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Advanced Reactors**

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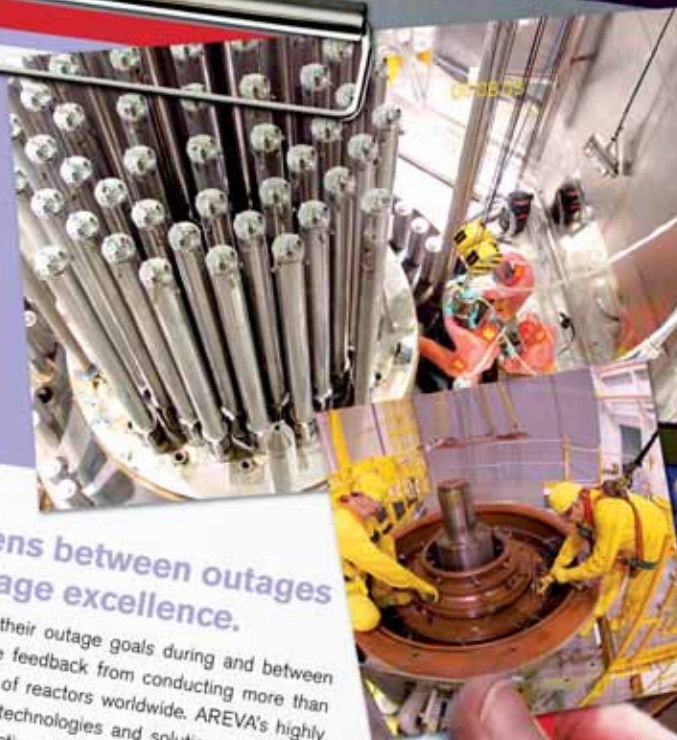


Fitzpatrick, United States

ISSN: 0892-2055

FIELD REPORT#4

Topic	Outage Excellence
Location	USA



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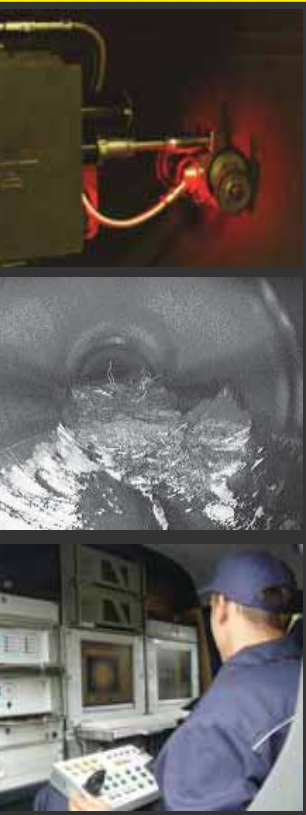
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29 years of Journal issues are now available online through the Journal website www.NuclearPlantJournal.com (search box on the right-top) for a nominal fee of \$25 per issue. Contact: Anu Agnihotri, email: anu@goinfo.com

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Articles & Reports

Standards of Excellence in Emergency Response 20
 By Bill Webster, Institute of Nuclear Power Operations (INPO)

Being Halfway in Nuclear Doesn't Work 24
 By Preston Swafford, TVA Nuclear Power Group

Globally Engaged 28
 By Jeffrey Merrifield, Shaw's Power Group

International Trade Obstacles to Fukushima Recovery 32
 By Elina Teplinsky, Stephen L. Markus and Yukinori Machida, Pillsbury Winthrop Shaw Pittman LLP

Reliable Fuel Pool Instrumentation 42

Mitigation Strategies 44

Industry Innovations

50 TIP Awards since 2001 18

Nuclear Grade Air Trap 36
 By Turner Wood, NUCCORP, Inc.

Preventing Half-SCRAMS with Insulated Srew Bit 38
 By Bruno Giorgio, Entergy Nuclear

RI-ISI 46
 By Electric Power Research Institute

Reducing AOA Risk 48
 By Electric Power Research Institute

Cable Aging Management Programs 51
 By Electric Power Research Institute

Plant Profile

Right at Home in Oswego 53
 By Tammy Holden, Entergy Nuclear

Departments

New Energy News 8

Utility, Industry & Corporation 10

New Products, Services & Contracts 12

New Documents 14

Meeting & Training Calendar 16

Research & Development 17

Journal Services

List of Advertisers 6

Advertiser Web Directory 40

On The Cover

Currently, FitzPatrick is operating in its second longest run of safe, continuous operation as the station prepares to enter its twentieth refueling outage this fall. See page 53 for a profile.

Mailing Identification Statement

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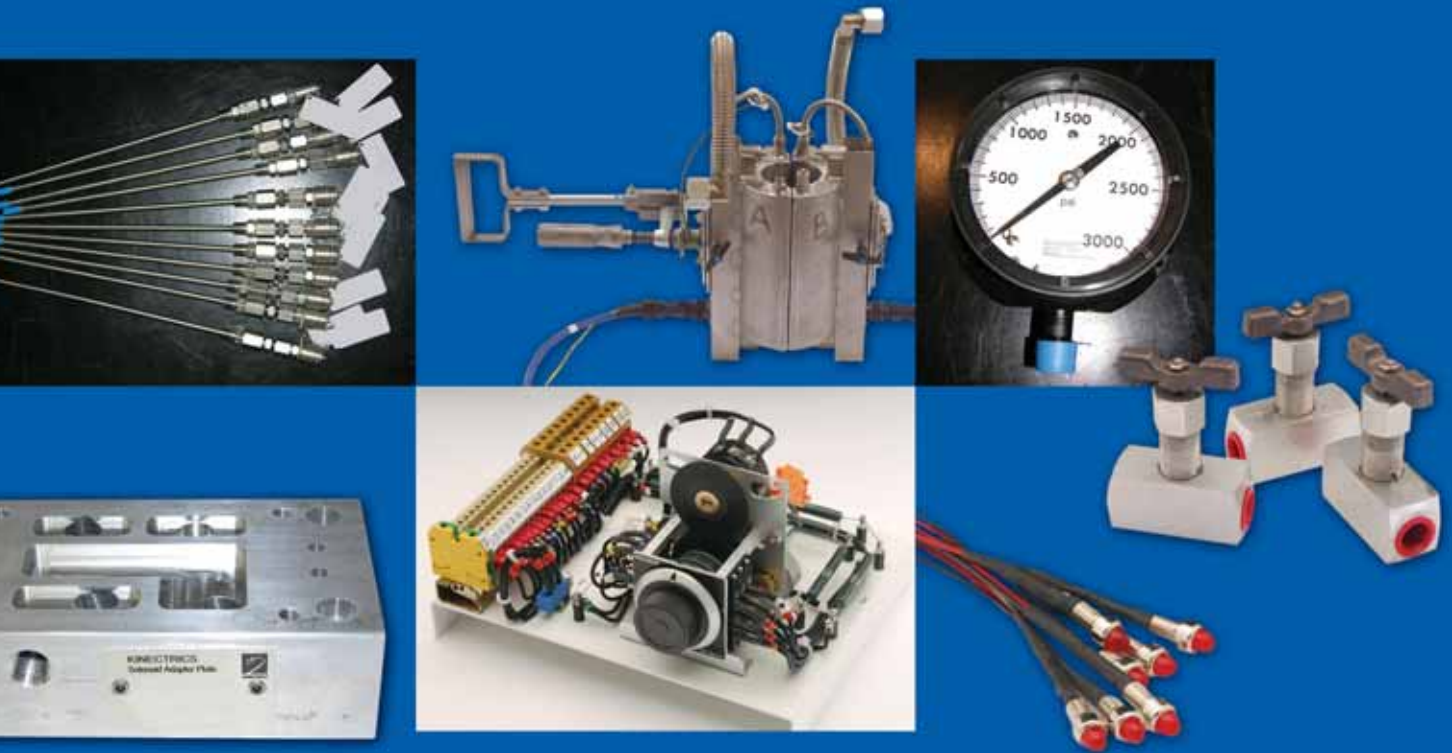
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Canada

The Joint Review Panel (JRP) of the **Canadian Nuclear Safety Commission** (CNSC) issued a Nuclear Power Reactor Site Preparation License to Ontario Power Generation Inc. (OPG) for its new nuclear power plant project at the Darlington nuclear site for a period of 10 years. The license is valid from August 17, 2012 to August 17, 2022.

In making its decision, the JRP considered information presented at the 17-day public hearing held from March 21 to April 8, 2011, in Courtice, Ontario. During this hearing, the JRP received and considered submissions from OPG and 264 intervenors, as well as 14 government departments, including the CNSC.

The JRP is satisfied that the licensee meets the requirements of section 24 of the Nuclear Safety and Control Act, that OPG is qualified to carry out the activities that will be permitted under the license, and that the health and safety of people and the environment will be protected.

Contact: Sophie Gingras, telephone: (613) 947-0247, email: interventions@cnsccsn.gc.ca.

United Arab Emirates

The **Emirates Nuclear Energy Corporation** (ENEC) officially commenced the construction of the UAE's first nuclear energy plant on July 18, 2012, by pouring the first nuclear safety concrete for Barakah Unit 1.

This significant milestone for the UAE's peaceful civil nuclear energy program follows the receipt of the Construction License from the Federal Authority of Nuclear Regulation (FANR) and a No Objection Certificate from Abu Dhabi's environmental regulator, the Environment Agency – Abu Dhabi (EAD).

The safety concrete was poured at Barakah on July 18, 2012 in front of a gathering including ENEC's senior management and site team, and ENEC's

Prime Contractor, the Korea Electric Power Corporation (KEPCO).

ENEC poured more than 1500 cubic meters of concrete to form a portion of the foundation slab of the Barakah Unit 1 Reactor Containment Building, which will ultimately house the nuclear reactor.

In preparation for the safety concrete pouring, ENEC had carried out a number of activities on site under its Limited Construction License. Excavation for Units 1 & 2, dredging for the intake and outfall channels, construction of the marine breakwaters, wharf construction, excavation and construction of the Cooling Water Ducts and foundations for the safety related concrete were prepared.

ENEC will apply for an Operating License for Unit 1 in 2015 and will pour concrete for Unit 2 in 2013. ENEC is building a total of four Units at the Barakah site. The first Unit will be operational in 2017, with one additional Unit becoming operational each year up to 2020.

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

Belarus

A commemoration capsule laying ceremony was held on August 9, 2012 in Ostrovets (Belarus, Grodno Region).

The message signed by Belarus President Alexander Lukashenko says: "In furtherance of the motto to build the strong and prosperous Belarus we start implementing with the fraternal Russia the largest investment project, i.e. the construction of the first nuclear power plant in our territory. Development of the national nuclear power is a significant step in the strengthening of energy security of the country, a strong incentive to accelerate science and technology progress and innovative development."

During the ceremony Lukashenko stated that debates on building a NPP in Belarus have finished and noted that Russia and Belarus can build NPPs in third countries in the future as well as sell nuclear electricity abroad.

After the ceremony First Deputy Director General of **ROSATOM** Alexander Lokshin stated that preliminary work had been already done on the NPP construction site, including the pit of the future first power unit. "The pace we have gained allows us planning that we will be able to reach first concrete by early fourth quarter of 2013," he said.

Contact: Sergey Novikov, telephone: 7 499 949-44-12, fax: 7 499 949-27-22, email: press@rosatom.ru.

Sweden

Vattenfall has submitted an application to The Swedish Radiation Safety Authority (SSM) as part of the process to determine which conditions apply for the replacement of existing nuclear power sometime in the latter half of the 2020s.

The application submitted to The Swedish Radiation Safety Authority (SSM) is a way of analyzing the conditions for a possible future investment decisions. To carry out a complete analysis will take several years.

Vattenfall considers various possible options to replace older plants that need to be phased out. Today's nuclear reactors still need safety improvements and capacity increases and eventually phased out and replaced with new baseload power. Phase-out is expected to begin after 2025.

Contact: website: www.vattenfall.se. ■

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CASE STUDY
Date *August 23, 2011*

Time	Event
1:51 p.m.	Earthquake strikes Virginia
8:50 p.m.	Zachry receives call for assistance
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Response Time: *13 hours, 10 minutes*

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Utility

Bruce 1

The Canadian Nuclear Safety Commission gave **Bruce Power** the go-ahead to power up its Unit 1 reactor on July 20, 2012.

The permission to remove reactor shutdown order from Unit 1, which has been shut down for 15 years, means it is now ready to go live and Bruce Power can complete final safety checks in preparation for synchronization to Ontario's electricity grid.

On Monday, Aug. 27, 2012, the refurbished Unit 1 reactor produced its first steam in 15 years.

Contact: John Peevers, telephone: (519) 361-6583, email: john.peevers@brucepower.com.

Wylfa 1

Wylfa Power Station, United Kingdom, has been given the go-ahead to transfer fuel between its reactors, enabling electricity generation to continue until September 2014, almost four years beyond its original closure date.

Following several independent reviews, the site has been permitted to continue using one reactor, transferring partially used fuel from Reactor 2 to Reactor 1. The move has been given approval from the Office for Nuclear Regulation and is supported by the Department for Energy and Climate Change (DECC).

Inter-Reactor Fuel Transfer (IRX) has already been used at Oldbury and has now been successfully trialled at Wylfa. Wylfa had originally planned to shut down in December 2010, but an opportunity was identified to continue producing electricity for a further period. Reactor 2 was shut down in April, 2012 because of limited fuel stocks, following the final shipment of Magnox fuel – which is no longer manufactured – to the site in 2011.

Contact: Deborah Ward, Nuclear Decommissioning Authority, telephone: 019525832280.

CEO and CNO

Dennis Koehl, currently the Senior Vice President and Chief Nuclear Officer of Xcel Energy, has been selected to be the Chief Executive Officer and Chief Nuclear Officer of the **South Texas Project Nuclear Operating Company**. He will assume this position on October 15, 2012.

In his current position, Koehl is responsible for activities at Xcel Energy's three nuclear units at Prairie Island and Monticello. He is the Chairman of the Nuclear Energy Institute's Nuclear Strategic Issues Advisory Committee, Vice Chairman of the Board of Utilities Services Alliance (USA) and serves on the 12-member U.S. Fukushima Response Steering Committee, the Executive Committee of the Electric Power Research Institute's Nuclear Power Council and the board of directors for the Boy Scouts of America Northern Star Council.

Contact: David Knox, telephone: (713) 537-2130.

Industry

Post-Fukushima

The **Nuclear Regulatory Commission** has issued Interim Staff Guidance (ISG) to U.S. nuclear power plants to ensure proper implementation of three Orders the agency issued in March, 2012, in response to lessons learned from the Fukushima Dai-ichi nuclear accident.

The ISGs represent acceptable approaches to meeting the Orders' requirements before their Dec. 31, 2016, the compliance deadline. The ISGs are not mandatory, but U.S. nuclear power plants would have to seek NRC approval if they wanted to follow a different compliance approach. The NRC issued draft versions of the ISGs on May 31 and asked for public input; the final ISGs reflect information gained from the month-long comment period and subsequent public meetings.

The full Orders can be found at <http://adams.nrc.gov/wba/> under accession numbers ML12221A339 and ML12240A304.

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

Environmental Excellence

The Waste Isolation Pilot Plant (WIPP), the **U.S. Department of Energy** (DOE) facility known as the nation's only deep geologic repository for the permanent disposal of radioactive waste, was recently honored for its pollution prevention efforts for the second year in a row.

Recognition was for continual improvements to environmental stewardship and sustainability in the areas of energy use, hazardous waste reduction, recycling, and water use reduction. Some of the facility's specific achievements that were cited included a 13 percent reduction in energy use over eight years, a 19 percent reduction in petroleum use over six years, and a 15 percent reduction in site water use in 2011.

Contact: Deb Gill, telephone: (575) 234-7270.

Corporation

Working Groups

Luc Oursel, President and Chief Executive Officer of **AREVA**, and Sergey Kirienko, Director General of **ROSATOM** have signed a Memorandum of Understanding where companies agreed on the setting up of working groups in charge of studying ways of strengthening the cooperation between the two groups in the nuclear sector.

This decision is in line with the Franco-Russian intergovernmental declaration of November 18, 2011 calling for closer ties between the companies involved in the nuclear industry in both countries. With this agreement, **AREVA** and **ROSATOM** demonstrate their shared desire, in the form of closer cooperation between leading players in the nuclear industry, to ensure the highest level of safety for the products and services offered to their customers.

The working groups will amongst other topics focus their attention on services to existing nuclear reactors, on the management of spent fuel and on cooperation in manufacturing and supply chain for nuclear island's components. Progress with the studies and the analysis of conclusions will be supervised by a

steering committee led by Chief Operating Officers of both groups.

Contact: Patricia Marie, telephone: 33 1 34 96 12 15, email: press@areva.com.

