation can bring sweeping change to an industry and society. More often, however, significant change comes from the aggregated effect of hundreds of smaller innovations, all applied to the same broad purpose.

A perfect illustration of the latter is the nuclear power industry. In 1985, the annual electricity production of the US nuclear fleet was 384 million megawatt hours. Today, it is close to 800 million. This doubling of the power output, over 25 years, might not seem extraordinary until you realize that there are actually fewer nuclear facilities today than there were in 1985.

Today, nuclear power plants in the US are more efficient and more effective than at any time in history. Indeed, the nuclear power industry represents one of the most remarkable innovation stories in American industrial history.

The reason it doesn't get the attention it deserves may lie in the specific way it has transformed itself. Enormous gains in productivity, security and operational performance have not been the result of a couple of big ideas, such as the way Microsoft and Apple catapulted off the microprocessor and Google and Facebook catapulted off of the internet. The nuclear industry, by contrast, has operated largely within the same basic confines for half a century. The core science (nuclear fission) and most of the operational fundamental remain unchanged since the industry's advent. So the nuclear industry has had to innovate itself without a game-changing breakthrough that alters an industry's entire construct.

Yet, a doubling the output with the same infrastructure is a feat as impressive as any innovation story you'll find and, therefore, illustrates the extraordinary power of incremental innovation. Sometimes a focus on "hitting singles" is the best route to scoring runs.

I help lead the innovation process at Exelon Nuclear, the largest operator of nuclear plants in the country and third largest in the world. In just the last five years, Exelon has developed over 170 innovations that represent 1080 person-rem savings and $796 million in cost saving. We have won (multiple times) most industry award there is to win and transformed power plant assets that were once thought to be albatrosses on the necks of state regulatory agencies, to some of the most productive assets in the US electricity generation space.

We have been able to achieve these results by adhering to what I think are six key principles that any organization can employ to achieve incremental innovation.

1. Opportunities for innovating are found in all areas of the organization.

Innovation should extend beyond the narrow parameters of the core business function. Since the core science of nuclear generation is largely settled, we innovate around it. We have implemented innovations in everything from security, to refueling, to operation to maintenance.

In just the last year, for example, we've invented and installed robotic devices for our reactor vessels, underwater machine vision camera and measurement technologies, ultrasonic cleaning devices, and even a locking device for water tight doors. Each innovation makes our plants run either more safely or more efficiently. The results from each innovation, in terms of dollars or other metrics, is significant. But added together and leveraged over the entire company, you begin to see how the industry has made such monumental progress.

2. Innovation must infuse the very culture of the company.

When innovation is expected from everywhere, it must involve everyone. Finding innovation at Exelon is the responsibility of all. There is no "innovation team" squirreled off in the corner of some R&D department – allowing everyone else to only concern themselves with the status quo. Innovation

(Continued on page 34)

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Incremental Innov...

Continued from page 32

is part of the culture at all levels and across all departments. This approach requires creating an environment that incents and rewards individuals and groups for not just thinking about their daily responsibilities – but of new ways to make their daily responsibilities more effective. Innovation is talked about at all levels and is – in some form or another – part of everyone's performance review. This culture of innovation doesn't just happen. It must be championed by a senior leadership that is committed to the innovation philosophy and invested in its success.

3. A process must be created to incubate the good ideas and toss out the bad.

To this end, the senior leadership at Exelon provided the needed backing to create the Exelon Innovation Process that focuses on the triad of innovation process engineering; 1) encouraging ideas, 2) driving the ideas through a rigorous vetting process, 3) tenaciously pursue the very best ideas through a robust resource allocation and implementation regime.

Each of these steps are critical, especially for a nuclear power plant operator. Innovation by its very nature requires risk taking. But the innovation success rate for the best companies is not nearly good enough for a nuclear utility when safety related or production projects are being considered. To this end, creating a structure that appropriately analyzes and implements innovation is of paramount importance.

4. Scalability is as important as the innovation itself.

Standardization is a core operation principle for any enterprise. At Exelon, standardization across its fleet of 17 diverse operating plants has made the company much more operationally effective. With this in mind, innovations must be transferable across operating units or they can create havoc with standardization. An innovation with applicability only to one particular place is not as valuable as an innovation that can be leveraged throughout. This 'transferability' test is an important step in determining mere 'ideas' from actionable innovation.

5. Collaboration with outside expert brings a whole new level of resources.

While Exelon is interested in innovation across every area of its operations, we don't have the expertise and wherewithal to create the innovations by ourselves. To help us, we work with notable tech firms who bring considerable expertise to a particular innovation project. On our underwater camera measurement ability, for example, was a joint effort between us and Newton Labs. They brought technical expertise and married it to our operational and requirements expertise. The partnership worked perfectly.

6. Collaboration with industry peers is an accelerator of innovation.

Finally, a key driver of our innovation has been collaboration with industry peers. Admittedly, this is not a viable option for other industries. (You won't see Ford sharing operational best practices with GM) But, thankfully, the nature of our industry is very conducive to innovation sharing. All nuclear operators have an open exchange of emerging technologies and developments that can improve safety and performance and solve technical issues. This collaboration even extends internationally. All have benefited from sharing plant operating experience, best practices, lessons learned, equipment reliability, risk management, and predictive and preventative maintenance practices.

Incremental innovation may never be the dramatic stuff found in the new movie "The Social Network" but what it can create is real change. The remarkable achievements of the nuclear power industry is a testament to that fact.

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An Industry...

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5. *How does Exelon benefit from "Safety Culture" of other non-nuclear organizations?*

We have received several benefits from looking at safety cultures within other industries. For example, we've completed benchmarking trips to chemical companies and airlines. The airline industry is probably closest to us in terms of the rigor of their processes and the need to be near perfect in human performance. We benchmarked Southwest Airlines. They have excellent employee engagement. We wanted to know how they get all of their employees really involved in the safety aspect of their work. We came back with suggestions about how we can change our coaching and feedback program to be more like Southwest. We bring back what we see as better work safety approaches and implement them at Exelon.

Twice a year we have all the management at all the stations and at the corporate office go through case studies for INPO SOER10-2. This is an INPO document that came out in 2010 and it identified a number of significant operations shortfalls that had happened in the industry. The title of the document is "Engaged Thinking Organizations". The first half of this year we are using the learnings from British Petroleum's Deep Water Horizon oil spill as the case study. It is remarkable how many similarities there can be between company challenges because people are people and the human element is often at the root of operations gaps.

Looking at examples in the nuclear industry is great but we do try to mix it up a little bit to keep people's interest and to really encourage them to think a little bit more broadly. There's a lot of benefit to not putting blinders on and thinking the nuclear industry is only place to go and benchmark for additional learnings. One of my leaders is the Vice President of Performance Improvement. She's on a hospital board and she's been talking to them about what they do in their programs to analyze human error. She is

thinking about how she can use some of those techniques to help Exelon.

