

Nuclear News

A PUBLICATION OF THE AMERICAN NUCLEAR SOCIETY

August 2014

20th Annual Vendor/ Contractor Profile Issue

Special Section begins on page 48

Also in this issue

Report on the 2014 ANS Annual Meeting—
The Global Nuclear Energy Enterprise:
A Changing Landscape p. 149



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NUCLEAR PLANTS



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Left: Main control room of an advanced nuclear power plant Upper right: State-of-the-art nuclear power plant under construction Lower right: One of the world's largest nuclear power turbines

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¹ As of January 2011 ² When compared to the same amount of energy, 110 GW, if produced by conventional coal-fired thermal plants. Annual CO₂ reduction per 1.35 GW nuclear power plant is calculated at 9 million tons.



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PWR: AP1000™

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1000 YEARS OF ENERGY

Toshiba's Nuclear Energy Technology – Focused on the future



20th Annual Vendor/ Contractor Profile Special Section

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Coming up ...

October—Special Section on Nuclear Power Plant Maintenance (See insert, page 26A)

December—Special Section on Advanced Reactors

Members: View Nuclear News online!

At <www.ans.org>, click on Member Center at the upper right of your screen. Log in with your user name (member ID#) and password (last name, all lowercase, or your selected password). Click on the heading for the current issue of *Nuclear News*.

TWENTIETH ANNUAL VENDOR/CONTRACTOR PROFILE SPECIAL SECTION

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SPECIAL REPORT: 2014 ANS ANNUAL MEETING

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The global nuclear energy enterprise: A changing landscape	149
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POWER

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NRC's new-reactor oversight process won't be very "qualitative." Final safety evaluation report for Watts Bar-2 now expected in October. TVA says peak maximum flood levels at Sequoyah and Watts Bar are higher than previous analyses found, but safety equipment would not be affected. SCE&G requests license amendment for Summer -2 and -3 to allow change to condensate return. NRC's annual reactor fee up 19 percent in FY 2014. NRC projects that draft design-specific review standard for NuScale reactor will be issued next year. Renaissance Watch: An update on developments that may lead to new power reactors. NRC cites Wolf Creek for emergency preparedness violations. STARS plans to submit only one more license renewal application. NRC asks Advisory Committee on Reactor Safeguards to waive further review of ESBWR design certification application; other licensing developments. NRC returns LaSalle -2 to standard oversight status.

SECURITY

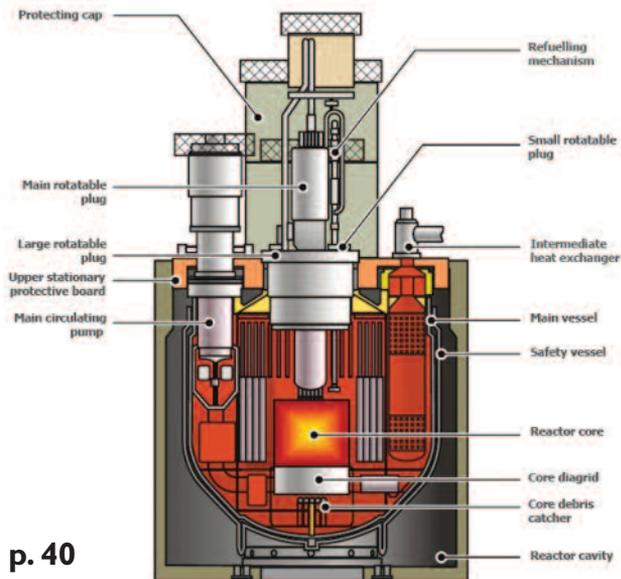
34

Consolidated Nuclear Security is new operating contractor for Y-12 and the Pantex Plant; other NNSA news. NRC revises guidelines on firearms use by plant security personnel. NRC submits annual security report to Congress. Japan is 77th nation to sign the amendment to the Convention on the Physical Protection of Nuclear Material.

INTERNATIONAL

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Toshiba, GDF Suez close deal to build three AP1000 reactors in the United Kingdom. U.K. government to take control of foreign plutonium. Graphite loss limit relaxed at the United Kingdom's Dungeness B. Russia's Beloyarsk BN-800 fast reactor goes critical. India accepts stronger IAEA safeguards inspections. Amendment to the European Union's Nuclear Safety Directive approved.



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WASTE MANAGEMENT 44

Los Alamos National Laboratory admits to errors in processing of nuclear waste sent to WIPP. DOE cites contractor for worker safety violations at the Portsmouth Gaseous Diffusion Plant. Mallinckrodt asks NRC to reduce financial assurance ceiling for decommissioning project. NRC to complete Yucca Mountain safety evaluation report first, then the environmental impact statement.

INDUSTRY 171

Westinghouse to acquire Mangiarotti; other business developments. Ribbon-cutting ceremony held at Lockheed Martin's new facility in Texas. Babcock & Wilcox receives multiyear contract from Dominion Generation; other news. Issues with actuators, component irradiation reported under 10 CFR Part 21.

FUEL 185

Alliance Resources proposes sale of its 25 percent stake in Four Mile Project. Energy Fuels to sell Piñon Ridge project; other business developments. Dropped container results in contamination event at Nuclear Fuel Services' fuel fabrication facility.

STANDARDS & DOCUMENTATION 187

NRC issues supplemental staff guidance on post-Fukushima orders, other documents.

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Texts of most *Nuclear News* articles are available on the LexisNexis database, from Mead Data Corporation.



What happened to the dog days?



Senior Editor E. Michael Blake came into my office the other day to add another piece of Late News copy to the in-box on my desk. “Is there an opposite of ‘the dog days?’” he asked, referring to what are usually, at this time of year, slow news days. “‘Cat nights,’ maybe?” And although “cat nights” makes pretty much no sense, we laughed, and Mike proceeded to fill me in on the uncharacteristic number of hot news stories that kept breaking, repeatedly bumping what we thought would be the lead story in the August issue’s Late News section.

What ultimately qualified as the number-one item was the comment by Southern Company’s chief executive officer, Tom Fanning, about a possible announcement later this year of an additional new nuclear power plant in the utility’s service area. This would certainly be a welcome piece of news, especially considering the plant closings announced and pending in 2013 and 2014.

Other breaking news included tentative approval from Japan’s Nuclear Regulation Authority for the restart of Kyushu Electric Power Company’s Sendai-1 and -2, the first power reactors in Japan determined to have satisfied the upgraded safety standards put in place following the Fukushima Daiichi disaster; the naming of two individuals by President Barack Obama as nominees to fill the Nuclear Regulatory Commission positions being vacated by George Apostolakis and William Magwood; a four-month extension of talks between Iran and the E3+3 countries under the Joint Plan of Action to ensure that Iran’s nuclear program will be peaceful; and the NRC staff’s completion of the spent fuel rule (what has until now been called “waste confidence,” now to be known as “continued storage of spent nuclear fuel”). And those are just a few of the news stories in the Late News section, which begins on page 17.

In uncharacteristic fashion, the news has not shown evidence of letting up during what is usually a slower time of the year.

Also in this issue is a report on the ANS Annual Meeting, held June 15–19 in Reno, Nev. With the overall meeting theme “The U.S. Role in a Global Nuclear Energy Enterprise,” the opening plenary session of the meeting departed somewhat from the usual format, considering that the majority of it consisted of questions and answers, and all of the questions except for the first one posed to each of the panelists were collected from the audience after the session began. And good questions they were, with the panelists providing informative, thoughtful answers. Other session topics covered in the report include small modular reactors, a look back over ANS’s 60 years, reactor construction worldwide, plutonium disposition issues, and communicating with the public and with policy makers. Coverage of the Decommissioning and Remote Systems and Advances in Thermal Hydraulics topical meetings is also part of the report.

And it must be August, as this issue contains the 20th Vendor/Contractor Profile Special Section. Starting on pages 48–49 with a complete index to the 68 advertisers included in the section (six are new this year), the section includes a free half- or full-page space (depending on the size of the advertiser’s paid ad) for each company to provide a profile highlighting the products and services it offers. Our thanks go once again to our advertisers, those that are loyal long-timers and those that are new to the pages of *Nuclear News*, whether their ads appear in the special section or outside of it. We sincerely appreciate your support.

Whether we are in the midst of the dog days or the “cat nights,” we aim to bring you the news, features, and meeting reports—and information on the latest offerings from our advertisers—that will provide you with insights into what’s happening in the area of nuclear science and technology.—*Betsy Tompkins, Editor and Publisher*

h

Field Report

Topic | **Engineering**

Location | **North America**



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August

Aug. 19–21 **EPRI Procurement Forum**, Clearwater Beach, Fla. Sponsored by the Electric Power Research Institute. Contact: Lynette Evans, EPRI, phone 704/595-2548; e-mail <aevans@epri.com>; web <www.epri.com>.

Aug. 24–28 **8th International Conference on Isotopes and Expo (8ICI)**, Chicago, Ill. Organized by the American Nuclear Society and the World Council on Isotopes. Contact: Paul Dickman, Argonne National Laboratory, phone 703/489-1591; e-mail <pdickman@anl.gov>; web <www.8ici.org>. ■

Aug. 24–28 **19th Pacific Basin Nuclear Conference (PBNC-19)**, Vancouver, British Columbia, Canada. Hosted by the Canadian Nuclear Society, the Canadian Nuclear Association, and Natural Resources Canada. Contact: CNS-SNC, phone 416/977-7620; fax 416/977-8131; e-mail <cns-snc@on.aibn.com>; web <www.pbnc2014.org>.

Aug. 24–28 **International Symposium on Future I&C for Nuclear Power Plants and International Symposium on Symbiotic Nuclear Power Systems (ISOFIC/ISSNP 2014)**, Jeju, South Korea. Organized by the Korea Nuclear Society. Contact: Gee Yong Park, phone/fax +82 42 868 4653; e-mail <isofic2014@gmail.com>; web <www.isofic.org/>.

Aug. 27–31 **11th Congress of the World Federation of Nuclear Medicine and Biology (WFNMB 2014)**, Cancún, Mexico. Organized by BP Servimed. Contact: Wendy Arrellano, BP Servimed, phone +52 55 9171 9570, ext. 104; e-mail <wfnmb@servimed.com.mx>; web <http://php.servimed.com.mx/wfnmb14/welcome.html>.

Aug. 28–30 **International Nuclear Science and Technology Conference (INST2014)**, Bangkok, Thailand. Hosted by the Thailand Institute of Nuclear Technology. Contact: Wannipa Phianphak, phone +66 2 401 9889, ext. 6300; e-mail <inst2014@gmail.com>; web <www.inst-th.com>.

Aug. 31–Sept. 7 **Zakopane Conference on Nuclear Physics**, Zakopane, Poland. Organized by the Polish Academy of Sciences' Henryk Niewodniczański Institute of Nuclear Physics. Contact: Zakopane Conference on Nuclear Physics, phone +48 12 662 82 02; fax +48 12 662 84 23; e-mail <zakopane@ifj.edu.pl>; web <http://zakopane2014.ifj.edu.pl/>.

● First time listed, or significant change made.

■ ANS event.

□ Non-ANS event cosponsored by ANS.

Meetings listed in the Calendar that are not sponsored by ANS do not have the endorsement of ANS, nor does ANS have financial or legal responsibility for these meetings.

September

Sept. 1–4 **2nd International Conference on Technological Innovations in Nuclear Civil Engineering (TINCE 2014)**, Paris, France. Organized by the French Nuclear Energy Society (SFEN) Civil Engineering Nuclear Architecture Technical Section. Contact: Patricia Hamel-Bloch, SFEN, e-mail <patricia.hamel-bloch@sfen.org>; web <www.sfen.fr/tince-2014>.

Sept. 2–5 **8th Annual RadWaste Summit**, Las Vegas, Nev. Organized by ExchangeMonitor Publications & Forums. Contact: Nicole Mattar, ExchangeMonitor, phone 877/303-7367, ext. 109; fax 202/296-2805; e-mail <forums@exchangemonitor.com>; web <www.radwastesummit.com>.

Sept. 3–5 **27th Spent Fuel Workshop 2014**, Karlsruhe, Germany. Organized by the Joint Research Centre's Institute for Transuranium Elements (JRC-ITU) and the Karlsruhe Institute of Technology's Institute for Nuclear Waste Disposal. Contact: Paul Carbol, JRC-ITU, phone +49 7247 951 178; e-mail <paul.carbol@ec.europa.eu>; web <http://itu.jrc.ec.europa.eu/index.php?id=539&type=0>.

Sept. 7–12 **3rd International Conference on Radioecology and Environmental Radioactivity**, Barcelona, Spain. Organized by the Norwegian Radiation Protection Authority and the Institut de Radioprotection et de Sûreté Nucléaire. Contact: Grupo Pacifico, phone +34 902 103 496; fax +34 93 238 74 88; e-mail <icrer2014@pacifico-meetings.com>; web <http://radioactivity2014.pacifico-meetings.com/>.

Sept. 7–12 **Plutonium Futures—The Science 2014**, Las Vegas, Nev. Sponsored by the ANS Materials Science & Technology Division. Contact: Kerri Blobaum, Lawrence Livermore National Laboratory, phone 925/422-3289; e-mail <blobaum1@llnl.gov>; web <http://pu.ans.org/>. ■

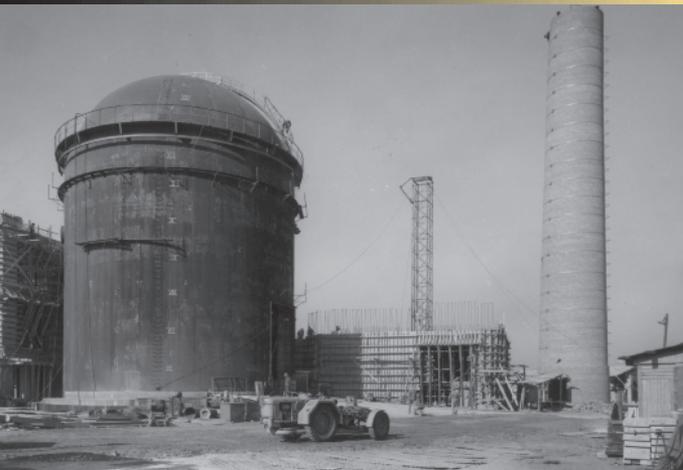
Sept. 8–11 **23rd International Conference on Nuclear Energy for New Europe (NENE 2014)**, Portorož, Slovenia. Sponsored by the Nuclear Society of Slovenia. Contact: NENE 2014, phone +386 1 588 53 02; fax +386 1 588 53 76; e-mail <nene2014@ijs.si>; web <www.nss.si/nene2014/>.

Sept. 10–12 **WNA Symposium 2014**, London, England. Organized by the World Nuclear Association. Contact: Julia Deere, WNA, phone +44 0 20 7451 1521; e-mail <events@world-nuclear.org>; web <www.wna-symposium.org/>.

Sept. 13–17 **4th African Regional International Radiation Protection Association Congress (AFRIRPA04)**, Rabat, Morocco. Sponsored by the Moroccan Association of Radiation Protection (AMR). Contact: Khalid Talsmat, AMR, e-mail <afrirpa04secretariat@gmail.com>; web <http://afrirpa04.com/>.

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From the First Generation
of nuclear power...

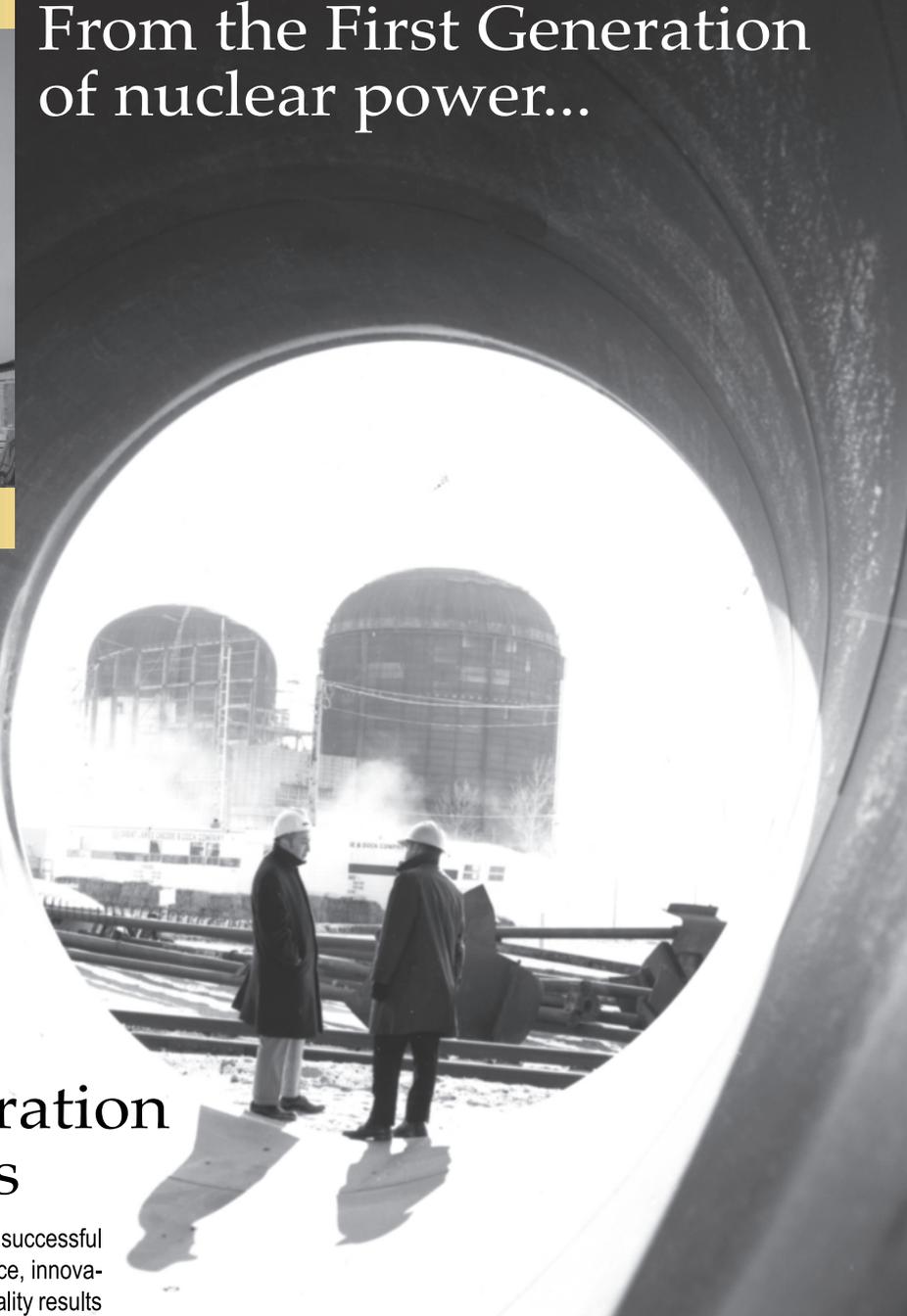


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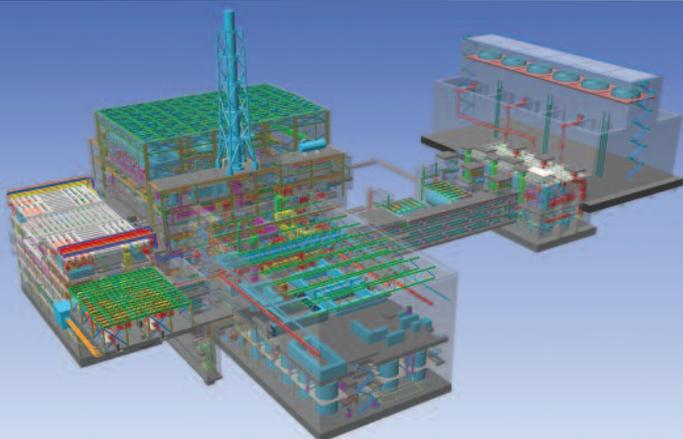
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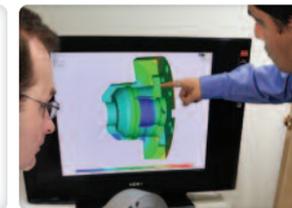
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Continued from page 6

Sept. 14–17 **2014 Water Reactor Fuel Performance Meeting/Top Fuel/LWR Fuel Performance Meeting (WRFPM2014)**, Sendai, Japan. Sponsored by the Atomic Energy Society of Japan and cosponsored by ANS and others. Contact: AESJ, e-mail <wrfpm2014@aesj.or.jp>; web <http://web.apollon.nta.co.jp/wrfpm2014/index.html>. □

Sept. 14–18 **18th Topical Meeting of the Radiation Protection & Shielding Division of ANS (RPSD 2014)**, Knoxville, Tenn. Organized by the ANS Oak Ridge/Knoxville Local Section. Contact: Larry Townsend, University of Tennessee, phone 865/974-7569; e-mail <ltownsen@utk.edu>; web <www.rpsd2014.org/>. ■

Sept. 14–18 **International Symposium on the Contribution of Materials Investigations and Operating Experience to LWRs' Safety, Performance, and Reliability (Fontevraud 8)**, Avignon, France. Organized by the French Nuclear Energy Society (SFEN) Materials NDT Chemistry Technical Section. Contact: Patricia Hamel-Bloch, SFEN, phone +33 1 53 58 32 12; e-mail <phamel-bloch@sfen.fr>; web <www.sfen.fr/fontevraud-8>.

Sept. 14–19 **4th International Nuclear Chemistry Congress (4th INCC)**, São Paulo, Brazil. Organized by Acqua Consultoria and cosponsored by ANS and others. Contact: Acqua Consultoria, phone/fax +55 11 3868 0726; e-mail <4thincc@acquacon.com.br>; web <www.acquacon.com.br/4thincc/>. □

Sept. 17–18 **Best Practice Workshop on the End of Life Management of Radioactive Sources**, Paris, France. Organized by the World Institute for Nuclear Security, with GIP Sources HA. Contact: Jadallah Hammal, WINS, phone +43 1 23060 6086; e-mail <jadallah.hammal@wins.org>; web <www.wins.org/index.php?article_id=114>.

Sept. 17–19 **Source Term and Radiation Field Reduction Workshop 2014**, Charlotte, N.C. Sponsored by the Electric Power Research Institute. Contact: Jennifer Kern, EPRI, phone 704/595-2516; e-mail <jkern@epri.com>; web <www.epri.com>. ●

Sept. 17–19 **12th International Symposium on Nuclear and Environmental Radiochemical Analysis (ERA12)**, Bath, England. Organized by the Radiochemistry Group of the Royal Society of Chemistry. Contact: Claire Lowe, ERA12, phone +44 0 1509 222581; fax +44 0 1509 223925; e-mail <c.l.lowe@lboro.ac.uk>; web <www.rsc.org/Membership/Networking/InterestGroups/Radiochemistry/ERA12/?CFID=1909245&CFTOKEN=bdf7a4935725ee1c-2D57D3EA-E22D-C737-B43226917114A832>.

Sept. 18–19 **2nd Asian Nuclear Fuel Conference (ANFC2014)**, Sendai, Japan. Sponsored by the Atomic Energy Society of Japan and Tohoku University's Institute for Materials Research. Contact: Masahiko Osaka, Japan Atomic Energy Agency, e-mail <anfc2014@res.tagen.tohoku.ac.jp>; web <http://res.tagen.tohoku.ac.jp/~anfc2014/>.

Sept. 21–24 **Fire Protection Information Forum**, Milwaukee, Wis. Sponsored by the Nuclear Energy Institute. Contact: Conference Registrar, phone 202/739-8039; e-mail <registrar@nei.org>; web <www.nei.org>.

Sept. 21–24 **International Conference on Development and Applications of Nuclear Technologies (NUTECH-2014)**, Warsaw, Poland. Organized by the Institute of Nuclear Chemistry and Technology, the AGH University of Science and Technology, and others. Contact: Mazurkas Congress & Conference, phone +48 22 389 41 50; fax +48 22 536 46 10; e-mail <info@nutech2014.com>; web <http://nutech2014.com/>.

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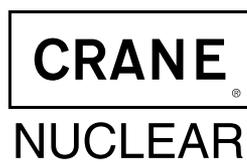
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Sept. 21–26 **5th Joint International Conference on Hyperfine Interactions and Symposium on Nuclear Quadrupole Interactions 2014 (HFI/NQI 2014)**, Canberra, Australia. Presented by the University of New South Wales and the Australian National University. Contact: Barry Neame, Consec, phone +61 2 6251 0675; fax +61 2 6251 0672; e-mail <hfinqi2014@consec.com.au>; web <www.hfinqi.consec.com.au/>.

Sept. 22–26 **58th IAEA General Conference**, Vienna, Austria. Organized by the International Atomic Energy Agency. Contact: IAEA, phone +43 1 2600 0; fax +43 1 2600 7; e-mail <official.mail@iaea.org>; web <http://www-pub.iaea.org/iaeaemeetings/46100/general-conference>.

Sept. 23–24 **Scientific Forum on Radioactive Waste: Meeting the Challenge—Science and Technology for Safe and Sustainable Solutions**, Vienna, Austria. Sponsored by the International Atomic Energy Agency. Contact: Julie Zellinger, IAEA, phone +43 1 2600 21321; fax +43 1 2600 7; e-mail <scientificforum2014@iaea.org>; web <http://www-pub.iaea.org/iaeaemeetings/2014>.

Sept. 23–25 **IAEA Scientific Forum**, Vienna, Austria. Organized by the International Atomic Energy Agency. Contact: IAEA, phone +43 1 2600 0; fax +43 1 2600 7; e-mail <official.mail@iaea.org>; web <http://www-pub.iaea.org/iaeaemeetings/46089/scientific-forum>.

Sept. 23–25 **Steam Generator Secondary Side Management Conference 2014**, Baltimore, Md. Sponsored by the Electric Power Research Institute. Contact: Jennifer Kern, EPRI, phone 704/595-2516; e-mail <jkern@epri.com>; web <www.epri.com>.

Sept. 23–26 **9th International Symposium on the Natural Radiation Environment (NRE-IX)**, Hirosaki, Japan. Organized by Hi-

rosaki University, the University of Salzburg, and the National Institute of Radiological Sciences. Contact: NRE-IX, e-mail <secretary@nre9.com>; web <www.nre9.com/>.

Sept. 23–26 **Nuclear Power for the People**, Chiflika Palace Resort and Spa, Bulgaria. Sponsored by the Bulgarian Nuclear Society, with the Bulgarian Atomic Forum and others. Contact: Boryana Atanasova, Bulgarian Nuclear Society, phone +359 2 979 5565; e-mail <b_atanasova@irnne.bas.bg>; web <www.bgns.bg>.