Fuel Technology Center

The Babcock & Wilcox Company (B&W) joined by Representative Bob Goodlatte (VA-6) and Bob Sledd, Senior Economic Advisor to the Governor of Virginia, participated in a ribbon-cutting ceremony at the new B&W mPower™ Fuel Technology Center (FTC) in Lynchburg, Virginia. The advanced manufacturing technologies B&W will use to produce nuclear fuel for its B&W mPower small modular reactor (SMR) will be developed and qualified at the FTC. Longer term, the technologies developed at the FTC provides B&W the ability to support the manufacture of fuel for other reactors.

This newly dedicated facility marks the third major infrastructure development project in Virginia related to the B&W mPower reactor, including the establishment of a dedicated design office in 2010 and an Integrated System Test facility in 2011.

Contact: Jud Simmons, telephone: (434) 522-6462, email: hjsimmons@babcock.com.

Uranium Project

Cameco has reached an agreement with BHP Billiton to acquire the Yeelirrie uranium project in Western Australia for \$430 million (US). Yeelirrie is a near-surface calcrete-style deposit, amenable to open pit mining techniques.

Yeelirrie is one of Australia's largest undeveloped uranium deposits and is located about 650 kilometres northeast of Perth and about 750 kilometres south of Cameco's Kintyre exploration project.

"Yeelirrie represents an attractive deposit that fits well with Cameco's vision and corporate strategy," said Cameco's president and CEO Tim Gitzel. "We are pleased to add this promising deposit to our suite of uranium assets and look forward to advancing this property through our process for assessing development projects."

Cameco expects the transaction to close by the end of 2012, subject to

approvals from the government of Western Australia and the Australian Foreign Investment Review Board. Upon closing, stamp tax duty of about \$22 million will be payable by Cameco to the government of Western Australia.

Contact: Donna Cole, telephone: 011 61 419 901229.

Recycled Uranium

Candu Energy Inc. has signed an expanded agreement with China National Nuclear Corporation's subsidiary companies, Third Qinshan Nuclear Power Company (TQNPC), China North Nuclear Fuel Corporation (CNNFC) and Nuclear Power Institute of China (NPIC) to continue co-operation in the development of recycled uranium and thorium as alternative fuels for new CANDU® reactors.

With 24-month duration, the agreement is expected to result in a detailed conceptual design of the Advanced Fuel CANDU Reactor (AFCR). The APCR is a further evolution of the successful CANDU 6® and Generation III Enhanced CANDU 6®, which is optimized for use of recycled uranium and thorium fuel.

The agreement follows the successful irradiation demonstration of recycled uranium fuel bundles in operating CANDU reactors at the Qinshan site, about 150 km southwest of Shanghai. The tests demonstrated the feasibility of using natural uranium equivalent (NUE) fuel, composed of recycled uranium and depleted uranium in CANDU reactors. The parties are now working on a project to convert the Qinshan CANDU reactor units to full core use of NUE fuel by 2014.

The agreement marks the third phase of cooperation between Canada and China. Beginning in 2008, it demonstrates not only the use of recovered uranium but also thorium in CANDU reactors and serves as evidence of Candu's commitment to customer driven partnerships and the CANDU reactor's inherent capability to use alternative fuels. This CANDU flexibility offers a unique opportunity to realize closed fuels cycles in countries that have both CANDU and LWR reactors.

Contact: Katherine Ward, telephone: (905) 403-7349.

NAECP Board

Day & Zimmermann, a provider of industrial, defense and workforce solutions for government and commercial customers, announced that Kristopher Cravey, Vice President of D&Z ECM (Engineering, Construction and Maintenance) Business Services & Corporate Safety, has been elected to the Board of Directors of The National Association of Employee Concerns Professionals (NAECP). Cravey is a leader in the nuclear industry delivering best practices in Safety, Training, Continuous Improvement, and Organizational Development for more than a decade. He serves on the INPO Supplier Participant Advisory Committee and on the Board of Directors for the Construction Industry Institute. Cravey holds an MBA and MA from Regent University in Virginia and is a PhD candidate in Organizational Leadership.

Contact: Steve Wanczyk, Braithwaite Communications, telephone: (215) 564-3200, email: swanczyk@gobraithwaite.com.

Decommissioning Services

Studsvik and Westinghouse have signed a teaming agreement to jointly offer a full range of decommissioning services for nuclear power plants in Europe, initially in Germany and Sweden. The cooperation will be marketed under the separate brand name of NDCON, Nuclear Decommissioning Consortium by Studsvik and Westinghouse.

The first commercial nuclear power plants in Europe were commissioned 50 years ago and many of these units are now approaching their designed operating life. Additionally, in some instances, political decisions have shortened the expected operation of nuclear power plants. In the case of Germany, it has been decided to phase out its 17 nuclear reactors by 2022. Eight of those reactors were immediately shut down in March 2011. For these reasons, a significant number of nuclear power plants across Europe will need to be decommissioned and dismantled in the next 15 to 20 years.

Contact: Anders Jackson, telephone: 46 155 22 10 82. ■

New Products, Services & Contracts

New Products

Pipe Clamp

Fauske & Associates, LLC, (FAI) has obtained patent protection for its recent invention: "Pipe Clamps for Vibration Measurement."



In power plants, it is important to monitor pipe vibration at all times as excessive pipe vibrations can ultimately lead to failure of the structure and result in an accident (e.g. high energy line break). The preferred methodology to accurately monitor vibration levels is to install sensors (accelerometers) directly on the pipeline. However, in practice this is often not feasible because of high temperature and / or radiation levels that could damage the equipment. With this new innovation, FAI has developed a solution to make the process of monitoring pipe vibration levels easier.

The specialized FAI pipe clamp can be used to seat vibration sensing equipment. A beam attached to the clamp protrudes through the pipe insulation. The beam is partially hollow and vented to promote cooling so that accelerometers can be installed on the tip of the beam outside the high temperature and / or radiation for accurate vibration level monitoring.

Contact: AnnMarie Fauske, email: afauske@fauske.com.

DREAM Inserts

The U.S. Patent and Trademark Office (USPTO) has issued patent number 8,158,962B1 to Holtec's engineers for the design and method of installing the DREAM (Device For REActivity Mitigation) insert technology for used fuel storage racks. The DREAM insert serves to replace the neutron attenuation function of the degraded neutron absorber material in the host rack allowing the nuclear plant to recover the lost storage cells and also increase the criticality safety margins in the pool. DREAM inserts consist of precisely formed shapes of Metamic™ with remote handling features. Metamic is a porosity free metal matrix composite of aluminum and boron carbide widely used for reactivity control in high density fuel storage racks and dry used fuel storage casks.

Contact: Joy Russell, telephone: (856) 797-0900, email: j.russell@holtec.com.

Services

Quality Control Training

National Inspection and Consultants (NIC) continues to provide Quality Control (QC) Inspector Training to the nuclear industry. NIC's current training courses cover the Mechanical, Electrical / I&C and Civil inspection disciplines, and provide the classroom and inspection technique training necessary for qualification as a Quality Control Inspector in today's nuclear power industry.

NIC's training courses utilize extensive hands-on specimens and mock-ups for "real world" applications. NIC can tailor this training to the specific Plant / Fleet criteria, and can develop / present additional QC and Nondestructive Examiner training to meet industry needs.

Contact: Bernie Komara, email: Bernie.komara@nicinc.com, website: <http://www.nicinc.com/>.

Contracts

Control Systems

Alstom Thermal Power has been awarded a contract worth over 50

million euros (\$64 million) to retrofit the Controbloc N20 units for the 1300 MW nuclear power plants of Electricité de France (EDF). All of the twenty 1300 MW nuclear units in France are equipped with Alstom control system, installed during the construction of the power plants. Alstom has been servicing it ever since.

Controbloc N20 is a control system for power plant operators, which enables them to improve the control of their plant with various sensors throughout the plant monitoring components such as valves, actuators of pumps, engines and electrical units. Alstom will modernize the current system, adding new technology, based on its latest ALSPA Series 6 control system, to the existing Controbloc N20. Deployment for the first retrofitted unit is scheduled for spring 2015.

Contact: Christine Rahard, telephone: 33 1 41 49 32 95, email: christine.rahard@chq.alstom.com.

Enriched Uranium

On August 15, 2012, Emirates Nuclear Energy Corporation (ENEC) and AREVA signed an integrated enriched uranium supply contract, worth more than 400 million euros (\$522 million).

This contract stipulates that AREVA will supply the future nuclear plants at Barakah, which is under construction in the United Arab Emirates, with enriched uranium over an eight-year period. The UAE's nuclear program plans for the commissioning of the first two of four reactors in 2017 and 2018, pending regulatory approval.

Contact: Patricia Marie, telephone: 33 1 34 96 12 15, email: press@areva.com.

Uranium Delivery

AREVA and EDF announce the signature of two contracts which make a significant contribution to securing the long-term supply of natural uranium to EDF nuclear facilities.

Under the terms of these agreements, AREVA will supply more than 30,000 tonnes of natural uranium to EDF for the period from 2014 to 2035, one of the largest deliveries of uranium ever carried

(Continued on page 15)

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In the 21st century, the power sector finds itself facing unprecedented operational pressures, shifting priorities, and increasing regulatory scrutiny. With our comprehensive industry experience and seasoned professional staff, Day & Zimmermann is uniquely positioned to partner with our customers to deliver the value-added solutions they require in order to thrive in this environment.

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New Documents

Book

Business Innovation in the 21st Century, by Praveen Gupta.

This book accommodates business as well as technical aspects of innovation. This innovation aspect of the book is preserved here to be one source of information in the technology age, where everyone must be somewhat innovatively applying technology and business sense to develop solutions or strategies.

The book presents examples and cases integrated throughout the book. Besides, considering the unique integration of various available and practiced approaches, one can see around the case studies of various principles presented in the book. ISBN: 1-4196-4663-X.

Contact: Praveen Gupta, email: Praveen@accelper.com.

Paper

Lessons Learned from "Lessons Learned": The Evolution of Nuclear Power Safety after Accidents and Near-Accidents.

Following each of the world's worst nuclear accidents—Three Mile Island, Chernobyl, and Fukushima—governments and plant operators adopted safety and security measures to help prevent future disasters. Most recently, the U.S. Nuclear Regulatory Commission has designed a new set of rules to harden American reactors against earthquake-triggered failures like those that crippled Japan's Fukushima-Daiichi plant last year.

But has the response from industry and nuclear regulators always been adequate? *Lessons Learned from "Lessons Learned": The Evolution of Nuclear Power Safety after Accidents and Near-Accidents*, a new paper from the American Academy of Arts and Sciences, examines the changes in safety procedures and protocols that were

or were not implemented after major nuclear disasters. The authors evaluate several less catastrophic accidents and near-mishaps as well, noting that those less serious incidents also offer critical lessons.

The paper provides recommendations for increasing plant safety and security as commercial nuclear power spreads globally. Authors, Michael M. May and Edward D. Blandford stress the need for better communication among nuclear states. "Mechanisms to facilitate and, where needed, enforce mutual learning have not always been adequate," they write. "Information-sharing, import/export agreements based on safety standards, agreements to facilitate cooperation among regulatory authorities, and the participation of financial interests such as investors and insurers all have a role to play in improving mutual learning among different states."

This paper, published as part of the American Academy's Global Nuclear Future (GNF) Initiative, is available online at <http://www.amacad.org/projects/globalnuclearbooks.aspx>.

Contact: Paul Karoff, telephone: (617) 576-5043, email: PKaroff@AMACAD.ORG.

EPRI

1. *Guidelines for Replacement Materials for Service Water Systems.* Product ID: 1025275. Published August, 2012.

This report from the Electric Power Research Institute (EPRI) looks at the reasons why materials often fail to perform as expected and offers guidelines to help plants obtain suitable replacement materials for service water system components

2. *Identification of Critical-to-Power-Production I&C Systems.* Product ID: 1025729. Published August, 2012.

This report from the Electric Power Research Institute (EPRI) documents an investigation of methods for identifying critical-to-production systems and components, with the intent of finding opportunities to enhance instrumentation and control (I&C) dependability and/or implement new I&C capabilities in

order to improve the dependability of non-I&C equipment. Several existing industry programs were reviewed, and available operating experience and information regarding the determination of equipment criticality were assessed. This phase of the study focused primarily on digital I&C, but the same methods can be used for other types of equipment. The next phase of the project will extend the scope accordingly and will provide more specific guidance for utility engineers.

3. *Impacts Associated with Transfer of Spent Nuclear Fuel from Spent Fuel Storage Pools to Dry Storage After Five Years of Cooling, Revision 1.* Product ID: 1025206. Published August, 2012.

In 2010, EPRI performed a study of the accelerated transfer of spent fuel from pools to dry storage in response to the threat of terrorist activities at nuclear power plants (report 1021049). Following the March 2011 Great East Japan Earthquake and the subsequent accident at the Fukushima Daiichi nuclear power plant, some organizations issued a renewed call for accelerated transfer of used fuel from spent fuel pools (SFP) to dry storage. Their reasoning was that this would lessen the potential consequences from a loss-of-spent-fuel cooling accident by decreasing the heat load and source term available for release. This report revises the 2010 study to evaluate the dose and cost impacts of accelerating transfer of used fuel from SFPs to dry storage for two scenarios—one taking 10 years to transition the removal of all fuel cooled for at least five years, and the other taking 15 years to complete the transition.

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

Contracts...

Continued from page 12

out by AREVA. These contracts thus further consolidate AREVA's position as a key partner to the world's leading supplier of nuclear power, and secure EDF's natural uranium supply over the very long-term.

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

Speed Sensors

DRS Consolidated Controls, Inc., a DRS Defense Solutions, LLC line of business, has been awarded a contract to supply the reactor coolant pump speed and phase sensors for the Westinghouse AP1000® nuclear power plants.

These sensors will be installed in the United States at Vogtle Electric Generating Plant in Georgia and V.C.

Summer Nuclear Station in South Carolina, as well as in China at Sanmen 1&2 in Zhejiang Province and Haiyang 1&2 in Shandong Province.

The speed and phase sensors monitor the rotational speed and direction of the reactor coolant pump. They are designed, built, and tested in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements for Class 1E safety-rated equipment under the DRS Consolidated Controls' 10 CFR Part 50 Appendix B nuclear quality assurance program. Their all-stainless-steel construction allows the sensors to operate continuously in the most extreme environments.

Contact: Brian Gallagher, telephone: (973) 898-7322, email: gallagher@drs.com.

Feasibility Study

Westinghouse Electric Company has received a contract from the Kozloduy NPP New Build PLC of Bulgaria to perform a feasibility study on a potential seventh unit at the Kozloduy

Nuclear Power Plant. The required study will encompass a review of two potential designs: a reactor of VVER design utilizing equipment already purchased by the customer together with Westinghouse instrumentation and control (I&C) systems, fuel and a Toshiba Corporation turbine generator, and the construction and operation of a pressurized water reactor (PWR) 1000-1200 MW design.

Westinghouse will perform this study with Kozloduy NPP New Build PLC calling upon its experience at Kozloduy and other VVER units. The scope of the feasibility study includes an evaluation of the site, radioactive waste and spent fuel management, reuse of existing infrastructures and facilities, licensing, local economic aspects, and the profitability of the two reactor designs.