6. *What guidance can Exelon provide to other utilities in the U.S. and other countries interested in developing a "safety culture" similar to that of Exelon?*

- In December 2010, the Chief Nuclear Officers of all US nuclear stations endorsed an industry document entitled NEI 09-07, "Fostering a Strong Nuclear Safety Culture".
- NEI 09-07 includes specific guidance for identifying, monitoring and trending information that may indicate a decline in the nuclear safety culture at a station.
- The industry guidance document also discusses actions and follow-up to ensure that any noted degradation in nuclear safety culture is appropriately addressed.
- Exelon has routinely shared its Nuclear Safety Culture program learnings with other utilities and will continue to do so.

7. *Does Exelon participate in international safety programs?*

We will on occasion participate in assessments of international plants, not necessarily to specifically review just safety culture, but various aspects of plant operations. There's a lot Exelon can bring to these assessments as a leader in the industry. I do think there are aspects of the United States nuclear program that are different from those of other countries in terms of the way the regulator sets standards, the focus on safety culture, and the fact that the whole industry in the U.S. works very closely together on important issues.

There is tremendous cooperation between U.S. nuclear energy companies that I sense doesn't always happen in other countries. I think the cooperation is critical to safe and reliable plant operations. U.S. companies can contribute to the growth of nuclear energy in other countries by sharing their safety learnings. U.S. companies may also get new perspectives for their safety programs from other countries.

At the end of the day, we are passionate about nuclear safety at Exelon. However, we know that passion alone is not enough. We can never take safety for granted and we must always look for new ways to improve our safety performance.

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Oil Setting Tool

By Lew Beck, Duke Energy.

Lew Beck

Lew Beck is a Senior Engineer in the Engineering Rapid Response Team (ERRT) at Oconee Nuclear Station. Lew holds degrees in Mechanical Engineering and Business Management from the University of South Carolina and a MBA from Clemson University.

Lew was awarded the International Technical Innovation of the Year Award for his laser guided oil setting tool in 2009 in Coventry, England by the Pump Industry Awards. He has also been published by Pump & Systems and World Pumps magazines for articles he has written on improving rotating equipment performance and reliability. Lew has been with Duke Energy for 24 years.

Nuclear Energy Institute's Top Industry Practice (TIP) Award's highlight the nuclear industry's most innovative techniques and ideas.

This entry was a 2011 NEI Process Award winner.

Summary

In the past the nuclear power industry has experienced equipment failures due to improperly set automatic oilers. There was never a precision tool available that ensured the level was being properly set on a typical automatic oiler used on rotating equipment.

Maintaining the correct oil level on a piece of rotating equipment such as a pump or motor is extremely critical to the longevity, reliability, and safe operation of that equipment.

Proper oil level is essential for the life of both the lubricant and the equipment. If a critically low oil level condition exists, the rotating equipment bearings will not receive enough lubricant necessary to maintain proper film strength, which results in surface contact and eventual failure. Without enough oil to prevent excess friction, thermal runaway can quickly occur and lead to a rapid catastrophic failure.

Churning of the oil will also occur if a critically high oil level condition exists. This accelerates the oxidation rate as a result of excess air and elevated temperatures. Too much oil will also lead to oil leaks and can affect the proper operation of oil rings and flingers. This critical oil level range – between the low and high level – can be extremely narrow for rotating equipment with small bearings. In smaller equipment, setting the oil level so that it is accurately maintained within its critically low and high level range becomes even more imperative.

Oconee Nuclear Station realized that with the hundreds of pumps, motors, and other rotating equipment using automatic oilers that are routinely adjusted by maintenance, it was of paramount importance that we develop a precision tool to ensure the most accurate oil setting possible. Oconee Engineering took on the challenge and developed an innovative tool which would help Maintenance precisely set automatic oilers and thus prevent equipment failures due to an incorrectly set automatic oiler.

Safety Response

Operating experience (OE) has shown that there have been issues with automatic oilers being incorrectly set on critical safety equipment. Use of the laser guided oil setting tool will enhance nuclear safety. Being able to acquire the most precise setting for the oilers for pumps and motors by using a calibrated laser vs. the conventional method of using a ruler and level will result in increasing the reliability of critical equipment that have automatic oilers and thereby improve nuclear safety. The following are some examples of safety related pumps at Oconee that will benefit from the use of the laser guided oil setting tool:

- Building Spray Pumps
- Low pressure Injection Pumps
- Standby Shutdown Facility Aux Service Water Pumps
- Standby Shutdown Facility Diesel Pumps
- Low Pressure Service Water Pumps
- Spent Fuel Cooling Pumps
- High Pressure Service Water Pumps
- Motor Driven Emergency Feedwater Pumps

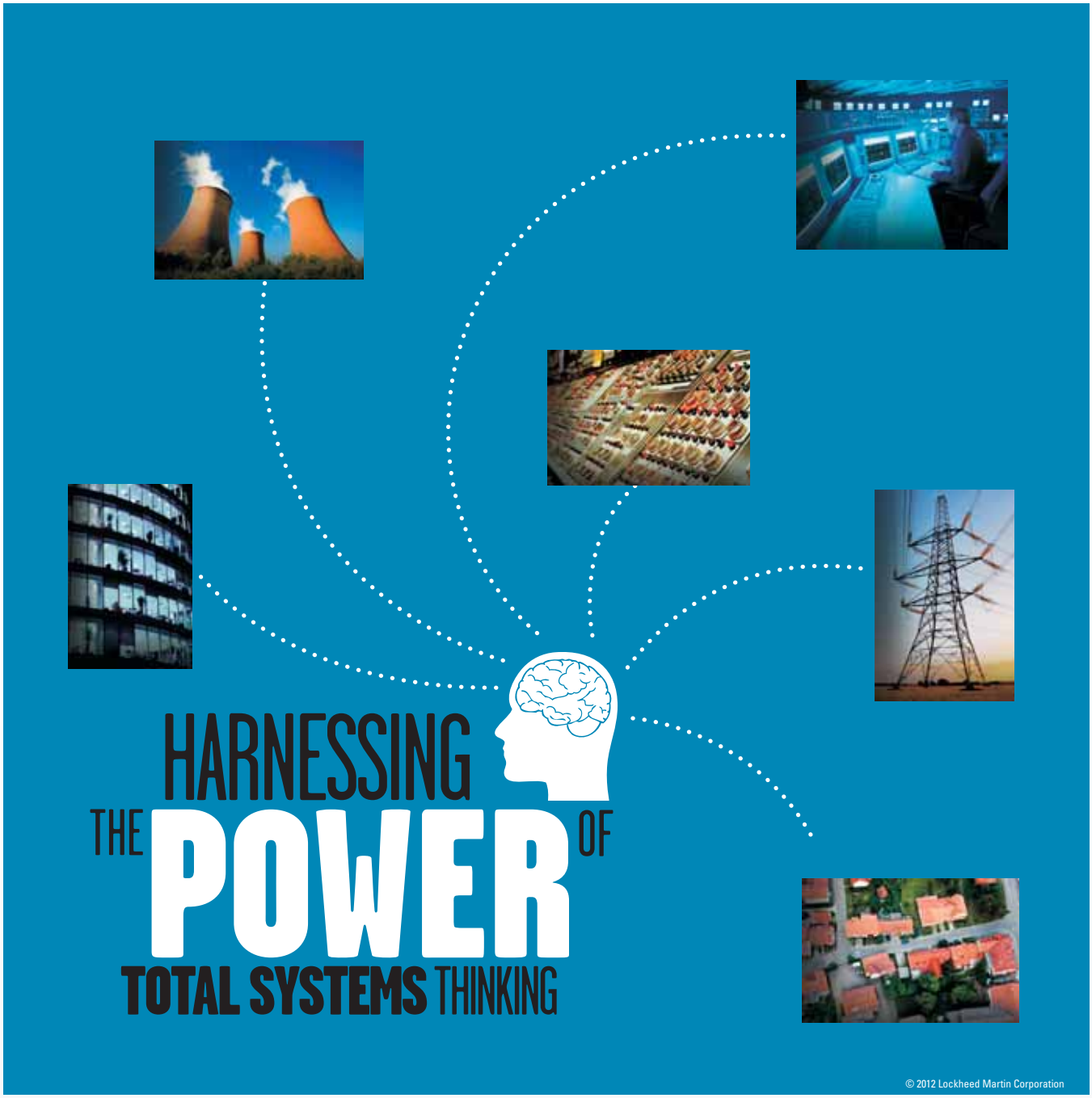
Less time is required to set or check an automatic oiler using the laser guided oil setting tool instead of the conventional method which requires the use of several tools and more setup time. This is especially true when the equipment is in close quarters with less than adequate lighting. The laser makes it quick and easy to determine the correct oil setting thus the maintenance technicians will be able to reduce dose by spending less time in a radiation area (e.g., the Spent Fuel Cooling Pumps and Building Spray Pumps are located in a radiation area) when performing a lubrication preventative maintenance (PM) that involves an automatic oiler.