Sept. 25 **UK in SMR; SMR in UK**, Manchester, England. Sponsored by the Nuclear Institute. Contact: NI, phone +44 0 203 475 4701; e-mail <events@nuclearinst.com>; web <www.nuclearinst.com>. ●

Sept. 28–Oct. 3 **PHYSOR 2014 International Conference: The Role of Reactor Physics toward a Sustainable Future**, Kyoto, Japan. Sponsored by the ANS Reactor Physics Division and others. Contact: Ken Nakajima, Kyoto University Research Reactor Institute, e-mail <nakajima@rri.kyoto-u.ac.jp>; or Shigeaki Okajima, Japan Atomic Energy Agency, e-mail <okajima.shigeaki@jaea.go.jp>; web <http://physor2014.org/>. □

Sept. 29–Oct. 1 **WINS Best Practice Workshop on Understanding and Mitigating the Insider Threat**, Vienna, Austria. Sponsored by the World Institute for Nuclear Security. Contact: Jadallah Hammal, WINS, phone +43 1 23060 6086; e-mail <jadallah.hammal@wins.org>; web <www.amacad.org/content.aspx?i=591>. ●

Sept. 29–Oct. 3 **9th International Conference on Nuclear Physics at Storage Rings (STORI '14)**, Sankt Goar, Germany. Contact: GSI Helmholtzzentrum für Schwerionenforschung GmbH, e-mail <stori14@gsi.de>; web <http://stori14.gsi.de>.

Continued



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14_412

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Sandia is seeking a company or companies interested in partnering opportunities leading to improvements in operations and safety of new small modular nuclear reactors. Partnerships may take the form of Cooperative Research & Development Agreements (**CRADA**), or Work for Others (**WFO**) agreements.

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(Potential partners must have a significant interest in developing this technology since the CRADA or WFO is expected to include funds-in to Sandia from the partner. See Federal Business Opportunity 14_412).

Interested companies are preferred but not required to have experience and expertise in one or more of the following areas:

- Nuclear system design, including:
 - Physical security systems.
 - Safeguards methodologies.
 - Safety systems.
 - Operations.
 - Cyber security.
 - Emergency planning.
 - Nuclear power plant licensing.
- Nuclear power plant construction.
- Nuclear power plant operations.



For registration or further information please contact:

Bobby Middleton via email at bmiddle@sandia.gov
or Suzette Srader at sgsrade@sandia.gov.

Sept. 30–Oct. 1 **EPRI Japan Technology Seminar & Workshop**, Tokyo, Japan. Sponsored by the Electric Power Research Institute. Contact: Tracy Wilson, EPRI, phone 704/595-2543; e-mail <trwilson@epri.com>; web <www.epri.com>.

October

Oct. 13–16 **Atoms for the Future 2014**, Paris, France. Sponsored by the Société Française d'Énergie Nucléaire (SFEN). Contact: SFEN, e-mail <atomsforthefuture@sfenjg.org>; web <www.sfen.fr/atoms-for-the-future/>.

Oct. 13–18 **25th Fusion Energy Conference (FEC 2014)**, Saint Petersburg, Russia. Organized by the International Atomic Energy Agency in cooperation with Rosatom. Contact: Karen Morrison, IAEA, phone +43 1 2600 21317; e-mail <k.morrison@iaea.org>; web <http://www-pub.iaea.org/iaeametings/2014>.

Oct. 14–16 **13th EPRI International Decommissioning and Radioactive Waste Management Workshop**, Brussels, Belgium. Sponsored by the Electric Power Research Institute, in collaboration with Electrabel. Contact: Linda Nelson, To Plan Ahead, phone 828/318-8428; e-mail <lnelson@toplanahead.com>; web <www.epri.com>.

Oct. 14–16 **World Nuclear Exhibition (WNE)**, Paris, France. Organized by Reed Expositions. Contact: Laurence Gaborieau, Reed Expositions, e-mail <laurence.gaborieau@reedexpo.fr>; web <www.world-nuclear-exhibition.com>.

Oct. 14–17 **2nd International Workshop on Perspectives on Nuclear Data for the Next Decade (P(ND)²)**, Bruyères-le-Châtel, France. Organized by the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), with the OECD Nuclear Energy Agency. Contact: Stephane Hilaire, CEA, phone +33 0 1 69 26 40 00; fax +33 0 1 69 26 70 63; e-mail <stephane.hilaire@cea.fr>; web <www.oecd-nea.org/science/meetings/pnd2/>.

Oct. 14–17 **7th International Workshop on the Application of Field Programmable Gate Arrays (FPGAs) in Nuclear Power Plants**, Charlotte, N.C. Hosted by the Electric Power Research Institute. To request an invitation, contact: Debbie Rouse, EPRI, phone 704/595-2520; e-mail <drouse@epri.com>; web <www.cvent.com/d/m4q2dh>.

Oct. 20–22 **International Uranium Fuel Seminar**, Atlanta, Ga. Sponsored by the Nuclear Energy Institute. Contact: NEI, phone 202/739-8000; fax 202/785-4019; e-mail <conferences@nei.org>; web <www.nei.org>.

Oct. 20–23 **26th Annual Waste Management & Cleanup Decisionmakers' Forum**, Amelia Island, Fla. Organized by Exchange-Monitor Publications & Forums. Contact: Nicole Mattar, Exchange-Monitor, phone 202/296-2814, ext. 109; fax 202/296-2805; e-mail <forums@exchangemonitor.com>; web <www.exchangemonitor.com/index.cfm/forums/the-annual-decisionmakers-forum/>.

Oct. 20–23 **Nuclear Inter Jura 2014**, Buenos Aires, Argentina. Sponsored by the International Nuclear Law Association and organized by the Asociación Argentina de Derecho Nuclear. Contact: AADN, phone +54 11 4321 7500; fax +54 11 4321 7555; e-mail <info@aidn-inla.org.ar>; web <www.aidn-inla.org.ar>.

Oct. 20–24 **Symposium on International Safeguards: Linking Strategy, Implementation, and People**, Vienna, Austria. Sponsored by the International Atomic Energy Agency. Contact: Martina Neuhold, IAEA, phone +43 1 2600 21314; fax +43 1 2600 7; e-mail <m.neuhold@iaea.org>; web <http://www-pub.iaea.org/iaeametings/46090/symposium-on-international-safeguards>.

Oct. 22–23 **EPRI/EDF International Cavity Decontamination Workshop**, Charlotte, N.C. Sponsored by the Electric Power Research Institute. Contact: Jennifer Kern, EPRI, phone 704/595-2516; e-mail <jkern@epri.com>; web <www.epri.com>.

Oct. 26–31 **International Conference on Water Chemistry of Nuclear Reactor Systems (NPC 2014)**, Sapporo, Japan. Organized by the Atomic Energy Society of Japan, and cosponsored by the Ministry of Economy, Trade and Industry, and others. Contact: ISS, Inc., phone +81 3 6369 9995; fax +81 3 3453 1258; e-mail <npc2014@issjp.com>; web <www.npc2014.net>.

Oct. 27–31 **60th Radiobioassay and Radiochemical Measurements Conference (RRMC 2014)**, Knoxville, Tenn. Contact: Tom Rucker, RRMC 2014 Organizing Committee, e-mail <chair@rrmc.co>; web <www.rrmc.co>.

Oct. 27–31 **International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security**, Beijing, China. Organized by the International Atomic Energy Agency. Contact: Martina Khaelss, IAEA, phone +43 1 2600 21315; fax +43 1 2600 7; e-mail <m.khaelss@iaea.org>; web <http://www-pub.iaea.org/iaeametings/2014>.

Oct. 29–31 **ATOMEX 2014**, Moscow, Russian Federation. Organized by Rosatom. Contact: Eugene Yavdolyuk, Atomexpo, phone +7 495 66 33 821; fax +7 495 66 33 820; e-mail <eayavdolyuk@atomexpo.com>; web <www.atomeks.ru/en/atomex-2014>.

November

Nov. 8–15 **IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC 2014)**, Seattle, Wash. Sponsored by IEEE and the IEEE Nuclear and Plasma Sciences Society. Contact: NSS/MIC 2014, e-mail <nssmic2014@ieee.org>; web <http://nssmic2014.nps-conf.org/>.

Nov. 9–13 **2014 ANS Winter Meeting and Nuclear Technology Expo**, Anaheim, Calif. Contact: Ed Halpin, PG&E/STARS, phone 805/545-4100; e-mail <e1h8@pge.com>; web <www.ans.org/meetings/m_137>.

Nov. 9–13 **Embedded Topical: 21st Topical Meeting on the Technology of Fusion Energy (TOFE)**, Anaheim, Calif. Sponsored by the ANS Fusion Energy Division. Contact: Brian Wirth, University of Tennessee, phone 865/974-2525; e-mail <bdwirth@utk.edu>; web <www.ans.org/meetings/m_137>.

Nov. 10–13 **International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques**, Vienna, Austria. Sponsored by the International Atomic Energy Agency. Contact: Julie Zellinger, IAEA, phone +43 1 2600 21321; e-mail <j.zellinger@iaea.org>; web <http://www-pub.iaea.org/iaeametings/46092/food-safety-and-quality>.

Nov. 17–20 **International Workshop on Multi-Unit Probabilistic Safety Assessment**, Ottawa, Canada. Sponsored by the International Atomic Energy Agency and hosted by the Canadian Nuclear Safety Commission. Contact: Maria Videla, IAEA, phone +43 1 2600 25151; fax +43 1 26007 25151; e-mail <m.videla@iaea.org>; web <http://www-pub.iaea.org/iaeametings/2014>.

Nov. 18–20 **NATO-2014 Conference on Preparedness for Nuclear and Radiological Threats**, Los Angeles, Calif. Sponsored by the North Atlantic Treaty Organization's Science for Peace and Security Program, and organized by the National Center of Security and Protection

Continued on page 20



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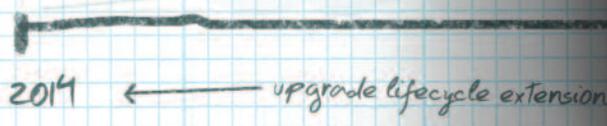
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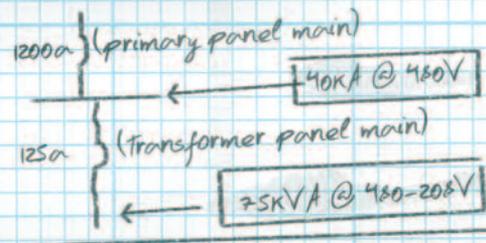
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HITACHI



Fanning: No commitment, but no backpedaling either.

A HINT THAT SOUTHERN IS PLANNING MORE NEW REACTORS was dropped by Tom Fanning, chief executive officer of Southern Company, on July 23 during a conference held by the Bipartisan Policy Center in Washington, D.C. “I would love to tell you later this year that we’re going to announce another nuclear plant,” Fanning said. He did not back off from or qualify this statement later, saying in response to questions that the project could be at one of six sites in Southern’s service area (mainly Georgia and Alabama) and would probably be based on Westinghouse Electric Company’s AP1000 pressurized water reactor, the design of the two reactors that Southern is building at the Vogtle site in Georgia. A few years ago, Southern indicated to the Nuclear Regulatory Commission that it might apply for a second twin-AP1000 plant, but the company did not pursue the project at that time.

SENDAI-1 AND -2 HAVE RECEIVED TENTATIVE RESTART APPROVAL from Japan’s Nuclear Regulation Authority (NRA), which released its draft safety assessment of the reactors on July 16. The two units, which are owned and operated by Kyushu Electric Power Company, are the first power reactors to be confirmed by the NRA as satisfying the upgraded safety standards introduced last year in response to the March 2011 accident at the Fukushima Daiichi nuclear plant.

Kyushu Electric submitted its application for the assessments on July 8, 2013, the day that the NRA’s new safety standards went into effect. The technical analysis undertaken by the NRA included an investigation of the scale of possible natural disasters, such as earthquakes and tsunamis, that the plant might experience, and the measures put in place to deal with serious accidents. Another 17 reactors are undergoing assessments against the new requirements. Currently, all 48 operable nuclear plants in Japan are off line.

The next step in the process to restart the reactors is a 30-day public consultation, including public hearings on the NRA’s 400-page draft report, which ends on August 15. Once the NRA issues the final safety assessment, Kyushu Electric will have to seek approval from Kagoshima Prefecture and local communities to restart the plant. The utility must also complete final regulatory and inspection procedures. According to reports in the media, the reactors are unlikely to restart before October.

TWO LAWYERS WILL BE NOMINATED TO FILL NRC VACANCIES. The White House announced on July 22 that President Barack Obama’s choices to replace George Apostolakis and William D. Magwood IV on the Nuclear Regulatory Commission are Jeffery Baran and Stephen Burns, both of whom have held attorney positions in federal offices. Baran, staff director for energy and environment on the House of Representatives’ Energy and Commerce Committee, was previously the committee’s senior counsel. Burns, head of legal affairs for the OECD Nuclear Energy Agency (NEA), was formerly the NRC’s general counsel. At this writing, the two nominations had not yet been sent to the Senate for confirmation. Until Apostolakis’s term ended on June 30, all five commissioners had technical backgrounds.

Just as Burns is coming from the NEA, Magwood is going there to become director general on September 1. On July 22, the NRC announced that Magwood will step down from the commission on August 31. Magwood has also made it clear that he intends to remain active until then. Some citizen organizations have called for him to step down immediately or to recuse himself from pending actions, asserting that the NEA promotes nuclear energy and that this conflicts with the need for the commissioners to be impartial. On July 14, Magwood declined to recuse himself from the licensing proceeding for a third reactor at DTE Electric’s Fermi site in Michigan and from a Sierra Club intervention petition on Omaha Public Power District’s Fort Calhoun reactor.

TALKS ON IRAN’S NUCLEAR PROGRAM HAVE BEEN EXTENDED until November 24, as agreed to by Iran and the E3+3 countries (China, France, Germany, Russia, the United Kingdom, and the United States). The four-month extension was announced in Vienna on July 19. The aim of the negotiations, which are taking place under the Joint Plan of Action (JPOA) that was finalized last November (NN, Dec. 2013, p. 18), is, in the words of President Barack Obama, “to reach a comprehensive agreement that assures us that Iran’s program will, in fact, be peaceful.”

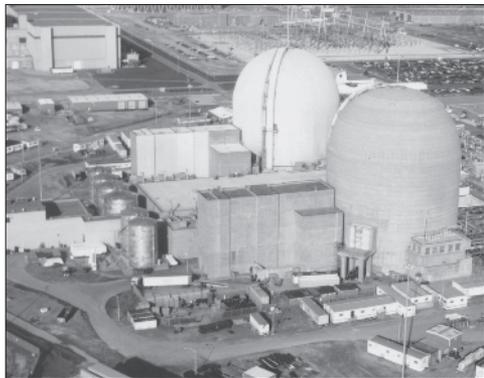
According to Secretary of State John Kerry, “The JPOA . . . has been a clear success. Since its implementation, Iran has complied with its obligations to neutralize its stockpile of 20 percent enriched uranium; cap its stockpile of 5 percent enriched uranium; not install advanced centrifuges; not install or test new components at its Arak reactor; and submit to far more frequent inspections of its facilities.” In exchange, he said, Iran has been given limited sanctions relief.

Continued

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“Today,” Kerry added, “we have a draft [final] text that covers the main issues. . . . To turn our back prematurely on diplomatic efforts when significant progress has been made would deny ourselves the ability to achieve our objectives peacefully.”



Salem: Torquing led to intergranular stress corrosion cracking.

► **SALEM-2 WAS RESTARTED, WITH DIFFERENT PUMP BOLTS**, on July 14, ending the extended refueling outage at the 1,181-MWe pressurized water reactor near Salem, N.J., which had been off line since April 12. This was the third consecutive refueling outage during which the broken heads of turning vane bolts from the reactor coolant pumps were recovered from the primary coolant system. The pumps themselves had performed acceptably, but plant owner PSEG Nuclear extended the outage to allow for additional work, with vendors Westinghouse and AREVA, aimed at resolving the problem. All four pumps were shipped off-site for inspection and repair, and it was determined that this type of bolt was prone to intergranular stress corrosion cracking. The new bolts are made of a different grade of stainless steel that is considered less prone to this type of failure.

The pumps are Westinghouse model 93A, which have also been delivered to Dominion's Surry-1 and -2 (each rated at 874 MWe) in Virginia. No chronic problems have been reported there. Salem-1 uses pumps of a different design, with bolts that require less torquing and so are under less stress.

THE NRC STAFF HAS COMPLETED THE SPENT FUEL RULE AND GEIS

and has sent them to the commissioners for publication approval. In staff paper SECY-14-0072, dated July 21, the Nuclear Regulatory Commission staff summarized its work on what has been called “waste confidence” but now will be known as “continued storage of spent nuclear fuel” at power plant sites. The final rule would amend 10 CFR Part 51 and is supported by the generic environmental impact statement (GEIS), which was prepared in part to address the June 2012 ruling by the U.S. Court of Appeals for the District of Columbia Circuit. That ruling vacated the NRC's Waste Confidence Decision and Rule and forced the agency to suspend final actions on power reactor license renewals and new reactor licenses. When the proposed rule was published in September 2013, the staff had specifically requested comments on four issues, and the development of the final rule was based on the following key points: There no longer is a timeline for the availability of a high-level waste repository; the safety of continued storage is not discussed in the rule; the statements of consideration have been streamlined; and the use of the term “continued storage” was adopted, as noted above. In the staff's view, the GEIS addresses all of these points sufficiently, and the rule text refers to the GEIS as needed.

ARGENTINA AND RUSSIA SIGNED A NUCLEAR COOPERATION PACT

on July 12 during a visit to Buenos Aires by Russian President Vladimir Putin. The agreement, which covers a wide range of nuclear activities, including power plant construction, was signed by Sergei Kiriyenko, the head of Rosatom, Russia's state atomic energy corporation, and Julio De Vido, Argentina's minister of planning. Following the signing ceremony, De Vido told journalists that the agreement was especially significant given Russia's intention to finance projects that would help develop Argentina's nuclear program. He also noted that Rosatom is one of five vendors that are prequalified to bid on the construction of a third unit at Atucha. De Vido invited Kiriyenko to visit Atucha -2, which is now being commissioned, when it reaches full power.

THE NRC DENIED A LICENSING SUSPENSION PETITION

that was submitted in February by 13 environmental organizations (*NN*, Apr. 2014, p. 28). On July 17, the five members of the Nuclear Regulatory Commission issued their findings that there is no hazard demonstrated by the long-term storage of spent nuclear fuel in spent fuel pools in the current quantity and density, and that the petitioners' assertions are being addressed through a rulemaking petition that was also submitted in February. The petitioners had argued that a 2013 study by the NRC staff on whether there would be any benefit from the expedited transfer of cooled fuel from pools to dry storage presented new and significant information that (in the petitioners' view) supports the suspension of all license renewal and new reactor proceedings. The commissioners stated that even if such information is pertinent to the rulemaking petition, it does not show that there is a threat to public health and safety that could be alleviated by the suspension of ongoing licensing proceedings. The NRC also noted that no final actions can be taken in any of the proceedings until the agency's Waste Confidence Decision and Rule are restored by the U.S. Court of Appeals for the District of Columbia Circuit (see story above), and that the environmental impact statement being prepared by the NRC could not lead to such a restoration for at least a few months.

Continued on page 175

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November—Continued from page 14

(NATSP), Brookhaven National Laboratory, and the Institute for National Security Studies of Israel. Contact: Samuel Apikyan, NATSP, e-mail <apikyan@natps.org>; web <www.natps.org>.

Nov. 30–Dec. 5 **Radiological Society of North America's 100th Scientific Assembly and Annual Meeting (RSNA 2014)**, Chicago, Ill. Sponsored by the RSNA. Contact: Kim Christianson, RSNA, phone 630/571-7848; e-mail <kchristianson@rsna.org>; web <www.rsna.org/Annual_Meeting.aspx>.

December

Dec. 1–5 **International Conference on Occupational Radiation Protection: Enhancing the Protection of Workers—Gaps, Challenges, and Developments**, Vienna, Austria. Organized by the International Atomic Energy Agency and the International Labour Organization. Contact: Martina Khaelss, IAEA, phone +43 1 2600 21315; e-mail <m.khaelss@iaea.org>; web <http://www-pub.iaea.org/iaeametings/2014>.

Dec. 8–10 **9th Nuclear Plants Current Issues Symposium: Moving Forward**, Charlotte, N.C. Sponsored by North Carolina State University and cosponsored by the ANS Nuclear Installations Safety Division and others. Contact: Ajaya Gupta, NC State, phone 919/881-2090; e-mail <ajaya.gupta@ncsu.edu>; web <www.ans.org/meetings/c_3>. □

Dec. 9–11 **Nuclear Power International**, Orlando, Fla. Produced by PennWell. Contact: Heather Williams, PennWell, phone 918/831-9560; e-mail <nuclearconference@pennwell.com>; web <www.nuclearpowerinternational.com>. ●

Dec. 14–18 **10th International Topical Meeting on Nuclear Thermal Hydraulics, Operation, and Safety (NUTHOS-10)**, Okinawa, Japan. Sponsored by the Atomic Energy Society of Japan, the ANS Thermal Hydraulics Division, and others. Contact: Hisashi Ninokata, Politecnico Di Milano, phone +39 334 613 2308; e-mail <hisashi.ninokata@polimi.it>; <www.nuthos10.org>. □

January

Jan. 12–14 **30th INMM Spent Fuel Seminar**, Arlington, Va. Sponsored by the Institute of Nuclear Materials Management's Packaging, Transportation and Disposition Technical Division in cooperation with the U.S. Nuclear Infrastructure Council. Contact: INMM, phone 847/480-9573; fax 847/480-9282; e-mail <inmm@inmm.org>; web <www.inmm.org>.

Jan. 21 **Nuclear Fuel Supply Forum**, Washington, D.C. Organized by the Nuclear Energy Institute. Contact: NEL, phone 202/739-8000; fax 202/785-4019; e-mail <conferences@nei.org>; web <www.nei.org>. ●

February

Feb. 1–4 **48th Midyear Topical Meeting of the Health Physics Society**, Norfolk/Virginia Beach, Va. Sponsored by HPS. Contact: Secretariat, HPS, phone 703/790-1745; fax 703/790-2672; web <http://hps.org/meetings/meeting41.html>. ●

Feb. 17–20 **7th Annual Nuclear Deterrence Summit**, Arlington, Va. Sponsored by ExchangeMonitor Publications & Forums. Contact: ExchangeMonitor, phone 877/303-7367, ext. 109; e-mail <forums@exchangemonitor.com>; web <www.deterrencesummit.com>. ●

Feb. 22–26 **9th International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies (NPIC&HMIT 2015)**, Charlotte, N.C. Sponsored by the ANS Human Factors, Instrumentation & Controls Division and the ANS Piedmont-Carolinas Section. Contact: H. M. Hashemian, Analysis & Measurement Services Corporation, phone 865/691-1756; e-mail <hash@ams-corp.com>; web <www.npic-hmit2015.org/>. ■ ●

And coming up (ANS meetings) ...

Advances in Nuclear Fuel Management V, Mar. 29–Apr. 1, 2015, Hilton Head, S.C.

International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2015), Apr. 19–23, 2015, Nashville, Tenn.

International Topical Meeting on Probabilistic Safety Assessment and Analysis (PSA 2015), Apr. 26–30, 2015, Sun Valley, Idaho.

2015 ANS Annual Meeting, June 7–11, 2015, San Antonio, Texas.

16th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-16), Aug. 30–Sept. 4, 2015, Chicago, Ill.

2015 ANS Winter Meeting and Nuclear Technology Expo, Nov. 8–12, 2015, Washington, D.C.

12th International Topical Meeting on Nuclear Applications of Accelerators (AccApp '15), Nov. 8–12, 2015, Washington, D.C.

Young Professionals Congress 2015, Nov. 8–12, 2015, Washington, D.C.

2016 ANS Annual Meeting, June 12–16, 2016, New Orleans, La.

Embedded Topical: Nuclear Fuels and Structural Materials (NFSM-2016), June 12–16, 2016, New Orleans, La.

Calls for Papers

Conference on Nuclear Training and Education (CONTE 2015), Feb. 1–4, 2015, Jacksonville, Fla. Sponsored by the ANS Education, Training & Workforce Development Division, with the European Nuclear Society. **Deadline for summaries: Oct. 17.** Author notification: Oct. 31. Revised summaries due: Nov. 14. PowerPoint slides due: Dec. 5. Revised PowerPoint slides due: Dec. 19. Submit summaries per the instructions at <www.ans.org/pubs/transactions/docs/guidelines.pdf>.

16th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-16), Aug. 30–Sept. 4, 2015, Chicago, Ill. Hosted by the ANS Chicago Section. **Deadline for abstracts: Nov. 15.** Author notification: Dec. 31. Draft papers due: Feb. 28, 2015. Review notification: Apr. 30, 2015. Final papers due: May 31, 2015. Submit abstracts per the instructions at <http://nureth16.anl.gov/meeting-information/#call>.

European Research Reactor Conference 2015 (RRFM 2015), April 19–23, 2015, Bucharest, Romania. Organized by the European Nuclear Society and the Asociația Română Energia Nucleară. **Deadline for abstracts: Nov. 15.** Author notification: Jan. 19, 2015. Full papers due: Mar. 15, 2015. PowerPoint presentations due: Apr. 5, 2015. Submit abstracts per the instructions at <www.euronuclear.org/meetings/rfrm2015/cfp.htm>. **IN**



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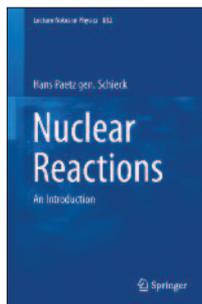
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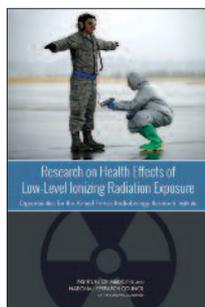
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Recently Published



Nuclear Reactions: An Introduction, by Hans Paetzgen, Schieck. Emphasizing the interplay between theory and experiment, this volume brings together essential material that is presented in the form of lecture notes from nuclear physics courses for graduate students at the University of Cologne. It follows the courses' approach, conveying the subject matter by combining experimental facts, methods, and tools with basic theoretical knowledge. Special attention is given to the importance of spin and orbital angular momentum

and on the operational definition of observables in nuclear physics. The end-of-chapter problems serve primarily to elucidate and detail physical ideas that could not be presented in full detail in the main text. *Nuclear Reactions* is intended for those with a working knowledge of quantum mechanics and a basic grasp of both nonrelativistic and relativistic kinematics. (365 pp., PB \$89.99, ISBN 978-3-642-53985-5. Order from Springer Science+Business Media: phone 212/460-1500; fax 212/460-1700; e-mail <customerservice@springer.com>; web <www.springer.com>.)