Contact: Hans Korteweg, telephone: 32 (0) 645-7162, email: kortewh@westinghouse.com. ■

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Meeting & Training Calendar

1. NuMat 2012: The Nuclear Materials Conference. October 22-25, 2012, Osaka, Japan. Contact: Pamela Liang, **Elsevier**, email: p.liang@elsevier.com.
2. **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.
3. Web-Based Radiation Course, November 5, 2012, Contact: Anu Agnihotri, **Nuclear Plant Journal**, telephone: (630) 858-6161 x 101, email: anu@goinfo.com.
4. **World Nuclear Association** 3rd Annual China International Nuclear Symposium, November 7-9, 2012, Renaissance Beijing Capital Hotel, Beijing, China. Contact: Julia Deere, telephone: 44 (0) 20 7451 1520, email: deere@world-nuclear.org.
5. 2012 **American Nuclear Society** Winter Meeting, November 11-15, 2012, Town & Country Hotel & Resort, San Diego, California. Contact: website: www.new.ans.org/meetings.
6. The 3rd Annual Nuclear New Build (China) Summit 2012 (NNBS2012), November 15-16, 2012, Shanghai, China. Contact: **Innch International**, telephone: 86 (21) 51920620, fax: 86 (21) 51920621, website: www.innchinc.com.
7. European Nuclear Conference, December 9-12, 2012, Manchester, United Kingdom. Contact: Kirsten Epskamp, **European Nuclear Society**, email: enc2012@euronuclear.org, website: www.euronuclear.org/events/enc/enc2012/.
8. Nuclear Power International, December 11-13, 2012, Orange County Convention Center, Orlando, Florida. Contact: **Penwell**, telephone: (918) 831-9160.
9. IV International Forum-Exhibition of Nuclear Industry Suppliers ATOMEX 2012, December 12-14, 2012, Moscow, Russia. Contact: Maria Lisovskaya, **ATOMEXPO**, email: malisovskaya@atomexpo.com.
10. The Fukushima Ministerial Conference on Nuclear Safety, December 15-17, 2012, Fukushima Prefecture, Japan. Contact: **International Atomic Energy Agency** website: <http://www-pub.iaea.org/iaeameetings/20120216/-The-Fukushima-Ministerial-Conference-on-Nuclear-Safety>.
11. 4th Annual Nuclear Power Asia, January 15-16, 2013, Shangri-La, Kuala Lumpur, Malaysia. Contact: Shantal Chapman, **Clarion Events**, telephone: 65 6590 3970, email: Shantal@clarionevents.asia.
12. International Experts' Meeting on Decommissioning and Remediation after a Nuclear Accident, January 28-February 1, 2013, Vienna, Austria. Contact: **International Atomic Energy Agency**, <http://www-pub.iaea.org/iaeameetings/44453/International-Experts-Meeting-on-Decommissioning-and-Remediation-after-a-Nuclear-Accident>.
13. CONTE Conference on Nuclear Training and Education, February 3-6, 2013, Hyatt Regency Jacksonville-Riverfront, Jacksonville, Florida. Contact: **American Nuclear Society**, telephone: (708) 352-6611.
14. **Waste Management Symposia 2013**, February 24-28, 2013, Phoenix Convention Center, Phoenix, Arizona. Contact: Mary Young, telephone: (480) 968-7559, email: mary@wmarizona.org.
15. International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13), March 4-7, 2013, Paris, France. Contact: **International Atomic Energy Agency**, telephone: 43 1 2600 21315, email: M.Khaelss@iaea.org.
16. **Risk Assessment Corporation's** 2nd Annual Radiological Risk Assessment for Decision Making, Compliance, and Emergency Response, March 4-8, 2013, Washington, D.C. Contact: fax: (202) 544-7992, email: pilliodmp@aol.com.
17. Avignon Decommissioning Challenges Conference, April 7-11, 2013, Avignon Pope's Palace, France. Contact: JG Nokhamzon, **French Nuclear Energy Society**, email: jean-guy.nokhamzon@cea.fr.
18. International Conference on Effective Nuclear Regulatory Systems, April 8-12, 2013, Ottawa Canada. Contact: **International Atomic Energy Agency**, website: www-pub.iaea.org/iaeameetings/41986/International-Conference-on-Effective-Nuclear-Regulatory-Systems.
19. World Nuclear Fuel Cycle, April 9-11, 2013, The Fairmont Singapore, Singapore. Contact: Linda Wells, **Nuclear Energy Institute**, telephone: (202) 739-8039, email: ljwt@nei.org.
20. 2013 **International Congress on Advances in Nuclear Power Plants**, April 14-18, 2013, Jeju Island, Korea. Contact: telephone: 82 2 538 2042 3, fax: 82 2 538 1540, email: info@icapp2012.org, website: www.icapp2013.org. ■

Research & Development

Protective Coatings

Protective coatings and linings are used throughout power plants as a first line of defense against corrosion, cracking, erosion and other types of degradation that can damage components ranging from nuclear reactor containments and concrete structures to buried piping and tanks. An effective coatings and linings maintenance program is critical in sustaining this line of defense, but requires a thorough understanding of coating fundamentals, degradation mechanisms, condition assessment methods, and repair or mitigation options. EPRI developed a practical field guide to support coating and lining condition assessment, Field Guide: Coatings Assessment (EPRI Product 1025323) in July, 2012.

Coatings degrade or fail due to many factors, including chemical exposure, temperature extremes, and mechanical forces. The common degradation mechanisms associated with coating failure in power plants are cracking, mudcracking, blistering, chalking, flaking, intercoat delamination, oxidation, pinpoint rusting, and zinc depletion.

Documentation of observed conditions is critical to an accurate coating condition assessment. The field guide includes sample worksheets for recording the observed conditions. Coatings specialists can then evaluate the collected data to identify actions to take if conditions are degrading, ranging from "No action required, continue periodic monitoring" to "Plan for total coating replacement during next outage." The field guide also provides guidance on assigning priority rankings to the recommended actions to resolve the observed conditions. Finally, to equip coatings specialists with the foundation to develop or augment effective coating maintenance programs, EPRI offers a comprehensive coatings training course.

Contact: Liz Sisk, telephone: (704) 595-2713, email: esisk@epri.com.

Zinc Injection

EPRI published the PWR Primary Zinc Application Sourcebook, Volumes 1 and 2 (1025316) in early July 2012. Drawing on almost 20 years of industry experience with this technology, the sourcebook provides guidance to plants evaluating zinc injection, plants just beginning zinc injection, and plants with established zinc injection programs. Since its first application in 1994, zinc injection into the primary coolant in pressurized water reactors (PWRs) has successfully contributed to source term reduction and mitigation of primary water stress corrosion cracking (PWSCC) in nickel alloys.

Zinc injection is now practiced at 80 PWR plants, representing 30% of the PWR fleet worldwide and almost 60% of the U.S. PWR fleet. At least 10 additional units plan to begin zinc injection before the end of 2013. All plants that have ever commenced zinc injection continue application, with the exception of three units in Germany that have permanently shut down.

The sourcebook is divided into two volumes. Volume 1 includes guidance related to long-term zinc injection strategy; operational decision-making; best practices; and enhanced monitoring, maintenance, and program optimization. Volume 2 is dedicated to plant experience, and includes detailed operational data and chemistry and radiological data from 48 plants, expanded from 16 plants in the original guidance document.

Key changes reflected in the sourcebook include: enhanced discussion of the technical basis for zinc injection from initial application to establishment of steady-state conditions; quantification of the PWSCC mitigation benefit; expansion of the fuel performance data from 36 cycles at 14 plants to 120 cycles at 38 plants; expansion of the crud analysis database from 12 cycles at seven plants to 32 cycles at 17 plants; and an updated

(Continued on page 52)

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Early on Michael Baron led the innovation charge with an outage management focus. Just one of Mike's 8 NEI TIP Awards, the 360 degree work has saved Exelon over \$18 million in cost savings. Keith Moser contributions were centered around NSSS Asset Management and working with Mike on outage improvements. James Tusar's focus on nuclear fuels has resulted in 7 NEI TIP Awards, most impressively James has twice won 2 awards in one year and is the most likely to be the awards record holder in the very near future.

Michael Baron

Michael Baron has been with Exelon for over 31 years holding various positions in new plant / business development, engineering, construction, research and development, maintenance, project management and outage services in

both its fossil and nuclear generation organizations. In his current role as Technical Service/Engineering, Procurement and Construction Executive Director, Michael is responsible for all technical consulting, assessments,



associated engineering, deployment preparations and project construction execution for Exelon Nuclear Partners. Exelon Nuclear Partners is a business development unit that delivers a variety of services to clients interested in new nuclear development or improving existing nuclear program performance.

He has been instrumental in the design and development of hundreds of structural, mechanical, robotic and advanced tooling components, holding over 138 co-patents. Michael is also recognized world wide as a subject matter expert in mega-project process optimization, advanced nuclear construction execution and refuel outage optimization. He continues to consult with numerous research facilities, universities and

manufacturers, developing innovative projects for the advancement of nuclear power world wide. Michael is currently a representative and consultant to the IAEA (United Nations), WANO, WNA, NEI, INPO and EPRI.

In addition to his 31 years of professional experience, Michael is certified Reactor Component Engineer, Six Sigma Master Blackbelt, holds a Senior Reactor Operator certification and BS in Mechanical / Industrial Engineering and a MS in Technical Project Management.

Email: michael.baron@exeloncorp.com.

Keith Moser

Keith Moser has over 30 years experience designing, manufacturing, constructing and operating nuclear power plants. Currently Keith Moser 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 32 Nuclear Energy Institute Top Industry Practice Awards.



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

He has a Bachelor of Engineering from LeTourneau University in 1980 and a Masters of Business from Olivet University in 1990.

Email: keith.moser@exeloncorp.com.

James Tusar

Jim is currently the Manager of Boiling Water Reactor (BWR) Design, Nuclear Fuels, for Exelon Generation. Jim is responsible for the technical expertise and strategic direction for nuclear fuel cycle activities including energy plan development, nuclear fuel bundle and reactor core design, cycle management, core monitoring system support, and overall reload coordination for Peach Bottom, Limerick, Oyster Creek, and Clinton Power Station.



He has a B.S. in Nuclear Engineering from Pennsylvania State University, a M.S. in Environmental Engineering from Drexel University, and a Nuclear Engineering Professional Engineer's License in the State of Pennsylvania.

Email: james.tusar@exeloncorp.com. ■

Year	Individual	Award	Award Description
2001	Keith Moser	GE Nuclear Energy Vendor Award	Web based fleet-wide, BWR long-term asset management plan
2001	Keith Moser Team Lead Mike Baron Team Member	Materials, fuel and support services category	Recirculation jet pump riser pipe repair at Quad Cities 1
2002	Keith Moser	Equipment Reliability	Pressurized water reactor asset management system instituted at Exelon's Byron and Braidwood plants
2002	Mike Baron	GE Nuclear Energy Vendor Award	360-degree boiling water reactor vessel-servicing platform
2003	Mike Baron	Work Management Process Award	Underwater inspection system was developed for installation in the reactor cavity and vessel to create a total work surveillance envelope
2003	Keith Moser	GE Nuclear Energy Vendor Award	(BWR) on line chemistry optimizer
2003	James Tusar	Materials and Services Process Award	Streamlining of the core reload design and licensing schedule
2004	Mike Baron	Work Management Process Award	Invader - BWR RX Internals Robotic Inspection
2004	Keith Moser	Configuration Management Process Award	JP clamp device installed at the LaSalle Plant
2005	Mike Baron Team Lead Keith Moser Team Member	GE Nuclear Energy Vendor Award	Enforcer outage support bridge developed at the Clinton plant
2006	Keith Moser	Configuration Management Process Award	Acoustic Circuit Model for Power Uprates Steam Paths
2006	Mike Baron	GE Energy, Nuclear Vendor Award	A data management system that facilitates efficient refuelings by transporting data from the fuel floor to a remote viewing location and automating inspection aspects, tracking and recording
2007	Mike Baron Team Lead Keith Moser Team Member	Loss Prevention Process Award	Installation of new steam dryers during a refueling outage, and then disassembling and disposing of the old ones with the Quad Cities Generating Station's two reactors in Illinois operating at full power
2007	James Tusar	Nuclear Fuel Process Award	N-Streaming™ fuel bundle design concept with Global Nuclear Fuel to improve fuel cycle efficiency with six different nuclear designs for Peach Bottom Unit 2
2009	James Tusar	GE Hitachi Nuclear Energy Vendor Award	Defender Debris Filter to prevent debris from entering and potentially damaging fuel assemblies
2009	James Tusar	Nuclear Fuel Process Award	Next Generation Core Design strategy for Boiling Water Reactors
2009	Keith Moser Team Member	Special combined Vision & Leadership Award	International technical exchange program and industry group leadership and industry participation plan
2010	James Tusar	Nuclear Fuel Process Award	Fuel Vendor Collaborative Management Review Process that implemented an integrated management review process between the utility and fuel vendor across a fleet of reactors.
2010	Mike Baron	Operate Plant Process Award	Exelon Jet Pump Ultrasonic Cleaning Hummingbird used to clean the jet pumps
2012	James Tusar	GE Hitachi Nuclear Energy Vendor Award	Developed a moisture carryover (MCO) mitigation strategy that reduces the amount of water carried in steam exiting the reactor at the Limerick plant
2012	James Tusar	Fuel Award	Boiling Water Reactor Fuel Channel-Control Blade Interference Mitigation Program



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Standards of Excellence in Emergency Response

By Bill Webster, Institute of Nuclear Power Operations (INPO).

Bill Webster

Bill Webster is senior vice president of Industry Evaluations for INPO, a position he assumed in December 2007. He has leadership responsibility for Plant and Corporate Evaluations, Plant Operations, Plant Technical Support, and Emergency Response.

Mr. Webster joined INPO in 1982 and was elected vice president in 1998. He has served INPO as vice president of Evaluations, vice president and director of Plant Support, manager of Engineering Support and Plant Analysis departments, and assistant manager for the Emergency Preparedness Department.

Before joining INPO, he served in the U.S. Navy and graduated with a bachelor of science degree in civil engineering from Villanova University.

An Interview by Newal Agnihotri, Editor of Nuclear Plant Journal at the American Nuclear Society Utility Working Conference in Hollywood, Florida on August 7, 2012.



1. *How has INPO helped the utilities become proactive in taking voluntary measures to upgrade systems, structures and components of its nuclear power plants with improved technology?*

Through our significant operating experience program, we make recommendations to utilities on improving the margins of safety. These recommendations have a variety of requirements. They can include procedural changes, practice changes, or equipment changes. They can also include leadership and managerial approaches to nuclear power. These recommendations are issued to the utility. The utility responds to them and then INPO follows up with the utility to make sure that they are fully in place. Sometimes if there's going to be a regulatory requirement with a very specific standard that requires an equipment upgrade, INPO will work with the utilities to implement an interim measure until the NRC issues the regulation. One place we're dealing with this right now is in regard to the extended loss of AC power. We have recommended that utilities purchase equipment that will expand their coping time, even though there is no clarity yet in what the regulation may be. But it is a good interim measure that will provide some interim margin until the regulatory requirements are specified.

2. *How did INPO help the utilities get on board with the Byron Nuclear Power Plant's 500 KV transmission line off-site power failure, "Lesson Learnt"?*

We communicated operating experience to the entire industry, asking everybody to go look at their transformer protective schemes immediately. The NRC continued their review and they recently issued a requirement for the sites to conduct similar reviews. What the industry did in response to INPO's recommendation will serve them well in responding to the NRC. So this sets an example where

the industry proactively looked ahead and said, "We need to get after this quickly." The NRC also looked at it through their process, decided that they also needed to get after it.

3. *How are WANO and INPO structured?*

There are two different governing bodies. INPO is in the United States and it was formed after Three-Mile Island, and it has a board of directors made up of US Utility CEOs. INPO facilitates efforts to make continuous improvements in safety for 104 nuclear plants in the United States. Now, WANO was formed after Chernobyl. It has a separate governing board and it has four centers -- in Atlanta, Moscow, Paris, and Tokyo. The mission of INPO and the mission of WANO are similar. We operate in the United States; WANO operates worldwide. The governance structure is again, similar, with Chief Executive Officers participating on the WANO governing board. The INPO CEO, Bob Willard, sits on the WANO governing board representing the United States. Gary Gates, the CEO of Omaha Public Power District, is another member of the WANO governing board. He's also on the INPO Board of Directors. So the governance is certainly intertwined. INPO has the advantage of addressing issues for a single country, in a single language, and involving a single regulatory regime. The WANO task is much broader and much more challenging, in all the different nationalities and regulatory structures and languages that WANO needs to deal with. At INPO, we support WANO by providing technology and human resources. We have two people on loan to WANO in London. The WANO Atlanta Center staff is supplemented with INPO employees. So there's a high degree of INPO cooperation and support for WANO.

4. *What is INPO's role in utility's enablement in responding to emergencies? Describe the design and equipment aspects both.*

From the earliest days of INPO, we've had an emergency response requirement to support our member utilities. We do three things. First, when an event occurs, we get real-time operating information about

(Continued on page 22)

GE Hitachi Nuclear Energy



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HITACHI

Standards of...

Continued from page 20

what's going on to communicate to our members, to NEI, and to EPRI. Second, we coordinate assistance to the affected utility for equipment that may be needed to augment onsite material and portable equipment. We have memorandums of agreement with all utilities to share this equipment. So we would facilitate what the equipment needs are of the affected company and then who has that equipment that could be brought for that utility. Third, we coordinate technical support for the affected utility in terms of operating experience and technical experience to help the utility that's affected really solve the issue that is confronting it. We have an emergency response center in Atlanta that we would activate for those three missions. We also have an overall industry emergency response framework that specifies what INPO does, what NEI does, and what EPRI does in support of an affected utility.

5. *What is INPO's current role in assisting WANO with Fukushima Daiichi recovery?*

We activated our emergency response capability to help TEPCO. We sent a team to the TEPCO office and then we provided assistance from March 2011 through January 2012, with an ongoing presence of anywhere from seven to nine people from US utilities and vendors and INPO staff helping TEPCO respond to the event. We had a shadow team of probably twice as many people in Atlanta. Then we had communications all around the country. As that event played out, the real issues were more operational than anything else. It's how to move water, how to establish the right shielding, how to establish the right temperature monitoring, neutron monitoring, and things of that nature. We worked in concert with the NRC and TEPCO to help advise them on that event. We still have that connection with TEPCO but we don't have any presence in Japan anymore.