Cost Savings Response

Most importantly the tool will reduce the chance of operating with the oil level too low, which could result in an expensive equipment failure and unnecessary downtime. As discussed in the Summary Statement, industry OE demonstrates the potential for catastrophic failure if the oil level is set incorrectly.

In addition, more accurate settings of automatic oilers with this tool will help

(Continued on page 38)



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Oil Setting Tool...

Continued from page 36

prevent operating equipment with oil levels that are too high. Such operation leads to premature oil oxidation and the additional cost of having to replace the oil earlier than necessary.

Moreover, efficiency savings from the tool will translate to cost savings.

Technicians will be able to complete a check of an oil setting in less than 30 seconds, as opposed to 5 - 10 minutes with conventional techniques. Using a maintenance charge rate of $40 per hour translates to a cost of $6.70 per unit for a 10 minute job. Taking only 30 seconds to perform the job reduces the cost of that portion of the job to just a fraction of the original cost to only 33 cents/unit. Considering the large number of pumps and motors in a nuclear power plant that have automatic oilers this translates to a significant cost savings impact.

Laser Guided Oil Setting Tool

Innovation Response

The conventional method for setting an oiler involves using a straightedge and level and transposing the mark from the oil sump to the oiler, thus placing a mark on the oiler that corresponds to a mark on the oil sump.

The accuracy of this method depends entirely upon the experience of the user and how accurately he or she can visually sight the scale between the oil sump and the oiler – which becomes more difficult as the distance between the two points of reference increase. The greater the distance between the oiler and the housing, the easier it is to make a mistake setting the oiler using the conventional technique.

Previously, there was no tool available that ensured the level was being properly set on a typical automatic oiler.

Consequently, Oconee developed a laser guided oil level setting tool. This tool uses a laser to transfer the oil level setting from the adjusting arm in the oiler onto a reference mark on the bearing housing (oil sump) that represents the correct oil level for the equipment bearings.

More specifically, this tool provides a first portion that is configured to extend into the base of the constant level oiler and into engagement with the adjustable element, and a second portion that is disposed exterior to the base to indicate visually, by laser beam, the disposition of the adjustable element relative to the oil containing sump.

The laser beam is equipped with a line generator which projects a red line against the pump bearing housing, rather than just a red dot.

Thus, as the elevation of the adjustable element of the oiler is moved up and down during the setup process, the oil setting tool provides a visual reference, via the laser, at each step in the process. This accurately sights the position of the adjustable element relative to the oil sump from outside of the oiler, greatly improving the ability of the technician to ensure the most precise positioning of the adjustment element in relation to the oil sump.

This tool becomes particularly useful when an oiler is positioned three or more inches away from the oil sump housing. The laser guided oil setting tool eliminates the need for a straightedge, level, marking pen, and possibly a flashlight. Instead the laser projects a red line precisely from the oiler's setting to the oil sump, whether it is three inches away or three feet away.

This laser guided oil setting tool is a small hand held tool which can be carried in a pocket and has a built-in level to help ensure the most accurate settings are made. We find this tool quick and easy to use, and ideal for those areas where lighting may be less than adequate.

In 2009 Oconee Nuclear Station received the International Pump Industry Technical Innovation of the Year award in Coventry, England for this innovation.

The tool has just recently been commercialized based off of the initial design developed by Oconee Engineering. It is also being sold around the world in; Asia, Europe, North America, South America, and Australia. Currently eight different countries are using this innovative tool to set or check automatic oilers.

Productivity/Efficiency Response

Productivity improvement is realized by how quickly the maintenance technicians can now accurately set an automatic oiler by just using this one tool. Lubrications PMs are also much quicker using the new device.

It normally takes 5 – 10 minutes to check the settings on a typical automatic oiler. With the laser guided oil setting tool the check can be performed in less than 30 seconds.

Transferability Response

The laser guided oil setting tool is not only new and innovative, but highly transferable. The tool was developed for use on any equipment with a typical automatic oiler such as a pump or a motor. Automatic oilers are very common in United States nuclear power plants. There are literally millions of automatic oilers all over the world that can benefit from this tool.

The laser guided oil setting tool has now been commercialized, so it is readily available to the United States nuclear industry. Oconee worked with Trico Corporation to develop an affordable commercial unit that would benefit the entire industry, not just Oconee Nuclear Station, Southern Nuclear, Point Beach Nuclear Station, Catawba Nuclear Station, and McGuire Nuclear Station have all obtained the laser guided oil setting tool.

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Supporting the Digital World

By Erin Joy and Eric Mino, GE Hitachi Nuclear Energy.

Erin Joy

Erin Joy is the Services Instrumentation & Controls Engineering Manager responsible for project execution at GE Hitachi Nuclear Energy. Erin received her B.S. from Rochester Institute of Technology in Electrical Engineering. She has five years in the nuclear industry and over ten years of experience with digital electronics.

Eric Mino

Eric Mino is the Manager of Controls and Systems Upgrades at GE Hitachi Nuclear Energy. Mino received his B.S. from the Massachusetts Maritime Academy in Facilities and Plant Engineering. Eric is currently pursuing an MBA at the University of North Carolina-Wilmington, completing in April 2013. He has seven years in the nuclear industry with over sixteen years of experience in digital I&C maintenance and upgrades.

Utilities continue to install new digital instrumentation and control (I&C) equipment in their boiling water reactors (BWRs) to meet plant modernization initiatives and evolving requirements related to cyber-security, software safety and I&C system integrity. In response, GE Hitachi Nuclear Energy (GEH) in February 2012 opened a new I&C laboratory and customer validation center at its headquarters in Wilmington, N.C.