Research on Health Effects of Low-Level Ionizing Radiation Exposure: Opportunities for the Armed Forces Radiobiology Research Institute, by the Committee on Research Directions in Human Biological Effects of Low-Level Ionizing Radiation, Board on the Health of Select Populations, Nuclear and Radiation Studies Board, Institute of Medicine, at the National Research Council. This report presents recent scientific knowledge regarding the effects on humans of exposure to low-dose radiation

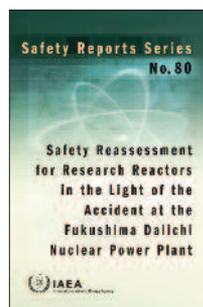
Nuclear medicine exhibit featured at nuclear museum

The National Museum of Nuclear Science & History will host a special exhibit, "Dr. Saul Hertz and the Origin of Nuclear Medicine," to celebrate Hertz's contributions as a pioneer and founder of nuclear medicine. The exhibit opens on September 13 and runs through October 12, 2014.

Hertz, a graduate of Harvard Medical School, served as chief of the Thyroid Unit at Boston's Massachusetts General Hospital from 1931 to 1943. He and his colleagues studied thyroid physiology in the 1930s, and before World War II, they began the first nonsurgical treatment of hyperthyroidism with radioactive iodine. Hertz's use of radioactive iodine as a tracer in the diagnostic process, as a treatment for Graves' disease, and in the treatment of cancer of the thyroid remains the preferred practice today.

For details on the exhibit, admission prices, and hours, go to the museum's website, <www.nuclearmuseum.org>, or phone 505/245-2137. The museum is located at 601 Eubank Blvd. S.E., in Albuquerque, N.M.

from medical, occupational, and environmental ionizing radiation sources. It is intended to provide advice to the Armed Forces Radiobiology Research Institute (AFRRI), an organization founded in 1961 to "preserve the health and performance of the U.S. military personnel and to protect humankind through research that advances understanding of the effects of ionizing radiation." The report identifies current research directions in radiobiological science, assesses how AFRRI programs are advancing the research in those directions, and provides guidance to AFRRI on how to build on its strengths and advance its mission while contributing to the body of scientific knowledge on the health effects of exposure to low-dose ionizing radiation. (200 pp., PB \$48, ISBN 978-0-309-30209-8), or PDF [free download]. Order from the National Academies Press: phone 800/624-6242; fax 202/334-2451; e-mail <Customer_Service@nap.edu>; web <www.nap.edu>.)



Safety Reassessment for Research Reactors in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant

This publication, part of the International Atomic Energy Agency's Safety Reports Series, provides guidance for all steps in the performance of safety reassessments for research reactors in light of the feedback from the March 2011 Fukushima Daiichi accident. It is intended for use by operating organizations, regulatory bodies, design organizations, and other groups involved in the safety of research reactors.

While the report is primarily focused on operating research reactors, it is also applicable to research reactors that are in the planning, design, or construction phase or are in an extended shutdown state. It is not intended to replace or supersede any of the requirements or guidance provided by the relevant IAEA Safety Standards, including those on safety analysis, evaluation of seismic and external hazards, and emergency preparedness and response for research reactors. Rather, the report should be used in close conjunction with these standards. (33 pp., PB [€20, about \$27.30, ISBN 978-92-0-100814-5], or PDF [free download]. Order from the IAEA: phone +43 1 2600 22417; fax +43 1 2600 29302; e-mail <sales.publications@iaea.org>; web <www.iaea.org/books>.)

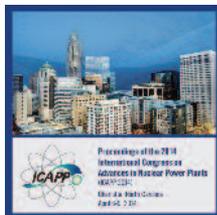
Proceedings Available



Advances in Thermal Hydraulics (ATH '14), proceedings of an embedded topical meeting held in conjunction with the 2014 ANS Annual Meeting in Reno, Nev., June 15–19. ATH '14 was the second such meeting organized by the ANS Thermal Hydraulics Division covering recent advances and new developments in nuclear thermal hydraulics. Leading

authorities from around the world assembled for the opening plenary session, which was dedicated to the late Novak Zuber, an ANS Fellow and a pioneer in the fields of two-phase flow and heat transfer. In addition, a special technical session was held to present research inspired by Zuber. The meeting program consisted of nine technical sessions spanning two-and-a-half days of peer-reviewed paper presentations in the following areas: computational methods; modeling, verification, and validation; thermal fluids and heat-transfer applications; two-phase flow; and nuclear plant safety and accident management. (CD-ROM, \$250,

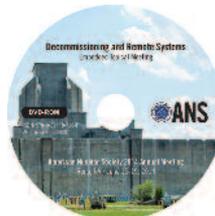
ANS Order No. 700388, ISBN 978-0-89448-711-8. ANS members receive a 10 percent discount. Order from ANS: phone 708/579-8210; fax 708/579-8314; e-mail <scook@ans.org>; web <www.ans.org/store/>.)



2014 International Congress on Advances in Nuclear Power Plants (ICAPP 2014), proceedings of a meeting held April 6–9 in Charlotte, N.C., sponsored by ANS, the French Nuclear Energy Society, the Korean Nuclear Society, and the Atomic Energy Society of Japan. ICAPP depicts the recent advances in thermal hydraulics, reactor physics, materials, operations and maintenance, safety, and licensing of nuclear power plants and provides a forum for leaders of the nuclear industry to exchange information, present results from new work, review the state of the art, and discuss future directions and needs for the deployment of new nuclear power plant systems around the world. Nearly 300 peer-reviewed, full-length papers and five plenary sessions were featured at ICAPP 2014, with sessions dedicated to the development of new technologies and the long-term sustainability challenges emphasized through many alternative designs, including innovative fast reactor concepts, fuel cycle and waste management strategies, and dedicated nonelectrical systems. (CD-ROM, \$220, ANS Order No. 700385, ISBN 978-0-89448-460-5. ANS members

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Decommissioning and Remote Systems (D&RS 2014), proceedings of an embedded topical meeting held in conjunction with the 2014 ANS Annual Meeting in Reno, Nev., June 15–19. The first embedded topical meeting to be jointly hosted by ANS's Decommissioning and Environmental Sciences Division and Robotics and Remote Systems Division, D&RS

2014 served as a forum for the discussion of the regulatory, scientific, and technical aspects of decontamination, decommissioning, and reutilization, along with the remote technologies being developed and demonstrated to improve worker safety and efficiency. The meeting program included more than 50 papers on commercial, government, and international project updates and project management, regulatory, and technology developments in the areas of decommissioning, nuclear material handling, waste management, site closure, and legacy management. (CD-ROM, \$200, ANS Order No. 700387, ISBN 978-0-89448-710-1. ANS members receive a 10 percent discount. Order from ANS: phone 708/579-8210; fax 708/579-8314; e-mail <scook@ans.org>; web <www.ans.org/store/>.)

IN



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REGULATION

New-reactor ROP won't be very "qualitative"

In a staff requirements memorandum issued on June 30, the Nuclear Regulatory Commission disapproved one staff recommendation and approved another in the ongoing process to develop a risk-informed approach for the Reactor Oversight Process (ROP) to be used for new power reactors. This was the second time that the staff had proposed that risk-informing be combined with the use of some deterministic (or qualitative) factors, and the second time that the commissioners have rejected the proposal.

The NRC has been planning for the operation of Generation III+ reactors for several years in various aspects of its regulatory mission. The agency hopes to use the overall structure of the ROP that exists for the power reactors now in operation, but it has spent a great deal of time considering whether the passive-safety features of Gen III+ reactors call for different kinds of operating and maintenance practices, and criteria for judging whether those practices are safe and effective.

For the second time, the Nuclear Regulatory Commission rejected a staff proposal to include determinism, along with risk-informing, in the reactor oversight process for the reactors now being built.

The commissioners stated some time ago that they want the new-reactor ROP to be risk-informed. In 2012, the staff proposed that changes be identified to augment the existing risk-informed guidance with "deterministic backstops," such as defense-in-depth and safety margins, rather than depending entirely on probabilistic risk assessment. In its disapproval of this proposal, the commissioners directed the staff to consider relative risk metrics to further risk-inform the process of determining the significance of inspection findings.

In the new proposal, submitted last December, the staff sought to make its case by replacing the deterministic backstops with "qualitative measures," which would be in-

tegrated with risk information to characterize the significance of ROP inspection findings. The staff recommended the development of this integrated approach for the evaluation of safety significance, and also the development of performance indicators and thresholds for new reactors, specifically in the initiating events and mitigating systems cornerstones of the ROP. The commissioners were unanimous both in rejecting the first proposal and approving the second.

As the staff and commissioners have noted in their statements, there is still time to put the Gen III+ ROP in place, as the first reactor of this kind will not begin operation until 2017 at the earliest. There have been

many meetings and discussions with stakeholders, and there will be many more. The commissioners and staff agree on the ultimate goal of a new-reactor ROP that is predictable, understandable, and objective. There remain, however, some disagreements on how to get to that goal.

The commissioners see the qualitative measures the same way they saw the deterministic backstops: as overly subjective and unclear as to how they would be applied. The commissioners did, however, accept the staff's conclusion that even if relative-risk metrics could be developed, they did not appear to provide any worthwhile benefits.

The commissioners did make a move in the staff's direction, saying that a "structured qualitative assessment" should be developed for conditions not evaluated in risk models in areas such as passive safety, digital instrumentation and controls, and human performance. The staff was also directed to explore further how the current ROP's performance indicator on Safety Systems Functional Failure would be applied to the passive-safety components of Gen III+ reactors as it pursues the approved second recommendation.

WATTS BAR

Unit 2 final SER now expected in October

The second power reactor at TVA Nuclear's Watts Bar site in Tennessee is moving from the bulk construction phase to system testing. A TVA spokesperson maintains that the project is on schedule for the start of commercial operation around the end of 2015, even after the Nuclear Regulatory Commission revealed that its supplemental

final safety evaluation report (FSER) is now scheduled for publication in October, a three-month delay from the previous target date.

The supplemental FSER is the last major documentation required from the NRC staff for the licensing of the 1,177-MWe Westinghouse pressurized water reactor. Even if the supplemental FSER is published on the current schedule, the staff has stated many times that additional supplements may be issued between now and reactor startup. Even so, it is not clear exactly how much the delay in the issuance of the supplemental FSER could back up other remaining milestones in the licensing process. The staff noted the delay on July 1 in its bi-monthly report to the presiding Atomic Safety and Licensing Board. There are currently no admitted contentions before the ASLB, however, and a proposed contention that is being held in abeyance—on the NRC's Waste Confidence Decision and Rule—may not involve the contents of the supplemental FSER. It is anticipated that the ASLB's final ruling will be delivered in December, according to the schedule the NRC developed in April.

The Advisory Committee on Reactor Safeguards' subcommittee and full committee meetings, scheduled for August and September, could be affected by the delay in the issuance of the supplemental FSER, as could a briefing of the commissioners planned for September. The schedule also indicates that the commissioners are to vote in November, and a final decision on license issuance is to be made in January.

For its part, TVA expects to meet its next few plant completion milestones, with hot functional testing in September, a letter in October indicating that the plant is sub-



Photo: Eselon Generation

Watts Bar: Unit 2 is still on schedule for year-end 2015 startup.

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stantially complete, and readiness for fuel loading in December. Beyond that point, however, progress at Watts Bar-2 will require formal NRC consent. Fuel loading, planned for January, can take place only after the license is issued.

EXTERNAL EVENTS

TVA: Max floods higher, but plants would endure

In licensee event reports sent to the Nuclear Regulatory Commission on June 30, TVA Nuclear stated that it had identified unanalyzed conditions at its Sequoyah and Watts Bar plants. Revised hydrologic analyses showed that the peak maximum flood could be 1.5 feet higher at Sequoyah and 1.7 feet higher at Watts Bar than the levels used in the plants' updated final safety analysis reports. In both cases, however, TVA has concluded "that all required safety equipment . . . would not be impacted and are considered operable."

Sequoyah and Watts Bar are both on the Tennessee River, with Watts Bar being farther upstream. There is also a hydroelectric dam at Watts Bar, part of TVA's power generation and flood control infrastructure that predates its nuclear program. The previous peak maximum flood analysis was based on the complete and instantaneous failure of the West Saddle Dike at Watts Bar. As part of the flooding hazard reassessment of every U.S. power reactor, spurred by the Fukushima Daiichi lessons-learned process, TVA saw that this failure may not be a valid assumption. If the dike were to hold up, the east floodwall of Watts Bar Dam could overtop and fail, leading to the higher water levels at both Watts Bar and Sequoyah.

The tools for both the failure analysis and the flood projection have been revised in recent years. TVA used the U.S. Army Corps of Engineers' Hydrologic Engineering Center River Analysis System to work out the new flood scenario and the possible effects on the nuclear plants. The event reports applied to Sequoyah-1 and -2 and Watts Bar-1. Watts Bar-2 was not included in TVA's "prompt determination of operability" because it is not yet in operation, but the expected maintenance of safety for Unit 1 at the higher flood level would also apply to Unit 2.

CONSTRUCTION

Change to condensate return sought for Summer

We regret to inform you that in this issue of *Nuclear News*, we are unable to report on the movement of extremely large objects at either the Vogtle site in Georgia or the Summer site in South Carolina, where a total of four Westinghouse AP1000 pressurized wa-

NRC

Annual reactor fee up 19 percent in FY 2014

In the June 30 *Federal Register*, the Nuclear Regulatory Commission published the final rule that sets the fiscal year 2014 annual fees for its licensees. While all of the 20 public comments received on the version that was proposed in April opposed the hourly rate increases and fee increases, the agency mainly stayed with the amounts it had proposed. In the final version, however, the power reactor fee is not as high as it was in the proposal, but is still

19 percent higher than the FY 2013 fee.

The fact that three amounts rose from the proposed version, two fell, and the other six stayed the same reflects mainly a more precise allocation of resources between the proposed and final versions. The proposed increase in the NRC's hourly rate, from \$272 to \$279 per hour of full-time employee equivalent, remains the same in the final rule. As for the overall increase in power reactor fees, the NRC staff pointed out in the supporting text that the reactor safety program that had been supported by 104 licensed reactors is now shared among 100.

NRC ANNUAL FEE SCHEDULE

Fee	FY 2013 Final	FY 2014 Proposed	FY 2014 Final
Operating power reactor, including spent fuel storage and decommissioning	\$4,390,000	\$5,328,000	\$5,223,000
Spent fuel storage and decommissioning	\$231,000	\$224,000	\$224,000
Nonpower reactor	\$81,600	\$84,500	\$84,500
High-enriched uranium fuel facility	\$6,997,000	\$6,329,000	\$7,175,000
Low-enriched uranium fuel facility	\$2,633,000	\$2,178,000	\$2,469,000
Uranium hexafluoride conversion and deconversion facility	\$1,429,000	\$1,293,000	\$1,466,000
Conventional mill	\$27,900	\$33,900	\$33,800
Radiographer	\$27,200	\$29,800	\$29,800
Well logger	\$12,600	\$13,600	\$13,600
Gauge user	\$6,400	\$6,800	\$6,800
Broad-scope medical user	\$32,900	\$35,700	\$35,700

ter reactors are under construction. For this issue, at least, we will provide information only on the progress of paperwork and will not dwell on the welding, fitting, and numerous other physical activities that are taking place at the two sites.

On July 8, South Carolina Electric & Gas Company (SCE&G) requested a license amendment and exemption for Summer-2 and -3 that follow on a design change requested last year for Duke Energy's two AP1000s planned for Levy County, Fla., for which the combined construction and operating licenses (COL) have not yet been issued. The change would alter the return of condensate to the in-containment refueling water storage tank.

In the case of Levy, the change has caused the NRC staff to spend more time on COL technical reviews and thus has delayed the completion of the final safety evaluation report (FSER), now expected next March. Because Duke has canceled the engineering, procurement, and construction contract for Levy, and operation is now scheduled to begin in 2024 or later, the delay in the completion of the FSER has not been a problem. Within the AP1000 Design-Centered Working Group, which includes Duke and Florida Power & Light Company, as well as SCE&G

and Vogtle's owner, Southern Nuclear, work that has been done on the Levy condensate return change will make it possible for the other owners of the AP1000, which has been certified by the NRC as a standard design, to adopt the change for their plants once the NRC has found it acceptable for Levy.

At Vogtle, meanwhile, the NRC issued the 21st license amendment for Units 3 and 4 on July 3. Design details of the auxiliary building floors may now be varied due to design and loading conditions, in accordance with code requirements. Notes will be added to figures in the detailed design to describe the specific variations.

REACTOR DESIGN

NRC to NuScale: Draft DSRS likely next year

NuScale Power informed the Nuclear Regulatory Commission in March that it would defer the submission of its design certification application for the NuScale small modular reactor until the second half of 2016. Later that month, NuScale Power requested that the NRC retain the original schedule for the development of the design-specific review standard (DSRS) for the NuScale reac-



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tor so that the company would be well-versed on the standard while developing the certification application (*NN*, May 2014, p. 25). On June 19, the NRC denied the request, holding to its position that the development of a DSRS depends on a more fully developed design, and projecting that the draft DSRS would be issued around mid-2015.

In a letter addressed to José Reyes, chief technology officer of NuScale Power, Michael Mayfield, director of the Division of Advanced Reactors and Rulemaking in the NRC's Office of New Reactors, wrote, "It is important to note that new reactor designs are judged against the regulations. While there are requirements in Title 10 of the Code of Federal Regulations for you to

address pertinent NRC guidance in your application, the fact remains that it is the regulations and not the guidance that will govern the acceptability of your design." Later in the letter, Mayfield wrote, "The details of the design must precede the content of the DSRS."

With the DSRS going through a draft version and then a final one, NuScale Power will at least have some time to use the draft in the development of the certification application for the 45-MWe integral pressurized water reactor. The DSRS will describe how the NRC will conduct its technical reviews of the design, and NuScale Power has maintained that a fully developed DSRS would ensure that its applica-

tion would address the issues likely to arise during the reviews.

During the ANS Annual Meeting in June, Reyes described recent changes to the NuScale design, saying that he believed that they will not pose problems during certification (see page 160). This does not mean, however, that the design is now so close to being complete that the NRC expects no further changes. Mayfield wrote that based on a meeting with NuScale Power in May, "It is not apparent to our technical staff that the recent design changes described during the meeting would not require significant changes to the guidance. Additionally, the fact that the basic NuScale design continues to evolve indicates that the NuScale design

Renaissance Watch

An update on developments that may lead to new power reactors

In what follows, **BOLD CAPITALS** are used for projects under (or approved for) construction; **bold** indicates a submitted application; *italics* means that an application is forthcoming. Acronyms: ACRS, Advisory Committee on Reactor Safeguards; ASLB, Atomic Safety and Licensing Board; COL, combined construction and operating license; COLA, COL application; CS, proposed date for the start of commercial operation; EPC, engineering, procurement, and construction; ESP, early site permit; FEIS (DEIS), final (draft) environmental impact statement; FSER (DSER), final (draft) safety evaluation report; ITAAC, inspections, tests, analyses, and acceptance criteria; MH, mandatory hearing and final decision; RAI, request for additional information; TBD, to be determined.

In many cases, detailed schedules for the NRC staff's technical reviews are in effect, and the following abbreviations are used for the phases of design certification: P1 (RAIs issued by the NRC); P2 (SER with open items); P3 (ACRS review of SER); P4 (advanced SER); P5 (ACRS review of advanced SER); P6 (FSER). COLA reviews are based on the same six phases (referred to below as SP1 through SP6), but in some cases, the NRC is using a four-phase safety review with letters instead of numbers (SPA through SPD), essentially skipping SP2 and SP3. The COLA environmental review has four phases: EP1 (scoping); EP2 (DEIS); EP3 (comments on DEIS); EP4 (FEIS).

Under Construction

WATTS BAR-2, 1,177-MWe Westinghouse pressurized water reactor, Tennessee Valley Authority; Spring City, Tenn.; close to 100 percent complete. CS: December 2015, but a delay to mid-2016 is considered possible by TVA officials. FSER: October 2014, perhaps with supplements later; *FEIS issued May 29, 2013*. The NRC schedule had anticipated a final commission decision in January 2015, and if the license is authorized, fuel loading that same month; this, however, was based on the FSER's being finished in July. There are no admitted contentions, but a proposed contention on waste confidence is being held in abeyance.

BELLEFONTE-1, 1,213-MWe Babcock & Wilcox PWR, Tennessee Valley Authority; Scottsboro, Ala.; 55 percent complete. CS: 2018–2020. On-site construction will not resume until Watts Bar-2 loads fuel; procurement and other project spending has been authorized by TVA's board of directors.

VOGTLE-3, -4, Westinghouse AP1000s, Southern Nuclear Operating Company; Waynesboro, Ga.; about 50 percent complete in EPC terms. CS: November 2016, November 2017. *The COLs were issued on February 10, 2012*. ITAAC status: eight closed for Unit 3, all confirmed by the NRC; five closed for Unit 4, all confirmed by the NRC.

SUMMER-2, -3, AP1000s, SCANA/Santee Cooper; Parr, S.C.; completion percentage not yet stated. CS: late 2016, mid-2018. *The COLs were issued on March 30, 2012*. ITAAC status: five closed for Unit 2, with four confirmed by the NRC; one closed and confirmed for Unit 3.

License applications

Both to save space and to keep the focus on the most active projects, the following list excludes Ameren Missouri's Callaway -2, Duke Energy's Harris-2 and -3, Entergy's Grand Gulf-3 and River Bend-3, Luminant Power's Comanche Peak-3 and -4, and TVA's Bellefonte-3 and -4, which have been suspended at the request of the applicants.

Calvert Cliffs-3, U.S. EPR, UniStar Nuclear Energy; Lusby, Md. CS: TBD; FSER: TBD; *FEIS issued May 13, 2011*. SP1 completed, April 2010; SP2 due, TBD (15 chapters are complete, as are parts of three others). The ASLB has terminated the licensing proceeding on the grounds of UniStar's foreign ownership, but the NRC staff is still carrying out technical reviews, and UniStar could apply later to reopen the proceeding.

South Texas-3, -4, Toshiba ABWRs, Nuclear Innovation North America (NINA); Palacios, Texas. CS: TBD. FSER: September 2015; *FEIS issued February 24, 2011*. SP3 completed, November 2010; SP4 due, December 2014 (18 chapters complete). All three intervenor contentions have been resolved in NINA's favor. An EPC contract was signed in February 2009.

North Anna-3, ESBWR, Dominion Generation; Mineral, Va. CS: TBD; FSER: March 2016; *FEIS issued March 17, 2010*, and the NRC stated in July that no reassessment will be needed. SP3 done, November 2009; SP4 due, September 2015. Dominion and GE Hitachi Nuclear Energy have stated that they have agreed on all contract terms, although Dominion has not committed to building the reactor and so has not signed an EPC contract. The hearing record is closed, but a new contention has been submitted in connection with the August 2011 earthquake near the site.

Lee-1, -2, AP1000s, Duke Energy; Gaffney, S.C. CS: 2024, 2026; FSER: December 2015; *FEIS issued December 20, 2013*; MH: April 2016. SPA completed, May 2010; SPB due, May 2015 (15 chapters completed). There are no intervenor contentions.

Levy-1, -2, AP1000s, Duke Energy; Levy County, Fla. CS: 2024, 2025–2026. FSER: March 2015; *FEIS issued April 27, 2012*.

maturity has not yet reached the desired balance point” asserted by the company.

ENFORCEMENT

Wolf Creek cited for EP failure

The Nuclear Regulatory Commission has issued a violation notice to Wolf Creek Nuclear Operating Corporation for a faulty emergency preparedness program at Wolf Creek-1, the company’s 1,200-MWe pressurized water reactor located near Burlington, Kan. In a July 1 letter of final significance determination and notice of violation to the utility, the NRC concluded that its pre-

liminary “white” finding (a finding of low to moderate safety significance), identified at the plant during a September 2013–March 2014 inspection, had been properly characterized. In addition, the finding was judged to be a violation of 10 CFR 50.47(b)(9), “Emergency Plans,” which states that “Adequate methods, systems, and equipment for assessing and monitoring actual or potential off-site consequences of a radiological emergency condition” must be used.

The NRC inspection found that during a November 5, 2013, emergency preparedness exercise at the site, Wolf Creek personnel failed to maintain adequate procedures for gauging the potential consequences of a radiological emergency condition. “Two errors

in the Electronic Dose Calculation Program would have resulted in calculating inaccurate off-site doses for the main vent stack effluent radiation monitor pathway when the effluent radiation monitor was in the accident mode, and for application of containment sprays following a loss-of-coolant accident,” the violation notice stated. The inaccurate calculation was corrected on February 25.

Wolf Creek is currently in the second column—Regulatory Response—in the NRC’s Reactor Oversight Process action matrix, as the consequence of a security-related “greater-than-green” finding (a finding of more than very low security significance), originating in the fourth quarter of 2013.

Section continued

SPC completed, January 2012. The contested hearing was resolved in Duke’s favor. The EPC contract was canceled on August 1, 2013.

Fermi-3, ESBWR, DTE Energy; Monroe, Mich. CS: June 2020; FSER: July 2015; *FEIS issued January 4, 2013*. SP1 completed, August 2010; SP2 due, December 2014 (17 chapters are finished, as is part of one other). Two intervenor contentions were admitted for a hearing that ended November 1, 2013; at this writing, the ASLB had not yet issued a decision.

Bell Bend, U.S. EPR, PPL/UniStar; Berwick, Pa. CS: TBD; FSER: TBD; FEIS: TBD. The NRC has begun a supplemental scoping process because of the relocation of the nuclear island. One SER chapter has been finished. There are no intervenor contentions.

Turkey Point-6, -7, AP1000s, FPL; Florida City, Fla. CS: 2022, 2023; FSER: TBD; FEIS, February 2016; MH: TBD. SPA due, TBD (four chapters are finished). EP1 completed, December 2010; EP2 due, February 2015. One intervenor contention is currently admitted into the hearing process.

Clinch River, two to six mPower reactors, TVA; Clinch River, Tenn. Application submittal TBD. This would be a 10 CFR Part 50 application with separate proceedings for construction permits and operating licenses.

Eastern Idaho, two or more NuScale reactors, Utah Associated Municipal Power Systems; on or near property of Idaho National Laboratory. Application submittal TBD.