6. *How has the responsibility for upkeep and deployment been assigned for emergency systems, instruments and equipment which will be shared by the utilities?*

The industry has always had access to equipment. We know where the equipment is but what we haven't done is centrally locate it, maintain it and ensure that it's ready to be moved. So that's what's going to change. There will be two or possibly three Emergency Response Centers. INPO's role is going to be to specify the equipment that's needed to be stored and the required preventive maintenance, and assure that the logistics are in place so that under different possible scenarios the equipment could get moved. The actual funding of that is going to be by the utilities. The centers will be set up where utilities will buy parts for specific equipment and it'll be managed by an organization that will have individual contracts with utilities.

7. *When will the pooled emergency equipment be in place?*

That's in play right now and is ongoing. The industry is going through that right now to get this in place.

8. *How is the criteria for seismic and flood "walk downs," specified, so that different utilities follow the same standards for seismic and flood walk downs?*

There are two walkdowns that are being done. One is through flood protection. The other is for seismic. The industry put together working groups that developed the guidelines for doing those walkdowns. Those guidelines specified what the training requirements are for the people doing the walkdowns, the acceptance criteria, what needs to be walked down and the template for which the walkdowns will be documented. Then we did training. EPRI did the seismic training because they wrote the guideline for that. Then INPO through our [NANTEL] system did (and continues to do) the flood walkdown training for both the utility people doing the walkdowns and the NRC inspectors who are going to go check everything. So that everybody has the same guidance, has the same template to document it, and the same training to ensure consistency.

9. *How do you ensure that the walk down procedures developed by the industry are satisfactory to the US NRC?*

The industry supported NEI in development of the guidance. NEI then takes that to the NRC for NRC review and input, so that if you do a walkdown to this standard with this training, with this documentation, that will meet the requirements. That's been done. Now, they're doing the pilot walkdowns to make sure that the guidance works. Then we'll move forward and each utility will go do the walkdowns. Then the NRC will follow up with its own review based on the same guidance and the same training.

10. *What is the status of implementation of INPO Event Report (IERs)?*

- IER 11 – 1, Fukushima Daiichi Nuclear Station Fuel Damage Caused by Earthquake & Tsunami.
- IER 11 – 2: Fukushima Daiichi Nuclear Station Spent Fuel Pool Loss of Cooling and Makeup.
- IER 11 – 4: Near-Term Actions to Address the Effects of an Extended Loss of All AC Power

We have reviewed utility responses and we gave the utilities feedback as to the adequacy of their responses. Now, we're putting six person teams in the field for a week at each site to go look at the effectiveness of how they responded, verifying that the equipment that people said they bought is there, that it's being adequately maintained, and that they have procedures in place as to how they would use it. Each utility's chief nuclear officer will get a report so they'll know where they stand. If we see anything that's really substantively a shortfall, then we'll ask for a response and we'll follow up on that response to make sure that things got completed.

IER 11-4 is the entry condition into Flexible Response Ability (FLEX). It's going to be done over the next year or so as the evaluations get done. We hope to have that essentially in place by 2014 but that becomes a little bit more challenging because it does really require plant specific evaluation. Substantial equipment has been bought, and the understanding is that if we have the equipment on site, and we have it reasonably protected from external

(Continued on page 37)

SETTING THE STANDARD IN OUTAGE PERFORMANCE

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Being Halfway in Nuclear Doesn't Work

By Preston Swafford, TVA Nuclear Power Group.

Preston Swafford

Preston Swafford is currently Chief Nuclear Officer and Executive Vice President of TVA's Nuclear Power Group. He is responsible for managing the nuclear fleet and providing a stable base load of power from six nuclear operating units at TVA's Browns Ferry, Sequoyah and Watts Bar plants. His responsibilities include power production, nuclear power plant operations, plant modification, nuclear support services, and all nuclear engineering activities, as well as ensuring compliance with nuclear regulatory commission requirements.

Swafford holds a B.S. in chemistry from Truman State University and an M.S. in nuclear engineering from the University of Missouri. He is certified as a Senior Reactor Operator for boiling water reactors.

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An Interview by Newal Agnihotri, Editor of Nuclear Plant Journal at the American Nuclear Society Utility Working Conference in Hollywood, Florida on August 7, 2012.

1. *How has TVA created Dedicated Operation & Maintenance standards to benefit its nuclear power plants?*

Many of the American Society of Mechanical Engineering (ASME) standards and codes are required as part of our maintenance programs.

The nuclear industry has its standards and INPO has created operating fundamentals and standards that we use across our nuclear fleet. So, we have a series of procedures on how we operate the plant. Operating standards and fundamentals are incorporated into those procedures. We also conduct extensive training using



the operating fundamentals. We have produced tri-fold communications on each of the INPO fundamentals. We use them to create standards and expectations within our fleet workforce. These are routinely reinforced through our observation programs.

Our outage and work control programs have fundamentals and standards as well.

We have them for outage management, radiation protection, chemistry, operations, maintenance and engineering. All the main work disciplines have their own key fundamentals that reinforce the standards and expectations of the leadership team at the site and within the fleet.

While the fundamentals are how we would utilize something like Stop, Think, Act, Review (STAR), for example. They are also a guide which provides key bullets of information. It's the tri-folds that contain the standards and expectations, in a quick reference format. They are designed to provide workers with what we expect regarding behaviors and actions.

So, whatever work location you are at, when you get to a point where you're not sure what to do next, you pull out your tri-fold and it quickly provides you what the expectations are, which leads to adjustments in behavior accordingly.

We actually have a bound book which contains all our key standards and fundamentals, from INPO best practices, to our own vision and mission of what we want to accomplish, what our goal and strategies are and how we execute them.

2. *How has TVA standardized its maintenance and operating procedures to ensure safety of its nuclear power plants?*

We've created something called the Nuclear Operating Model (NOM). We're not the first in the industry to develop this, but it's essentially a higher-tiered document that sets the tone and direction for all our implementing procedures underneath it. We put the NOM in place about three and a half years ago and it's been a part of our TVA fleet turnaround. It establishes key standards in our organization. It's how we're going to operate. Another key thing that brings us all together is our gap-based business plan. The gap-based business plan is a management tool which uses a five-year, forward-looking, business plan to identify our key gaps to excellence. In the plan we identify those gaps, and what it will cost to address each and every initiative, and then tie it all together.

One of the benefits of being a U.S. nuclear utility is that we have INPO. INPO is all about excellence. So the whole intent of our gap-based business plan is to identify the best of the best. What are the best of the best processes? Who's doing it the best? We are no longer measuring ourselves against ourselves. We're now measuring ourselves against the industry's best.

INPO can tell us whose performance on pump maintenance is the best. We then use our Corporate Functional Area Manager (CFAM) organization, a central corporate group whose whole job is to

(Continued on page 26)

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Being Halfway...

Continued from page 24

benchmark and find the very best of the best practices. We use INPO to identify who does it the best. We go visit them and we take their best practices and institute them in our place. Perhaps the most important benefit of U.S. nuclear utilities is that we openly share information. Whoever's doing it the best, openly shares with anybody that chooses to come in. And from that, it helps solve the weakest link issue where we can strengthen the weaker performer by giving them best practices.

3. How was the offsite power restored despite immediate unavailability of 500 KV lines, after the 2011, tornadoes?

Browns Ferry is blessed with eight emergency diesel generators. Prior to the tornado storm, we did have one diesel generator out of service for planned maintenance. We were actually finishing up the work and just about returned it to service when the tornadoes came through. The storm took all offsite power lines out of service except for one 161 kV line. Browns Ferry has seven 500 kV lines and two 161 lines, that means we lost eight transmission lines. All seven available emergency diesel generators started as designed and provided AC power to safely shut down all three units. The transmission lines were destroyed and lying on the ground, so it wasn't a quick restring fix. With the super structures destroyed the duration to get the offsite power back was substantial. We ran on diesels for five days, during this period, we proved that we only need three of the eight to really support the site power needs. However, our technical specifications require us to have all eight available or enter a Limiting Condition of Operations (LCO). Overall, the plant responded well, we did have a couple of glitches, but overall I'd describe our performance as nearly perfect. At no time was I concerned that the site wasn't being sufficiently managed and the equipment

was sufficiently operable and doing what it needed to do.

If all diesels had flawlessly operated, and we didn't lose shutdown cooling for a short period of time I would have scored it a 4.0 performance. In one case we took the diesel out of service, we decided to manage the situation versus it managing us. In another case, the diesel tripped off. At no time did we not have sufficient power to do what we needed to be done.

Browns Ferry's diesel generators are cross-tied, we have four diesels tied to Unit 3 and four diesels tied to Unit 1&2. With the crossties you've multiple combinations of ways to get power where you need it.

4. How did TVA deal with the challenges of the tornado?

We had just had a media tour which took local, state and national reporters through Browns Ferry allowing them to see first-hand all our facilities. Very shortly thereafter, we were challenged by Mother Nature ourselves. It was a testament to the robust design of our plant, but obviously it wasn't a tsunami. Part of the reason for the media was to show the reporters that Browns Ferry's design is a little bit different than the Japanese plants in Fukushima, including the fact that our key switchgear cannot get inundated with water like what occurred in Japan. Our switchgear is actually located inside secondary containment, behind watertight doors, and not susceptible to localized flooding. Some of the key things that happened at Fukushima, couldn't happen at Browns Ferry and our design is a little different helping to prevent it as well. The takeaways are just as poignant and just as important, so we've been working very hard at TVA to go above and beyond what is required. We're not in it to just get by. We're in it to have highly flexible means of getting AC power and getting water into the vessel under almost any situation.

Our sirens were affected by the tornadoes due to lack of power. With no back-up battery capability many sirens were rendered inoperable by the storm. We already had plans to install new sirens containing battery backup. Since then, we have purchased and installed them at Browns Ferry and plan to do the same for Sequoyah and Watts Bar. Having the new sirens with AC/DC capability will strengthen the notification systems.

During the time period while the sirens had no power we worked with state and local officials, our own team to use route alert notification if necessary. Remember with all diesels performing their function there was no need for sirens. So, in this particular case, we ended up not needing to make notifications because the plant was stable and responded properly.

Another lesson learned from Fukushima was the need to purchase satellite phone systems. While land-line and cell service was available to some extent during the tornadoes, we recognized the need for satellite phones.

5. Did TVA implement any "Lessons Learned" from Fukushima regarding AC power availability?

We've also been very aggressive. We're buying several three-megawatt diesel generators, one for each of our operating units (six in total). They are going to be trailer-mounted and we're going to put them in a robust building that'll be able to withstand an EF-5 tornado and able to handle a significant seismic event. They will not be in the flood plain, so if we were to have our switchgear get in trouble, or our emergency diesel generators not run, we're going to have a totally independent source that we have on-site. Some utilities may have a regional location for them. Some may have them on site, but we've made the decision to have an additional three megawatt diesel for each one of our units so that we're not even going to debate the ability to

get alternating current back in our plant. We learned from Fukushima, that AC is the king and if you don't have it you're in trouble. So we've made a commitment, and our board of directors has supported the commitment, that we're going to have redundant and flexible means of having AC generation on our sites.

They'll be stored in separate robust locations somewhat away from the plant so it won't be part of that building but it'll be in relatively close proximity. Again, it's not going to be in a flood plain and they're going to be in a strong enough building, so a tornado will not take the building out.

The purpose of having it close enough to the plant was illustrated by Fukushima which showed us the difficulty of getting anything in and out of the plant after a major storm. I don't want to have to worry about the roads. I need to be able to have a building strong enough to withstand the worst thing Mother Nature can dish out and still hook it up.

Our transmission organization performed very well following the tornadoes, restoring power as quickly as they could. We obviously didn't start the units back up for over a month because it took that long to restore enough transmission capability to handle the units power output. So, we were sitting there with three plants ready to run and we couldn't do anything with them for almost a month. We did get a lot of good maintenance performed. We took advantage of the fact that three units were down at the same time and did some work that is really difficult to do any other time except when all three units were down. We did service water valve work, improving the plant substantially while it was unavailable for service.

We had one or two lines come back within five or six days, but one line isn't sufficient to carry the amount of load coming out of the plant. So, we had to wait until we got at least four 500 KV

lines back and one more 161KV line back, and that took over a month.

We were able to start the units up in about 30 days when we got sufficient offsite power lines back.

We've always believed in our design basis and our license basis were robust and strong. Don't get me wrong, that's very important, but to have these flexible means to keep the plant safe. I use the term "farmer smart" in our approach. We've got the Einstein-engineered approach nailed, but as we witnessed in Fukushima, Mother Nature hits you from all angles, sometimes you need something a little more like a farmer might do as opposed to what the Einstein might do. So, we've been approaching it that way and I think in the end, it'll make our system very robust and very flexible and AC will be king. It will be able to

get water in that vessel through multiple pathways using multiple vehicles and will have power through multiple vehicles, and our operators will have so many more tools capable of doing their job correctly, even more than they have right now. So, in the end, there's no doubt in my mind that the industry will be stronger for the investments we're going to have to do over the next few years.

6. *Is cost of implementing post Fukushima modifications an issue for TVA?*

I've already done some preliminary discussions with the board in terms of the significant expense. I've not quantified it for them, but the orders of magnitude, I think are understood that this is not going to be cheap. We factored a fair amount of money into the Watts Bar 2 construction project roughly \$100 million. It's

(Continued on page 50)



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Globally Engaged

By Jeffrey Merrifield, Shaw's Power Group.

Jeffrey Merrifield

Jeffrey S. Merrifield joined Shaw in 2007 as a senior vice president in its Power Group. As a member of the Power Group's executive team, Mr. Merrifield directs Shaw's nuclear and plant services business development activities, as well as external relations, government relations, marketing communications and community relations.



Mr. Merrifield served two terms (1998 to 2007) as a U.S. Senate-confirmed commissioner of the U.S. Nuclear Regulatory Commission. Appointed by President Clinton and reappointed by President Bush.

With a law degree from the Georgetown University Law Center, he is an environmental attorney and is a member of the bar of both New Hampshire and the District of Columbia.

Mr. Merrifield is a member of the board of the Charlotte Chamber of Commerce, the Central Piedmont Community College Foundation and the Energy Production and Infrastructure Center at the University of North Carolina-Charlotte.

An Interview by Newal Agnihotri, Editor of Nuclear Plant Journal at the Nuclear Energy Assembly in Charlotte, North Carolina on May 22, 2012.

1. Describe Shaw's current activities in new construction worldwide.

Shaw is very involved with AP1000® technology, given the fact we are currently building AP1000 nuclear power plants on two continents, and we think there are many places around the world where we could also do the same. In China, we are building four units, and in

the United States, we are building two new units for Southern Company at the Vogtle site in Georgia, as well as two new units for SCANA at the V. C. Summer site in South Carolina. We also are under contract for two new AP1000 units at a site in Florida. These projects give us an extraordinary base of knowledge, not just with the AP1000 technology,

but also modern construction techniques for the nuclear industry. We certainly hope to have a continued stream of new nuclear projects come online throughout the coming years. As the current economic recession continues to recover, we expect utilities here and abroad will want to use nuclear power and that the consumption levels continue to rise and our consumers will support this happening. Fuel diversity is important. SCANA, for example, has a chart that shows when the two new AP1000 units at V. C. Summer are complete, about one-third of the company's energy portfolio will be coal, one-third will be gas and one-third will be nuclear.

2. What are Shaw's activities in the service area?

Shaw exclusively does outage work at 45 of 104 operating units in the United States. We believe we bring a reasonable

price, along with high-quality outages that allow utilities to get their plants refueled and back online in a reasonable period of time - typically ten days less than our competitors. That's real value.

With clients like Exelon, Entergy, APS and others, that level of expertise gives us the skills that benefit the United States' nuclear fleet as a whole.

In the area of engineering, Shaw is a leader in nuclear engineering, supporting the existing fleet by designing major modifications and the necessary equipment to keep these plants operating to its extended life terms.

3. What is Shaw's involvement in the small reactor business?

Shaw has a terrific collaborative relationship and partnership with Westinghouse. On the small reactor market, more recently, we have been providing assistance to Holtec with their small reactor technology. They are in the process of submitting an application to the Department of Energy. We haven't committed to one particular project. We think there are a variety of projects for which we could certainly provide assistance.

4. What is the construction progress at Vogtle and V.C. Summer nuclear power plants?

The NRC granted the combined licenses (COL) for both the Vogtle and V. C. Summer projects. Nuclear construction has begun at both of those facilities. Later this year, we will move forward with the first concrete pour, which is a major milestone in getting the plant built. Right now at both sites we have approximately 1,600 individuals. They're working diligently to keep on schedule and make sure we can meet the timelines we set out for ourselves. One of the things I think is noteworthy about both of those sites is that we have been doing construction for some time now. All of the underground utilities are pretty much complete. We are placing underground piping and

(Continued on page 30)



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Globally Engaged...