In the U.S., the continued demand for new I&C systems by utilities has increased reliance on vendors to provide compliant systems that help plants meet the new cyber security regulations of the U.S. Nuclear Regulatory Commission (NRC)—including Reg. Guide 5.71 (Cyber Security Programs for Nuclear Facilities) and Reg. Guide 1.152 (Criteria for use of Computers in Safety Systems in Nuclear Power Plants)—which govern reactor safety systems. Utilities are now required to have robust plans to protect their plant I&C systems from potential cyber threats. Additionally, U.S. nuclear plant operators are now in various stages of incorporating these cyber-security requirements into purchase specifications for new I&C systems.

These cyber-security requirements, coupled with recent changes from the NRC concerning licensing of safety-related I&C system upgrades spurred GEH to review its own digital I&C system lifecycle development processes. This has motivated GEH to reinvent these processes with a greater emphasis on independence, security and access control—efforts that drove the company's decision to build its new, secure centralized I&C facility.

The first floor of the new, two-story, 26,000 square-foot I&C lab features a dedicated, cyber-secure space for software development, as well as separate areas for hardware prototyping, environmental testing and customer validation of I&C systems. In addition, customer training centers and employee offices are housed on the second floor.

Importantly, the new I&C lab allows the company to focus on developing and staging its portfolio of advanced safety products for nuclear measurement analysis and controls (NUMAC). These include radiation monitoring, wide range neutron monitoring, power range neutron monitoring, automatic traversing in-core probe used for calibration of in-core sensors, and rod control management. This larger footprint not only allows the customer to see and test the product, but also to receive training all in one central location.

In addition to enabling more robust access control for the secure software development area, the new building also allows GEH to double the number of its I&C products that can be staged simultaneously for customers, accommodating up to six systems simultaneously.

After arriving at GEH's I&C facility, a utility customer's team of representatives will undergo several days of classroom and hands-on training before beginning the process of validating their new I&C equipment – work that normally takes about a week-and-a-half to complete. During this time, customers are expected to work very closely with GEH experts to learn about this equipment.

The new I&C lab is an important benefit because it gives customers greater flexibility to manage the customer validation process in compliance with the NRC's Interim Staff Guidance - 06, which established the current roadmap for the agency to review a given utility's digital I&C technology upgrade plans.

The new facility also enables GEH to offer its customers a more effective way to comply with several key regulatory and industry standards that guide high-quality software development, as well as software verification and validation. These guidance documents include the NRC's Interim Staff Guidance -06, NRC Branch Technical Position 7-14 (Guidance on

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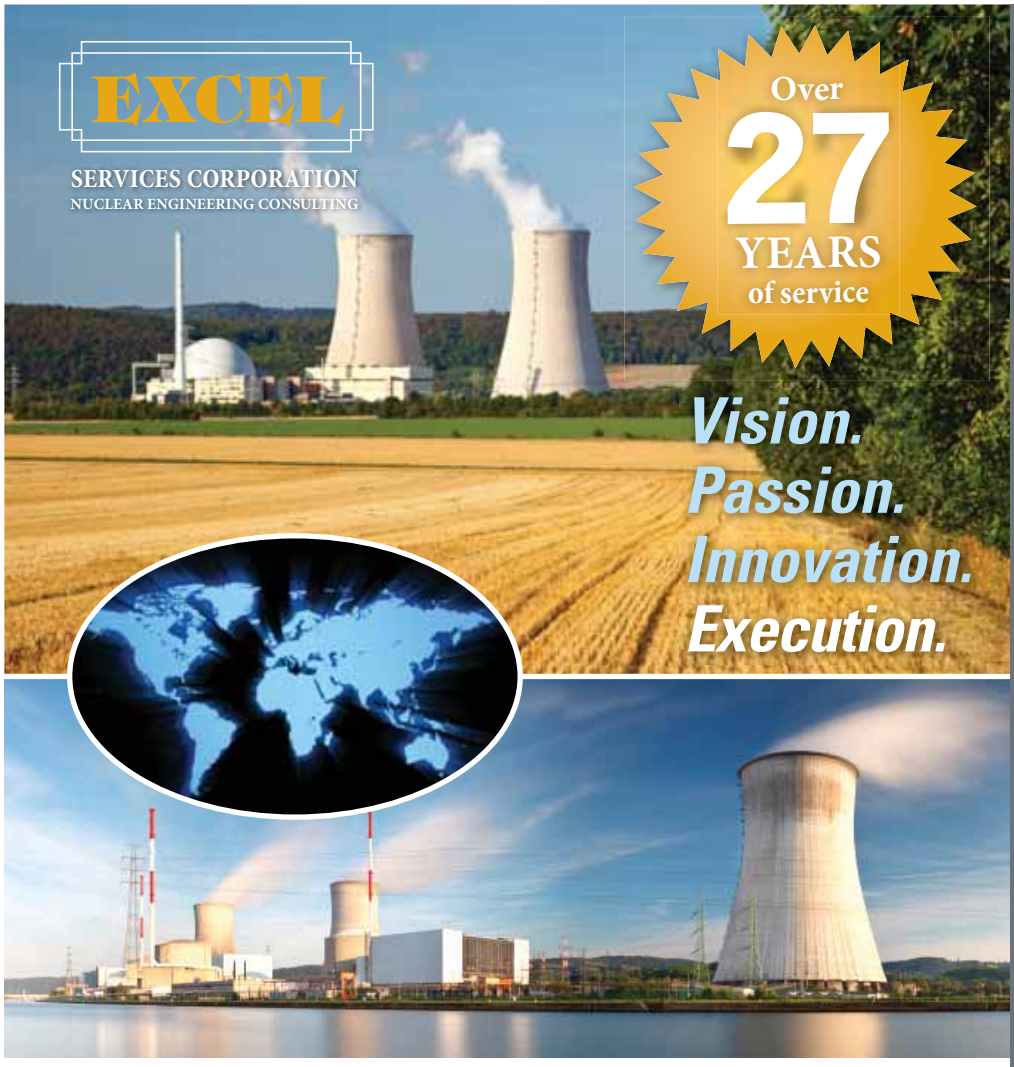

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Meeting the Obsolescence Challenge

By Greg Keller, Nuclear Logistics Inc.

Greg Keller

Greg Keller is the Manager, Strategic Business Development for Nuclear Logistics Inc. He has extensive experience with inventory identification, product standardization, equipment obsolescence, and reverse engineering. His more than thirty-year nuclear career began as a Navy nuclear operator and instructor. He has a B.S. in Management and an MBA.

Operating nuclear plants in the US have recently become more accepting of new technologies given new plant construction here and abroad, power uprates, plant life extensions, and equipment obsolescence issues. That said, it is still an uphill battle given the conservative nature of plant staffs as well as their high comfort level with proven older technology.

"May you live in interesting times" is a well-known phrase of unknown origin. For those that have been in the nuclear industry for a couple decades or longer, these are certainly interesting times. The Fukushima Daiichi event has certainly put a damper on the nuclear renaissance, but for the first time in over 30 years, the NRC has granted a license for new plant construction. We also have the TVA's Bellefonte project to look forward to.