Payette, reactor TBD (perhaps APR-1400), Alternate Energy Holdings Inc.; Payette, Idaho. The NRC has not expected the submission of a COLA, but the applicant has stated that it intends to submit one in the third quarter of 2014.

Early site permits

PSEG site, reactor TBD, PSEG; Salem, N.J. FSER: TBD; FEIS: September 2015. SPA due, TBD. EP1 completed, December 2010; EP2 due, September 2014.

Blue Castle Project, reactor TBD, Blue Castle Holdings; Green River, Utah. The NRC expects the application around the start of 2015.

Design certification

ABWR, 1,350-MWe boiling water reactor, GE Hitachi or Toshiba. The original General Electric design was certified in 1997. **The final certification rule for Toshiba’s version, for South Texas-3 and -4, was published on December 16, 2011, and became effective on January 17, 2012.** GE Hitachi and Toshiba have both applied for the renewal of the ABWR certification, which expired in 2012. The NRC has docketed both applications, with no review schedules issued as of this writing.

AP1000, 1,100-MWe pressurized water reactor, Westinghouse. This design was certified in 2006. In 2007, Westinghouse applied to amend the design. **The final certification rule was published on December 30, 2011, and became effective immediately.**

ESBWR, 1,520-MWe BWR, GE Hitachi. The approval process for the final rule has resumed, with issuance of the final certification now expected in September.

U.S. EPR, 1,600-MWe PWR, AREVA. The certification target date is TBD because of the NRC’s continued dissatisfaction with the digital instrumentation and control system. P3 completed, May 2012; P4 due, TBD.

US-APWR, 1,700-MWe PWR, Mitsubishi Heavy Industries. At the applicant’s request, work was suspended at the end of March; all target dates are now TBD. P1 completed, January 2009; P2 due, TBD (17 chapters finished).

APR1400, 1,400-MWe PWR, consortium led by Korea Electric Power Corporation. The application was submitted on September 30, 2013, but in December, the NRC stated that the application did not contain sufficient information and did not accept it for docketing. The consortium plans to resubmit the application by the end of this year.

Westinghouse SMR, 225-MWe integral PWR, Westinghouse. The application submittal date is TBD, and Westinghouse has reduced work on the design.

mPower, 180-MWe integral PWR, Generation mPower (Babcock & Wilcox/Bechtel). The application will not be submitted until 2015 at the earliest. A draft design-specific review standard was issued in May 2013.

NuScale, 45-MWe integral PWR, NuScale Power. The application is expected in the second half of 2016.

SMR-160, 160-MWe integral PWR, Holtec International. The application submittal date is TBD.

XE-100, 100-MWt (electrical rating not yet specified) pebble-bed fueled gas-cooled reactor, X-Energy, Inc. This start-up company has told the NRC that it intends to apply for certification, and the NRC expects the application around the start of 2017.

There are no other declared certification candidates at this time, but many other designs are being developed, among them Gen4 Energy’s liquid metal-cooled *Gen4 Module*; TerraPower’s project, formerly known as the *Traveling Wave* reactor; General Atomics’ gas-cooled *Energy Multiplier Module*; and AREVA Inc.’s gas-cooled *SC-HTGR*, named the preferred design of the NGNP Industry Alliance, which may apply for a construction permit in the period 2016–2018. The Department of Energy is not pursuing licensing for the NGNP, and no public-private partnership has been established.

STARS plans to submit only one more application

In a July 1 update to its license renewal page at <www.nrc.gov>, the Nuclear Regulatory Commission confirmed revised submittal dates for license renewal applications planned by Entergy Operations and the Strategic Teaming and Resource Sharing Alliance (STARS). Entergy had deferred application submittals for Waterford-3 and River Bend-1 to the first quarter of 2016 and the first quarter of 2017, respectively, in each case one year later than the previous target dates (*NN*, Apr. 2014, p. 68). STARS had planned to submit its sixth and seventh applications in the third quarter of 2016 and the fourth quarter of 2018; the alliance

now plans to submit its sixth application in the fourth quarter of 2018, and it will not submit a seventh application.

STARS has always maintained the confidentiality of its applicants prior to the submittal of their license renewal applications. Because the alliance represents a small number of plants from Missouri to the Pacific, however, it has usually been fairly clear who the applicants would be, and the only mystery to outsiders was over which plant would apply when. The only possible remaining plants represented by STARS were Comanche Peak in Texas and San Onofre in California. With Southern California Edison Company's decision last year not to seek the restart of San Onofre-2 and -3 after the discovery of substantial wear in the plant's replacement steam generators, there would

no longer be any reason for the utility to apply for license renewal. The current licenses of Luminant Power's Comanche Peak-1 and -2 expire in 2030 and 2033, respectively, so there is no hurry to begin the renewal process.

Of the 100 operable reactors in the United States, the licenses of 72 have been renewed, renewal applications for 18 are under review by the NRC, and seven are identified as having planned submittal dates. The unidentified STARS plant (which can only be Comanche Peak) would account for two more reactors. The only U.S. reactor for which an intent to renew has not been declared is TVA Nuclear's Watts Bar-1, which was licensed less than 19 years ago. A full 20-year renewal cannot be sought until a reactor's license reaches the 20-year mark.

Power Briefs

GEORGE APOSTOLAKIS'S NRC TERM ENDED ON JUNE 30, with no replacement having yet been announced by the White House. The Nuclear Regulatory Commission had been at its full five-member strength for more than four years. Commissioner William Magwood is scheduled to leave the NRC on September 1 to become director general of the OECD Nuclear Energy Agency (*NN*, Apr. 2014, p. 17), and at this writing, no candidate has been announced to replace him either.



THE MEMPHIS FLEX FACILITY OPENED ON JUNE 27, completing the Nuclear Energy Institute-led establishment of centers housing equipment and supplies that are available to any power reactor licensee should extreme external events overwhelm the licensee's emergency response capabilities. Like the facility in Phoenix, Ariz., which opened in May, the Tennessee FLEX site is intended to be able to deliver equipment anywhere in the continental United States within 24 hours. The FLEX centers are the nuclear power industry's response to the Nuclear Regulatory Commission's desire for more response capability, as a "lesson learned" from the Fukushima Daiichi accident.



A HOT SHORT CONDITION WAS FOUND AT PERRY and reported to the Nuclear Regulatory Commission by FirstEnergy Nuclear Operating Company on June 19. As with most of the other recently reported unanalyzed conditions that concern electrical equipment at nuclear power plants, it has been determined that a fire in one area could lead to an electrical fire in another area that could disable safe-shutdown equipment. In this case, there are unfused control circuits related to the turbine emergency-bearing oil pump, the "A" and "B" reactor feed pump turbine emergency lube oil pumps, and the turbine emergency seal oil pump. These circuits are routed to other areas, including the control room. FirstEnergy stated that it has taken interim compensatory actions, such as fire watches.



A THREE-MONTH DELAY IN THE SEABROOK RENEWAL SEIS was announced on July 2 by the Nuclear Regulatory Commission. NextEra Energy's license renewal application for its Seabrook power reactor is already stalled on the safety review side, with the target date for the final safety evaluation report currently listed as "to be determined." The new target for submittal of the supplemental environmental impact statement is October of this year. The current license for the 1248-MW pressurized water reactor near Seabrook, N.H., is good until October 2026, so even though the renewal proceeding has continued for more than four years, there is no urgency to obtain the approval to extend the license for 20 years.



SEVERAL POST-FUKUSHIMA RULEMAKINGS WILL BE COMBINED into a single rulemaking activity. On July 9, the Nuclear Regulatory Commission approved a staff proposal to combine the rulemakings for station blackout mitigation strategies and on-site emergency response capabilities and to coordinate this with rulemaking related to a 2013 mitigation strategies order and related activities being pursued by industry.

LICENSING

ACRS asked to waive further ESBWR review

In addition to what is reported elsewhere in this section, the following developments have recently occurred in connection with new reactor licenses, permits, and certifications.

ESBWR

GE Hitachi Nuclear Energy's ESBWR design continued to progress toward certification when on July 2 the Nuclear Regulatory Commission staff asked the Advisory Committee on Reactor Safeguards to waive further review of the final rule. The ACRS has already reviewed and approved the supplemental safety evaluation report that includes the resolution of the steam dryer issues that prompted a halt to the certification final rule in 2012, and the staff asserted that the only changes in the new version of the final rule relate to those steam dryer issues. The staff also stated that the limited opportunity for public input on the rule, which closed on June 5, drew no comments. The ACRS was to state by July 16 whether it would waive further review. The final rule was scheduled to go to the commissioners for their vote in July, and if approved, the rule will be published in September.

Turkey Point-6 and -7

In June, a new contention was proposed—and then withdrawn—by intervenors in Florida Power & Light Company's application for combined construction and operating licenses (COL) for two Westinghouse AP1000 pressurized water reactors at the Turkey Point site in Florida. Joint intervenors had filed a motion related to environmental impacts of the addition of new transmission lines, but were then informed of a supplement to the environmental report by FPL. The intervenors then



Comanche Peak: The current licenses for Units 1 and 2 would expire in 2030 and 2033.

stated that the supplement appeared to resolve many of the concerns in the contention.

Comanche Peak-3 and -4

On July 1, the NRC officially listed Luminant Power's application for COLs for Comanche Peak-3 and -4 as suspended. The company had stated last November that it expected to stop work on the project around the end of March 2014, and it requested that the NRC also suspend work (and thus not apply any more billable hours to Luminant) at about that time. Comanche Peak-3 and -4 are planned as Mitsubishi Heavy Industries (MHI) US-APWR pressurized water reactors, at the site near Glen Rose, Texas, where Luminant currently operates two PWRs. MHI also suspended work on the design certification of the US-APWR at the end of March. The environmental review has been completed for the COL application, and the final environmental impact statement was issued in May 2011, but little progress has been made on the safety review for US-APWR certification. As a result, little progress has been made on the safety review for Comanche Peak-3 and -4: Only one of the six phases of the review has been completed.

PSEG site

PSEG had requested on April 30 that the NRC issue an exemption on its early site permit (ESP) application for land adjacent to its Hope Creek/Salem plant in New Jersey. PSEG had sought to have the storm surge analysis deferred from the ESP stage, and addressed only if the company later submits a COL application (*NN*, July 2014, p. 28). On June 17, the NRC denied the request, stating, among other things, that the analysis cannot be deferred "without undercutting the regulatory purpose of an ESP to resolve all necessary site suitability issues."

Bellefonte-2

On June 10, TVA Nuclear requested that the NRC extend the expiration date of the construction permit for the second power reactor at the Bellefonte site in Alabama, from October 1 of this year to October 1, 2017. TVA has planned to resume construction of the first reactor at the site once fuel is loaded at Watts Bar-2 in Tennessee, perhaps early next year, but the completion of Unit 2 is not currently included in the main scenario of TVA's integrated resource plan. Bellefonte-1 and -2 are Babcock & Wilcox pressurized water reactors, designed to be rated at 1213 MWe each. TVA suspended work on them in the 1980s. Also suspended are the COL applications for two

Westinghouse AP1000 PWRs, which would become Bellefonte-3 and -4.

OVERSIGHT

NRC returns LaSalle-2 to standard oversight status

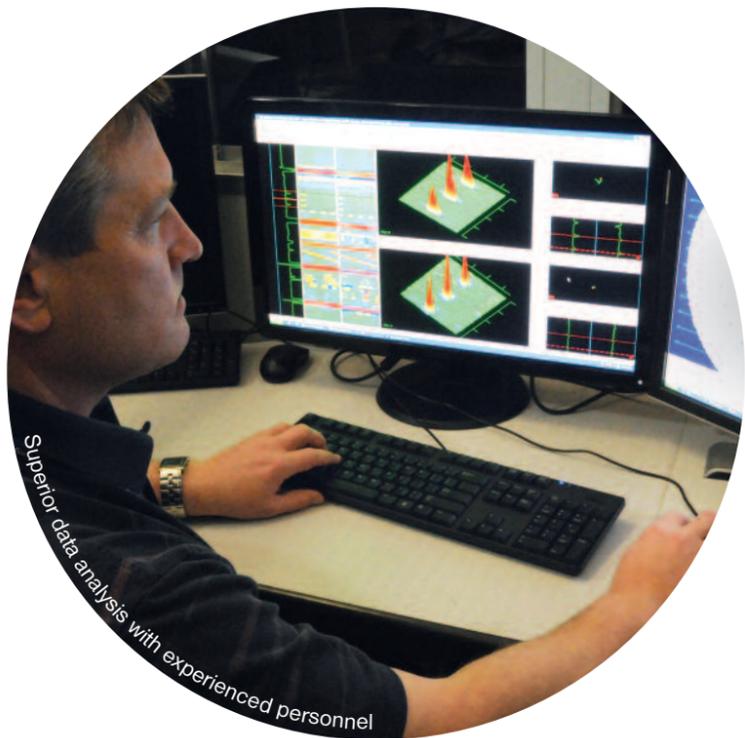
In a July 1 update to the Nuclear Regulatory Commission's Reactor Oversight Process action matrix, LaSalle-2 was returned to standard regulatory oversight. In a supplemental inspection report and assessment follow-up letter dated May 2, the NRC informed Exelon Nuclear, the operator of the LaSalle plant, in Seneca, Ill., that Unit 2 would be transitioned back to the first column, Licensee Response, of the five-column matrix from the heightened oversight of column two, Regulatory Response, beginning with the third quarter of 2014.

LaSalle-2 had been moved to the Regulatory Response column in August 2013 after scrams on April 17 and April 25 of that year exceeded the agency's limit for unplanned scrams with complications. The NRC also later determined that the April 25 scram was associated with a "white" finding (a finding of low to moderate safety significance) involving the failure of station personnel to follow the "Dewatering the Circulating Water System" procedure, which resulted in the loss of the reactor's normal heat sink and led to the unplanned scram.

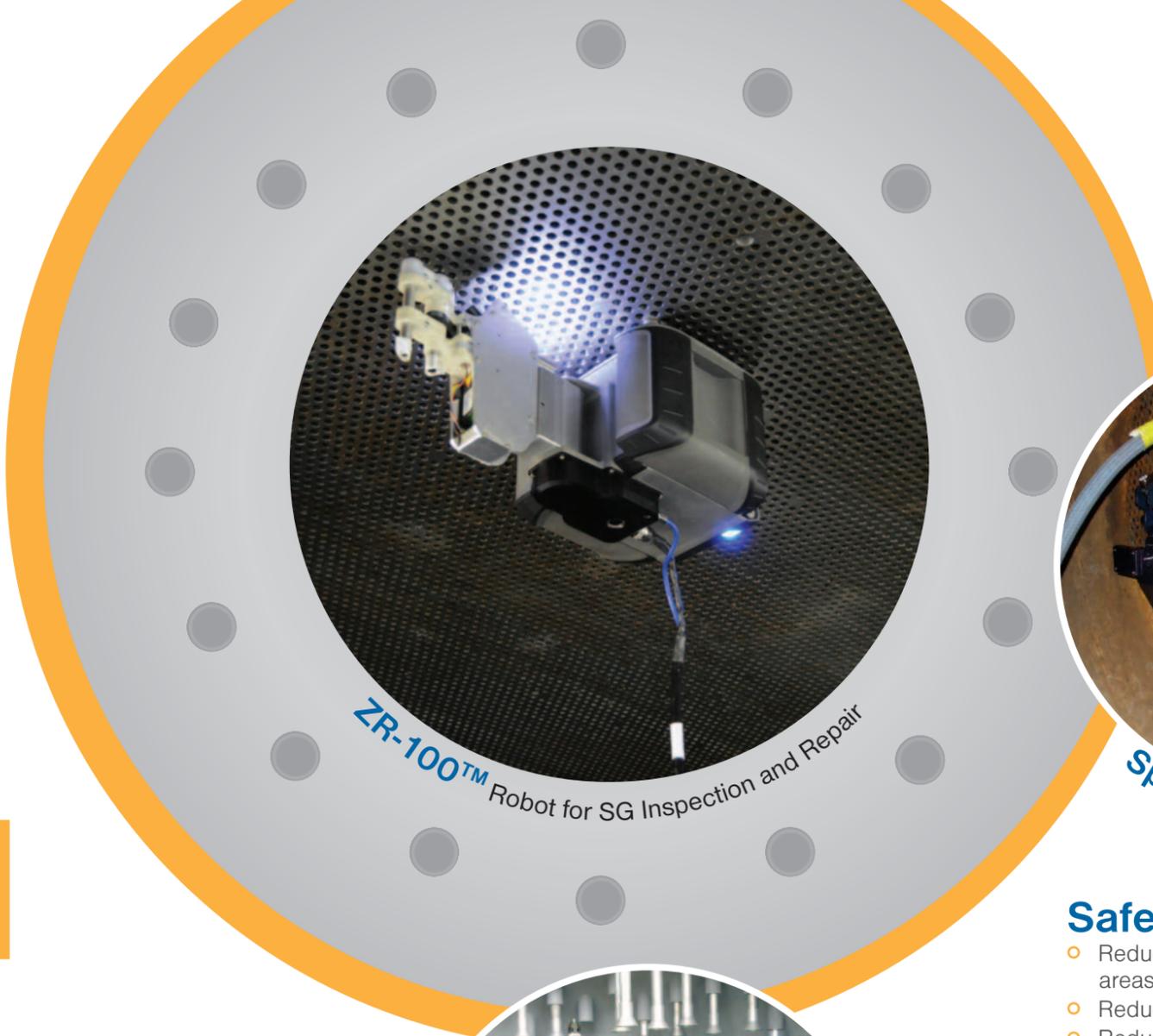
The NRC completed its supplemental inspection in March of this year, concluding that Exelon had adequately addressed the issues that caused the problem and had implemented the necessary corrective actions to avoid a recurrence. **NN**



LaSalle: Unit 2 returned to regular NRC oversight on July 1.



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NNSA

New operator takes the reins at two NNSA sites

On July 1, after disputes with competitors and the National Nuclear Security Administration that lasted for more than a year, Consolidated Nuclear Security (CNS), a consortium headed by Bechtel National, began its tenure as the management and operating contractor for the Y-12 National Security Complex and the Pantex Plant. The Y-12 site, located in Oak Ridge, Tenn., is focused on the processing and storage of uranium and the development of associated technologies, while the Pantex Plant, near Amarillo, Texas, is the nation's primary site for the assembly and disassembly of nuclear weapons.

CNS's main rival for the consolidated contract, Nuclear Production Partners, a group headed by the Babcock & Wilcox Company, gave up its fight to retain the contract in March after the Government Accountability Office denied its third protest of the NNSA's decision to award the contract to CNS (*NN*, Apr. 2014, p. 35). The decision to move the contract to CNS was made in large part because the company has said that it can save the government about \$3.27 billion over a 10-year period by consolidating the management of the sites. Y-12 and Pantex had been managed for well over a decade by two B&W subsidiaries, B&W Technical Services Y-12 and B&W Technical Services Pantex.

In a July 1 statement from the NNSA Production Office, Manager Steve Erhart said, "The new contract will allow NNSA to continue the safe and secure maintenance of the nuclear weapons stockpile; provide enriched uranium for naval, research, and isotope production reactors; and support non-proliferation activities to reduce the global nuclear threat. The conclusion of this transition will bring much needed stability to

Bechtel's Consolidated Nuclear Security is now the management and operating contractor for both the Y-12 National Security Complex and the Pantex Plant.

the thousands of men and women who play an important role in our enduring national security mission. All contract transitions create some change and uncertainty. But, throughout this process, the highly skilled professionals at Pantex and Y-12 have remained focused and dedicated to the safe and secure completion of the mission."

Other NNSA news

The NNSA has announced the appointment of Tim Driscoll, a senior defense programs official, as the agency's uranium program manager, a newly created position with responsibility for overseeing all uranium manufacturing in support of U.S. national security.

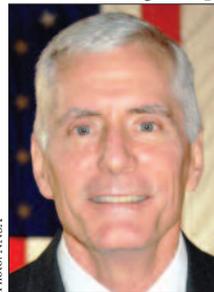


Photo: NNSA

Driscoll

In a statement on the appointment, NNSA Administrator Frank Klotz said, "Mr. Driscoll will be responsible for balancing resources among the challenges and will create a cohesive, results-oriented uranium program for NNSA that will foster cross-communication of ideas and information."

The appointment of Driscoll is believed to be one of the first steps in carrying out the recommendations of the recent NNSA-endorsed "Red Team" report, which rejected the concept of a single, "big box" Uranium Processing Facility at the Y-12 Nation-

al Security Complex (*NN*, July 2014, p. 42). Driscoll was a member of that team.

■ The construction of the Pantex wind farm (*NN*, Mar. 2013, p. 86), officially known as the Pantex Renewable Energy Project (PREP), was completed in June and was dedicated by NNSA Administrator Frank Klotz at a June 17 ceremony. "Pantex has an important and enduring mission, ensuring the safety and effectiveness of U.S. nuclear weapons," Klotz stated in a June 18 press release. "In carrying out this mission, here at Pantex and elsewhere in the nuclear security enterprise, we are committed to managing costs and to delivering projects on time and under budget. The Pantex Renewable Energy Project is a major milestone toward keeping that promise to the U.S. taxpayer."

According to the NNSA press release, the 11.5-MW, five-turbine PREP will generate approximately 47 million kilowatt-hours of electricity annually, enough to power 3,500 homes, and will reduce CO₂ emissions by more than 35,000 metric tons per year, the equivalent of removing 7,200 cars from the road each year or planting 850,000 trees. The NNSA estimates that some 60 percent of the electricity needed for Pantex's operations will be provided by PREP, which is situated on 1,500 acres of land adjacent to the Pantex facility.

PREP was built by Siemens under a finance model known as an energy savings performance contract, which allowed for the construction of the facility with no up-

Photo: NNSA



Pictured (from left to right) at the Pantex Plant wind farm ribbon-cutting ceremony on June 1 are NNSA Administrator Frank Klotz, DOE Chief of Staff Kevin Knobloch, NNSA Production Office Manager Steve Erhart, Siemens Government Technologies' President and Chief Executive Officer Judy Marks, and Texas Tech University's Associate Vice Chancellor and Director of Corporate Engagement Russell Thomasson.

front costs to the taxpayers. According to the NNSA press release, Siemens will be paid directly from the value of guaranteed energy savings generated by the turbines, an amount expected to average \$2.8 million annually.

■ In early June, the NNSA conducted an International Consequence Management training course in Armenia to provide attendees with information on methods for establishing a monitoring and assessment program in the aftermath of a nuclear or radiological incident. Forty individuals from 18 Armenian ministries and organizations participated in the course, receiving hands-

on equipment training in monitoring techniques, as well as instruction in data collection and analysis. The course was conducted by personnel from National Security Technologies' Remote Sensing Laboratory at Joint Base Andrews and Nellis Air Force Base in Las Vegas, Nev.

NRC

Guidelines on firearms use by security forces revised

The Nuclear Regulatory Commission has issued revised guidelines for the use of

Photo: NNSA



NNSA personnel conduct an International Consequence Management course in Armenia on June 4.



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Security Briefs

THE NRC HAS AMENDED ITS EXPORT/IMPORT REGULATIONS as they pertain to nuclear materials and equipment, publishing the final rule in the July 10 *Federal Register*. The changes were made to bring U.S. export controls in line with the revised guidelines of the Nuclear Suppliers Group (NSG)—a group of nuclear supplier countries, including the United States, that seeks to contribute to the nonproliferation of nuclear weapons through the implementation of guidelines for nuclear and nuclear-related exports—as well as to incorporate the current version of the International Atomic Energy Agency’s “Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities.” The final rule goes into effect on August 11, except for changes to 10 CFR 110 appendix M and §110.44(a) and (b)(1), which go into effect on December 31. The NSG guidelines can be accessed at <www.nuclearsuppliersgroup.org>.



THE DEFENSE THREAT REDUCTION AGENCY HAS AWARDED a \$2.8-million contract to Alion Science and Technology, an engineering, research and development, and information technology firm based in McLean, Va., to conduct R&D into new nuclear detection technologies. According to an Alion press release, the company will develop new methods for employing an advanced detection system that uses bundles of thin copper tubes, called “straws,” coated with boron. Current detection systems typically rely on helium-3, the supply of which is rapidly dwindling. Under the contract, Alion will research ways to make the boron-coated straw detector directional, allowing users to precisely locate radiological sources. Current He-3 detectors can alert users only to the presence of neutrons.

“By researching the means to make the boron-coated straw detector more precise and more reasonable to produce, Alion can help DTRA employ improved technologies to mitigate threats effectively and keep warfighters and citizens safe,” said Terri Spoonhour, Alion’s senior vice president and Distributed Simulation Group manager. “But, beyond providing a drop-in replacement for He-3 detector components, this engineering effort opens up a number of possibilities for new or enhanced portable systems that can be carried into questionable areas or permanently installed to protect ports and depots.” Alion’s teaming partner is Proportional Technologies Inc., of Houston, Texas.



THE NRC HAS APPOINTED TWO ADJUDICATORY EMPLOYEES to advise the agency on issues related to the review of an Atomic Safety and Licensing Board’s initial decision in the case of Shaw AREVA MOX Services’ application for a license to possess and use strategic special nuclear material at the Mixed Oxide Fuel Fabrication Facility, currently under construction at the Savannah River Site. The ASLB proceeding arose from contentions filed by Nuclear Watch South, the Blue Ridge Environmental Defense League, and the Nuclear Information and Resource Service, which challenged MOX Services’ material control and accounting system. The appointees are Larry Harris, senior materials program manager, and John Rycyna, senior security specialist, both from the Nuclear Regulatory Commission’s Office of Nuclear Security and Incident Response. An announcement of the appointments was published in the July 8 *Federal Register*.



MEXICAN OFFICIALS SECURED A QUANTITY OF IRIIDIUM-192 on July 4 that had been in a pickup truck that was stolen the day before in Tlalnepantla, a suburb of Mexico City. The material was found abandoned on a road several miles from where the truck had been hijacked, in an intact specialized container, which, according to a statement from Mexico’s Interior Ministry, prevented it from posing a health risk. Ir-192 is used in industrial radiography to detect flaws in metal components. Just one month before, on June 8, a group of armed thieves stole a device containing cesium-137 and americium-beryllium from a Mexican government research facility in Tultitlán.