Continued from page 28

underground cabling. We have done everything that the NRC has allowed us to do prior to getting the COLs. That puts us in very good shape to move forward in the desired timeframe.

5. What are the industry's current challenges with the US Nuclear Regulatory Commission?

When I was a commissioner at the NRC, one of the things that I led was a task force to better understand if there was a way in which you can have the combined operating licenses process move at a quicker pace. The NRC staff, for the most part, did a very good job of meeting those expectations and making judgments about the AP1000 design. We need to take another look at whether there are further efficiencies that could be garnered.

I left the commission five years ago. There are about 4,000 people who work for the agency today, compared to the about 2,800 in the early 1980s when I was there. There's been a tremendous increase. Today, about one-third of NRC's workforce is new. There are some incredibly bright young people who have joined the agency. The downside is really two-fold. One is in a generic way because many of these people are younger inspectors and may not yet have the seasoning or understanding of having been in staff. So, for them technically everything seems new. They ask lots of questions. The problem is that it is raising a lot of issues that were settled a long time ago. It imposes a level of burden on utilities and contractors like us to have to go through every issue trying to address concerns that were really settled 20, 30 years ago. The next layer involves the issues associated with construction inspection. These are construction sites. Obviously there are requirements that need to be met but you have the experience and understanding of what it means to be an

inspector in a construction environment. The problem is there aren't that many folks around who went through the earlier evolution of building power plants. The transition of knowledge from that older generation to the younger generation has been difficult for inspectors to grapple. The older inspectors have come back and helped coach the new inspectors. This is important from the safety standpoint, to identify an issue. They don't fully understand that the environment that you encounter at a construction site is different than what you would see at a plant that has been operating for 20 years. That makes it difficult for the agency. It makes it difficult for the utility. It makes it difficult for us as a contractor to work through these issues. We'll get through it, but there will be some learning curves along the way.

6. How has Fukushima affected Shaw's business?

The Fukushima event has impacted Shaw at a variety of different levels. Within days of the event, we sent a team of about 20 people to Japan. I was there within a couple of weeks. We were stationed at the headquarters of Toshiba, our partner in support of TEPCO. That team accomplished several things. The most noteworthy included Shaw designing the simplified active water retrieve and recovery system (SARRY). This system was used to filter the water at the site. AvanTech was involved in manufacturing the modules. There were other proprietary materials we have used to service the filter need. After the first modules and the assembly structure were built, some of the manufacturing also was done by Shaw. Additional modules were manufactured by IHI in Japan, then Toshiba was involved with the design.

We stand ready to assist TEPCO and the government of Japan. We will be continuing ongoing remediation with

Shaw's Environmental and Infrastructure Group, one of the largest radiation contractors in the United States, with significant experience in radiological cleanup. Shaw has a lot to offer.

Turning to the United States, there are several issues that the NRC has looked at and requirements that they are placing on utilities to respond. We have come up with a variety of capabilities that we think we can give utilities as full solutions for the NRC issues. Shaw is talking to various clients right now on how we can help them meet NRC standards.

7. Concluding remarks.

I think knowing all of the commissioners, this has been a busy year for all five of them. This led to some very uncomfortable testimony that they have all had to endure in front of both the House and the Senate and in terms of the relevant committees. They certainly have the potential to write a chapter for the commission. I certainly hope that the current NRC chairperson can look at those relationships and recognize its importance for the commission to work together collaboratively for the good of the people. We hope that the current commissioner brings a degree of cordiality to the commission and bringing it back together?

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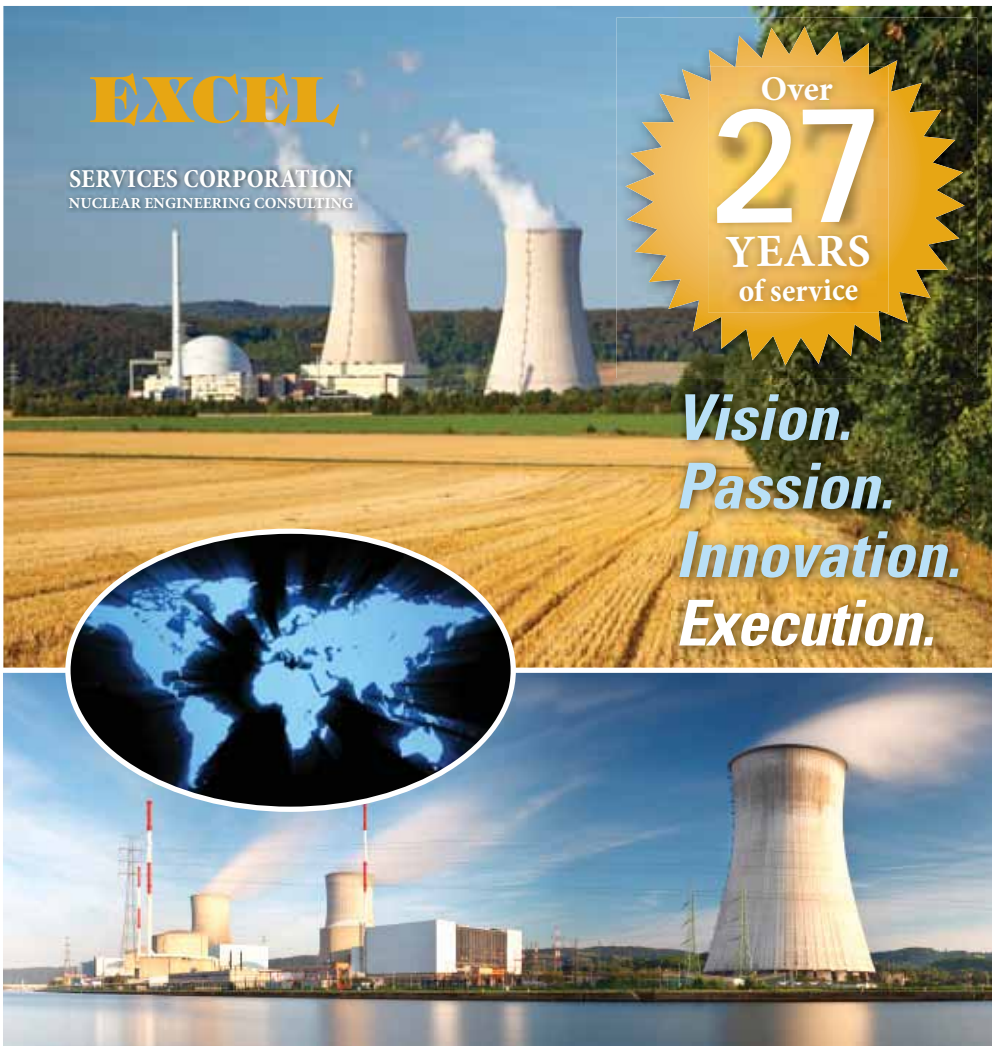
Footnote: interview was conducted on May 22, 2012. Some items may be outdated.

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International Trade Obstacles to Fukushima Recovery

By Elina Teplinsky, Stephen L. Markus and Yukinori Machida, Pillsbury Winthrop Shaw Pittman LLP.

Elina Teplinsky

Elina Teplinsky is a senior associate in Pillsbury's Washington, D.C. office. Her practice focuses on international nuclear energy matters, including advising U.S. and foreign clients on a full spectrum of issues related to nuclear trade, nuclear liability, procurement of equipment, fuel and services, investment in nuclear projects and nuclear financing. Mrs. Teplinsky assisted a number of clients in addressing regulatory and commercial issues related to providing post-Fukushima assistance to Japanese entities. She is a graduate of the Georgetown School of Foreign Service and Fordham University Law School. Mrs. Teplinsky speaks fluent Russian, Spanish and Portuguese.



In the wake of the devastating earthquake and tsunami that crippled Japan's Fukushima Daiichi nuclear power facility in March 2011, the international nuclear industry not only has studied the incident and begun to apply lessons learned, but also has actively provided supplies and assistance to support the recovery efforts of Tokyo Electric Power Co. (TEPCO). Within days of the disaster, experts from the nuclear industries of the United States and other countries arrived in Japan and began to assist TEPCO with recovery measures. In addition to sending expert volunteers, the industry has contributed a wide array of critical supplies, including safety equipment, radiation-monitoring devices and robotic surveillance systems.

As international support initiatives continue, questions have emerged regarding the international trade control hurdles that confront existing and would-be suppliers in providing nuclear-related products and assistance to Japan. Before sending equipment or personnel to Japan to aid TEPCO in its recovery efforts, foreign companies should be aware of any trade restrictions or approval requirements that may apply to their planned activities. These controls may arise in both the export and import contexts. As a result, suppliers from the United States and other countries that adhere to the Nuclear Suppliers Group Guidelines for Nuclear Transfers (NSG Guidelines) must ensure that any transfers are compliant with the their country's export control laws and regulations. In addition, suppliers should work with Japanese recipients to verify that the goods or technology will be imported in compliance with any applicable Japanese import controls, and that personnel providing in-person services satisfy Japanese immigration and visa requirements.

U.S. Export Controls

The U.S. Government strictly controls the exports of nuclear reactors, material, equipment and technology. The three key U.S. federal agencies that regulate commercial nuclear exports are the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Commerce (DOC).

The DOE, in accordance with its regulations at 10 C.F.R. Part 810, regulates the transfers of nuclear technology outside of the United States and the provision of nuclear technical assistance to foreign entities. This type of controlled assistance includes expert support provided by U.S. vendors, nuclear reactor operators and technical consultants to TEPCO and other Japanese entities post-Fukushima.

Under Part 810, U.S. companies and U.S. citizens are required to obtain a specific authorization (i.e., license) from the DOE prior to transferring technology or providing assistance to companies in countries listed in 10 C.F.R. § 810.8(a) ("DOE Restricted Country List"). However, in accordance with 10 C.F.R. § 810.7(h), commercial nuclear technical activities in countries not listed on the DOE Restricted Country List are subject to a general authorization (no prior DOE approval required). Japan is not included on the DOE Restricted Country List. Therefore, U.S. companies and U.S. citizens can provide post-Fukushima assistance to Japanese entities without seeking prior approval from the DOE. In addition, Part 810 includes an additional general authorization in section 810.7(b) for "furnishing information or assistance to prevent or correct a current or imminent radiological emergency posing a significant danger to the health and safety of the off-site population." This general authorization under section 810.7(b) does, however, require advance DOE notification and approval, which DOE provides on an expedited basis. Some U.S. companies providing assistance in Japan immediately after Fukushima did seek approval from the DOE in accordance with section 810.7(b); however, the section 810.7(b) general authorization is intended for providing emergency support in countries listed on the DOE Restricted Country List.

Notably, generally authorized activities are subject to a 30-day reporting requirement. The reports must include an assurance that the U.S. company has an agreement in place with the foreign recipient that precludes the recipient from retransferring the U.S. technology to countries on the DOE Restricted Country List without prior government approval. It may be challenging for U.S. companies to obtain such agreements during emergency situations. In these cases, it may be appropriate for the U.S. company to discuss with the DOE the difficulty of immediately obtaining contractual assurances from the foreign recipient.

The NRC, in accordance with its regulations in 10 C.F.R. Part 110, regulates the export of nuclear material, reactors, equipment and components. Most exports of nuclear material and reactors require the exporter to obtain an NRC specific export license. However, 10 C.F.R. § 110.26 provides a general license for exports to a number of countries, including Japan, of minor reactor components listed in paragraphs (5) through (9) of Appendix A to Part 110. Therefore, any exports of minor nuclear components to Japanese entities as part of post-Fukushima recovery will not require prior NRC approval.

Finally, the DOC controls the export of all commodities, technologies and software not regulated by another federal agency through the Department's Bureau of Industry and Security (BIS), which administers the Export Administration Regulations (EAR). A relatively small percentage of total U.S. exports require a license from the BIS. License requirements are dependent upon an item's technical characteristics, the destination, the end-user and the end-use. Certain safety, radiation monitoring and surveillance equipment is subject to the EAR, but most exports of such equipment to Japan will not require a license from the BIS.

U.S. export control requirements are incredibly complex and ever-changing. Therefore, U.S. companies seeking to provide Fukushima-related assistance should consult legal counsel for an export control determination.

Japanese Import Controls

Japan's Ministry of Economy, Trade and Industry (METI) manages the Japanese import control regime, in accordance with Article 52 of the Foreign Exchange and Foreign Trade Act and Article 4, Paragraph 1, Item 2 of the Import Trade Control Order. Items subject to METI import approval requirements, as specified in METI's so-called "Import Announcement" (Public Notice No. 170 of the Ministry of International Trade and Industry of 1966, as amended), include the following nuclear-related commodities: (1) nuclear material (including but not limited to natural, enriched or depleted uranium, thorium and fresh or spent fuel elements); (2) nuclear reactors and reactor components; (3) zirconium tubes; and (4) instruments for measuring or detecting ionizing radiation which contain nuclear fuel materials, as well as parts and accessories for such instruments. This import approval requirement applies to all items falling within the specified categories, regardless of their country of origin. METI import approvals, once issued, are valid for six months from the date of approval.

However, the Import Trade Control Order contains an exemption from the import approval requirement for "relief supplies provided without charge." This special provision makes METI import approval unnecessary for import-controlled items which are donated by foreign suppliers to Japan as "relief supplies." Accordingly, import-controlled nuclear items which are provided to Japan at no cost by suppliers of any country, including Russian, Ukrainian and Belarusian suppliers, may qualify for the "relief supplies" exemption, while these items would appear to remain subject to ordinary METI import approval requirements where they do not

Stephen L. Markus

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His practice focuses on energy

regulatory matters, with an emphasis on international nuclear commerce. Mr. Markus advises private and government clients on nuclear export and import licensing, nuclear liability, procurement and contractual issues, international agreements, and the development of emerging nuclear power programs. In addition, he assists

in the representation of clients in the energy industry in litigation before the U.S. Nuclear Regulatory Commission and the federal courts. He is a graduate of Middlebury College and Cornell Law School.



constitute "relief supplies" or are sold to the Japanese recipient under ordinary commercial terms. Suppliers wishing to utilize this exemption should consult with the recipient to confirm that the import may be accorded this special treatment and will be imported under procedures which satisfy any applicable consultation or reporting requirements.

METI does not impose restrictions on, or require specific approval for, the import of nuclear technology from any country, including nuclear technology imports from Russia, Ukraine and Belarus. Although METI administers a highly prescriptive set of controls on the export of nuclear technology from Japan, its import ordinance does not specify nuclear technology among the items subject to import controls. This treatment is consistent with U.S. regulations, which control the export but not the import of nuclear technology. Thus, while foreign entities seeking to provide controlled technical data and assistance to Japan

(Continued on page 34)

International Trade...

Continued from page 33

must satisfy applicable export control requirements of their own countries, as well as any additional controls imposed by the countries of origin (if applicable), it is not necessary to separately obtain Japanese import approval for such transfers. However, foreign personnel traveling to Japan for the purpose of providing in-person assistance will need to comply with certain Japanese immigration and visa requirements, as outlined below.

Japanese Immigration and Visa Requirements

Japan's Ministry of Foreign Affairs prescribes a detailed set of requirements and procedures for applying for Japanese entry visas. Whether a visa is required, and if so, what procedures apply, depend on the purpose and length of stay, as well as the nationality of the person concerned. In general, nationals of countries with which Japan has visa exemption arrangements need not apply for a visa for short-term stays. Depending on the nationality, the allowable period of stay ranges from 14 days to six months. U.S. nationals, for example, are allowed a visa exemption for stays up to 90 days. Many European countries also qualify for short-term visa exemptions. Foreign nationals subject to visa exemptions may conduct commercial activities in Japan, but must obtain a working visa if they engage in "paid activities" in Japan or exceed the period of stay applicable to their nationality.

In contrast, citizens of Russia and Newly Independent States (NIS) (defined as Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan), as well as China and certain other countries, must obtain an entry visa for short-term stays. Such visas require various documents from the inviting entity or guarantor, including a schedule of stay, a letter of guarantee and corporate

information. This type of visa generally requires one week to process and is valid for three months.

"Short-term business affairs" which may be performed under the visa exemption or short-term visa include: (1) business meetings; (2) consultations; (3) post-sale installation or service; (4) promotional activities; (5) market research; (6) attendance at a conference, workshop or course of lectures; (7) factory tour; (8) inspection tour; or (9) trade fair. "Paid activities" requiring a working visa include most services, other than ancillary "short-term business affairs" or participation in a lecture or other events not given on a regular basis, performed in Japan by a foreign national who receives any type of remuneration in compensation for his or her services. Remuneration for "paid activities" is deemed to occur regardless of whether the entity providing such remuneration is located in Japan, and regardless of whether such remuneration is paid to the foreign national in Japan.