New and renewed construction activities are exciting in the overall sense of the nuclear industry, but new plant construction in Georgia will likely have little or no short-term effect on the typical nuclear professional working at an operating plant. However, for the suppliers to the nuclear industry, the impact is significant. New units will use new technologies. New products and equipment will be qualified for nuclear use and this could prove to be a benefit to the industry as a whole.

For a variety of reasons, nuclear plants have been slow to embrace new technologies. This propensity to cling to older equipment and technology has created an environment where fairly unique supplier business models have emerged. Some specialize in maintaining and refurbishing old equipment, some specialize in reverse engineering and manufacturing equivalent replacements, and some offer both solutions. The companies that offer equivalent replacements also tend to specialize in equipment qualification.

But the older plants become, the harder it is to obtain original equipment or anything even resembling the installed original equipment. When the level of difficulty maintaining or obtaining original equipment reaches a certain point, plants become willing to embrace new technology. This can sometimes be easier said than done, and while individuals may rush to be the first to own the newest mobile device, nuclear plants do not like being the first to install a new technology or model.

In the last several years, however, nuclear plants have begun accepting new technology for certain equipment types. And new plant construction has been the catalyst for developing new products capable of being qualified for nuclear environments. Many of these new products using new technologies are applicable to the existing fleet of operating units. What is a new technology for nuclear may have been adopted by other industries years ago.

Cobalt-Free Metal-Seated Ball Valves

One product innovation that is fairly new to nuclear is the metal-seated ball valve (MSBV). Soft-seated ball valves are common in low pressure air and water lines, but the manufacturing technology required to manufacture a MSBV did not exist until fairly recently. When the US operating fleet was being built, gate and globe valves were the leading technology; used in high-pressure applications, these valves often relied on alloy steels containing cobalt to achieve hard and durable seating surfaces.

Several new manufacturing technologies permit MSBVs to achieve extremely hard seating surfaces without the use of cobalt, as well as the precision to achieve zero or near zero leak rates. MSBVs would not be used to replace soft-seated ball valves, but are ideal for high temperature and high-pressure applications where gate and globe valves are currently installed.

With two or three percent of thermal output lost through leaking vent and drain valves, MSBVs are a great way to capture lost power. This is especially important for those sites facing environmental issues related to heating rivers, lakes, etc. The cost to replace a few problem leaking

valves is minimal compared to what plants are spending on power uprates for similar percent increases in output.

Ultrasonic Flow Measurement

Another innovative technology is ultrasonic flow measurement. The old technology involves measuring the differential pressure across a flow—a method that is inefficient and only moderately accurate. Ultrasonic flow measurement passes sound waves diagonally across the flow and measures the time difference between the sound waves headed against the flow and the sound waves headed with the flow. Multiple sets of sensors can compensate for uneven flow, differences in fluid density, and other factors, making them extremely accurate.

Accuracy can be increased by increasing the pairs of sensors transmitting and receiving the sound waves. When the multiple signals are analyzed, the instrument can compensate for turbulence and other flow irregularities. Early versions often required flow straighteners to minimize turbulence, but newer designs with additional sensors and more sophisticated algorithms do not need flow straighteners, which can be difficult to find space for in existing piping systems.

Metal Frame Breakers

Electrical equipment has changed greatly in the past several decades. With the changes in technology have come significant changes in physical size. One example of this is low voltage metal frame breakers. These breakers—hundreds of which are installed in each plant—have become significantly simpler and smaller than their maintenance-intensive predecessors. Plants struggle to maintain older breakers, typically overhauling each one on a six-year cycle. The maintenance personnel most familiar with the older designs are retiring, and spare parts are extremely difficult to obtain. Legacy breakers are obsolete both in terms of technology and the ability to procure them.

The main challenge to replacing metal frame breakers is the fact they rack into and out of switchgear cells and interface with the switchgear using non-permanent connections such as spring-loaded fingers. Plants could certainly replace their switchgear to accommodate smaller modern breakers, but this would be an extensive and costly modification. The innovative solution to this particular challenge is custom designed cradles that bridge the gap between the new smaller breakers and the large existing switchgear cells.

To install cradles and new metal frame breakers, plants rack out the existing breakers and remove them. Next the cradles are racked into the existing cells. The cradles are designed to interface with all plant connections exactly as the original breaker did. The cradle creates a new smaller cell. The new breakers rack into and out of the cradles

Custom designed cradles make it easy to cost-effectively replace obsolete breakers with new, nearly maintenance free breakers.

(Continued on page 44)

Meeting the...

Continued from page 43

similar to how the older breakers racked into and out of the original switchgear cells. An added benefit to using the new breaker and cradle solution is that modern breakers do not require overhauls for the life of nearly all operating US plants. Another benefit is that plants or fleets having different manufacturers or models of breakers can all standardize on a common modern breaker by using different cradles for each different legacy breaker. This allows plants to have high levels of interchangeability with very minimal inventory.

Digital Controls

The nuclear industry has been slow to adopt digital equipment, especially for safety-related applications. Digital devices can typically perform many more functions than their analog ancestors, but when replacing an existing analog control device, many of those additional functions are unneeded. This tilts the risk-reward equation in favor of sticking with analog. But one application that can greatly benefit from digital technology is chiller controls.

Chillers are vital pieces of equipment and when they trip offline, plants may have to shut down. But chillers are the type of equipment that can take advantage of the added features digital control units offer. Unlike old analog chiller controls, digital controls can take certain actions to optimize the performance of a chiller or reduce its output to prevent trips. Older chillers are often incapable of operating at peak performance. When stressed by high loads, these chillers operate as well as they can until they simply trip. But with more sophisticated digital logic, the output can be reduced slightly to prevent trips, while still maintaining an adequate output level.

The nuclear industry takes the notion of caution to the extreme. For reasons too numerous to list, we do not chase technology like consumers that must have the latest mobile device. We stick with what works and has worked for decades. But at some point one of two things happens. First, we may reach the point where the costs associated with maintaining or obtaining older equipment greatly exceed the costs associated with adopting new technology. And second, we may reach the point where the performance benefits of new technology far exceed the risks associated with that of the new technology.

Interesting times indeed. New plant construction, power uprates, plant life extensions, and solutions to obsolescence have driven the development and qualification of new technologies for nuclear. With many of these trails already blazed, the operating units can take full advantage of these new technologies as the lives of these plants are extended decades into the future.

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Enhancing Safety Margins

By Gerard van Loenhout, Flowserve Flow Solutions Group, Etten-Leur, The Netherlands.

Gerard van Loenhout

Gerard van Loenhout is the Industry Specialist for Nuclear Aftermarket at Flowserve Engineering & Technical Services, in Flowserve Flow Solutions Group, Etten-Leur, The Netherlands. He has 22 years of experience in designing mechanical seals with a specific interest in sealing solutions for reactor coolant- and reactor recirculation pumps. Mr. van Loenhout received his B.Sc. degree (Mechanical Engineering) from the Avans Institute of Technology, Breda, The Netherlands.