THE NRC HAS SUSPENDED GENERAL ATOMICS’ LICENSE to export a research reactor to Thailand. The Nuclear Regulatory Commission’s June 28 order was the result of the expiration on June 27 of the 123 agreement between the United States and Thailand. According to the order, the suspension will be lifted when a new 123 agreement between the two countries comes into force and the necessary assurances are received from Thailand. A pact under Section 123 of the Atomic Energy Act allows the transfer of nuclear material, equipment, or components from the United States to other nations.

firearms by its licensees’ security personnel. With the revisions, the NRC no longer requires all licensees and certificate holders eligible to apply for 161A preemption authority to submit their security officers to an FBI-administered firearms background check regardless of whether or not a particular licensee or certificate holder intends to apply for that authority. (“Preemption authority” is a term denoting NRC permission for a licensee to arm its protective force with firearms, ammunition, and other devices—including large-capacity ammunition feeding devices—notwithstanding local, state, or federal laws prohibiting such possession and use.) Under the revised guidelines, only security officers of NRC licensees and certificate holders that have actually applied for preemption authority are required to undergo background checks. According to the agency, this adjustment will reduce the administrative and financial burden on licensees, as well as on the NRC and the FBI.

The NRC first issued its firearms guidelines on September 11, 2009. The revised version, which was approved by the U.S. attorney general on March 21 of this year and by the NRC on May 28, went into effect on June 25. “Guidelines on the Use of Firearms by Security Personnel in Protecting U.S. NRC-Regulated Facilities, Radioactive Material, and Other Property, Revision 1” can be accessed from the NRC’s ADAMS document retrieval system at <www.nrc.gov>, by using accession number ML14108A422. Notification of the issuance of the guidelines was published in the June 25 *Federal Register*.

NRC submits annual security report to Congress

The NRC’s annual report on its nuclear security inspection program was submitted to Congress on June 25, providing lawmakers with information regarding the security and safeguards performance of the nation’s commercial nuclear power plants and Category I fuel cycle facilities in calendar year 2013. (Category I facilities are those that deal with special nuclear material of high strategic significance.)

According to the report, the NRC conducted a total of 289 security inspections at nuclear power plants and Category I sites, including 23 force-on-force (FOF) inspections, wherein teams of mock adversaries are deployed in order to test the sites’ protective capabilities. During the FOF inspections, 24 findings were identified, all rated “green,” or of very low security significance. “Two of the findings resulted from the failure to effectively protect designated target set components during NRC-evaluated FOF exercises,” the report states.

Of the 255 non-FOF inspections conducted at nuclear power plants, 182 (71 percent) yielded no findings. Of the 125 findings that were identified, 114 (91 percent)

were characterized as green, and four as “greater than green.” In addition, five were termed Severity Level IV findings (the least significant of the NRC’s four severity levels), and two were found to be greater than Severity Level IV.

Also in 2013, the NRC began conducting inspections of power reactor licensees’ cybersecurity plans and implementation, as well as preparations for responding to potential aircraft threats. The agency completed 20 cybersecurity inspections in 2013 and identified no significant violations. “Most inspections revealed several very low security significance violations of cybersecurity plan requirements,” the report states. “Because the cybersecurity requirements are new, and licensees have demonstrated a good-faith attempt to implement the requirements, the NRC has used enforcement discretion for these violations.” Regarding aircraft threat response preparation, the NRC completed 50 inspections during 2013 and failed to identify any significant issues.

An unclassified version of the document, *Report to Congress on the Security Inspection Program for Commercial Power Reactors and Category I Fuel Cycle Facilities: Results and Status Update*, can be accessed through the NRC’s ADAMS document retrieval system at <www.nrc.gov>, through the use of accession number ML14184A646.



JAPAN IS THE 77TH NATION TO SIGN THE AMENDED CPPNM. The Convention on the Physical Protection of Nuclear Material, signed in Vienna and New York in March 1980, is the only international legally binding document concerning the physical protection of nuclear material. The 2005 amendment to the convention strengthens its provisions and makes it legally binding for parties to protect nuclear facilities and material in peaceful domestic use, storage, and transport. In addition, it facilitates cooperation between state parties in cases of nuclear or radiological sabotage. The amendment, which the United States has yet to approve, requires ratification by an additional 22 states before it can enter into force. In the above photo, Ambassador Toshiro Ozawa (at left), resident representative of Japan to the International Atomic Energy Agency, delivers the instrument of acceptance to IAEA Director General Yukiya Amano on June 27, following its formal approval by the Japanese government earlier that day. **IN**

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UNITED KINGDOM

Toshiba, GDF Suez close new-build deal

The planned Moorside nuclear new-build project was given a boost with the closing of a deal between Toshiba and GDF Suez that gives the Japanese company a 60 percent stake in the nuclear development company NuGeneration Ltd. (NuGen), which plans to build three Westinghouse AP1000 reactors at its site in northwest England. French energy company GDF Suez had held a 50 percent stake in NuGen, and will retain a 40 percent share.

In the joint June 30 announcement, Hisao Tanaka, president and chief executive officer of Toshiba, Westinghouse Electric Company's parent company, said that the contract's completion "reconfirms Toshiba's, GDF Suez's, and Westinghouse's commitment to build three AP1000 reactors" at the site on land to the north and west of the Selfield nuclear fuel complex in West Cumbria. Talks between the two concerns started earlier this year after Toshiba purchased the 50 percent stake in NuGen held by Spain's Iberdrola (*NN*, Feb. 2014, p. 17).

According to the announcement, a new NuGen management team will also be formed under CEO Sandy Rupprecht, who will be concentrating on immediate project milestones, such as site assessments, site layout, and recruitment of leading nuclear

With a 60 percent stake in NuGeneration Ltd., Toshiba plans to build three AP1000 reactors in northwest England.

professionals to join the project. The team will also be working closely with stakeholders "to keep them informed and included in the process," said Rupprecht, adding that the Moorside project is "the most exciting new nuclear build project in Europe, without a doubt." NuGen, which plans to undertake the first public consultation on its plans next year, hopes to make the final investment decision for the project by the end of 2018.

Before then, the Westinghouse design must undergo the Generic Design Assessment procedure conducted by the country's nuclear regulators and required if a design is to be licensed in the United Kingdom. In 2011, having received an interim acceptance of the design, Westinghouse suspended the process until it secured a U.K. customer to build a new AP1000 plant.

Construction of each reactor will take approximately four years, with the first unit to come on line in 2024 and all units to be in commercial operation by 2026. With a com-

bined output of around 3.4 GWe, the project will deliver about 7 percent of the country's future electricity requirements. The fuel for the reactors, which will be Europe's first AP1000s, will be supplied by Westinghouse's Springfields fuel fabrication facility at Preston in the United Kingdom.

The announcement also noted that the Nuclear Decommissioning Authority has agreed to extend NuGen's land option for the site, which is valued at about £200 million (about \$343 million).

Gérard Mestrallet, GDF Suez's chairman and CEO, paid particular tribute to the United Kingdom's "strong strategic vision and political consensus," which have enabled the country to create a legal and industrial framework for new nuclear projects that is attractive to investors. Westinghouse President and CEO Danny Roderick added, "The local economy will reap many benefits as a result of this project, including calling upon the local supply chain and creating thousands of skilled jobs."

U.K. government to take control of foreign plutonium

The United Kingdom is taking ownership of nearly a ton of foreign separated plutonium that is being stored there by two European reprocessing customers: a Swedish utility (about 800 kg) and a German research organization (about 140 kg). The names of the organizations and the value of the agreements were not disclosed. Ownership will be transferred to the U.K. Nuclear Decommissioning Authority (NDA).

A government statement explained, "Title transfers offer a cost-effective and beneficial arrangement which allows the U.K. to gain national control over more of the civil plutonium in the U.K. and avoids the need to physically transport separated plutonium," which involves significant security measures. The statement also stressed that these transactions will not result in any new plutonium being brought into the country or an increase in the overall amount of plutonium in the United Kingdom. In addition, according to the statement, "The financial benefits to the U.K. of taking ownership are considered to be sufficient to offset the estimated long-term cost of managing that plutonium in the U.K."

In a July 3 written statement to parliament, Energy Minister Michael Fallon explained that the possibility of taking own-

ership was set out in a government policy statement on plutonium management in December 2011. According to that policy statement, "Subject to compliance with intergovernmental agreements and acceptable commercial arrangements, the U.K. is prepared to take ownership of overseas plutonium stored in the U.K."

In line with this policy, the NDA will continue to engage with other foreign concerns regarding plutonium in the United Kingdom arising from previous reprocessing contracts.

Graphite loss limit relaxed at Dungeness B

The United Kingdom's Office for Nuclear Regulation (ONR) has approved an increase in the allowed weight loss of graphite blocks in the Dungeness B reactor cores from 6.2 percent to 8 percent. According to operator and owner EDF Energy, the justification for relaxing this requirement is based on the results of its continuing monitoring program of the station's two advanced gas-cooled reactors (AGR), which includes full inspections of the graphite cores and physical sampling of the graphite. This information is fed into computer models and analyses to ensure that the reactors' safety margins remain "robust and appropriate." EDF Energy said that it expects to request further increases in the al-

lowed weight loss if it is justified by the data.

The loss of mass over time is one of the normal aging processes of AGR graphite, the behavior of which has been studied for many decades. According to Martin Pearson, Dungeness B's station director, "The increase in weight-loss limits has been based on an extensive program of modeling and sampling. The limits are set at conservative levels and still include wide safety margins. This gives us the knowledge and confidence that the reactors are well within safe limits of operation."

ONR's approval of the weight-loss requirement also supports EDF Energy's safety case for a 10-year life extension of Dungeness B, allowing operation to continue until 2028. The company hopes to confirm this with the ONR by the end of the year. To ensure that the safety margins continue to be satisfactory, plant modifications have been developed and are being implemented. EDF Energy is also investing in the extension of the lives of its other nuclear plants.

RUSSIA

Beloyarsk BN-800 fast reactor goes critical

The Beloyarsk-4 BN-800 sodium-cooled fast reactor in Russia reached initial criticality on June 27 and began operating at the minimum controlled power level of about

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one-tenth of 1 percent of nominal power while system tests were launched. The operators will continue to test and raise the power in stages, with the next major milestone being grid connection in a few months. Regular operation at the reactor's nominal capacity of 789 MWe is not expected until 2015.

In the press release announcing the event, Beloyarsk's director, Mikhail Vasilyevich Bakanov, celebrated this long-awaited achievement. Early measurements confirmed that the plant systems were functioning properly, Bakanov said, ensuring that the reactor will work as well as its predecessor, Beloyarsk-3, a BN-600 fast reactor.

Startup of the plant, according to the press statement, also has global significance, since fast reactors are being developed or being considered for future deployment in a number of countries besides Russia. Beloyarsk-4 will be used to demonstrate fast reactor technology using both uranium and a mixed-oxide fuel. The reactor will form the basis of a closed nuclear fuel cycle that breeds plutonium from leftover uranium in the spent fuel, as well as other sources of uranium. It will also be used to burn long-lived isotopes and plutonium from dismantled nuclear weapons.

Beloyarsk-3, the BN-600 pilot plant for the country's fast reactor design, has been in operation since 1980. Construction of Unit 4 began in 1984, but all nuclear plant construction in Russia was halted after the Chernobyl accident in 1986. Not until 2006 did the government include the project in

the Federal Target Program and provide the funds to construct the plant.

During the time that the project was suspended, the BN-800 design was significantly improved, and, according to its developer, Afrikantov OKBM, it will meet the latest requirements in terms of performance, safety, and clean operation. The company is also developing a commercial 1200-MWe version of the reactor that will form the basis of serial construction. The first is likely to be Unit 5 at Beloyarsk.

INDIA

India accepts stronger IAEA safeguards inspections

The Indian government has said that it will soon ratify the Additional Protocol granting the International Atomic Energy Agency stronger safeguards inspection powers than those in the basic safeguards agreement that is already in force. India was committed to adopting the Additional Protocol under the U.S.-India nuclear agreement that was signed in 2008. India is also expected to meet another commitment set out in the joint agreement, which is to add, during 2014, the two Narora pressurized heavy-water reactor units to the list of civilian nuclear plants under IAEA safeguards. These are the last of the 14 power reactors included in India's "Separation Plan," which lists all the reactors and other nuclear plants that are to be considered civilian facilities and placed under IAEA safeguards. Other

nuclear facilities considered by India as having strategic (particularly military) purposes are not under agency safeguards.

As is customary for such legal instruments, the Additional Protocol was signed by the Indian government in May 2009, but will come into force only when it is ratified by the national legislature and deposited with the IAEA. This protocol is considered particularly important as it gives agency inspectors broader rights of access to civilian nuclear facilities.

According to the July 9 government announcement to the Indian parliament, ratifying the Additional Protocol will help India build on the gains already made by the 2008 agreement, which has helped increase power production from India's nuclear plants. The announcement also said that signing the Additional Protocol demonstrates India's support for nuclear nonproliferation and the safeguards system of the IAEA.

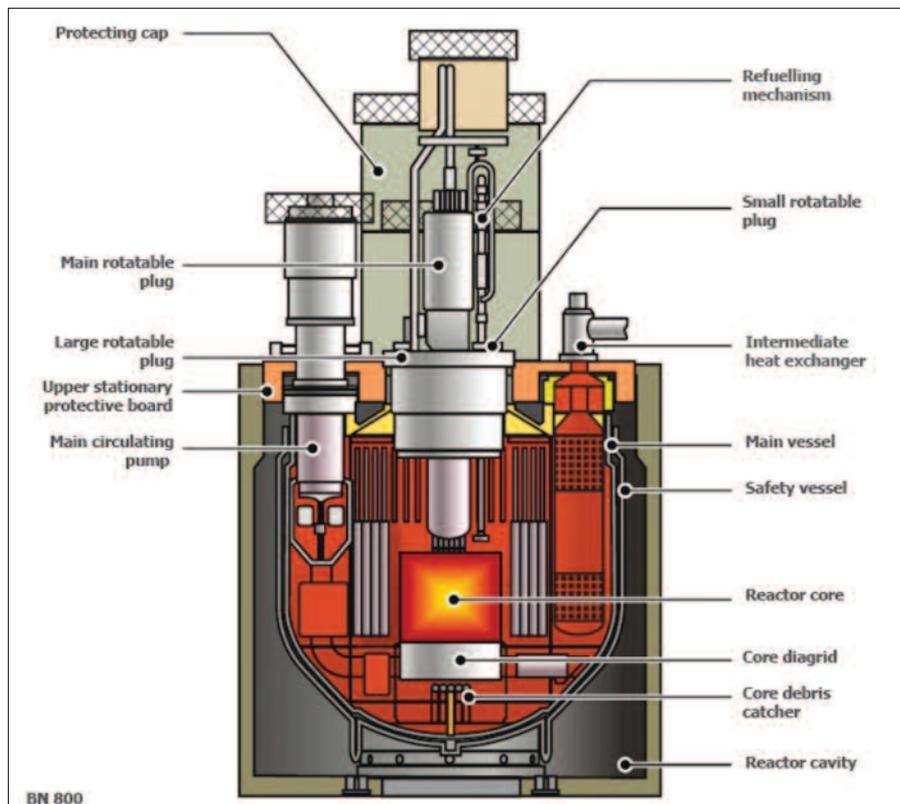
The U.S.-India deal paved the way for the Nuclear Suppliers Group (NSG)—which sets out rules for engaging in international nuclear-related trade—to permit India to undertake commercial nuclear trade, such as purchasing uranium, which continues to be in short supply in the country. An NSG waiver was necessary, as India has not signed the Nuclear Non-Proliferation Treaty and therefore has been excluded from nuclear trade with members of the NSG. According to media commentators in India, the ratification of the Additional Protocol is also seen as a strong indication that the new prime minister, Narendra Modi, wants to have a good relationship with U.S. President Barack Obama, whom he is expected to visit in September. It should also bolster India's aspiration to become a member of the NSG.

EUROPEAN UNION

Council approves nuclear safety directive update

National nuclear safety regulators in the European Union (EU) will gain more power and independence under an amendment to the EU's Nuclear Safety Directive, which was adopted by the European Council of Ministers on July 8. According to a European Commission (EC) statement, the update to the directive, which has been in force since 2009, provides a stronger framework for nuclear safety, a measure that was called for by EU member states in the aftermath of the 2011 accident at the Fukushima Dai-ichi nuclear power plant. Under EU rules, member states must transpose the provisions of the directive into their national law within three years.

The amended directive reinforces the 2009 version with a number of new measures. Besides strengthening the powers of national regulators, the amendment introduces a high-level EU-wide safety objective



Cutaway diagram of the BN-800

International Briefs

TALKS FOR MORE RUSSIAN REACTORS IN IRAN took place in Tehran on June 23 and 24. Two new units have been proposed for the Bushehr site, where Iran's only power reactor is now in operation. During this latest round of talks, Nikolai Spassky, deputy director general for international affairs at Russian reactor vendor Rosatom, met with Iranian officials, including Ali Akbar Salehi, the head of the Atomic Energy Organization of Iran (AEOI), and Seyyed Abbas Araqchi, Iran's deputy foreign minister. According to AEOI spokesman Behrouz Kamalvandi, agreement was reached on general legal, technical, and commercial issues regarding a project to construct two 1,000-MWe units equipped with desalination plants. Kamalvandi told Iranian news agencies that a cooperation protocol on the project is expected to be signed in a few months and that construction of the two new power reactors could start early next year. Plans for additional units at Bushehr were included in the 1992 nuclear cooperation agreement between the two countries.

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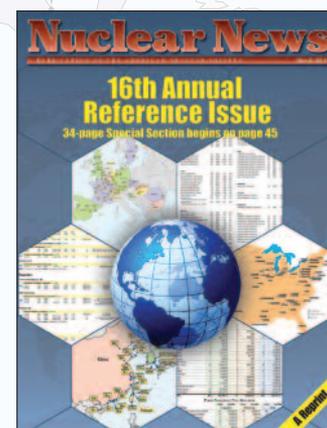
ARGENTINA'S ATUCHA-2 WAS CONNECTED TO THE GRID on June 30. Among those in the control room for the start of power generation of the 692-MWe heavy water reactor, which is now also known as the Néstor Kirchner plant, was Julio De Vido, federal minister for planning, along with local political figures and nuclear officials. De Vido described this milestone as a "proud day for all Argentines." Atucha-2 achieved initial criticality on June 3 within a few days of receiving authorization from the regulator to commence the nuclear commissioning. Testing of the plant will continue at various power levels to verify the behavior of the reactor's systems. Power will be gradually increased until the reactor finally reaches its nominal capacity, which is expected in November.

Construction of Unit 2 began in 1981, but was suspended in 1994 due to severe funding problems and other issues. In 2006, Néstor Kirchner, who was then Argentina's president, announced a strategic plan to relaunch the country's nuclear program, which included completing Atucha-2.

Nuclear News

2014 World List of Nuclear Power Plants

The World List of Nuclear Power Plants, a reprint from the March 2014 issue of **Nuclear News**, provides data on nuclear plants worldwide that are operable, under construction, or on order as of December 31, 2013. Plant listings are arranged alphabetically by country and by utility, with information on net MWe, reactor type, reactor model, initial criticality, commercial start, reactor supplier, and major participants. The 36-page reprint, available either as a PDF download or print copy, includes the entire Reference Section from the March issue: the updated World List (and notes), the maps showing the location of each plant site, and the tables.



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to prevent accidents and avoid radioactive releases. To meet this objective, the directive requires member states to ensure that "nuclear installations are designed, sited, constructed, commissioned, operated, and decommissioned with the objective of preventing accidents, and, should an accident occur, mitigating its consequences and avoiding radioactive releases."

According to the EC, this means that at all stages of the life cycle of a nuclear installation, a government must make nuclear safety its first priority. The EC further explained that for new nuclear power plants, this objective is to be understood as calling for significant safety enhancements in the design, using state-of-the-art knowledge and technology and taking into account the latest international safety requirements. For existing plants, "this objective should lead to the implementation of reasonably practicable safety improvements."

The amendment also includes other safety goals, calling for countries to do the following:

- Increase transparency on nuclear safety matters by informing and involving the public.
- Promote an effective nuclear safety culture.
- Enhance accident management and on-site emergency preparedness and response arrangements and procedures.

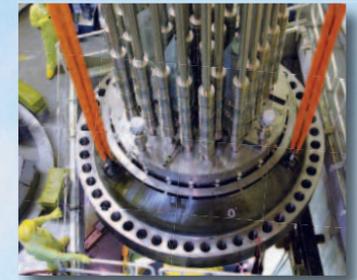
With respect to the strengthening of na-

tional regulatory authorities, the commission statement made clear that regulators must be assured full independence from outside influences in their regulatory decision making, and be given the resources to carry out their responsibilities. This means being provided with the necessary legal powers, money, and qualified and experienced staff.

The amendment also establishes a European system of topical peer reviews in which regulatory authorities undertake an in-depth examination of a specific safety issue. The results of each national review will be submitted for peer review by other EU countries. The findings of the peer reviews are expected to be translated into concrete technical recommendations. This exercise will be carried out every six years, starting in 2017. The commission sees these topical reviews as supporting the development of a common understanding on nuclear safety issues. The introduction of topical peer reviews was largely inspired by the peer review process used during the nuclear stress tests conducted after the Fukushima accident. Those stress tests focused on how EU nuclear plants would behave faced with extreme external events.

Today, more than 130 power reactors are in operation in 14 EU countries, providing 27 percent of the electricity and more than half of the low-carbon power produced in the EU.

IN



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WIPP

LANL admits to errors in processing of nuclear waste sent to WIPP

In a letter released on July 3, Los Alamos National Laboratory officials informed the New Mexico Environmental Department (NMED) that an internal probe of the lab's transuranic waste packaging practices has revealed certain "noncompliances" with LANL's Hazardous Waste Facility Permit. The investigation was spurred by the radioactive release at the Waste Isolation Pilot Plant on February 14 that many experts believe was caused by a ruptured LANL waste drum (NN, June 2014, p. 17).

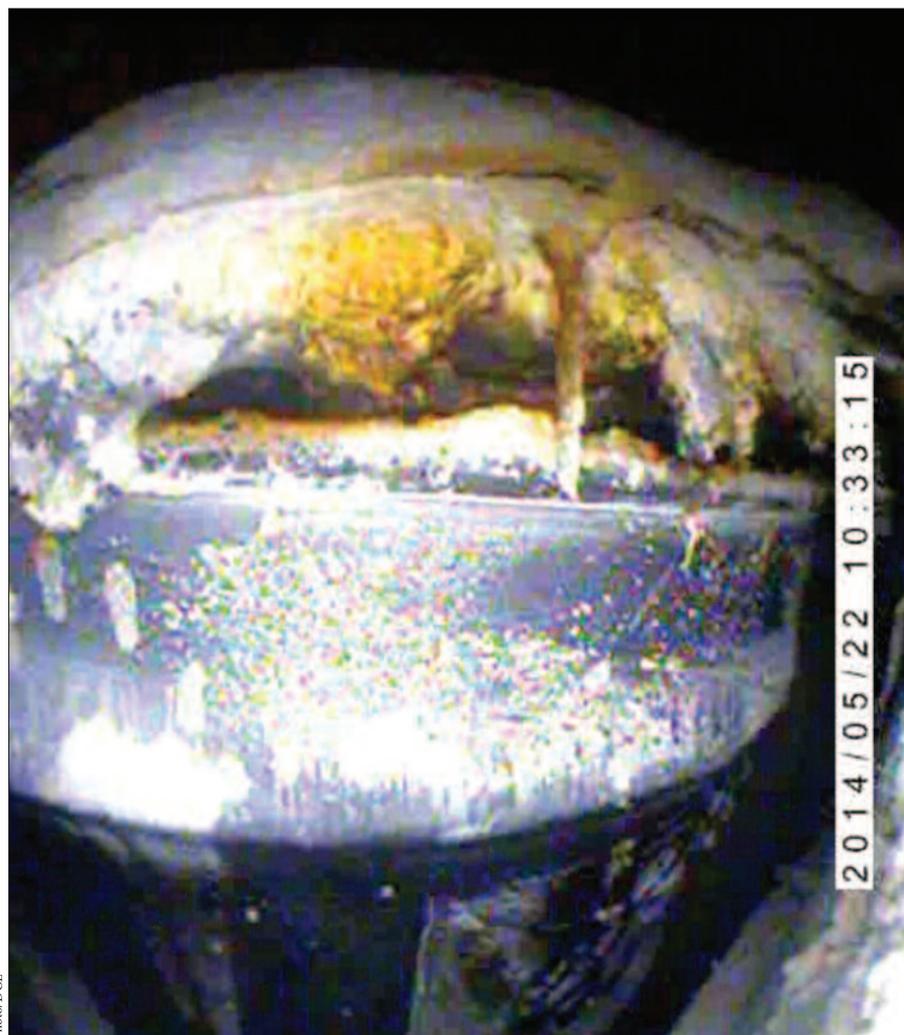
LANL said in the letter that lab workers failed to follow proper procedures in packaging nitrate salt-bearing waste, a process that beginning in August 2012 included the use of an organic, wheat-based cat litter as an absorbent in place of the previously used inorganic litter. (A leading theory suggests that a chemical reaction between the organic litter and the nitrate salts in the waste led to the drum rupture.) The letter also stated that the lab failed to follow up on waste that tests indicated was highly corrosive.

LANL added, however, "At this time, there is insufficient information to conclude that these reported noncompliances relate to the radioactive release at WIPP."

Responding to the LANL letter in a statement, NMED officials said that they are reviewing the noncompliances and plan "to take appropriate actions" after the department has conducted its own review of the incident at WIPP and the activities at LANL.

At this writing, LANL has halted the processing of nitrate salt-bearing drums while officials continue their investigations. A total of 86 of the drums are stored in domes at the lab's Area G waste facility. Of those, 57 have been treated with the organic cat litter, while 29 have yet to be processed. The lab has formed a remediation team to de-

Los Alamos National Laboratory has acknowledged that it mishandled the packing of nuclear waste linked to the radiation leak at the Waste Isolation Pilot Plant.



A close-up of the unsealed waste container in Room 7 of Panel 7, taken on May 22.

not injured in the incident, the DOE rated both the hazard identification and crane operational safety violations at Severity Level I, meaning they carried the potential for death or serious harm. The training and information violation was classified at Severity Level II, a level the DOE characterizes as “other than serious.”

Regarding the crane operational safety violation, the preliminary NOV states: “FBP failed to operate the 60-ton mobile crane within the rated lifting capacities described in the crane manufacturer’s rating manual. . . . The manual states that the crane lifting capacity when operated on tires shall not exceed 75 percent of the tipping load. The manual also states that the rated lifting capacities must include the weight of the hook block (estimated to be 977 pounds). The crane boom was extended 100 feet at an angle of approximately 40 degrees when the crane tipped forward. This configuration is not permitted by the manufacturer when the crane is operated on tires over the front without the use of outriggers.”