If the purpose of the visit is for "paid activities" (e.g. as an engineer) or will be a long-term stay, the person (regardless of nationality) must apply for a working visa. In addition to the customary application materials, working visa applicants are strongly encouraged to obtain and submit a certificate of eligibility from the applicable regional immigration authority, agencies which fall under the jurisdiction of Japan's Ministry of Justice. Once the certificate of eligibility is requested by the inviting Japanese entity and obtained on the applicant's behalf, the standard processing time for a working visa is five business days. However, an applicant may submit a working visa application without a certificate of eligibility, in which case the application will require

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additional documentation and may be delayed several months. Working visas are valid for stays of one or three years.

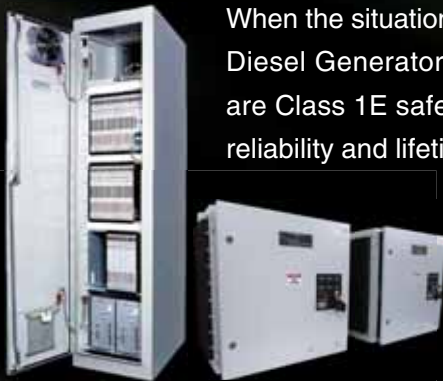
Japanese entry visas, by default, only permit one entry to Japan during the designated period. Persons such as business travelers who anticipate needing to visit several times over a designated period may apply for a multiple-entry visa, which is valid from one to five years.

Due to the intricacies of the Japanese immigration and visa system, persons interested in visiting Japan to provide Fukushima-related assistance should consult the nearest Japanese embassy or consulate general for more information.

Contact: Elina Teplinsky, Pillsbury Winthrop Shaw Pittman LLP, 2300 N Street, NW, Washington, DC 20037; telephone: (202) 663-9009, fax: (202) 663-8007, email: elina.teplinsky@pillsburylaw.com. ■



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Nuclear Grade Air Trap

By Turner Wood, NUCCORP, Inc.

Turner Wood

Turner Wood is a graduate of the University of South Carolina with a BS and MS in Mechanical Engineering and holds a Professional Engineering License. He has over 25 years of experience in the commercial nuclear industry and is currently the Chief Engineer at NUCCORP, Inc., a 10CFR50 Appendix B component design and manufacturing company.



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

This was a 2012 NSSS Vendor Award Winner.

The team members who participated included: Turner Wood, NGAT Developer; John Garza, GL08-01 Project Engineer; Doug Edwards, Plant Operations; Brenda Brown, Design Engineering Supervisor.

Summary

All stations experience and deal with GL08-01 (Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems) issues. In order to monitor and provide a direct method for eliminating accumulated air/gases in otherwise liquid-filled systems, a Nuclear Grade Air Trap (NGAT) was developed and currently six are installed at V. C. Summer (VCS) Unit 1. The traps require no electricity and provide Operations with a direct indication of the amount of air/gas that has accumulated and allows the operator to vent-off the air/gas that would otherwise be potentially harmful to fluid systems and pumps that are important to nuclear safety. The traps

employ a magnetic float which provides the level of the water/air interface on an externally mounted indicator, which reacts to the float's magnetic field. The NGAT promotes ALARA principles by allowing operators to determine if ECCS systems are full, just by quickly glancing at the

NGAT indicator reducing the need to vent the system if not required.

Safety

The use of the Nuclear Grade Air Trap (NGAT) enhances safety as follows:

Nuclear Safety

The NGAT defines when ECCS and other ESF systems are "full" to show technical specification compliance on a full-time basis, rather than every 30 days. This improves nuclear safety by ensuring ECCS systems are full and ready to perform their intended design basis functions.

The NGAT eliminates the need for scaffolding that would need to be erected and left standing for an on-going, monthly UT inspection (for void detection). This enhances nuclear safety by eliminating the risk of damaging or declaring SSCs inoperable while the scaffolding is being built and left in-place over safety-related equipment, as the NGAT does not require scaffolding.

Radiation Protection

The NGAT promotes ALARA principles by allowing operators to

determine if ECCS systems are full, just by quickly glancing at the NGAT indicator. Without the NGAT, worker dose would be increased, as crews would have to be dispatched to perform UT measurements to determine if voids are found in ECCS piping. Also, scaffold building crews would receive doses by erecting scaffolding for the UT crews.

The NGAT eliminates unnecessary venting. Some stations forgo the UT process and open vents to determine if voids are present. This is problematic because of increased doses received and the risk of personnel contamination is high.

It is estimated that a yearly re-occurring, 300 mrem/yr could be saved by installing NGATs in the existing vent locations in the RHR system at VCS.

Industrial Safety

The NGAT eliminates the need for scaffolding to be constructed at locations now requiring UT inspections. Also, UT personnel would not be exposed to the industrial safety risk of working from scaffolding.

The NGAT eliminates human error in the interpretation of UT data for void determination. There have been stations that have declared systems inoperable due to initial false-positive indications of voids. The NGAT is a go/no-go indication that voids are present by quick visual observation.

Cost Savings

Assume 15 locations per month to check in the RHR system:

- 15 scaffolds to build, 3 men/scaffold, 4 hrs to build = 180 man-hrs/month at \$40/hr=\$7200/month
- 15 UT inspections, 1 inspector and 1 helper, 2 hrs/location (includes dress-out, ingress and egress), 2 men/location, 2 hrs/location = 60 man-hours/month at \$60/hr=\$3600/month
- Est. total cost for determining if RHR system is full, using UT, per month=7200+3600=\$10,800/month
- Cost for using NGAT to determine if RHR system is full: one person, 5 minutes/location at 15 locations = 1.25 hrs at \$60/hr = \$75. Add one hour for both ingress and egress for a total cost of 3.25 hrs at \$60/hr = \$195/month. The NGAT method saves \$10,605/month=\$127,260/yr=\$5 million over plant life for checking if the RHR system is full and in tech spec compliance. The savings can be

even greater if the NGAT is employed on other ECCS/ESF systems.

Innovation

The NGAT is unique in that it uses passive principles of nature (buoyancy and magnetism) to constantly show whether air/gas is gathering at a high point in fluid systems. It is easily determined by



NGAT installed in the RHR System at V. C. Summer Unit 1.

a quick glance at the indicator that the location requires venting or not. It is a fresh and unique, direct approach to void determination, as it requires no special skills for interpreting UT readings.

Transferability

The NGAT technology is easily transferable across the industry. All stations experience and deal with GL08-01 issues. The NGAT can easily become the “common denominator” and standard method for determining if systems are “full” and in tech spec compliance. Also, the NGATs can be valuable for the new build stations, as well.

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NUCCORP, Inc. holds the patent rights to the NGAT. NUCCORP designs, manufactures and sells NGATs to commercial nuclear power facilities.

Standards of...


Continued from page 22

hazards, then the emergency response organization will find a way to use it. So at this point we have bought some margin, and we now need to follow through and get the FLEX fully implemented.

11. Concluding Comments.


The big lesson from Fukushima is that the US and the world nuclear industry need to establish and strive for the same standards of excellence in emergency response that we have done in plant operations. The US Chief Nuclear Officers have demonstrated incredible leadership in really understanding what happened there, defining what are the right things to do, and then working very closely with the USNRC to make sure we do the right things in building our capability to respond to an emergency and to verify that the things that we think we have in place to allow us to do this are, in fact, well-maintained and in place. The working relationship between the NRC and the industry has been very positive. Finally, the world community is beginning to pull together well with the strengthening of WANO. I do think this is going to be a new day for WANO. Although the barriers of governance and language and culture and geography are extraordinary - the commitment is really growing. That's very important - I would like to see that be the real legacy of Fukushima, excellence in emergency response and a strengthened WANO for the world. Those are both within our grasp.

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Preventing Half-SCRAMS with Insulated Srew Bit

By Bruno Giorgio, Entergy Nuclear.

Bruno Giorgio

Bruno Giorgio is a 13 year veteran at Entergy Nuclear where he serves as I&C supervisor. An accomplished machinist and welder, Giorgio earned his degree in electronics engineering technology from the New England Institute of Technology.



All torque screwdrivers include a variable torque range, and all have a unique torque limiting clutch that disengages once the preset torque has been reached preventing over-tightening which can cause possible damage to components and the final product. While torquing terminal screws in an ATS (Analog Trip System) cabinet, the metal screwdriver bit can inadvertently short-out the adjacent terminal screws causing an unexpected half-scrum.

Entergy's Pilgrim team was frustrated with not being able to find a non-conductive bit that could be used in ATS cabinets especially since there was a history of half-scrums from this function. Non-conductive material provides electrical insulation to prevent inadvertent short of screw terminals.

Attacking the Half-Scram Issue:

Beginning in October 2010, Pilgrim employees began researching non-conductive materials. It was soon decided that ceramic would be the material of choice for this unique and demanding function.

During testing, silica-based ceramic was found to be too brittle and cracked easily under stress. A second version was made with zirconia ceramic. Zirconia ceramic is harder than steel and must be machined with a diamond cutter or grinder. After obtaining the material and a diamond cutter, the next iteration was ready for testing.

The zirconia ceramic bit performed well. It went through a series of tests to the maximum electrical termination screw torque nuclear requirements of 18 inch-pounds without failure.

A brass hexagon-fitted bit is used. A delrin rod – a plastic/nylon non-conductive polymer – is the connective material to hold brass and zirconia ceramic together. Glue would not hold nor bond to the ceramic.

Delrin is an engineering thermoplastic used in precision parts that require high stiffness, low friction and excellent dimensional stability. It was discovered by Hermann Staudinger, a German chemist who received the 1953 Nobel Prize in Chemistry and first synthesized by DuPont research chemists around 1952.

The hex bit is machined with a deep groove. The zirconia ceramic tip is diamond-cutter machined with a deep tongue. The bit and tip are press-fit into the delrin rod. The delrin was machined



0.05 of an inch smaller; it fills in around the inserted bit and tip when pressed; and the delrin plastic is hard enough/stable to withstand nuclear torquing requirements.

Production, testing, input and revisions took about two months.

Safety Improved and Half-SCRAMs Eliminated

At Pilgrim, there was a stop-work order on the ATS cabinet until it was proven that the new zirconia ceramic torquing bit would work.

After testing, all of the remaining ATS screws (over 1500) at the Pilgrim station were worked/torqued without any incident. About 2 percent (~30) were

(Continued on page 40)

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

This was a 2012 NEI Process Award Winner.

The team members who participated included: Bruno Giorgio, Team Lead, Nuclear Control Technician; Amy Niederberger, Senior Engineer; Chris Hultstrom, Lead Nuclear Control Technician; Bob Wheaton, Lead Nuclear Control Technician.

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Preventing Half...

Continued from page 38

found loose and out of specification. Now that all 1500 screws in the ATS cabinets are torqued to specs, they do not have to be more-than-routinely checked.

The use of the insulated screwdriver bit eliminates inadvertent ATS cabinet short-outs that can cause half SCRAM events. A half SCRAM event greatly challenges plant operations with respect to controlling the plant; and a full reactor SCRAM challenges every department from operations, chemistry, maintenance and more.

Radiation savings could be up to 50 to 100 Rem that would occur during forced outage activities that would need to be performed by workers due to a reactor SCRAM. One reactor SCRAM would cause a loss of revenue of up to \$1 million dollars per day for every day that the plant is not generating electricity.

Pilgrim Nuclear Power Station has had greater than 25 unexpected half

scrams in the past five years. About half of these, 12 could have been prevented by the insulated crew bit. Additionally, there has been approximately 12 days of lost generation within the past five years due to related issues equating to approximately \$12 million in lost revenue.

The World Nuclear Association reports that unplanned automatic scrams result in thermal and hydraulic transients that affect plant systems. On average, each plant experiences 0.6 SCRAMs per year. This equates to approximately \$600k loss of revenue per year.

The zirconia ceramic torquing screwdriver bit has also been used for lifting and landing leads for surveillance testing, a common nuclear function. This improves occupational and nuclear safety further.

"This is a great addition to our tool chest. The team worked together from the research and production of the bit at

the Pilgrim shop to testing it in the plant. This is another way that we are making operations safer and more productive here at Pilgrim," said Bob Wheaton, lead nuclear control technician and team member.

Pilgrim started using the new bit in December of 2010. All I&C technicians are trained on the use of the new screwdriver bit and it is presently being used on any terminations where there is a high risk of shorting terminations to each other or to ground.

Working together, Entergy's Pilgrim Nuclear Power Station addressed the problem with an innovative solution not found in the nuclear industry.

Contact: Terry Young, Entergy Nuclear, telephone: (601) 368-5650, email: tyoung5@entergy.com. ■

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Reliable Fuel Pool Instrumentation

Introduction

The U.S. Nuclear Regulatory Commission staff has determined that, with the exceptions listed below, conformance with the guidance in Nuclear Energy Institute (NEI) 12-02, *Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation"* Revision 1, is an acceptable method for use in satisfying the requirements in Order EA-12-051 regarding reliable spent fuel pool instrumentation. Licensees and construction permit (CP) holders may use methods other than those provided in NEI 12-02, Revision 1, to meet the requirements of Order EA-12-051. The staff will review such methods and determine their acceptability on a case-by-case basis.

Instrumentation Design Features

Staff Position: NEI 12-02, Revision 1, Section 3, provides an acceptable methodology for reliable spent fuel pool instrumentation with the following clarifications and exceptions specific to Section 3.4 Qualification:

Guidance

The second bullet under subheading "Guidance" states that instrument channel reliability shall be demonstrated for the "effects of shock and vibration on instrument channel components used during any applicable event for only installed components." To comply with the intent of the order, the NRC staff position is that such reliability demonstration applies to the "effects of shock and vibration on instrument channel components used during and following any applicable event for installed components."

Guidance

The paragraph after the third bullet under subheading "Guidance" states that the selection of instrument channel components

should consider ease and simplicity of design and replacement after the event" and that readily available commercial components shall be considered. The NRC staff position is that commercial components may be considered, but that licensees may choose to utilize augmented quality components, up to and including the quality and capability of components typically used in safety-related applications.

Guidance

The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the effects of shock and vibration on all instrument channel components, rather than only installed components. This exception is necessary because the guidelines do not otherwise specify that portable instrument channel components be designed as hand-held portable devices or similarly rugged components. This clarification removes potential confusion regarding the extent of design basis shock and vibration loadings that are different from the design basis seismic loadings.

Regardless of plant design basis, components of the instrument channels should be qualified for shock and vibration using one or more of the following methods:

- components are supplied by manufacturers using commercial quality programs (such as ISO9001, "Quality management systems-Requirements") with shock and vibration requirements included in the purchase specification at levels commensurate with portable hand-held device or transportation applications;
- components have a substantial history of operational reliability in environments with significant shock and vibration loading, such as portable hand-held device or transportation applications; or
- components are inherently resistant to shock and vibration loadings, such as cables.

Seismic

The first bullet under the section "Seismic" makes a provision for "instrument channel components...supplied by manufacturers with commercial quality programs... with seismic requirements... and commercial design and testing for operation in environments where significant seismic effects are common." It is the NRC staff position that the guidance in this clause does not adequately address seismic levels

and frequencies seen at the installation location or methods for demonstration.

Demonstration of seismic motion consistent with that of existing design basis loads at the installed location is adequate. Quality programs are addressed in Appendix A-1 of NEI 12-02, Revision 1.

Seismic

The second bullet under the section "Seismic" makes a provision for demonstrating adequacy of design and installation to account for seismic effects which includes "substantial history of operational reliability in environments with significant vibration." Typically, vibration is an effect that occurs at higher frequency and lower amplitude than that of seismic motion. It is the NRC staff position that seismic design and installation adequacy cannot be reasonably demonstrated solely through operational history of performance of components when subjected to vibration, but that the effects of low frequency, high acceleration need to be included in any demonstration of seismic design adequacy. This clause is not appropriate without stating that such a vibration design envelope shall be inclusive of the effects of seismic motion imparted to the components proposed at the location of the proposed installation.

Seismic

The third bullet under the section "Seismic" lists four methods of demonstrating reliability. It is the NRC staff position that the adequacy of seismic design and installation should be demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," or a substantially similar industrial standard.

References

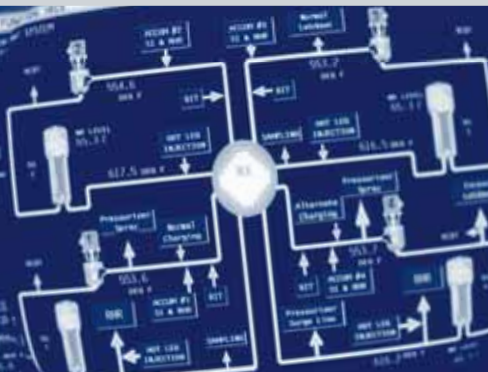
A. NRC Order EA-12-051, *Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Effective Immediately)*, issued March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 12056A044.