Increasing nuclear safety margins during various operating and emergency scenarios have become a major objective for nuclear equipment suppliers. Both the June 2011 report released by the U.S. Nuclear Regulatory Commission (NRC) titled 'Recommendations for Enhancing Reactor Safety in the 21st Century' and the E.U. 'Stress Tests' specifications compiled by the European Commission and the European Nuclear Safety Regulatory Group (ENSREG) discuss a thorough evaluation of the nuclear safety margins by the nuclear power plants, along with assessing improved protection from concurrent related events, such as fires.

Sealing a primary coolant pump (PCP) in a light water reactor using a mechanical end face shaft seal is considered one of the most challenging applications found in the nuclear industry. Primary coolant pump seals limit the leakage of the reactor coolant fluid along the pump shaft. Therefore, these seals are an integral part of the reactor coolant system (RCS) pressure boundary. Maintaining the pressure boundary integrity under all operating conditions was demonstrated in the past by the use of a Flowserve N-Seal. This mechanical seal cartridge was designed and tested to withstand the most demanding operating scenarios and has a proven track record of up to 17 years of continuous service. All N-Seal seal cartridges have redundant staging capabilities, whereby each seal stage is capable of handling full RCS operating conditions. To meet the foreseen increased industry demand for the highest available nuclear safety margins, Flowserve has proactively initiated two different development programs that apply new sealing insights and technology to nuclear plant safety.

The first development program explored the capability of the N-seal to operate at full RCS temperatures. Under certain control room fire scenarios, plant operators are unable to control PCP operation remotely, and, at the same time, could face the loss of all seal cooling from other fire-induced damage. To regain control, the PCP's operators must be equipped with appropriate protective clothing that allows them to enter the reactor building and manually trip the circuit breakers to stop the pumps. It could potentially take more than 20 minutes to perform such an action. In the meantime, the PCP seal must be dynamically operating at full RCS pressure and temperature without external seal cooling. To better understand the capability of the N-Seal to withstand such arduous conditions, a test was conducted simulating this type of scenario. The main purpose was twofold: First, to determine whether the seal would be able to physically cope with these conditions and for how long; second, to determine to what extent loss of reactor coolant could be minimized until operators stabilize conditions and shutdown the pump.

The vertical test rig set-up used for this critical test consisted of two N-Seals mounted in a face-to-face double seal configuration, whereby the simulated pressure was applied between the two seals. Seal leakage connections were provided on the low pressure side of both seals allowing accurate leak rate measurements during the test. Standard N-Seal materials and configurations were used.

The test began with two hours of operation at 400 ºF (204 ºC) water and a simulated single-stage sealing pressure of 750 PSIG (51.7 barG). After these initial test conditions, both the water temperature and sealing pressure were increased to 560 ºF (293 ºC) and 1250 PSIG (86.2 barG) respectively. The latter pressure condition simulates the situation where the upper stage of the N-seal cartridge has reached vapour conditions on the inlet. No credit is taken for operability of that stage under those conditions and the two remaining seal stages assume the total sealing function.

During this dynamic test, no measurable changes in seal leakage were detected. Close inspection of the seal faces and parts after the test detected no measurable change in carbon graphite wear nose height. Some slight extrusion was found on some of the O-rings, but did not compromise sealing function.

The main conclusion drawn from this first development program is that, even under the most extreme operating

conditions and complete loss of seal cooling, the N-Seal shows a high degree of sealing reliability with no appreciable loss of reactor coolant. Even discounting the time it takes to heat up to full RCS temperature at the PCP mechanical seal, the N-Seal can operate for one hour and beyond. It shows that nuclear safety risk margins can be proactively impacted by selecting the appropriate sealing solution.

Flowserve's N-Seal

The objective of the second program was to upgrade our first generation auxiliary shutdown seal, the Abeyance Seal, to a new technology, with near zero leakage. The second generation Abeyance Seal maintains a passive solution with zero leakage in the unlikely event of a complete loss of a PCP mechanical seal cartridge. The second generation Abeyance Seal is positioned on top of the mechanical seal cartridge towards the atmospheric side. The Abeyance Seal is relatively far away from the high temperature influences of the PCP. The large running clearances of the N-Seal package have been maintained to avoid incidental contact and wear during normal PCP operation. The design goals for this new technology were to be self-actuated (no operator action required), have no complex parts such as springs or pistons, provide near zero leakage after actuation, demonstrate a quick response to minimal mass flow of steam while ensuring no premature actuation under normal leakage conditions, and, most importantly, provide additional safety margin in case of an extended Station Black Out (SBO) event. It is crucial to note that the Abeyance Seal is actuated by steam flow (not temperature) after complete loss of the N-Seal cartridge. This removes the risk of unintended actuation due to minor operational temperature elevations, which then could make the standby seal unavailable without the operators being aware.

The design of the new advanced second generation Abeyance Seal consists of a metal thermal expansion prevention ring, a polymer initial actuation ring, a metal sealing anti-extrusion ring and a metal load support backing ring.

Prior to the actual testing of the device on a test rig, detailed finite element (FE) calculations were made to optimize the design of the individual parts. Such FE calculations involve both linear and non-linear behaviour of the various materials within the design. Once the design was established, FE calculations showed that initial sealing of the polymer ring onto the shaft sleeve occurs rapidly and minimizes total reactor coolant volume

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Enhancing Safety...

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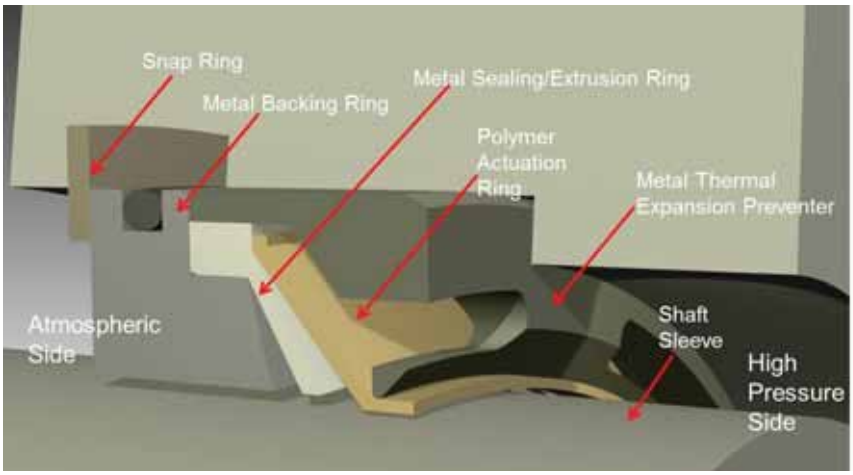
loss. As leakage flow is reduced to near zero as a result of the polymer ring sealing, pressure starts to build on the high pressure side of the Abeyance Seal. At an elevated pressure the metal sealing anti-extrusion ring positioned behind the polymer ring begins to activate and create a positive seal on the shaft sleeve. As pressure continues to climb on the high pressure side, the metal sealing anti-extrusion ring yields until it lies flat against its metal back up ring, which provides a full parallel support area for a zero-leakage seal.