The DOE reduced FBP’s contract fee by \$150,000 for a negative safety performance trend during fiscal year 2012 and continuing into FY 2013, specifically citing the crane incident as one reason for the reduced fee. In view of that action, the DOE has decided not to propose any civil penalty in the matter.

FBP was given 30 days to reply to the preliminary NOV. If no reply is submitted, the preliminary NOV will constitute the final order.

DECOMMISSIONING

Mallinckrodt seeks lower financial assurance

Mallinckrodt LLC, a longtime manufacturer of products that use radioactive materials, has asked that the Nuclear Regulatory Commission allow the company to reduce its financial assurance ceiling for a decommissioning project in Hazelwood, Mo. The change requires an amendment to Mallinckrodt’s source materials license, and in the July 11 *Federal Register*, the NRC gave notice of the amendment request and opened an opportunity to request a hearing and to petition to intervene.

The decommissioning of Mallinckrodt’s Columbian-Tantalum (C-T) Plant has been carried out in two phases, the first of which—the decontamination of buildings and equipment—was completed to the NRC’s satisfaction in February 2007. The physical work for the second phase—the remediation of building slabs and foundations, paved surfaces, and subsurface material—has been completed, but it has not yet been concluded through surveys and inspections that the work satisfies NRC requirements for the termination of the license. Mallinckrodt asserts that the remaining project costs are limited to contractor and consulting fees, plus oversight and contingency costs, and that the assurance need not be greater than \$5,600,337. The current assurance, which Mallinckrodt is required to make available, is \$21,113,000.

Columbium is another name for the element now commonly known as niobium. (During the 19th century, when advances in chemistry made it possible to fill in the blanks on what became the periodic table of elements, different researchers sometimes isolated the same element at about the same time, and claimed naming rights; the element now known as tungsten carries the symbol W, a holdover from its variant name of wolfram.) Tantalum has chemical properties similar to those of niobium/columbium, putting the elements in the same column of the periodic table. These two elements are not themselves radioactive, but the ores from which they are extracted often contain substantial amounts of naturally radioactive uranium and thorium.

Processing at the C-T plant ended in 1989. In a survey report in April, Energy-Solutions LLC said that it considers the second-phase work to have met the NRC’s requirements and that the license should be terminated.

Hearing requests and petitions to intervene will be accepted through September 9 at <www.regulations.gov>, with a search for Docket ID NRC-2014-0164.

HIGH-LEVEL WASTE

NRC: Yucca Mountain SER first, then EIS

In its monthly status report to Congress on its resumption of technical reviews for the proposed high-level waste repository at Yucca Mountain, in Nevada, the Nuclear Regulatory Commission stated on June 20 that it is on schedule and within budget to complete the safety evaluation report (SER) in January. The report also stated that work on the supplement to the environmental impact statement (EIS) will not begin until at least the fall, and only after the NRC staff determines whether there is enough money left in the allocation from the Nuclear Waste Fund to complete the job.

The NRC’s work toward technical and regulatory goals seems like a small island of calm in the midst of a long-running pitched battle between the Obama administration and Republicans in the House of Representatives over the fate of the Yucca Mountain repository project. Sen. Harry Reid (D., Nev.) has used every means at his disposal to prevent the repository from being licensed and built in his state, including orchestrating the appointment of his onetime aide Gregory Jaczko as an NRC commissioner. Since Barack Obama became president, he and his administration have supported Reid, in part by trying to block appropriations for licensing.

The entire tortuous history of the conflict will not be rehashed here. It has, after all, been reported in this magazine over the past several years. Suffice it to say that under a

Waste Management Briefs

THE LATEST NUHOMS CASK AMENDMENT WILL WAIT until the Nuclear Regulatory Commission can address adverse comments and issue a final rule. On April 15, the NRC published both a proposed rule and a direct final rule approving Amendment No. 3 to the certificate of compliance for Transnuclear’s NUHOMS Horizontal Modular Storage System for spent reactor fuel (*NN*, June 2014, p. 85). The direct final rule was to go into effect on June 30 if no adverse comments were received by May 15, but because there were 13 such comments, the direct final rule was withdrawn on June 25.



THE COMMENT PERIOD ON THE NRC’S REGULATION OF LLW has been extended. On May 15, the Nuclear Regulatory Commission published a request for public comment on its low-level waste regulatory program to provide input for an update to the strategic assessment that was issued in 2007 (*NN*, June 2014, p. 88). At that time, the deadline for comments was set for July 14. In the July 9 *Federal Register*, the NRC announced that comments will continue to be accepted through September 15. Comments can be submitted by mail to Cindy Bladey, Office of Administration, Mail Stop: 3WFN-06-44M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; or electronically to <www.regulations.gov>, with a search for Docket ID NRC-2014-0080.



HOLTEC’S USED FUEL DRYING TECHNOLOGY IS NOW AVAILABLE to any dry storage facility owner under an appropriate license. Holtec International announced on July 7 that its patented Forced Helium Dehydration technology, which is used to dry spent fuel as it is moved from water pools into dry casks, previously was available only to owners of Holtec dry casks. Holtec will also provide technical advice to users to adapt their canisters/casks for use of the technology.

federal court ruling in a lawsuit filed by various litigants who want the repository to be licensed, built, and opened, the unexpended funds allocated from the Nuclear Waste Fund for the NRC's technical reviews are now being used until they run out.

The NRC is an independent federal agency, and it does not take orders from the White House. The Department of Energy, however, is a part of the administration. The DOE's attempt to withdraw as the license applicant for Yucca Mountain has included a refusal to prepare an EIS supplement, which the NRC determined was necessary for the licensing process. The NRC, therefore, decided that it will write the EIS supplement, which will require more money than the adoption of a supplement written by the DOE.

It appears that there will be enough money available to complete the SER (the cost of work to date is estimated to be within the budget of \$8.3 million). The staff's assessment this fall is intended to determine whether there is enough money left (from what is provided through the court ruling) to produce an EIS supplement that meets all requirements under the National Environmental Policy Act.

Even if there is enough money for all staff work, it is considered unlikely that there would then be enough money left to carry through the actual licensing process for



Yucca Mountain: Current funding is enough for one document, maybe both.

Yucca Mountain. Some repository proponents, however, believe that if the NRC at least documents the suitability of Yucca Mountain (through the SER and the EIS supplement), the case in favor of the repos-

itory would gain ground, and perhaps the project could resume someday in a federal complex that no longer includes the current administration and is (somehow) less influenced by Harry Reid. **IN**



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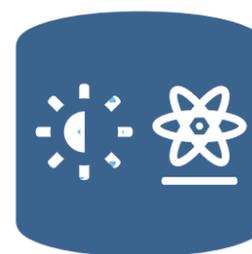
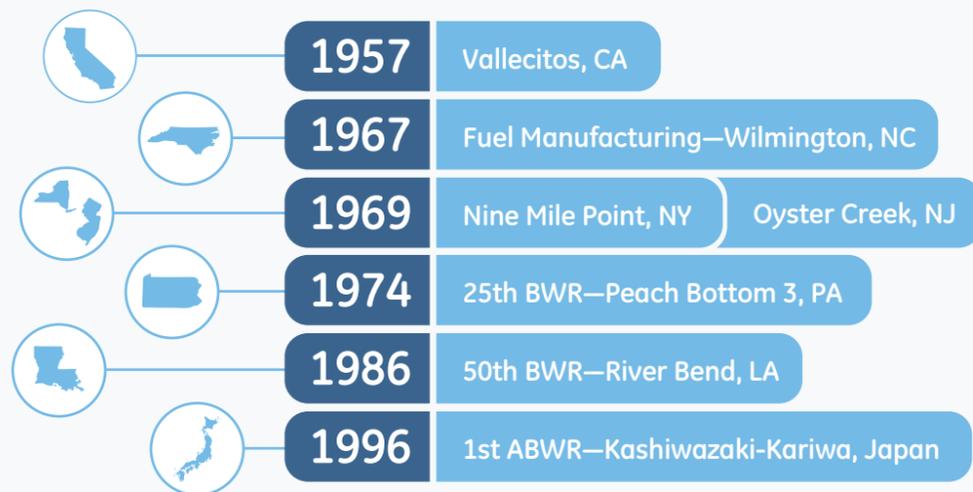
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Global Laser Enrichment
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2012

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Stinger
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2014

PRISM
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Westinghouse Manufacturing: Meeting Customer Needs Around the Clock

For nuclear utilities, response time for emergent issues is critical, especially during an outage. In the midst of a recent outage, a utility discovered that some reactor coolant pump (RCP) bolts needed to be replaced. The bolts were not standard replacement parts and had to be custom manufactured on deadline in order to meet the outage schedule.

Knowing that Westinghouse has the capabilities to manufacture major components, the utility contacted Westinghouse to provide the RCP bolts. Westinghouse's manufacturing facilities are staffed around the clock, and the company's skilled welders, machinists and manufacturing technicians were able to safely manufacture high-quality parts to meet the customer's outage schedule and deadline.

Westinghouse's world-class, global manufacturing capabilities include: precision machining with heavy and light Computer Numerical Control System (CNC) mills and lathes; large horizontal and vertical



An air tank mid-frame is prepared for fabrication by a Westinghouse fabrication mechanic.

CNC boring mills; heavy crane capacity (up to 200 tons); fuel-handling equipment manufacturing, nuclear fuel and components manufacturing; instrumentation and control, and electro-mechanical products. Westinghouse welders, machinists and technicians are experienced in working with numerous metals, including stainless steel, carbon and alloy steels, Inconel®, Monel®, Stellite™ and zirconium alloys. A variety of precision manufacturing, welding and machining processes are used in our state-

of-the-art global manufacturing facilities.

At Westinghouse, safety, quality and customer support are our top priorities. Westinghouse's manufacturing quality assurance programs are top notch, employing a number of non-destructive examination (NDE) methods, including magnetic particle, liquid penetrant, visual, radiographic (RT) and ultrasonic testing to ensure optimal quality.

Westinghouse employs the best welders, machinists and manufacturing technicians in the industry, and they are on hand to support critical needs around the clock. Whether a replacement part is needed, a damaged component is found during an outage, or you're placing your next routine order, you can be sure that Westinghouse has the facilities and the experience to deliver what you need.



A machine-arch, gas tungsten welding process called hard surfacing is performed on a Stellite™ product at a Westinghouse manufacturing facility.



Engineering Solutions to Improve Plant Performance

Did you know ... AREVA offers a diverse team of engineering and hardware solutions as an extension of your team? And we understand that the real success is in an ongoing relationship — one where we work together to make the right decisions for your plant.

We combine a unique blend of engineering expertise with equipment and system knowledge, rigorous project management experience and regulatory expertise — all driven to reduce risk while saving time and money. The combination of nuclear steam supply system engineering and field service capabilities with secondary-side expertise allows AREVA to deliver a total-plant perspective.

With customer-focused innovation, AREVA can deploy the technology and resources to lower your total costs and improve your facility's performance. We pledge uncompromising support for the long haul as you realize your vision for highly reliable, high-quality and safe nuclear power. To learn more about AREVA's solutions and commitment to operational excellence, visit: us.aveva.com



Major Solutions Include:

- Cyber Security Solutions
- Digital Control Systems
- Electrical Distribution Equipment
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- Fire Protection
- Flexible Operations
- Global Testing Centers
- Integrated Electrical Systems Upgrade
- Integrated Procurement Solutions
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- Mechanical Products
- Nuclear Parts Center
- Plant Modifications
- Post-Fukushima Regulatory Solutions
- Total Motor Solutions
- Variable Frequency Drives

AREVA
forward-looking energy

Emergency Response Is What We Do. Engineering Expertise Is How We Do It.



Critical Pump Seizes

A low head safety injection pump rotor seized in its casing, bringing a nuclear power plant to critical operation status and requiring emergency repairs. Hydro's Chicago nuclear qualified repair service center was engaged to work on the pump 24/7. From decontamination all the way through testing, Hydro's engineering and operations team responded quickly, providing a lasting solution at a critical time. Flexibility, qualified and thorough engineering analysis, and essential resources led to fast and reliable uptime – and a very satisfied customer.



Rotor was damaged due to pump running dry for approximately 30 minutes.



Pump Decontamination and DCI

While the damaged pump was being decontaminated at a dedicated facility, numerous spare parts from the plant's inventory were reviewed by Hydro's engineering team. Equivalencies such as dimensional and functional conformity were studied.



Spare Parts Analyzed

A spare OEM impeller supplied by the customer ostensibly manufactured to the same pattern and drawing numbers initially appeared to be a drop-in replacement. However, upon close inspection, Hydro's engineering team discovered the OD and vane underfiling geometry deviated from the OEM's specs. Expected loss of hydraulic performance due to this deviation was calculated and brought to the customer's attention, with suggested additional improvements.



Diminished Axial Float Diagnosed/Adjusted

While analyzing the pump assembly, engineers noted that the impeller's overall exit width was larger than spec, obstructing lowering of the casing's upper half. To meet the drawing requirements, machining the shroud was recommended. Evaluations and justifications confirmed that the original design's mechanical strength, axial thrust, and hydraulic performance would not be negatively impacted.



Final Testing and Turnaround

Hydro's performance test lab had been on standby throughout the repair process, with the preliminary test layout. When repairs were completed, the pump was immediately tested and approved by the customer. The pump was shipped to the customer only eight days after its arrival, and was up and running immediately after successful results of pre-service tests.

Engineering Pumps for Better Performance and Longer Life

The Hydro Difference

Hydro has built its business by bringing a high level of engineering expertise and service to customers around the world.

As an independent pump engineering and rebuilding company, Hydro has the unique capability of analyzing and understanding various OEM designs as well as their successes or failures in specific applications and operating environments. Based on extensive empirical data, Hydro is able to improve the original design for its intended service. Because we are independent, we offer unbiased recommendations in every repair situation. We are committed to our customer – not our brand.

Our mission is to work hand in hand with our valued customers to optimize the performance and reliability of

their pumping systems by evaluating and understanding root causes of pump degradation or failure and by providing unbiased engineering analysis, quality workmanship and responsive field service for improved plant operation.

We are Pump Experts

Engineering expertise is the foundation of our business. Our engineers and technical staff have extensive experience in the pump industry and with a broad spectrum of pumping equipment. This diverse engineering experience combined with use of the latest manufacturing and design technologies and our knowledge base of proven successes over more than 40 years of providing aftermarket services allows us to not only repair the pump but to improve it.

Our Comprehensive Services

Nuclear Pump Repairs | 24/7 Emergency Services | OEM Goulds Pumps, Parts & Accessories
Field Service Support for Installation & Start-up | Certified Performance Testing
Pump System Reliability | Engineering Services | Customer Training

We're On It.

To learn more about Hydro's comprehensive services, please contact us at [800-223-7867](tel:800-223-7867) or visit us at hydroinc.com

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NUCLEAR SOLUTIONS From Burns & McDonnell

Burns & McDonnell is focused on providing services to the nation's operating fleet of nuclear utilities. More than 80 percent of our engineers have spent much of their careers working full-time in the nuclear fleet and have lived the nuclear culture.

"When it comes to understanding the safety and operational culture of our nuclear fleet, we understand, we've lived it," says Glenn Neises, Chief Nuclear Officer for Burns & McDonnell. "There is no substitute for direct experience."

Burns & McDonnell has experienced engineers and project managers deployed in offices throughout the U.S. "We are

local and committed to the success of our clients wherever they are because we are familiar with their needs," Neises says.

As a 100 percent employee-owned firm, Burns & McDonnell is committed to the success of each and every project because "you are our client, both personally and professionally," Neises adds. "Ownership means we care about making sure every project is executed to perfection. Our clients notice this attention to detail.

"Burns & McDonnell has more than 4,500 employee-owners working in engineering and construction services across 11 divisions. We bring a broad experience base to the nuclear industry, which results

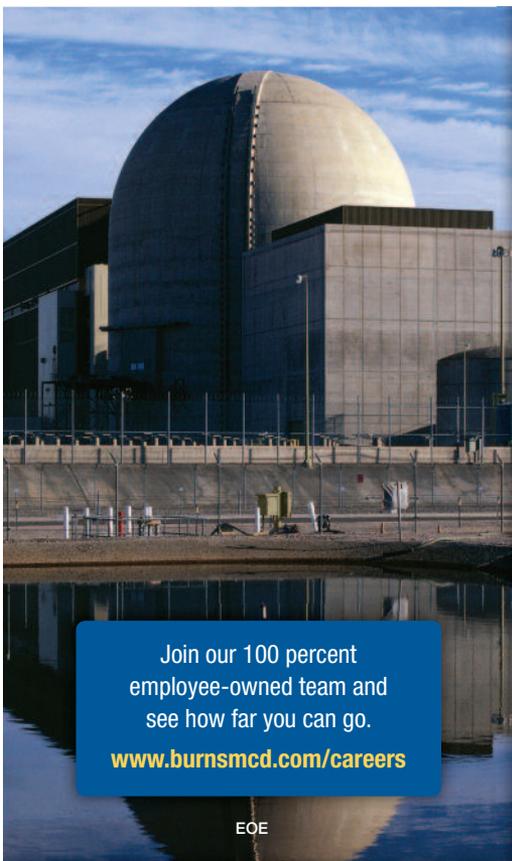
in innovative solutions for the most complex problems."

Burns & McDonnell has revenue of more than \$1.5 billion annually, half of which comes from construction projects. "We can do any size project from the smallest study to the largest design-build project," Neises says.

For more information, visit:



www.burnsmcd.com/nuclear



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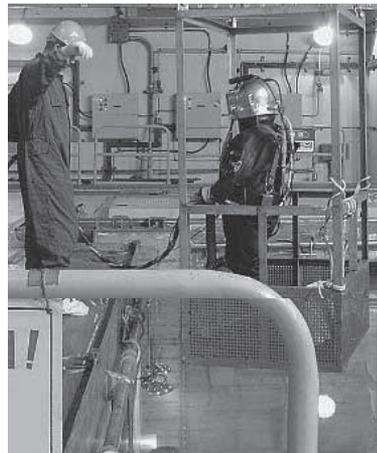
The prospect of new nuclear construction is exciting, but operating nuclear plants will require diligent management of facility assets for years to come. Innovative maintenance practices will be essential to keeping plants operating safely and efficiently. For over twenty years, Underwater Engineering Services, Inc. has provided quality technical services and outage support. In 1988, UESI developed a unique approach to the underwater inspection and repair of safety related coatings that remains in use around the world. Today, UESI is working with its industry partners to develop new maintenance processes that take advantage of advances in robotic technology to

lower maintenance costs, shorten outage schedules, and reduce radiation exposure.

As the nuclear industry moves into its next phase, UESI will continue to provide the kinds of quality technical and engineering services critical to meeting regulatory and safety requirements. Our services and capabilities include:

- ASME IWE code inspections
- Underwater coating assessment and repair
- Wet welding to ASME/AWS requirements
- Diving services in the suppression chamber, reactor vessel & fuel pool
- Robotic solutions
- Intake and discharge maintenance

- Project Management
- QA Oversight
- Staff Augmentation
- Engineering Assessments
- Maintenance Program Management



Underwater Engineering Services, Inc.



Specialized Services for the Nuclear Industry

UESI Nuclear Services provides specialized services uniquely suited to the nuclear industry. Work can be performed under our 10CFR Appendix B Program to UESI or site procedures.

- Manned Diving & Remote Intervention
- Diving Services for RV, Fuel Pool, Suppression Pool
- Underwater Coating Inspection & Application
- ASME Section XI Code Inspections (IWE & IWF)
- ANSI & NACE Nuclear Coating Inspectors
- Condition Surveys and Asset Management
- Wet & Dry AWS or ASME Code Welding
- Nuclear Coating Experts
- Buried Pipe Coating Assessment
- QA Oversight & QC Inspection
- Project Planning & Management
- Heavy Marine Construction
- Intake & Discharge Diving Services
- Deactivation & Decommissioning



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With over a half century of nuclear crane experience, **Konecranes Nuclear Equipment and Services** continues to develop engineering solutions that are safer and easier to use.

Our newest product is a robust, seismically qualified, Single Failure Proof Vertical Cask Transporter (VCT). It integrates a hoist unit which conforms to ASME NOG-1 criteria requiring redundancy and increased design factors.

This VCT is capable of moving a transfer cask outside the fuel building to perform cask stack-up and MPC transfer. The benefits are increased safety, faster processing time, less manual intervention and reduction in worker exposure.

When a VCT is combined with the family of Konecranes equipment including: Single Failure Proof Fuel Building Cask Handling Crane, Fuel Handling Hoists, Refueling Machine, Spent Fuel Bridge and Reactor Crane, then this extensive pool to pad lineup provides the greatest overall value.

Our highly qualified technicians perform the services to keep critical plant equipment operating reliably throughout its lifetime. Konecranes

designs, manufactures and services nearly every single piece of permanent plant lifting equipment found in a nuclear facility.

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- Dwight Foote™
- Kranco™
- CMS™
- Broadline
- Shepard Niles®
- Provincial™

We provide parts and service for all makes and models of cranes.



KONECRANES NUCLEAR EQUIPMENT & SERVICES LLC

Worldwide suppliers of nuclear lifting equipment and services



EQUIPMENT

Our wide range of products are designed specifically for operation in nuclear applications.

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We provide modernization services for all brands of cranes, hoists and material handling equipment.

PARTS

- Any OEM part for any brand of overhead crane or hoist
- Re-engineered parts
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QUALITY

Our quality control program ensures that each nuclear crane and component is designed to meet or exceed all mandated standards.

SERVICE

We provide service for all brands of cranes, hoists and material handling equipment. Services include outage support, inspections, repairs, and maintenance.

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RailQ generates 3D and 2D graphs of the runway rails and identifies misalignment and other problems of your cranes.
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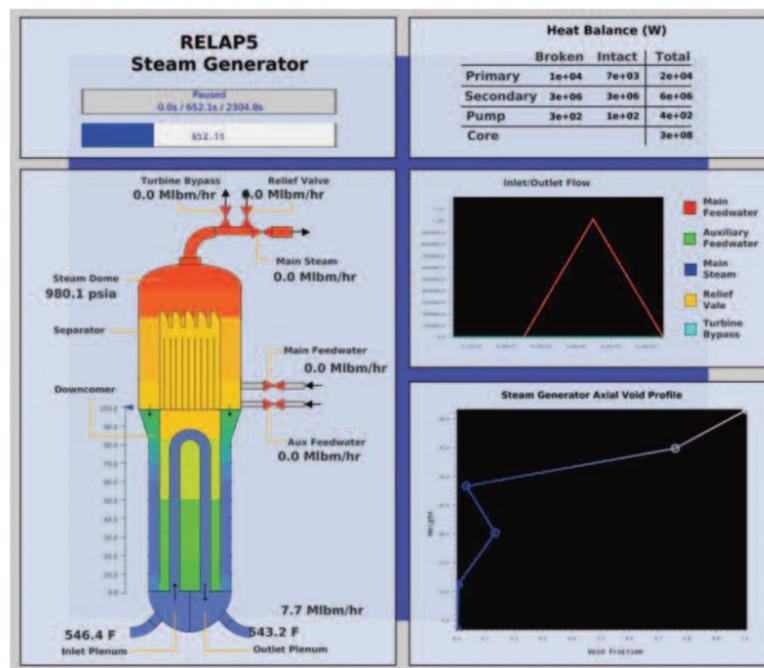
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Company Profile: Zachry Nuclear, Inc.

For more than three decades, Zachry Nuclear, Inc. has provided engineering, design and project management services to the operating U.S. nuclear fleet, with extensive PWR and BWR experience at the majority of the U.S. Commercial Fleet. The technical knowledge, experience and capabilities of the staff assist plant owners in support of a wide variety of operational, regulatory, maintenance, and upgrade needs.

Headquartered in San Antonio, Texas, Zachry Nuclear has offices located throughout the United States in Stonington, CT; Charlotte and Cary, NC; Richland, WA; and Chicago, IL. They offer mechanical, electrical, controls and civil/structural engineering professionals and designers who are knowledgeable and experienced in power plant systems; engineering analysis and modification package development; and startup of power plant systems and components. Zachry Nuclear is a qualified nuclear QA supplier; all services are performed in accordance with their Nuclear Quality Program, which complies with 10CFR50 Appendix B and ASME NQA-1 (1994), and has been successfully audited by NUPIC.

Zachry Nuclear's full range of engineering and design services are backed by years of nuclear power plant system experience and practical application of time-tested solutions. Their engineers, designers, project managers and system analysts have an impressive combination of training and experience. When you have a design need, Zachry assembles a fit-for-purpose team for the job, taking into account employees' specialties, education,



skills and expertise. Zachry utilizes industry-recognized design tools and processes, including an in-house Failure Modes and Effects Analysis (FMEA) procedure that fully evaluates proposed system modifications to ensure they will operate effectively and without error. The Numerical Applications Division (formally NAI) has consistently provided the industry with state-of-the-art modeling techniques and approaches for containment response and area heat-up during both design and beyond design basis events. This division of Zachry Nuclear provides a wide spectrum of engineering analysis services including thermal hydraulic, radiological, chemical, core physics and safety analysis, and is the leading developer of nuclear software including Proto-FLO™, Proto-HX™, Proto-HVAC™, Proto-Sprinkler™, CentralStor™, RADTRAD-NAI™ and GOTHIC™ computer code and applications. GOTHIC™, as applied by Numerical Applications, has become the industry standard for containment

modeling and analysis, and has been extensively utilized in operating and new plant licensing activities. Their team also has considerable experience using industry-standard software tools such as RELAP and RETRAN.

The Zachry team delivers high-quality design with the utmost care and strict adherence to safety and regulatory requirements. With a focus on cost-effective operations, Zachry engineers investigate plant performance problems; assess compliance to code and regulatory requirements; perform feasibility studies; develop conceptual designs; evaluate the cost and effectiveness of plant upgrades; and prepare detailed plant design changes including specifications and drawings for plant construction and modifications.

* This product incorporates technology developed for the Electric Power Industry under the sponsorship of EPRI, the Electric Power Research Institute.

Best People. Best Tools. Best Results.

ZACHRY



Zachry Nuclear Engineering provides engineering analysis services including thermal hydraulic, radiological, chemical, reactor physics/core design and safety evaluations. We are a leading developer of software used in more than 90% of the U.S. nuclear fleet, including GOTHIC™, Proto-FLO™, Proto-HX™, Proto-HVAC™, Proto-Sprinkler™, CentralStor™ and RADTRAD-NAI™.