B. NEI 12-02, *Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,"* Revision 1, dated August 24, 2012 (ADAMS) Accession No. ML 122400399. ■

JLD-ISG-2012-03

Provided in this Interim Staff Guidance are highlights of Compliance with U.S. Nuclear Regulatory Commission Order EA-12-051, *Reliable Spent Fuel Pool Instrumentation Interim Staff Guidance* Revision 0.

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Mitigation Strategies

Strategies

1.0 Evaluation of External Hazards

NEI 12-06 (Diverse and Flexible Coping Strategies (FLEX) Implementation Guide), Section 4 discusses the overall methodology for evaluating the impact of the hazards, discussed in Section 5.0 through 9.0, on the deployment of the strategies to meet the baseline coping capability. Staff Position: NEI 12-06, Sections 5.0 through 9.0 and Appendix B provide an acceptable methodology for the evaluation of external hazards, recognizing that it does not purport to compute beyond-design-basis hazard levels.

2.0 Phased Approach

Order EA-12-049 (Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events) requires a three-phase approach to mitigating beyond-design-basis events, with an initial response phase using installed equipment, a transition phase using portable equipment and consumables to provide core and spent fuel pool (SFP) cooling and maintain the containment functions, and a third phase of indefinite sustainment of these functions using offsite resources. Maintenance of core and SFP cooling and containment functions requires overlap between the initiating times for the phases with the duration for which each licensee can perform the prior phases. The NRC staff recognizes that for certain beyond-design-basis external events, the damage state could prevent maintenance of key safety functions using the equipment intended for particular

phases. Under such circumstances, prompt initiation of the follow-on phases to restore core and SFP cooling and containment functions is appropriate. If fuel damage occurs, the Severe Accident Management Guidelines should be used as guidance. Staff Position: NEI 12-06 provides an acceptable method for developing the phased approach required by Order EA-12-049.

2.1 Initial Response Phase

The initial response phase will be accomplished using installed equipment. Licensees should establish and maintain current estimates of their capabilities to maintain core and SFP cooling and containment functions assuming a loss of alternate current (ac) electric power to the essential and nonessential switchgear buses except for those fed by station batteries through inverters. This estimate provides the time period in which the licensee should be able to initiate the transition phase and maintain or restore the key safety functions using portable on-site equipment. This estimate should be considered in selecting the storage locations for that equipment and the prioritization of resources to initiate their use. Staff Position: NEI 12-06, Section 3.0, provides an acceptable method for determining the baseline coping capabilities, which will determine the duration of the initial response phase, with the following clarification:

An element of a set of strategies to maintain or restore core and SFP cooling and containment functions includes knowledge of the time a licensee can withstand challenges to these key safety functions using installed equipment during a beyond-design-basis external event. This knowledge provides an input to the choice of storage locations and conditions of readiness of the equipment required for the follow-on phases. This duration is related to, but distinct from the specified duration for the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.63, "Loss of all alternating current power,"

paragraph (a), because it represents the current capabilities of the licensee rather than a required capability and licensees must:

- 1) account for the SFP cooling function, which is not addressed by 10 CFR 50.63(a), and
- 2) assume the non-availability of alternate ac sources, which may be included in meeting the specified durations of 10 CFR 50.63(a).

This is implicit in the FLEX principles described in Section 3.2.1.7, Paragraph 6) and Section 3.2.2, Paragraph 1 of NEI 12-06; however, maintenance of the guidance and strategies requires that the estimate of capability be kept current to reflect plant conditions following facility changes such as modifications or equipment outages. Changes in the facility can impact the duration for which the initial response phase can be accomplished, the required initiation times for the transition phase, and the required delivery and initiating times for the final phase.

2.2 Transition Phase

The transition phase will be accomplished using portable equipment stored on-site. The strategies for this phase must be capable of maintaining core cooling, containment, and spent fuel pool cooling capabilities (following their restoration, if applicable) from the time they are implemented until they can be supplemented by offsite resources in the final phase. The duration of the transition phase should provide sufficient overlap with both the initial and final phases to account for the time it takes to install equipment and for uncertainties. Staff Position: NEI 12-06, Section 3.0, provides an acceptable method for determining the baseline coping capabilities for the transition phase.

2.3 Final Phase

The final phase will be accomplished using the portable equipment stored on-site augmented with additional equipment and consumables obtained from off-site. Staff Position: NEI 12-06 provides an acceptable method for determining the

JLD-ISG-2012-01,

Provided in this Interim Staff Guidance are highlights of Compliance with US NRC Order EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*.

baseline coping capabilities for the final phase.

3.0 Core Cooling Strategies

The first set of strategies necessary to meet the requirements of Order EA-12-049 addresses challenges to core cooling. Core cooling must be accomplished in all three phases described in the Order. The purpose of these strategies is to provide a means of cooling the core in order to prevent fuel damage.

Staff Position: NEI 12-06 provides an acceptable method of developing strategies to maintain or restore core cooling capabilities.

4.0 Spent Fuel Pool Cooling Strategies

The second set of strategies necessary to meet the requirements of Order EA-12-049 addresses challenges to SFP cooling. SFP cooling must be accomplished in all three phases described in the Order. The purpose of these strategies is to provide alternative means of cooling the spent fuel in order to prevent fuel damage. Licensees must consider all loading conditions relevant to their SFP, including a maximum core offload.

Staff Position: NEI 12-06 provides an acceptable method to develop strategies and guidance for SFP cooling.

5.0 Containment Functions Strategies

The third group of strategies and guidance necessary to meet the requirements of Order EA-12-049 addresses challenges to the containment functions. Containment functions must be accomplished in all three phases described in the Order.

5.1 Removal of Heat from Containmentment

Beyond-design-basis external events such as a prolonged SBO or loss of normal access to the ultimate heat sink could result in a long-term loss of containment heat removal. The goal of this strategy is to relieve pressure from the containment in such an event. Staff Position: NEI

12-06 provides an acceptable method to develop strategies and guidance for removal of heat from containmentment.

6.0 Programmatic Controls

6.1 Equipment Protection, Storage, and Deployment

Storage locations chosen for the equipment must provide protection from external events as necessary to allow the equipment to perform its function without loss of capability. In addition, the licensee must provide a means to bring the equipment to the connection point under those conditions in time to initiate the strategy prior to expiration of the estimated capability to maintain core and spent fuel pool cooling and containment functions in the initial response phase. Staff Position: NEI 12-06 provides an acceptable method to provide reasonable

protection, storage, and deployment of the equipment associated with Order EA-12-049.

6.2 Equipment Quality

Staff Position: NEI 12-06 provides an acceptable method to control the quality of equipment associated with Order EA-12-049 with the following clarifications.

1. Installed structures, systems and components pursuant to 10 CFR 50.63(a) should continue to meet the augmented quality guidelines of Regulatory Guide 1.155, "Station Blackout."

2. Development of maintenance and testing programs for the portable equipment responsive to Order EA-12-049, following the guidelines of NEI 12-06 and standard industry processes for ensuring equipment reliability, provides an acceptable method to reasonably

(Continued on page 54)



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RI-ISI

By Electric Power Research Institute.

Entergy and Dominion are applying a streamlined version of EPRI's risk informed in-service inspection (RI-ISI) methodology across their nuclear power plants to optimize piping inspections. The advanced methodology is helping to:

- Improve plant safety
- Reduce worker exposure and rad-waste generation
- Identify opportunities to improve safety in piping systems outside of the traditional inspection scope.
- Reduce costs of in-service inspection program implementation and maintenance

The streamlined approach is built on more than a decade of collaborative research and development by EPRI and the nuclear industry. It has been codified by the American Society of Mechanical Engineers (ASME) as Code Case N716 (Alternative Risk-Informed Inservice Inspection (RI-ISI) Program), and approved by the U.S. Nuclear Regulatory Commission for use in a number of units.

Risk-Informed Inspection: Reducing Burden, Improving Safety

In-service inspections use nondestructive evaluation (NDE) methods to identify flaws in components such as piping welds before they can cause structural failure. In the United States and a number of other countries, in-service inspections have historically been performed according to the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, using deterministic criteria including design stress analysis, structural discontinuities or random selection.

While some countries follow codes other than ASME, the inspection philosophy is often similar, for example, inspecting 25% of the welds for Class 1 piping, a smaller percent for Class 2 piping, and no requirements for NDE of Class 3 or Class 4 piping welds. These approaches do not consider actual plant operating conditions, potential causes of component degradation, or the probability and consequences of

failure. Because many piping inspection sites are inside the containment and only accessible during plant outages, a large number of inspections affect outage planning and increase worker exposure.

To improve the effectiveness, efficiency and safety of in-service inspection, EPRI developed a RI-ISI methodology as an alternative to these deterministic rules. The RI-ISI approach focuses inspection resources on the most safety-significant piping segments. As a result, the number of inspections can often be reduced while maintaining safety. The RI-ISI methodology has been codified by ASME and approved by the NRC. It has been widely adopted by most U.S. nuclear plants (85 units), and is being adopted and investigated by a number of plants outside the United States. Implementation of the RI-ISI approach has reduced the number of inspections by more than 70%, with an estimated dose reduction of 3,000 to 7,000 REM per ten-year inspection interval. The total cost savings of applying RI-ISI are estimated at \$60 to \$160 million when compared to ASME Section XI rules.

Extending the base EPRI RI-ISI method to other augmented inspection programs, such as high energy piping in containment penetration areas, can result in even greater burden reductions. As a comparison, the augmented inspection requirements for a high energy line break/break exclusion program can be 4 to 12 times higher than deterministic ASME rules, while the risk-informed approach for this augmented program can show reductions of up to 90% while maintaining or improving plant safety.

Making a Good Product Even Better

To make the RI-ISI methodology more effective, faster, and less costly to implement, EPRI developed a streamlined version based on lessons learned from numerous RI-ISI applications. Utilities can implement the new methodology, called Risk-Informed Safety Based (RIS_B), at significantly less cost than the traditional RI-ISI approach. The streamlined version has proved its ability to reduce costs, exposure and radwaste while further improving plant safety.

The streamlined version differs from the traditional RI-ISI approach in that it does not require a detailed consequence assessment for every piping segment. Instead, the streamlined methodology identifies a generic set of high safety

significant (HSS) segments, coupled with a rigorous analysis to identify any plant-specific HSS segments.

Whereas the original RI-ISI approach focused on high safety-significant Class 1 and Class 2 piping, the streamlined RIS_B approach also encompasses Class 3 and 4 segments. As a result, the streamlined approach not only allows plants to implement a risk-informed inspection program at less cost than the traditional RI-ISI approach, it entails a review of the entire plant that increases the likelihood of identifying opportunities for safety improvements in piping systems outside of the traditional inspection scope.

Fleetwide Benefits

Entergy has applied the streamlined approach, with NRC approval, at the Grand Gulf and River Bend boiling water reactor (BWR) plants, and at the Waterford and Arkansas Nuclear One pressurized water reactor (PWR) plants, and has applications underway at Pilgrim (BWR) and Indian Point (PWR). Dominion has applied the streamlined approach with NRC approval at North Anna Units 1 and 2 (PWR) and has an application for Millstone Unit 2 (PWR) in review with the NRC. Dominion also plans to convert Surry Units 1 and 2 (PWR) to RIS_B programs.

Applying the streamlined RIS_B methodology has enabled Entergy and Dominion to perform in-service inspections with fewer resources than required for RI-ISI, and with fewer maintenance requirements.

Related Work

EPRI is working with several plants to support conversion from traditional RI-ISI programs to the streamlined approach as well as to understand its applicability to plants that do not currently use ASME Section XI as their base ISI program (for example, the international fleet).

In addition, EPRI is working with other stakeholders to investigate the feasibility of adapting risk-informed methodologies to the procurement of components for future nuclear power plants, and for pre-service and in-service inspections of new plants. Efforts to date have not only shown the viability of these risk-informed approaches, but are identifying processes for cost-effective implementation.

Contact: Patrick O'Regan, Electric Power Research Institute, telephone: (508) 497-5045, email: PORegan@epri.com. ■

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Reducing AOA Risk

By Electric Power Research Institute.

Concerned that a series of planned projects might increase susceptibility to axial offset anomaly (AOA) at its Ulchin Units 1 and 2 pressurized water reactors (PWRs), Korea Hydro & Nuclear Power (KHNP) applied a set of EPRI tools to assess and reduce AOA risk.

Applying the EPRI tools—PWR Axial Offset Anomaly Guidelines, Boron-Induced Offset Anomaly (BOA) Risk Assessment Tool, and ultrasonic fuel cleaning—enabled KHNP to:

- Evaluate and manage AOA risk.
- Prevent power reductions or trips caused by AOA, saving an estimated \$2.4 million per year.
- Avoid the introduction of additional fresh fuel assemblies to moderate AOA risk, saving \$0.5 million to \$2 million and reduce outsourcing costs related to AOA risk assessments, saving \$0.2 million per project.

Avoiding a Costly, Complex Problem

Also called crud-induced power shift, AOA is a complex phenomenon that causes uneven power distribution in PWR cores due to the buildup of corrosion products and boron on fuel rod surfaces. AOA can affect many aspects of plant operation, including core reactivity and shutdown margin, fuel performance, chemistry, and power generation. The economic impact can range from tens of thousands to tens of millions of dollars. Plants with AO have also experienced significant activated corrosion product (crud) releases during outages, which have led to elevated radiation fields and increased worker dose.

Several planned projects at Ulchin had the potential to increase AOA susceptibility; steam generator replacement, power uprates, and the introduction of a new fuel design. Details are:

- New steam generator tubing surfaces release corrosion products at

an elevated rate early in life that can deposit on fuel cladding. The corrosion products provide a matrix to concentrate boron, which is added to the coolant to control reactivity. An asymmetrical accumulation of boron on the fuel rods can result in uneven power distribution and cause AOA.

- Power uprates can increase susceptibility to AOA by promoting a phenomenon called subcooled nucleate boiling, which accelerates the deposition of corrosion products.
- Similarly, a new fuel design results in a mixed core of different fuel assemblies, which may alter thermal hydraulic conditions and elevate subcooled boiling in some assemblies.

KHNP needed to assess whether these projects would increase crud deposition and lead to AOA. To perform the assessment, the utility applied tools developed by EPRI's Fuel Reliability Program.

Knowledge, Tools, and Training to Manage AOA

The Fuel Reliability Program has conducted research and development on AOA since 1998, producing an array of products to help PWR plants assess and avoid this costly problem.

KHNP applied the following products to assess its AOA risk:

PWR Axial Offset Anomaly Guidelines. KHNP staff followed the recommendations in the PWR Axial Offset Anomaly Guidelines, Revision 1 (EPRI product 1008102), which provide PWR operators with information to understand, diagnose and monitor the progression of AOA. The guidelines include a decision-tree risk assessment process to help PWR plants avoid AOA when making changes in core design, reactor coolant chemistry, or plant components such as steam generators.

BOA Software. KHNP also applied the Boron-Induced Offset Anomaly Risk Assessment Tool Version 3.0 (EPRI product 1021227). BOA combines thermal hydraulics, thermodynamics, and chemistry into a single risk assessment tool designed to predict where and how much crud and boron will form in a proposed core design. Version 3.0, which KHNP used, introduced a new set of high-temperature thermodynamics to improve the model's predictive capabilities.

EPRI provided technical support to KHNP while applying the BOA methodology to its units. In addition, KHNP staff attended a two-day EPRI training course after BOA v3.0 was released in

December 2010. The technical support and training enabled KHNP to perform risk evaluations for the planned steam generator replacement, power uprates, and new fuel design at Ulchin 1 and 2. Before the BOA assessment, the increased AOA risk from steam generator replacement could not be estimated. BOA 3.0 estimated the AOA risk and justified the application of ultrasonic fuel cleaning to reduce AOA risk after the steam generator replacement. KHNP is planning to use BOA to assess the AOA risk associated with zinc injection, steam generator replacement and fuel design changes at all of its pressurized water reactors.

Ultrasonic Fuel Cleaning. The BOA risk evaluations strongly suggested increased susceptibility of developing AOA as a result of the planned changes. To mitigate the risk, KHNP applied another EPRI product, ultrasonic fuel cleaning, to remove crud deposits on the fuel rod surfaces.

Ultrasonic fuel cleaning involves inserting complete fuel assemblies into a special cleaning canister equipped with ultrasonic transducers. The sonic energy loosens crud particles from the fuel surfaces, transporting them through lines to filter banks for disposal. The process reduces the mass of corrosion products available to deposit on fuel surfaces during the next cycle. The EPRI-patented technology has been licensed to several service providers.