Flowserve's Second Generation Advanced Abeyance Seal Concept (Patent Pending)

Testing has shown the success of the second generation Abeyance Seal to quickly activate under minimal steam flow and withstand full RCS pressure for extended periods. The first phase of tests involved the use of air at ambient temperatures, followed by actuation of air at elevated temperatures, because analysis showed that this was the most restrictive condition for actuation. To make sure the new Abeyance Seal would not unintentionally actuate when being presented with normal PCP seal leakage, tests were conducted flowing an order of magnitude greater than normal leakage at common PCP temperatures and demonstrated no actuation under these conditions. The next series of actuation tests involved the use of steam at varying pressures through an orifice with a supply source at near-full RCS temperature. Finally a high pressure actuation test was conducted at full RCS pressure where the Abeyance Seal held full RCS pressure for an extended period and a planned depressurization of the system concluded the test. The present test program involves actuation and sealing at full-rated RCS pressure and temperature and ensuring near-zero leakage beyond the recommendations discussed to date in the NRC and ENSREG reports referenced above. In addition to the extended hold time test in progress, testing will be conducted to simulate real world, used-part conditions and postulated emergency operating scenarios, such as high pressure/temperature actuation with a 48-hour hold time followed by depressurization with concurrent axial motion of the shaft.

While both of the development programs mentioned focus on different aspects of the overall PCP sealing integrity, one can conclude that, together, they present new and crucial insight and provide innovative sealing solutions for the nuclear industry, whereby different nuclear safety margins are significantly increased.

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Supporting the...

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Software Reviews for Digital Computer-Based Instrumentation and Control Systems) and the Institute of Electrical and Electronics Engineers' "IEEE-1012 (Standard for Software Verification and Validation)."

In addition to supporting more robust cyber security protections for the global BWR fleet, GEH's enhanced software development and validation capabilities offer other important advantages. In particular, they will enable GEH to more effectively work with utilities to implement the Detect and Suppress Solution–Confirmation Density (DSS-CD), which is the latest advanced reactor core stability Long-Term Solution (LTS) developed by GEH to support the Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain expansion. The DSS-CD solution, in conjunction with MELLLA+, is one of the GEH Extended Power Uprate (EPU) products. It is a sophisticated and cutting edge tool that allows plants to operate at their maximum output while providing additional operating margins and less restrictive fuel design operating limits.

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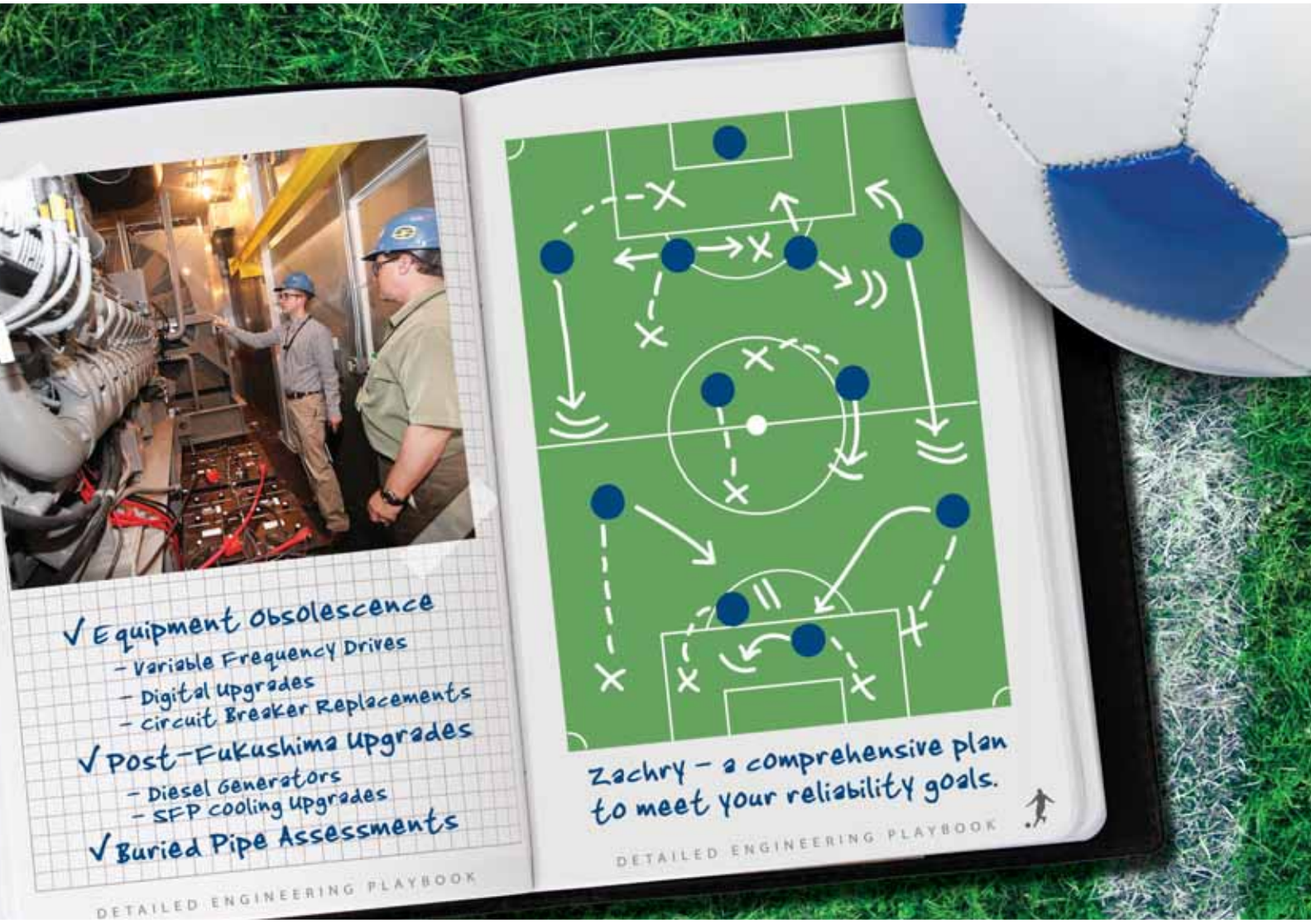

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An Exemplary Plant

By Robert Osgood, Dresden Generating Station.

David Czufin

David M. Czufin, Site Vice President of Exelon Nuclear's Dresden Generating Station, has nearly 30 years of experience in the nuclear power industry. Prior to assuming his current position in April 2011, Czufin served as Exelon Nuclear's Vice President of Engineering at the company's corporate headquarters. He joined Exelon in March 2000 as Assistant Engineering Director at LaSalle County Generating Station and then served as the site's Engineering Director. He also served Exelon Nuclear's Work Management Director.

Czufin holds a Bachelor's degree in Mechanical Engineering from the University of Florida and earned his Senior Reactor Operator certifications at both LaSalle and Crystal River Stations. He also holds leadership roles in several nuclear industry oversight and working groups, including the Electric Power Research Institute and serves on advisory boards for the Illinois Institute of Technology and the University of Florida.