Zachry developed and maintains the industry-standard GOTHIC™ analysis code, utilized for critical operating plant assessments including analyses of containments, fuel pools, reactors, primary and secondary piping/systems and buildings/compartments. We are pioneers in the systematic integrated approach to fluid system analyses including: system performance prediction; component capability analyses; licensing/design basis requirements; component in-service-testing acceptance criteria; maintenance periodicity; and 89-13 requirements. Zachry also investigates system and equipment performance, evaluates improvement options, and verifies the capability of plant systems under normal and accident conditions.

Combining the most experienced people with the best tools available creates optimal solutions. Contact Zachry today to find out how we can support your analysis needs.

What qualifies Zachry to help you? Scan QR code to find out.



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AOV Program Support

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RCP Seal Replacement

Small Modular Reactor Event Analysis

Digital Upgrades

Rad Monitoring Systems

Detailed Engineering & Design

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Radiation Protection Systems (RPS) has been developing and implementing engineered controls for radiological and hazardous material applications since 1978. We offer equipment and custom integrated systems that make working in the radiological or hazardous workplace safer, easier and more efficient.

Our clients include every U.S. and Canadian Commercial Nuclear Utility, every major U.S. Department of Energy (DOE) site, U.S. Department of Defense (DOD), Center for Disease Control (CDC), Universities, pharmaceutical & biopharma research, and manufacturing companies. Our roots are in both military and civilian nuclear programs commencing with development of the Naval nuclear programs of the 1950's and continuing into the commercial power reactor field. Today RPS continues to develop sophisticated techniques and engineering methods to confine, contain and control hazardous contaminants.



Engineering Controls are defined as devices, systems, or components that will minimize workplace hazards to reduce risks and exposure to both the worker and the environment. When properly designed and integrated into the work process, engineered controls perform without inhibiting operations. They improve productivity by minimizing the reliance on personnel protective equipment (PPE). Both OSHA and the NRC require the proactive use of engineered controls over other administrative controls. For radiological applications, the most commonly used controls are ventilation, containment, and shielding.

Ventilation is a well-proven and extraordinarily-effective engineered control, and it constitutes the keystone of RPS' services and products. We offer a full line of portable High Efficiency Particulate Air (HEPA) filtration units and carbon adsorber systems. When properly applied, these air cleaning systems can effectively control contamination at its source, reduce the spread of contaminants, and minimize personnel exposure while increasing worker safety and efficiency. RPS' extensive line of ventilation units and accessories incorporate "industry best practices" as defined by the American Conference of Governmental Industrial Hygienists (ACGIH) - Industrial Ventilation Standards and the Nuclear Air Cleaning Handbook. The quality and function of our suite of ventilation products reflects the decades-long experience and expertise of our design and engineering staff. As testament, RPS' ventilation products/systems have the lowest "Life Cycle Costs" of any like ventilation products available in the market today. Over 95% of our ventilation units carry the CSA Mark¹, further assuring customers that our products are of the highest quality and built with safety in mind.

The effectiveness of ventilation is greatly enhanced through the use of containment devices, which is why RPS also offers a full range of both standard and custom-engineered containments to augment our extensive ventilation product line. These products include Perma-Con[®] (our modular stainless-steel building system), hoods, gloved work stations, and flexible-membrane barrier systems.

Last but certainly not least, Shielding is essential for the keeping occupational radiation exposure as low as reasonably achievable – ALARA. RPS can provide both temporary shielding as well as engineered permanent shielding. We offer a complement of lead blankets, lead-free blankets, pipe wraps, storage containers, and other shielding products. Our extensive engineering and customization capabilities allow us to provide innovative, cost-effective shielding solutions for nearly any application.

With today's increased pressure to reduce exposure and respirator usage, RPS' engineered controls offer a safe and cost-effective way to minimize exposure and improve worker and workplace efficiency.

¹The CSA mark demonstrates to our customers, whether they are distributors, retailers or end users, that a sample of our product has been certified to applicable standards including standards written or administered by the American National Standards Institute (ANSI), Underwriters Laboratories (UL), CSA Group (CSA), NSF International (NSF), and other North American and global organizations.



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VENTILATION

RPS produces a high quality line of portable High Efficiency Particulate Air (HEPA) purification and filtration units. These range in size from portable units with a capacity of 125 CFM to large temporary and permanent units with capacities of up to 26,000 CFM. A complete line of accessories including filters, charcoal adsorbers, flexible duct, connectors, stainless steel couplings and adapters are also offered. RPS carries a JIT inventory of ~\$1,000,000 for the convenience of our customers.



SHIELDING

Broad experience has made RPS the leader in ionizing radiation shielding services. Our engineering staff has more than 100 years of experience in custom design of shielding through the application of Pb, steel, water, borated poly and ceramic (non-metal) based technology.



CONTAINMENT

RPS manufactures backdraft hoods, Perma-Con[®] modular panel enclosures, gloved enclosures, ventilated workstations, isolation chambers, and other customized products which may be used to contain nuclear, biological, or hazardous materials during work processes. These products prevent the spread of contaminants, protecting the operating personnel and the environment.



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Post Fukushima: Major Improvement in Severe Accident Containment Integrity of Nuclear Power Plants

THE international nuclear industry and its regulators are working intensely on adapting safety specifications following the 2011 Fukushima meltdown in Japan. The post-accident analysis has shown clearly that higher specifications and safety margins for the containment and its core components are mandatory, especially with regard to severe accident containment integrity. Electrical Penetration Assemblies (EPAs) are critical safety components.

Here in the United States, the international technology firm SCHOTT is at the forefront of nuclear safety technology with glass-to-metal sealed EPAs that perform consistently beyond severe accident conditions throughout the lifetime of a reactor. SCHOTT's EPAs allow the safe conduction of electricity and data through the fire-protective, pressure-resistant and tightly-sealed containment walls of Nuclear Power Plants (NPPs).

In March 2014, the US Nuclear Regulatory Commission (NRC) issued an Information Notice warning about the potential for Teflon degradation in reactors, and as far back as 1982, research sponsored by the NRC confirmed that organic polymer seal degradation is a containment failure mode during reactor over-pressurization. These are well known problems in the industry, however, SCHOTT glass-to-metal EPAs do not degrade over time in reactor containments.

SCHOTT's Eternaloc™ penetrations are sealed with glass, which allow them to survive significant accelerations and remain resistant to temperature, radiation and aging for periods much longer than the 60 year design lifetimes of the latest NPPs. Today, over 10,000 SCHOTT EPAs are installed in more than 50 NPPs and nuclear submarines worldwide, and they have remained maintenance-free since the early 1960s. After an extensive analysis of the Fukushima accident, results showed that extreme temperature and pressure levels overstressed the epoxy seals of the electrical penetrations at the plant, which is suspected to have led to the leakage of explosive hydrogen, according to TEPCO.

Current moves to increase global nuclear safety standards post-Fukushima aim to avoid another Fukushima-type accident where reactor penetrations were shown to be a weakness in containment.

SCHOTT North American Director Joe Hale said: "It is clear that the regulatory organizations are evaluating and raising stan-

dards for reactor penetrations as a result of the Fukushima incident. SCHOTT EPAs exceed severe accident conditions and are therefore the best product to use." "We do not want reactor penetrations to be the weak link in containment safety," said Hale. "We want these components to exceed severe accident conditions not just today, but decades after the reactor is operational. It is therefore essential that non-aging glass-to-metal seals are used as they do not degrade like organic compounds or Teflon, and will perform consistently after being subjected to a reactor lifetime of pressure, radiation, heat and severe accident conditions."

Recently, Hale participated in a panel with representatives of the NRC, the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Mechanical Engineers – key bodies which set and regulate nuclear standards - at the American Nuclear Society's (ANS) Annual Meeting in Reno, NV. During the panel session he explained why SCHOTT EPAs are critical safety components and exceed current high safety standards, as well as severe accident conditions.



Hale presented why SCHOTT's glass-to-metal sealing technology is the best technology for nuclear penetrations worldwide: "The reliability of our EPAs is far superior, and their non-aging properties make them a better component than one using epoxy or Teflon seals."

Furthermore, Hale pointed out that SCHOTT's Eternaloc™ penetrations are ideal for Generation 3+, Generation 4, and Small Modular Reactors, commenting: "Our EPAs perform well in high-pressure, high-temperature applications, where they maintain their integrity and do not age over the lifetime of the reactor." SCHOTT's glass-to-metal EPAs have been subject to stringent testing at Wyle Laboratories in Huntsville, Alabama in 2012.

The EPAs passed an extensive qualification test program per IEEE Standards 317 and 344, including full survivability in conditions analogous to an earthquake reaching a magnitude of 12 on the Richter Scale. The seismic test program exceeded the seismic Westinghouse AP1000 test plan 60-year qualification of EPAs by at least 400% for vertical seismic requirements and 575% for horizontal requirements.

The LOCA qualification test consisted of a 7-day LOCA simulation with chemical spray and temperature up to 232 degrees Celsius and pressure of 65psig. The severe accident test consisted of a series of high-pressure leakage tests up to 300psig, which is five times higher than what is required for generation 3+ nuclear power plants (60psig).

SCHOTT EPAs performed well throughout the seismic test program and qualify for IEEE 344-1987, IEEE 344-2004, and the seismic portion of IEEE 317-1983 (R2003). The performance range of these EPAs is significant, having also withstood over 400 bar and 400 degrees Celsius in previous tests.

SCHOTT recently developed a new type of EPA for Vattenfall's Forsmark 3 nuclear reactor in Sweden because the operator had defined new, modified safety scenarios. The EPAs were designed to withstand submerged conditions under 13 meters of water for at least 30 days, together with pressures of up to 8.3 bar, and temperatures up to 185 degrees Celsius. In addition, the radiological exposure of the EPA during a severe accident scenario had to reach 1.87MGy at a dose rate of 2360Gy/h. The use of inorganic sealing material like SCHOTT glass for the pressure boundary of the EPA minimizes the effect of high radiological exposures.

SCHOTT EPAs excelled in performance for this important European project. As a result, the EPAs are in the prime position to be used in new US reactors with the high safety standards expected in these new builds.

SCHOTT's Business Unit Electronic Packaging is a worldwide leading supplier of hermetic feedthroughs and terminal headers for harsh environment applications that require the highest level of safety and reliability, i.e. EPAs for nuclear power plants.

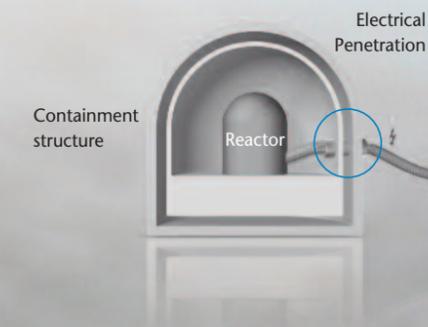
For more information:

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The safety of the nuclear containment is only as strong as its smallest elements.

Because even small components have a big impact on the overall safety. Glass-to-metal sealed penetrations from SCHOTT are key for improved severe accident containment integrity.
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Nuclear Programs Fuel Major Tool & Machine's Growth

Our Present...

Since 1946, Major Tool & Machine, Inc. has been providing engineering, fabrication, machining, assembly and testing services for critical application environments. Our customer-focused philosophy, coupled with continuous reinvestment in our capabilities, facilities and employees, has enabled us to evolve with and respond to the needs of our customers. Major Tool's best value approach provides our customers with the highest quality, competitively priced build-to-print services available.

Major Tool provides unsurpassed levels of capability and quality assurance. Maintaining over 600,000 sq. ft. of environmentally controlled manufacturing space under roof, Major Tool offers extraordinary capacity. Our continuous reinvestment in capital equipment allows us to provide prototype through production forming, welding, machining, assembly and testing services to meet the wide range of application specific shape, size and

configuration hardware required by the nuclear industry.

Our ability to execute this full spectrum of manufacture has allowed Major Tool to successfully participate in many critical government, industry and academia sponsored fission and fusion programs.

Our extraordinary capability, capacity and experience are driven by our commitment to quality assurance. Major Tool maintains ASME N, NPT, N3, NS, U and U2 certifications. Our Quality Assurance System is audited to ASME NQA-1, and is NRC 10CFR50, 10CFR71 and 10CFR72 compliant.

Your future...

It is bright on the nuclear energy horizon. Major Tool is committed to our future, your future, and the future of our generations by championing the growth of nuclear energy and the safe, successful remediation and disposal of radioactive waste.

We are well positioned to usher in the

next generation of nuclear science and technology, and we will continue to apply all our resources and knowledge to provide our customers the quality critical hardware necessary to meet tomorrow's demanding nuclear requirements.

Nuclear power plant upgrades, next generation power plants, naval nuclear, radwaste transportation and disposal casks, canisters and tooling, fuel fabrication, magnetic and inertial fusion, and government, industry and academia supported energy sciences initiatives are all areas where Major Tool applies our hardware manufacturing expertise.

We look forward to the bright future that nuclear energy provides us all.

For more detailed information on Major Tool & Machine, visit our website at www.majortool.com. To schedule a visit to our facilities, or to discuss your specific requirements, please contact Joel Manship, Director of Business Development, at (317) 917-2633, or by email at jmanship@majortool.com.

Over 600,000 square feet of world-class nuclear capabilities.

At MTM, we provide manufacturing solutions to nuclear fuel cycle challenges.

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MTM's Quality Assurance Program is compliant to NQA-1, 10CFR50 Appendix B, 10CFR71 Subpart H, 10CFR72 Subpart G



MIRION
TECHNOLOGIES

Mirion Technologies Sensing and Imaging Systems Divisions, featuring IST™ branded products, are present in a majority of the worldwide power generation facilities.

Mirion Technologies offers products with a range of operational safety and non-safety radiation monitoring equipment such as its IST, IST-Rees, and IST-Conax Nuclear® brands.

Sensing Systems Division

The Sensing Systems Division, maker of the IST and IST-Conax range of products, provides the nuclear power industry with in-core and out-of-core detectors and electrical penetrations. In addition, Mirion manufactures the associated electronics, temperature sensors, thermocouples, special purpose valves, connectors, cable/connector assemblies and electrical conductor seal assemblies.

Imaging Systems Division

The Imaging Systems Division is a global provider of highly specialized closed circuit camera systems used for inspection and surveillance in difficult and hazardous environments, supplying cameras for all stages of the nuclear life cycle, from construction through operation, to decommissioning and waste management. Our products are used in nuclear power plants, nuclear reprocessing plants and waste management facilities. The IST-Rees™ product line also includes a wide range of accessories, such as lighting attachments and positioning devices, that allow operators to carry out a variety of monitoring and inspection tasks. From small, low-cost cameras to high performance viewing systems, the Imaging Systems Division provides an imaging solution for the nuclear market.

Mirion Technologies

For more than 50 years, our products and services have helped to ensure the safe and efficient operation of nuclear facilities. Our customers rely on our solutions to protect people, property and the environment from nuclear and radiological hazards. Mirion's strength stems from its five divisions: Sensing

Systems, Imaging Systems, Health Physics, Dosimetry Services and Radiation Monitoring Systems. Our products and services include: dosimeters; contamination & clearance monitors; detection & identification instruments; radiation monitoring systems; electrical

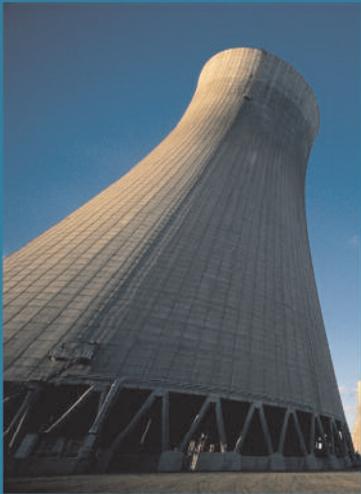
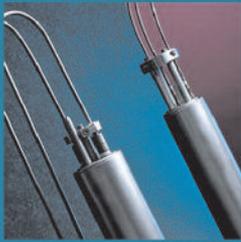
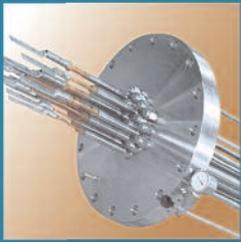
penetrations; instrumentation & control equipment and systems; dosimetry services; imaging systems; and related accessories, software and services. For more information about our products and services visit: www.mirion.com.



MIRION
TECHNOLOGIES

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The Best Camera for Many Applications..... The Only Camera for Some!

Thermo Scientific – CIDTEC is the preeminent supplier of radiation hardened and high dynamic range scientific cameras incorporating proprietary Charge Injection Device (CID) technology for use in the most demanding imaging applications.



The Thermo Scientific **MegaRAD** series of cameras are capable of operating in high-dose radiation environments such as nuclear reactors, fuel inspection, hot cell monitoring, remediation, surveillance, and X-ray imaging applications.

These extremely resilient and compact video cameras are available in either monochrome or color formats with remote head cable lengths of up to 150-meters. Imagers are available in RS-170, progressive scan, and CCIR formats.

Thermo Scientific also offers intensified versions of the MegaRAD cameras for extremely low light level imaging, UV signal enhancement, and for the gating of high-speed events.

The **SpectraCAM** scientific camera series offers unprecedented dynamic range, exceeding 26-bits in some applications. These cameras exhibit low noise, excellent native UV responsivity, non-destructive readout capabilities, and user-programmable windowing capabilities. The Thermo Scientific RACID Exposure software supplies an intuitive interface to the SpectraCAM while providing the user with the desired data in a wide variety of formats at the touch of a button.

All of the Thermo Scientific CID based cameras offer unmatched anti-blooming, wide dynamic range, and UV sensitivity performance that has become synonymous with CID technology.

Charge Injection Device

The Charge Injection Device (CID) is a solid-state imaging sensor with unique capabilities that make it well suited for applications where commercially available Charge Coupled Devices (CCDs) have difficulty. Like a CCD, the CID employs pixels to capture 2-D images, converting light into electronic charge, which is in turn displayed on a monitor or alternatively captured digitally on a computer. The CID architecture is designed to specifically be resistant to radiation damage, which is obviously a significant advantage for radiation tolerant and hardened imaging applications for the nuclear power, medical, dental, and aerospace industries. In addition, the inherent anti-blooming performance of the CID ensures accurate image detail even under extreme lighting conditions.

The CID is uniquely positioned to serve the growing imaging market and the challenges for higher levels of accuracy in the radiation tolerant inspection market, as well as machine vision, scientific imaging applications. Thermo Scientific - CIDTEC is the leading manufacturer of CMOS imagers using the CID pixel architecture, and Thermo Scientific provides imaging solutions to Original Equipment Manufacturers (OEMs) as well as directly to end-users throughout the world.

Applications

Thermo Scientific CID based video cameras and sensors provide solutions for the most demanding applications including:

- Radiation Hardened and Tolerant Video
- Spectroscopy
- UV Imaging
- Metrology
- Laser Profiling
- Medical Diagnostics
- Interferometry
- Aerospace
- Semiconductor Inspection
- Synchrotron Beam Profiling



Got Radiation?
See what you've been missing

The Thermo Scientific MegaRAD series of radiation hardened CID imaging cameras are capable of operating in high dose environments and provide excellent image quality to total dose levels over 100 times the tolerance of conventional solid state cameras.

- Color and Monochrome imaging to beyond 3 MegaRAD
- High resolution CID imager technology
- Small remote detachable head

Look closer at the Thermo Scientific line of radiation hardened cameras. Visit www.thermo.com/cidtec or contact us today about new innovative imaging products.

Tel: 1-315-451-9410 • Email: sales.cidtec@thermo.com



The world's only color rad hard camera

Innovative Preamp per pixel CID design allows high radiation tolerance and excellent image quality even in low light conditions.

Part of Thermo Fisher Scientific



Evolving to Serve You Better

We offer nuclear power customers a broad spectrum of high-level application solutions from a single point of contact. We work to bring superior products, services and the expertise you require. Choose from a variety of instrumentation, sold under the Thermo Scientific brand, to optimize your process.

Our products and services help power producers satisfy regulatory and safety requirements. They help customers achieve maximum efficiency and profitability to meet demand while generating low cost, clean and reliable power. Our integrated solutions assist you in exceeding customers' demands while delivering peace of mind.

Integrate Thermo Scientific products throughout your power process (see Fig. 1). Look to one company that can offer you solutions with a depth of products to fit your application and your environment throughout your operations.

Want to learn how Thermo Scientific products can benefit you and your plant?

Contact us at:
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Visit us at:
www.thermoscientific.com/nuclear

- Neutron Flux Monitoring
- Data Acquisition and Monitoring
- Level and Density Measurement
- Custom Radiation Shielding
- Industrial Hygiene
- Radiation Measurement & Protection
- Water Analysis
- Laboratory Informatics
- Radiation Tolerant Imaging (Inspection and Monitoring)
- Service and Training

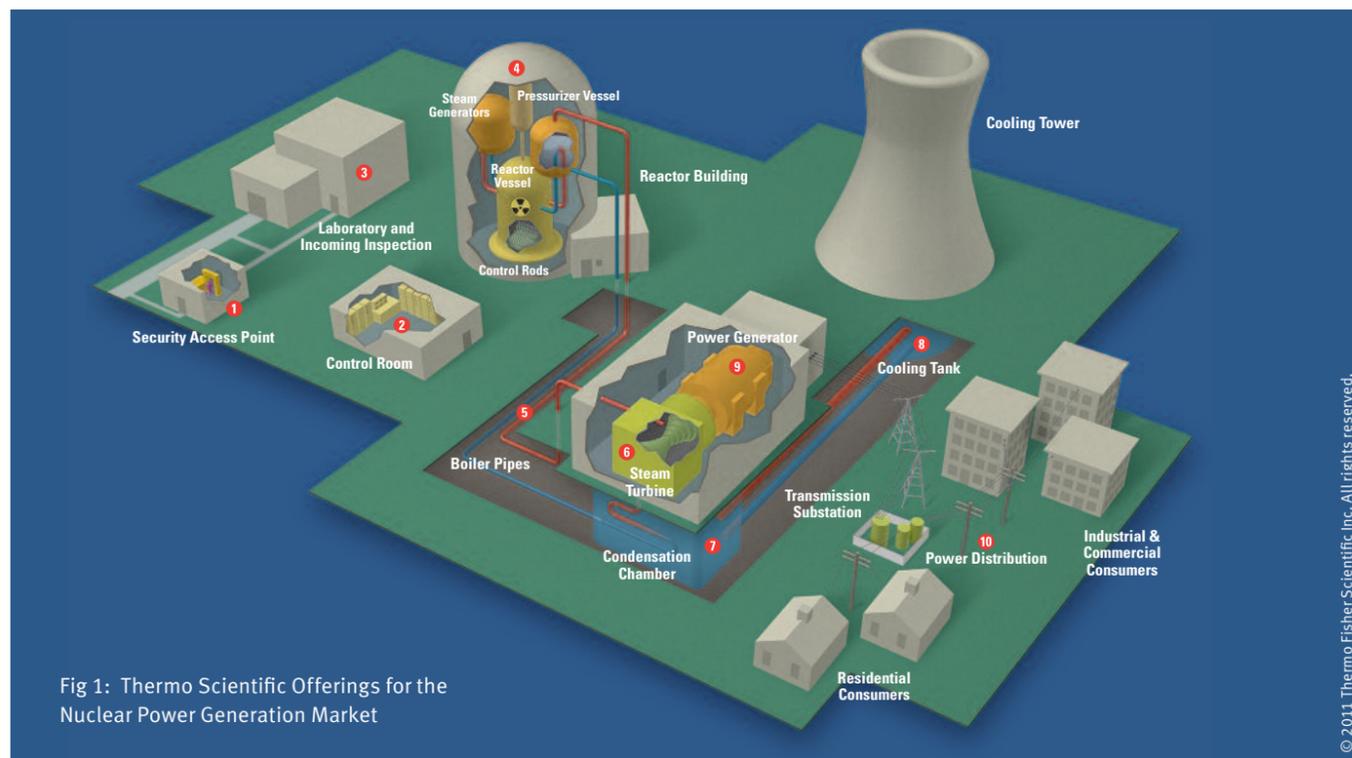


Fig 1: Thermo Scientific Offerings for the Nuclear Power Generation Market

Thermo Scientific Products in Nuclear Power Generation

1 Security Access Point

- Radiation measurement and protection monitoring

2 Control Room

- Radiation measurement and protection monitoring
- Data acquisition, monitoring and management
- Alarm monitoring
- Neutron flux monitoring
- Reactor protection systems
- Audible count rate drawers
- Boron dilution monitoring
- Thermal margin monitoring
- Class IE qualified safety-related cabinets
- Class IE qualified power supplies
- LCD digital meters

3 Laboratory and Incoming Inspection

- Radiation measurement and protection monitoring
- Data acquisition, monitoring and management
- Weld and alloy verification
- Informatics

4 Reactor Building

- Radiation measurement and protection monitoring
- Data acquisition, monitoring and management
- Level measurement
- Radiation hardened solid-state camera (black/white or color)
- Ex-core neutron flux detectors for source range, intermediate range and power range reactor power monitoring
- Class IE safety-related post-accident qualified cable assemblies
- Audible count rate during shutdown maintenance periods
- Installed gamma area monitors
- Boric acid storage monitoring
- Water analysis monitoring

5 Boiler Pipes

- Cooling water and condensate flow measurement

6 Steam Turbine

- Radiation measurement and protection monitoring
- Data acquisition, monitoring and management

7 Condensation Chamber

- Data acquisition, monitoring and management
- Level measurement

8 Cooling Tank, Cooling Tower and Reservoir

- Data acquisition, monitoring and management
- Influent and discharge flow measurement
- Density and level measurement
- On-line water analysis

9 Power Generator

- Data acquisition, monitoring and management

10 Power Distribution

- Data acquisition, monitoring and management

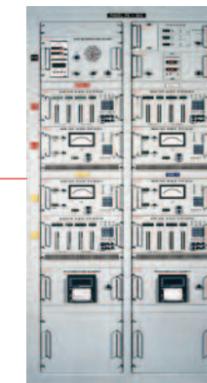
Thermo
SCIENTIFIC

The power of one

Why have more than 150 nuclear reactors in 16 countries replaced their aging, obsolete instrumentation systems with Thermo Scientific Nuclear Instrumentation Systems? Because this innovative solution is far more reliable and less costly than any other technology available. Our NIS uses a single-fission chamber-based detector assembly to provide four separate applications in one powerful system – Source Range, Intermediate Range, Power Range, and Post-Accident Monitoring. It has a proven 40-year qualified life, eliminating the need to periodically replace shorter-lived detector assemblies. Plus, it has demonstrated high immunity to electromagnetic interference and noise, meeting stringent RG 1.180 requirements. Which explains why it's quietly revolutionizing nuclear instrumentation and being supplied to new nuclear power plants under construction in three countries.

the work of four

- Learn more at thermoscientific.com/nuclear or call +1 (800) 488-4399 or +1 (858) 450-9811.