Results

EPRI guidelines, software, cleaning technology, and training enabled KHNP to evaluate and mitigate the risk of developing AOA, and thus avoid the costly consequences of this phenomenon.

Related Work

EPRI continues to expand the capabilities of the BOA software. One promising, and challenging, line of development involves modifying the code to monitor activation species such as Cobalt-58 during the operating cycle. Such a capability could support radiation management programs by identifying the location of elevated radiation fields during refueling outages that could affect worker exposure.

Contact: Dennis Hussey, Electric Power Research Institute, telephone: (650) 855-8529, email: dhussey@epri.com. ■

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Being Halfway...

Continued from page 27

probably tied to Fukushima upgrades for that project. So, the board is relatively understanding of the ballpark figures it's going to cost.

7. *Please provide an update on Browns Ferry.*

Browns Ferry has a "red finding" against it - a red finding, is a NRC term - we are in Column 4 of the NRC's Reactor Oversight Process, which is equivalent to a troubled plant. The issues with Browns Ferry started and were rooted in our fire protection processes. The nuclear industry responded to Appendix R regulation and in many cases, robustly implemented it. At Browns Ferry we did not robustly implement the Appendix R, but we did meet the letter of the law. As time has gone by, we gained more experience in the industry and as the regulators got more experienced around fire protection and the importance of fire protection programs, it became clear that how we were licensed is not as robust and as adequate as necessary. TVA was slow to adapt and put the proper rigor in place. During the last few years, we have been upgrading our fire protection systems. We've been working with the NRC and proactively and aggressively improving our fire protection systems at the plant. We have committed to something called the NFPA 805 process, which is an upgrade to the old Appendix R regulations and guides. We're firmly committed to that and we've already done many modifications to give us more margin and reduce risk at the station. So, it's a huge effort for us, but it is getting our systems upgraded. We've done other things that are important, we have put in brand new transformers in our units, put new digital voltage regulator systems in. We've put a lot of digital control systems. We've upgraded systems of plant materially. I think we're about two-thirds of the way through on the significant material condition improvements. So the last four years, we've been doing

major material condition improvements at the plant and fixing equipment that just wasn't working as well as it should. In the end, when we're done with this turnaround, the material condition of the asset is going to be strong and not only will we have more confidence in the operating equipment, it'll be more economical to the company because the plant will just run better. In nuclear you need to be all in, or you shouldn't really play in it. Being halfway in nuclear doesn't work very well.

8. *Concluding Comments.*

Excellent material condition of nuclear plants is job one. That affords us maximum safety for our workers and for the public that we serve. So, we are dedicated to fixing the plants materially and building on all the foundational programs and processes necessary to sustain it, so it's not just fixing it once. TVA has had cyclical performance of really good years and weak years. TVA at one time shut all the plants down in the past because of issues. I'm here to build the foundation so that that doesn't happen again. So we're going to have strong preventative maintenance programs with maintenance and testing frequencies established to keep equipment right where it needs to be. We're empowering our engineers to be owners of their systems and really engage and force management to keep them running right. And in the end, the plants will respond. Their machines, they do it. Essentially, people make them do it, so if you take care of them and run them properly, they'll respond. If you neglect them, they tend to not run as well. So, that's a big part.

We talked a little bit earlier about TVA's commitment to Fukushima corrective actions, which, is one where we're going to be a leader. We're absolutely going to do the right thing for our plants and for our communities and I'm confident I got the full support to do whatever it takes to increase our margins and reduce the risk and buy the appropriate equipment, and stage it properly. There's a real commitment from TVA to put this one behind us and gain confidence of the communities we serve, and we're not

going to skimp on it. We're all in, and I've had tremendous support, and I got a very large team mobilized at designing and building and procuring necessary equipment and how we're going to install it and how we're going to essentially ensure that next level of margin.

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Cable Aging Management Programs

By Electric Power Research Institute.

EPRI tools, technologies, and reference materials provide a consistent framework for cable program development, inspection, and condition assessment for cable system aging management.

All U.S. nuclear power plants and several non-U.S. plants are implementing cable aging management programs based on a strategic framework of knowledge, tools, and guidance developed by EPRI in response to regulatory and industry concerns.

The cable aging management programs have enabled nuclear power plants to:

- Identify cables in adverse environments.
- Apply applicable condition assessment tools.
- Identify cable degradation issues prior to in-use failure.
- Increase plant safety.
- Increase equipment reliability.
- Avoid unplanned plant downtime.

Aging Cables Raise Reliability Concerns

In 2009, the U.S. Nuclear Regulatory Commission (NRC) and industry leaders expressed concern that the aging of nuclear plant cables could lead to significant safety events or to long outages. Nuclear plants can contain 10,000 or more cable circuits, with a small but important set operating under adverse environments, including submergence, elevated temperature, or direct buried conditions. Under these harsh conditions, cable jackets and insulation may degrade over time, potentially to the point of failure. A single cable failure on a critical piece of equipment can result in lengthy and costly plant shutdowns. Nuclear plants have been out of service for up to several weeks due to the failure of a single critical electrical power cable circuit. Cable failures can also reduce safety margins if

This is an Electric Power Research Institute Success Story from August, 2012.

they cause the loss of an off-site electrical feed, emergency diesel generator, or an emergency cooling pump.

From mid-2009 into 2010, the NRC and industry worked on a Regulatory Issue Resolution Protocol pilot project on cable performance at nuclear plants. In parallel, EPRI began developing implementation guidance for nuclear plant cable aging management programs to ensure that cable systems will perform their intended design function when called upon.

Over Two Decades of Cable Aging R&D

Nuclear plant electrical cables have been a focus of EPRI research and development since 1985. One recent area of note is the forensic analysis of cables removed from plants after failure, which has provided a solid foundation of understanding of degradation mechanisms for ethylene propylene rubber, a key insulation type used in nuclear power plants. In turn, this knowledge has supported the refinement of condition assessment testing methodologies and acceptance criteria for the various vintages and designs of electrical cable.

EPRI's cable R&D has resulted in a wealth of cable-related reference materials and tools, including:

- Indenter modulus testing methodology, an in-plant nondestructive test for assessing aging (hardening) of electrical cable jackets and insulation due to thermal and radiation damage.
- Visual/tactile assessment methodology, which facilitates the screening of cables that have not aged from those that have aged significantly.
- Cable Polymer Aging Database, which contains cable insulation and jacket aging data from a number of U.S. and international research laboratories.

EPRI also has independently evaluated and demonstrated commercial diagnostic techniques, such as line resonance analysis (LIRA) testing to detect cable degradation.

Guidance for Cable Aging Management

EPRI has used these cable R&D results to develop aging management strategies for three classes of nuclear plant

(Continued on page 52)

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Cable Aging...

Continued from page 51

cables: low-voltage instrumentation and control cables, low-voltage power cables (less than 1 kV), and medium-voltage cables (4 to 45 kV). The guidance reports define a scoping process for determining which cables to assess, as well as test methodologies and acceptance criteria for classifying cable circuits as “good,” “further study required,” or “action required.”

Results

All U.S. nuclear power plants and several non-U.S. plants have started implementing cable aging management programs based on the EPRI implementation guidance and its large body of cable research products. The industry’s rapid response to cable aging concerns has resulted in increased plant safety and equipment reliability. More than 700 individual medium-voltage phase cables have been tested to date. Of those, 24 circuits required repair or replacement. The identification and

resolution of these problems has restored the integrity and strength of the electrical cable systems.

Cable inspections performed with EPRI guidance, tools, and techniques are identifying cable degradation issues prior to in-service failure, enabling plants to determine whether to replace a cable or to repair it and keep it in service. Field inspections of cable systems based on EPRI guidance show that most cable systems are not experiencing significant aging even in adverse environments. However, numerous adverse environmental conditions that potentially accelerate aging are being identified and corrected.

User Group and Training

EPRI sponsors a Cable User Group that provides a forum for exchanging information on cable aging management and for transferring research results to the field. Feedback from Cable User Group meetings helps guide research on aging and condition monitoring. EPRI

also offers a training course on cable aging management, and is developing computer-based training packages that will describe cable management methods and technology.

Ongoing and Future Work

Cable aging management is an evolving process. EPRI is assessing whether a submergence qualification program could provide the necessary technical data to inform decisions on the continued use of medium-voltage cables that have been submerged continuously or for long durations.

The Cable User Group is beginning to examine aging management in the context of very long-term operation, potentially out to 60 or 80 years and beyond.

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Research &...

Continued from page 17

empirical predictive model for the dose reduction benefit of zinc addition.

Contact: Rick Reid, telephone: (704) 595-2770, email: rreid@epri.com.

Low-Level Waste

Potential modifications to regulatory treatment of low-level waste concentration averaging and encapsulation could facilitate a risk-informed regulatory approach to utility waste management practices and expand the availability of disposal options. EPRI research – including a summary report issued in late May, 2012 (EPRI Product 1025302) – is contributing to the technical basis that will inform regulatory decisions in this area.

The changes being considered by the U.S. Nuclear Regulatory Commission (NRC) intend to balance the risks and

benefits of low-level waste disposal with the potential hazard to an inadvertent intruder following disposal site closure, while concurrently reducing radiation dose to workers, minimizing the need for on-site storage of waste, and minimizing the creation of orphaned wastes.

The final draft revision of the NRC’s Branch Technical Position (BTP) incorporates a number of recommendations that EPRI has provided in recent years related to the safe disposal of low-level waste, concerning topics such as concentration averaging restrictions, treatment of dewatered cartridge filters, and the difference between activated metals and sealed sources. The benefits associated with these recommendations could be significant. If the BTP draft were to be implemented at U.S. nuclear plants as currently written, an EPRI analysis indicates that 66% of Class B/C wet waste from pressurized water reactors and 90% of Class B/C wet waste from boiling water reactors could be disposed of as Class A.

This reduction in B/C waste generation could result in more than \$20 million in annual U. S. disposal cost savings.

EPRI research also has been important in informing the consideration of inadvertent intruder scenarios by demonstrating that cartridge filters in the disposal site do not pose a long-term gamma source risk to an inadvertent intruder.

NRC issued the final draft of the BTP in June 2012, with a 120-day comment period. Comments are due by October 8, 2012 and the NRC plans to issue the final BTP revision in early 2013. EPRI will begin developing implementation guidance in 2013 to enable continued safe disposal of low-level waste at reduced cost.

Contact: Bill Cox, telephone: (603) 583-2877, email: bcox@epri.com.

Source: Electric Power Research Institute’s (EPRI) Nuclear Executive Update, July, 2012. ■

Right at Home in Oswego

By Tammy Holden, Entergy Nuclear.

Tammy Holden

Tammy Holden is the communications specialist for Entergy's James A. FitzPatrick Nuclear Power Plant located in Oswego, New York. Holden is a 22-year employee at FitzPatrick. In her role she fulfills all public relations responsibilities, coordinates internal communications and is the chair of the site contributions committee in support of the Oswego regional community and volunteer activities. Holden serves on the board of the local Habitat for Humanity chapter and is a graduate of the Leadership Oswego County program sponsored by the Center for Business and Community Programs, Oswego State University.



James A. FitzPatrick Nuclear Power Plant is located in Oswego, N.Y. on the southeast shore of Lake Ontario in the town of Scriba.

On July 28, 1975, FitzPatrick began commercial operations. Together FitzPatrick and Entergy's Indian Point Energy Center along with three other nuclear reactors operating in the state of New York provide approximately 29 percent of the total energy demand of New York State.

FitzPatrick is a boiling water reactor, General Electric, producing 838 megawatts. FitzPatrick employs approximately 650 people with an annual payroll (salary and benefits) of about \$78 million. The FitzPatrick license expiration date is October 17, 2034.

FitzPatrick Fast Facts

- Entergy purchased the James A. FitzPatrick Nuclear Power Plant from the New York Power Authority in November 2000.
- In 2002, FitzPatrick employees exceeded 6.5 million labor-hours without a lost-time occurrence, setting a site record.
- In 2007, FitzPatrick was honored with a Nuclear Energy Institute's Top Industry Practice Award for utilizing a remote-operated, self-propelled submersible technology for delivery of tooling for vessel-weld examinations.
- In September 2008, the NRC issued a renewed license to James A. FitzPatrick Nuclear Power Plant. The expiration date is October 2034.
- 2010 was a stellar performance year: FitzPatrick entered its refueling outage following a breaker-to-

breaker run of 702 days of safe, continuous operation, its longest ever; this was the seventh longest run of any boiling water reactor unit in U.S. history.

- Currently, FitzPatrick is operating in its second longest run of safe, continuous operation as the station prepares to enter its twentieth refueling outage this fall.

Entergy's FitzPatrick continues to light the way for a brighter future by investing in its communities and supporting its neighbors through employee volunteerism and financial contributions. FitzPatrick employees provide time and talent for efforts that are important to their local communities. The FitzPatrick volunteer force is more than 650 people strong and dedicated to making a difference locally. Plant programs and initiatives instill employee pride, build public trust and foster education while responding to community needs.

Major community initiatives include being a primary sponsor for the Oswego Harborfest where more than 200,000 gather in July, get the latest nuclear education information and enjoy the Entergy-sponsored world-class Fireworks by Grucci, one of the top-rated displays nationally. Other areas of support include Habitat for Humanity, Leadership Oswego County, Oswego County Soil and Water Conservation, Project Smart and the Syracuse Rescue Mission.

FitzPatrick: People are the foundation of our success

The FitzPatrick mission focuses on employees as the foundation of FitzPatrick's success in achieving industry-leading performance. Together, the team focuses on the safe and reliable generation of electricity. Areas that FitzPatrick continuously emphasizes are standards of excellence, development of people, equipment reliability and refueling outage performance.

"Our strength is our people. Attracting and retaining the best talent while

(Continued on page 54)

Right at Home...

Continued from page 53

developing leaders of tomorrow makes us a stronger organization," states Site Vice President Mike Colomb. "Individual commitment and strong teamwork are key factors in our ability to be successful."

Employee groups also provide networking and support for community activities. The North American-Young Generation in Nuclear and Women in Nuclear groups work together to support local schools as mentors in the classrooms, with participation in high school career expos and through interaction with students through Project Smart. Project Smart promotes science, technology, engineering and math curricula at all grade levels.

Active, too, is the FitzPatrick Diversity and Inclusion Council fostering a professional environment of mutual respect, acceptance and open contribution. Initiatives include an "On Your Own Time" art show that showcases employees' talents, lunch-and-learn webinars and participation in Entergy Diversity Summits.

FitzPatrick since Fukushima

Over the past year, Entergy has taken a leading role in assisting the understanding and response to the events at Fukushima at an industry level. In addition to sharing our technical expertise with the industry to compile and review safety capabilities of certain U.S. plant designs, all Entergy plants – including FitzPatrick – have undergone extensive walk-downs and procedure reviews that validate our ability to respond during a disaster.

To further strengthen our emergency capabilities, all Entergy Nuclear plants

Michael Colomb

Mike Colomb was named site vice president in November 2011 for Entergy's James A. FitzPatrick Nuclear Power Station located in Oswego, N.Y. As site vice president, Colomb is

responsible for safe and efficient plant operation including the direction, management, performance and profitability of the plant.

He held a Reactor Operator license at the Fitzpatrick plant and Senior Reactor Operator licenses at both units at the Nine Mile Point Nuclear Generating Station.

Colomb earned an Associate Degree of Applied Science in Electrical Technology from Onondaga Community College, a Bachelor of Science degree in Mechanical Engineering Technology from Rochester Institute of Technology, and a Masters of Business Administration from Syracuse University.



are ordering new equipment in 2012. While equipment needs vary from plant to plant, some of the new equipment will include additional diesel driven pumps, portable diesel generator sets, portable ventilation equipment, communications tools and other equipment.

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Mitigation Strategies...

Continued from page 45

assure the equipment will be functional.

3. In the absence of consensus standards specifically developed for these mitigating strategies, a licensee's conformance to consensus standards developed for similar emergency uses, such as those of the National Fire Protection Association for fire protection equipment, provides an acceptable method to reasonably assure the equipment will be functional.

7.0 Guidance for AP1000 Design

Appendix F of NEI 12-06 provides specific guidance for licensees with reactors of the AP1000 design on how to satisfy provisions of Order EA-12-049, Attachment 3, for the final phase (for sufficient offsite resources to sustain functions indefinitely).

Staff Position: The guidance of NEI 12-06, Appendix F, provides an acceptable means to meet the requirements of Order EA-12-049 or license conditions imposing similar requirements.

References

A. Order EA 12-029, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736.

B. Nuclear Energy Institute document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, August 21, 2012 (ADAMS) Accession NO. ML12242A378. ■

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