The completion of Dresden Station's Unit 2 refueling outage in the fall 2011 marked a new era of generation at the nuclear facility. That's because the last of several key multi-year projects were completed during the shutdown that are enabling Dresden to increase the amount of safe, clean, reliable electricity that it produces.

During its 2011 fall outage, Dresden replaced all three of its Unit 2 low-pressure turbine rotors and casings, giving the unit about 40 additional megawatts of electricity it can now send to the grid. Originally licensed to produce 825 megawatts when Units 2 and 3 entered commercial service in 1971 and 1972, respectively, both of Dresden's two operating units have undergone various modifications over the years that have increased the amount of electricity they are capable of producing. However, the turbine retrofit project marked a monumental achievement for the site, with Unit 2 now generating approximately 980 megawatts of power.

Replacing the 138-ton turbine rotors and their casings was no small feat. The Unit 2 project was years in the planning and represents an investment of about $150 million by Exelon Corp. in the future of Dresden.

Extensive computerized mapping of all of the existing turbine components and associated piping had to be done to ensure that the old components could be disassembled, cut out and removed. And the new parts had to be manufactured to the exact specifications so they could be assembled and fit into position with no significant delays. A team of subject matter experts was assembled to develop the comprehensive schedule and coordination of all aspects of this project.

Exelon Nuclear awarded the contract for the new components to Alstom Corporation.

The rotor forgings came from Italy. Two of the new turbine rotors were manufactured, inspected, and tested in Alstom Power's facility in Chattanooga, Tennessee, and the third rotor was manufactured, inspected and tested in Switzerland. On Aug. 9, 2011,the two rotors in Tennessee were placed on a barge and made their way up the Tennessee, Mississippi and Illinois Rivers, arriving at Dresden a week later. The third rotor was shipped from Switzerland by ship to Baltimore, Maryland, and then by rail to Dresden.

The turbine casings were built in Poland, with final preparations performed in Mexico before being shipped to Dresden for installation.

Working with Alstom personnel, members of the Dresden team safely and successfully completed the Unit 2 turbine retrofit project in 17.5 days, which set a new world record. This milestone enabled Dresden to complete its outage ahead of its scheduled duration.

The turbine retrofit project is part of Exelon Nuclear's rigorous asset management program, which is designed to proactively replace aging equipment before issues arise. It is also a key part of Exelon's long-term strategy to increase electrical generation through plant upgrades rather than investing in new construction.

To date, the new turbines have performed exceptionally well and the generation increase has been as predicted. The same turbine retrofit project will be completed on Dresden Unit 3 during 2012's upcoming refueling outage in the fall. Exelon also completed turbine retrofits at its Quad Cities dual-unit facility in Western Illinois and on one of Peach Bottom's two units in Southern Pennsylvania in fall 2011. Like Dresden,

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1. "Nuclear Accident or Incident?"
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An Exemplary...

Continued from page 50

the second Peach Bottom unit will complete the project on its second unit this fall.

On a Quest for Continuous Improvement

In addition to the turbine retrofit project, Dresden has completed several other asset improvements during the past several years, including replacement of both units' main power transformers, the continuation of an extensive underground piping inspection and repair project, installation of digital EHC systems on both units and the completion of numerous switchyard breaker upgrades.

These and other material condition upgrades, coupled with strong employee development and the use of training to improve performance, have enabled the people at Dresden to achieve several milestones, including:

- A 684-day continuous "breaker-to-breaker" run between refueling outages on Unit 2—the first such run in Dresden's history.
- Industry top-decile Equipment Reliability Index performance of 100 points on Unit 2 and 99 points on Unit 3.
- The receipt of a Top Industry (TIP) Award in 2010 for developing the CRD Guide Tube Flushing Tool.
- Recognition by the Information System on Occupational Exposure (ISOE) by receiving its World Class ALARA Award for 2010.
- Achieving the number-one ranking on Unit 2 and the number-three ranking on Unit 3 for INPO's Chemistry Excellence Indicator (CEI) among all U.S. boiling water reactors.

Reaffirming Plant Safety at Dresden Following Fukushima

Since both Dresden units are General Electric Mark I boiling water reactors, similar to the units at the Fukushima-Daiichi site, the tragedy that occurred in Japan in March 2011 is of particular importance to the site.

Within a week of the tragic events in Japan personnel at Dresden – and throughout the Exelon Nuclear fleet – were reviewing systems and components to ensure that the plant could withstand the effects of seismic events, floods or a complete loss of AC power. In addition, teams of Exelon engineers and technical experts traveled to Japan to provide expertise and to begin learning as much as they could about what had occurred and how others in the industry could learn from the Fukushima experience.

Lessons learned from Fukushima have translated into extensive reviews of equipment, structures and procedures and the purchases of additional backup emergency equipment throughout Exelon Nuclear. The following actions were taken at Dresden to make the facility even safer:

- 5,200 person hours were applied to completing all Fukushima response activities.

(Continued on page 54)

Robert Osgood

As Site Communications Manager for Exelon Nuclear's Dresden Generating Station, Robert Osgood is responsible for managing the site's internal and external communications programs. In addition to his position at Dresden, Osgood has served in Exelon's Corporate Communications organization and at the company's LaSalle County Generating Station. He holds a Bachelor of Arts degree in Journalism from Southern Illinois University.

An Exemplary...

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- A second trailer-mounted, diesel driven pump was added to the site.
- 115 procedures and operating guidelines were created, revised or verified.
- Additional Operator Fundamentals Training and Severe Accident Response Proficiency Reviews were conducted.
- Approximately 400 pieces of portable and installed equipment throughout the facility were reviewed.
- 18 plant areas with internal or external design flood barriers or seals were inspected to verify their functionality.
- Additional flood assessments are currently in progress to validate external flood design margin.

In addition, letters and other communications were distributed to plant neighbors and other stakeholders, shortly after the events in Japan – and again a year later – reassuring them that Dresden is safe and that the station's physical barriers and redundant safety systems can withstand even the most-severe emergency conditions.

Dresden Station at a Glance

Dresden Generating Station is located on a 953-acre site in Morris, Illinois which is about 60 miles southwest of Chicago. The station has two operating units, both of which are General Electric boiling water reactors, which were built by Sargent and Lundy.

The site is also home to Dresden Unit 1, which was the first commercial nuclear power plant in the nation built without government funding. The 210-megawatt unit entered commercial service in 1960. It was permanently shut down in 1978 and is in long-term safe storage with the reactor fuel contained in dry casks onsite. Dresden Unit 1 is designated as a Nuclear Historic Landmark by the American Nuclear Society.

Units 2 and 3 went online in 1970 and 1971, respectively. In 2004, the Nuclear Regulatory Commission granted both units a 20-year extension of their operating licenses, allowing Unit 2 to operate until 2029 and Unit 3 until 2031.

In 2011, Dresden generated 14,714,359 megawatt-hours of electricity with a capacity factor of 95.8 percent.

Dresden is also a vital member of the community. In addition to making annual tax payments of about $21.1 million to fund area schools and other taxing bodies, the station and its employees contribute more than $200,000 in sponsorships and contributions to local civic and charitable organizations.

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