Thermo Scientific Nuclear Instrumentation System integrates four essential applications in one detector assembly.



Quest Integrity Group Inspects Buried and Inaccessible Piping in Nuclear Plants

Quest Integrity Group is a global leader in the development and delivery of asset integrity management and asset reliability solutions for the power, refining and chemical, pipeline and syngas industries.

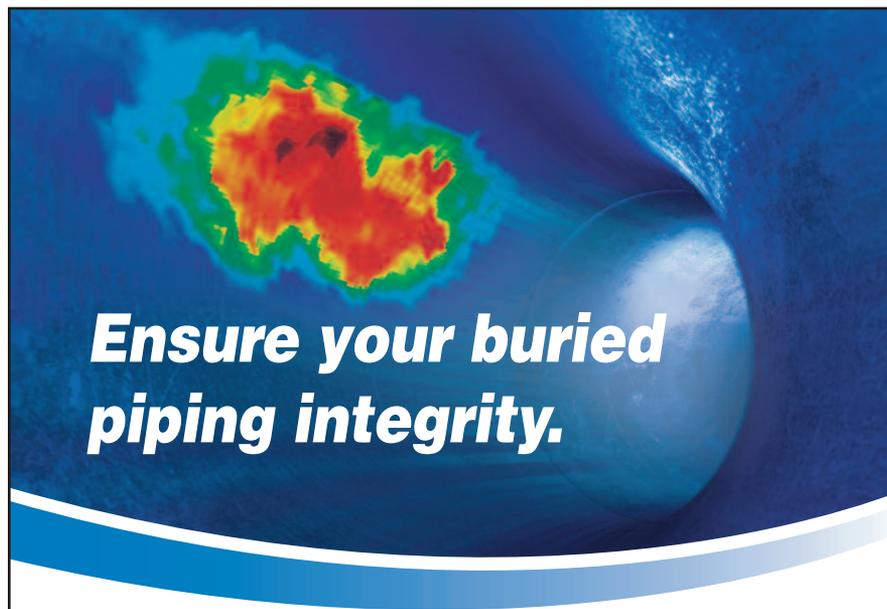
The nuclear industry focus is on inspection and assessment of

buried or inaccessible piping utilizing HYDRA™, an ultrasonic-based intelligent pigging technology.

HYDRA addresses the nuclear industry initiative on buried piping integrity and satisfies NEI 09-14 inspection requirements.

The tool is compact and lightweight making it easily transported into and around a plant, and since the tool is bi-directional, only one launch location is required. HYDRA navigates complex piping circuits, providing 100% inspection coverage of the interior and exterior surfaces.

The tool detects and records wall loss damage such as pitting, corrosion or erosion, and deformations such as denting, ovality, swelling or bulging with superior accuracy. In addition to providing high quality inspection data, Quest Integrity can also conduct a full fitness-for-service evaluation per ASME FFS-1 using its proprietary LifeQuest™ Fitness-for-Service software.



Ensure your buried piping integrity.

In today's operating environment, it's more important than ever to satisfy NEI 09-14 inspection requirements for your buried and underground piping systems.

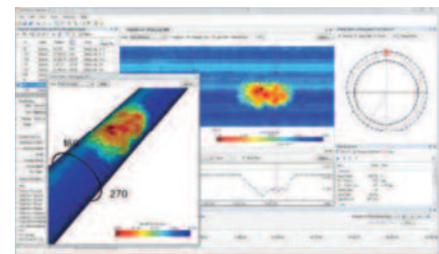
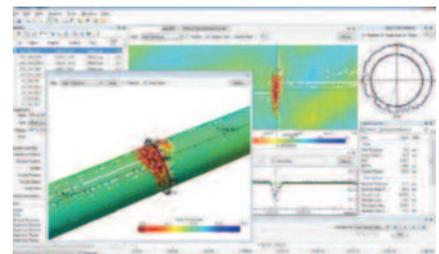
Quest Integrity offers a comprehensive solution that ensures 100% inspection coverage of your buried piping using HYDRA™, our proprietary, ultrasonic-based intelligent pigging technology.

Pipes are inspected for defects and degradation including:

- Pitting (interior or exterior of pipe)
- Corrosion (interior or exterior of pipe)
- Corrosion under insulation (CUI)
- Flow-accelerated corrosion (FAC)
- General wall thinning
- Denting or ovality
- Bulging or swelling

Ensure your buried piping integrity to NEI 09-14 inspection requirements.

www.QuestIntegrity.com/nn
+1 253 893 7070



HYDRA is a cost-effective in-line inspection solution for buried or inaccessible piping. The inspection results are generated and provided to the client within hours, enabling nuclear plant managers to ensure piping integrity, minimize operational and safety risk and comply with industry initiatives for inspection.

Additional information and animation can be viewed at:
www.QuestIntegrity.com/HYDRA
+1 253 893 7070

Candu Energy Pump Seals for LWRs: increased operational safety, performance & reliability

For years, Candu Energy experts have designed and fabricated specialized mechanical pump seals for CANDU reactors on four continents. We have taken that experience and tailored our design to meet light water reactor (LWR) design requirements, with installations in nuclear stations around the world.

Along with our full suite of engineering and field services solutions, Candu Energy specialty pump seals have unmatched service life. Our customers have confidently replaced their original pump seals with our top-performing designs to increase operational safety, performance and reliability.

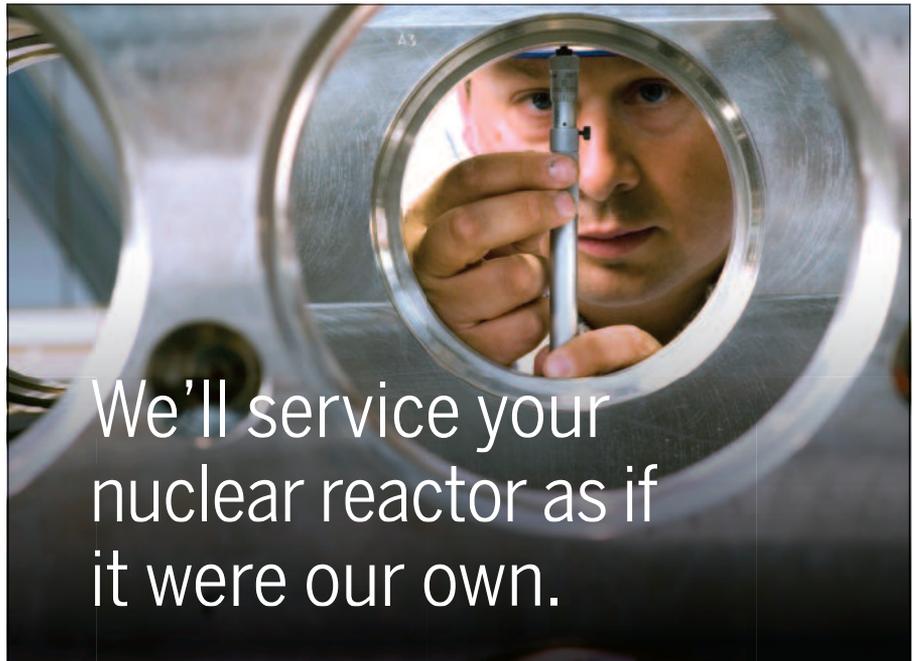
Our precision-engineered, application-specific pump seals use specialty materials and unique high-temperature-resistant elastomers to significantly exceed original seal manufacturers' performance specifications. For each installation, our experts visit customer sites to ensure pump seals are custom-designed to match exacting specifications. Candu Energy pump seals operate reliably for numerous fuel cycles, resulting in reduced maintenance costs as well as reduced radiation exposure to maintenance personnel.

All of our four basic designs can be customized to meet rigorous standards for each reactor. Candu Energy pump seals are a proven success in the field; they are significantly more reliable and durable than others offered in the market.

All our pump seals come with comprehensive operating and maintenance documentation, and training programs for plant staff. Highly experienced technicians provide on-site service support including flatness measurement and

lapping; refurbishment and assembly of pump seals and seal cartridges; and operation of pump seal maintenance equipment.

For more information, visit www.candu.com or email info@candu.com



We'll service your nuclear reactor as if it were our own.

Our history of developing and designing reactors to produce safe nuclear energy dates back over 50 years. With such breadth of experience comes a level of expertise that proves invaluable in servicing both heavy and light water reactors.

Candu Energy is a choice that makes sense, from a reliability, innovation and business standpoint.

In our capacity as an original equipment manufacturer and through our affiliation with AECL, we offer a full suite of engineering and field services solutions that meet the highest safety and regulatory standards.

Look to Candu Energy for both heavy and light water plant management programs, life extension projects, as well as a full range of operational and maintenance services.

We design and build nuclear reactors. It just makes sense that we're the best choice to service and maintain them.

www.candu.com

Candu 
Powering prosperity.

Doosan HF Controls leads the way in responsive I&C solutions to US and International plants.

Doosan HF Controls headquartered in the Carrollton, Texas USA is an I&C solution provider that has supplied and serviced Instrumentation and Control (I&C) systems to American and international clients for over 50 years across the fossil and nuclear markets. Doosan HF Controls has become a major nuclear supplier as it expands its business portfolio.

For example, Doosan HF controls has become the major supplier of nuclear I&C to the Korean nuclear program, supplying nearly 90% of I&C for Korean Hydro and Nuclear Power company's most recent new build programs. Our mid-sized company is a huge plus when your plant needs experienced, responsive solutions and service. Our quick response times allow us to assess your needs and recommend build and install I&C solutions. Our experienced field service team and extensive training capabilities will assure a successful installation with committed robust long-term technical support.

NRC Approved Plant Controls

Doosan HFC achieved an important milestone when the U.S. Nuclear Regulatory Commission (NRC) approved the Doosan HF Controls **HFC-6000** product line for safety applications in early 2011. This accomplishment provides potential customers with the highest level of confidence in the licensability and success of upgrade projects. Our company maintains a 10CFR50 Appendix B quality assurance program, so you can rest assured that our systems meet or exceed NRC standards.

This NRC approval of the **HFC-6000** system gives mature plants a new path towards safe operation with modern controls, providing American and international companies with clean, reliable electricity into the future. We also received approval from the Korean nuclear authority, KINS, as further confidence in the nuclear integrity of our platform. Outside of the nuclear market, **HFC-6000** Safety Control System is qualified for mission critical or safety control systems, such as in utilities, petrochemical and pulp and paper mill industries. We have a Triple Modular Redundant (TMR) version of **HFC-6000** having SIL 3 certification from TUV Rheinland and SIL 2 certification for Double Modular Redundant (DMR). These approvals give Doosan HF Controls the flexibility to address your diverse I&C solution needs.

FPGA Integration

As I&C technology evolves, HFC continues to move its platform forward. FPGA Safety applications are being integrated into our newest technology. FPGA technology is already used in most of our current modules and we continue to expand its use where it makes sense. Such an approach in our field proven system, with the flexibility and scalability your systems demand, makes HFC a good choice for fault tolerant, state of the art class 1E safety grade systems which are back fit capable or available for new system installs.

Nuclear Systems Deployment

With over five decades of innovation and manufacturing of control systems in hundreds of installations around the world, gives us the expertise in the deployment of Plant I&C (both for nuclear safety and non-safety systems). Our current **HFC-6000** platform is a flexible and modular design that allows it to be utilized for a variety of nuclear plant I&C solutions. Some of our current products are:

- Reactor protection system (reactor trip and ESFAS)
- Emergency diesel generator load shedding and sequencing
- Qualified display and processing systems or post-TMI control room applications, such as ICCMS
- Safety-grade Sequence of Events (SOE)
- Plant-wide control systems
- Automatic seismic reactor trip systems
- Control rod drive control systems
- Radwaste control systems

Our customers benefit from the experience of real world, reliable solutions to all your critical needs. For more detailed information, or to have our experienced engineers develop a detailed proposal complete with conceptual system arrangement drawings, equipment lists, and technical configuration data all in accordance with specifications provided.

Contact:

John A. Stevens VP Sales and Marketing
John.Stevens@doosan.com
 Call 866-501-9954 or visit
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WITH MORE THAN 10,000 NUCLEAR CONTROL LOOPS IN OPERATION OF OUR NRC-APPROVED HFC-6000 PLATFORM

YOU NEED A SYSTEM APPROVED AROUND THE WORLD



FROM TOTAL PLANT CONTROLS TO EDG CONTROLS YOU CAN BE CONFIDENT THAT HF CONTROLS CAN DELIVER COST-EFFECTIVE SYSTEMS

YOU NEED HFC-6000

CALL US TO SEE HOW WE CAN BE YOUR PARTNER IN YOUR JOURNEY OF I&C EXCELLENCE



HF CONTROLS

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AMEC is a global nuclear services provider delivering safe, high quality, cost effective, and predictable engineering and construction solutions. Committed to the nuclear industry for more than 60 years, AMEC today has over 3,000 dedicated nuclear specialists. Our full range of professional services covers the life cycle from site selection through plant modification to plant decommissioning.

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or email us at nuclearUSA@amec.com

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After the Fission Stops – Planning for Nuclear Power Decommissioning

By Guy Winebrenner

2013 marked a significant change in the US commercial nuclear power industry, as decisions were made to shut down five operating reactors at four sites. In addition, the Oyster Creek plant is scheduled to shut down in 2019, and several other reactors are in jeopardy of closure for economic reasons. These decisions are taking place at a time when the industry and the Nuclear Regulatory Commission have been focusing on license extensions for operating plants rather than planning for plant decommissioning.

Before the decommissioning process begins, it is essential to decide the end-state for the site and determine the schedule for decommissioning. To date, many of the reactors that have been closed have been placed in SAFSTOR status, allowing the decommissioning process to take place over a thirty-year period. Lately, however, local and state political entities, along with non-governmental organizations (NGOs), have pressured nuclear plant owners to accelerate the decommissioning process to restore sites for other uses, sooner rather than later.

Many stakeholders are involved in the decommissioning process. Political entities tend to focus on the ultimate use of the site and the potential for job creation. Sites in desirable locations, such as on the Pacific coast or on Lake Michigan, are sought after by governmental entities for public use. Environmental NGOs and regulators are concerned with the radiological and environmental cleanup of the site, and the restoration of the site to conditions that are consistent with the post-decommissioning use of the site, as well as the character of surrounding properties. The NRC is focused upon the decontamination of the site and the proper disposal of irradiated plant materials. In order to gain the necessary regulatory approvals, the concerns of each of these stakeholders must be taken into consideration when planning for the decommissioning of the plant.

Regardless of the overall decommissioning plan, one of the first steps involves removal of spent fuel from the reactor for cooling and then storage. Where there is not already an independent spent fuel storage installation (ISFSI) at the site, one will need to be built to

accommodate fuel from the fuel storage pool after it has cooled adequately to be transferred to dry cask storage. Since the design, licensing and construction of an ISFSI takes several years, the planning for fuel storage must begin early in the decommissioning planning process. An alternative is to move the partially cooled fuel to an off-site ISFSI at a secure location, such as another nuclear power plant site. This will continue to be an issue until the DOE develops its statutory-mandated site for long-term fuel storage.

Although the NRC, through its Office of Federal and State Materials and Environmental Management Programs, has primacy on the approval of decommissioning plans, the requirements of other federal, state and local agencies must be considered when developing a comprehensive closure plan. Consequently, it is important to engage a consultant with experience in dealing with all of these agencies early in the planning process.

AMEC at a glance

- 27,000 employees in 40 countries
- Annual revenues over \$6.2 billion
- Ranked in top of its sector in the Dow Jones Sustainability Index since 2004
- US Green Building Council Member





Trust

Technology

Turnaround

rely on the integrity of our results



Chemistry Certification, Mechanical Testing & Metallurgical Evaluations

Let our one-stop, Independent Commercial Testing Laboratory help you verify materials for **nuclear power applications**. Our Scientists and Metallurgical Engineers provide accurate results based on NSL's unparalleled comprehensive quality management system.

- 42,800 square foot Metallurgical and Chemistry facilities
- 10 CFR Part 21 reporting program, with compliance to applicable requirements from 10 CFR 50 Appendix B
- Certified test reports, in accordance with ASME sections 8 & 9
- Audited by NIAC and NUPIC member customers

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More Than 50 Years of Industry Innovation

Few, if any, scientific arenas have seen the proliferation of man's knowledge and innovation as has the world of radiation. In little more than 100 years, mankind has learned ever more about radioactive energies since its discovery in the late 1890's. In the early part of the 20th century man's focus was centered around the atomic bomb and its immense capability for destruction. By 1945 scientific efforts were focused on propulsion and the large scale generation of electricity. In the USA, Westinghouse designed the first fully commercial Pressurised Water Reactor (PWR) of 250 MWe, Yankee Rowe, which started up in 1960.

During these early days of man's relationship with radiation a young student named Don Ludlum was at Kansas State University, learning to become an electrical engineer. After graduating KSU in the early 1950's Don Ludlum went to work in the radiological industry. In only five years, Mr. Ludlum had earned the position of Chief Engineer at the Eberline Company.

In 1961 Don Ludlum set out to begin his own radiological company, based on the principles of trust and customer care.

Mr. Ludlum incorporated Ludlum Measurements in 1962 understanding that it's better to have ten small contracts rather than one large one.

Don Ludlum is still president of Ludlum Measurements, Inc., now a global radiation detection company located in Sweetwater, Texas. Ludlum Measurements, Inc., employs more than 500 people worldwide and has grown to become one of the leading suppliers of such equipment in the U.S. with exports reaching throughout the world.

“It's better to have ten small contracts rather than one large one.”

Ludlum Measurements, Inc., maintains its dedication to customer care. Regardless of name or size, Ludlum Measurements, Inc., lives up to the promise to do everything possible to provide and assist its customers with the very best customized radiation detection and measurement solution for whatever their needs may be.

As the radiation industry has grown to become a part of our every day lives, Ludlum Measurements, Inc., has grown to provide the instruments of safety

for any and all industries that make use of radioactive isotopes. With a thorough understanding of operational mandates and regulations, Ludlum Measurements, Inc., works diligently to help companies



satisfy their respective rules and safety practices. Ludlum Measurements, Inc., continues to design and manufacture innovative instrumentation for ind-

ustries as diverse as scrap metals recycling to health and medical physics.

Science and technology will continue to push man's progress into the future. As we grow the industries that improve



our lives, Ludlum Measurements, Inc., will continue to meet the need for detection and measurement of the radiation we use every day.



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email: sales@ludlums.com

address: 501 Oak Street
Sweetwater, Texas
USA 79556
web: ludlums.com

the Model 3000



the Latest Innovation from Ludlum Measurements, Inc.



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- Autoranging
- Rate, Max, and Count Modes of Operation
- Splash-Resistant Construction for Outdoor Use
- 4-Button Intuitive Interface for Easy Operation
- All-Digital Calibration
- USB Port
- Lighter Weight and Ruggedly Built

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Rolls-Royce Inspection Technologies Enable Top to Bottom Steam Generator Inspection Capabilities

- Secondary moisture separators
- Primary moisture separators
- Swirl vanes
- Vents
- Tangential nozzles
- Downcomer barrel
- Feedwater ring thermal sleeve
- Intermediate deck
- J-nozzle feedwater ring
- Central drain
- Lower deck
- Transition cone girth weld
- U bend region
- Anti vibration bars
- Upper in-bundle
- Tube support plates
- Flow distribution baffle
- Tubesheet in-bundle region
- Tubesheet annulus region

Rolls-Royce Inspection Experience

Rolls-Royce inspection personnel perform nearly 200 steam generator inspections for the nuclear power generation industry on a yearly basis. Our unique capabilities, knowledge of power generation systems and experience performing specialty inspections are utilized at facilities around the world to provide customers critical information about plant health and operation.

Foreign Object Quick Facts

821 - Average number of foreign objects found in steam generator internals per year.

78% of all objects found are metal in composition.

Metallic object makeup:

- 49% - Wire
- 20% - Gasket
- 18% - Machining Remnant
- 13% - Misc. Metal Objects

RE-DEFINING STEAM GENERATOR INSPECTION

Foreign Objects Search and Retrieval (FOSAR) is used by the global nuclear industry to ensure safe, reliable and predictable energy generation. Foreign objects in the steam generator of a pressurised water reactor can lead to primary and secondary side contamination leaks; increased radiation exposure, forced outages and ultimately decreased plant availability.

Reduced radiation exposure to plant personnel is of paramount importance and continues to drive the development of customised, advanced technical solutions for the inspection of steam generators around the world.

In 2012, Rolls-Royce was asked by a customer to develop remote in-bundle inspection capabilities that would not only enhance inspection quality and further reduce potential equipment damage; but most importantly would minimise the radiological hazards for inspection personnel posed by manual inspection techniques.

Project requirements included:

- The delivery of remote inspection capabilities to minimise exposure reduction when compared to typical manual inspection techniques
- The provision of the same high quality inspection images as the currently accepted industry standard
- The ability to inspect square pitched steam generator

Through technical innovation, and drawing from proven industry experience in the development and delivery of bespoke inspection and retrieval technology for areas with limited access and complex geometries, Rolls-Royce developed the REPTIL remote in-bundle inspection system.

Based on existing Rolls-Royce manual In-bundle inspection technology, the development of REPTIL focused on the automation of the following three inspection attributes:

- **Probe translation** – A robust cog assembly utilises integrated rivets on the ultra slim (2.4mm wide) Brooks In-bundle Camera System (BICS) for probe deployment and retraction; removing technicians from the inspection platform for a large majority of the inspection, maximising ALARA/ALARP techniques to reduce technician radiation exposure by up to 80% when compared to manual inspection techniques.
- **Guidetube Translation** – the BICS probe is automatically fed into new guidetube sections for increased inspection range within the steam generator; eliminating the risk of foreign object intrusion associated with manual techniques.
- **In-bundle Rotation** - Remotely operated in-bundle rotation capabilities allow for smoother inspection data collection, providing more reliable high quality data for review by subject matter experts.

These unique remote capabilities have enabled the majority of steam generator in-bundle inspections to be completed from a low dose area or outside of the containment building entirely, significantly reducing radiation exposure for plant personnel.

The REPTIL system has been successfully deployed in over 16 steam generators in France since its inception into the market in 2013.

2014 will mark a milestone for both Rolls-Royce and the US nuclear industry when the system is deployed in the US for the first time during the autumn outage season.



www.rolls-royce.com

In the dark about nuclear services?
Let's switch the light on.



That's better! You see, at Rolls-Royce we know just how important it is to keep your customers operational. Because, if they can switch the light on without a second thought, then we know we're fulfilling our part as your long-term nuclear services provider. Rolls-Royce has over 40 years of experience in designing custom solutions that enable optimal lifetime performance. In addressing utilities' most complex challenges, we have established a comprehensive range of nuclear services for operational reactors across Europe, North America and Asia, from remote tool design and delivery to total fleet management solutions. It's good to shed some light.

Trusted to deliver excellence



Rolls-Royce



Founded in 1973, Team Industrial Services is the worldwide leader in minimizing equipment and asset downtime, providing on-line maintenance, inspection and repair. We provide critical services to our customers that enable them to maintain and operate their facilities and equipment in a safe and productive manner.

Our line of specialized industrial services includes bolting/torquing, concrete repair, emissions control, exchanger services, field machining, fitness for service, heat treating, hot tap/line stop, isolation test plugs, leak repair, manufacturing/engineering, mechanical integrity, NDE/NDT inspection, specialty welding, turnkey tank program, valve insertion, and valve repair.

We employ only the best, most qualified technicians to ensure each and every job is completed to the highest standards every time. Our quality management system requires ongoing technical training for all personnel. Additional training and documentation are required based on specific technical job requirements.

In addition to our services, Team's ISO-certified engineering design and manufacturing facilities provide

the highest quality pipe repair, leak sealing and hot tapping hardware, sealants and related products. A company-wide commitment to quality control, safety and quick response drives the manufacturing of all Team products 24/7/365.

In our 40 years of experience in inspection, maintenance, repair, and compliance, we've come across a variety of unique business and industry challenges. We provided solutions for each of these challenges, which we then utilized to better our team, better our services and better our processes. Whether our customers are working on a capital expansion project in a nuclear power plant, planned maintenance in a paper mill, emergency repair to a mining massive loader assembly, or a scheduled turnaround in a refinery, more than likely one of our technicians has performed similar work in a similar situation.

Our customers have grown to count on Team when the going gets tough. However, we approach any project, big or small, with the same intensity to ensure each job is completed safely and to the highest standards every time. That is why HSE&S and quality are the core driving forces

behind everything we do at Team. We maintain management systems and documented work procedures designed to assure compliance with all applicable laws, regulations and internal requirements, as well as to facilitate the continuous improvement of our processes, products, and personnel. Our highest priority at Team is the safety of our employees, clients, and other contractors. We are committed to safety excellence and strive daily for Zero injuries and incidents.

Today, we are rapidly growing our global footprint across a wide range of industries - with service locations in five continents. We recognize that our global success is ultimately measured by our customers' trust and confidence, which can only be earned through continuing outstanding service. Team's trained and certified technicians are available worldwide 24/7/365. From single part repair to turnarounds and shutdowns - planned or unplanned - Team has the training, experience, technology and know-how to deliver high-quality maintenance, inspection, and testing services anytime, anywhere.



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- + Valve Repair

The management of nuclear assets requires personnel experienced in maintaining the integrity of the equipment and ensuring optimal production. From reactor inspections to in-service valve installations, Team has the experience, equipment, and locations to keep your power generation equipment going.

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WORTHINGTON ACQUISITION OF WESTERMAN STRENGTHENS U.S. MANUFACTURING OF UF6 CYLINDERS

Worthington Industries, a diversified metal processing company and manufacturer of tanks and cylinders, announced in 2012 it acquired Westerman Companies. The acquisition adds to Worthington's footprint in the energy industry and supports growth for the company's offering of UF6 cylinders and other nuclear power plant component products.

ABOUT WORTHINGTON

Worthington Industries was founded by John H. McConnell, a young steel salesman, who saw an opportunity for custom processed steel. He purchased his first load of steel by borrowing \$600 against his 1952 Oldsmobile and founded Worthington Industries in 1955.

Following several years of growth in steel processing, Worthington purchased a small cylinder facility in 1971, which formed the cornerstone of what is today Worthington Cylinders, a global manufacturer of pressure vessels and related products. Led since 1996 by John P. McConnell, the founder's son, Worthington Industries leads the diversified metal processing industry with a focus on the Golden Rule, valued employees, stability and innovation. The company's strategic growth plan has resulted in 12 acquisitions in the last three years, several of which are rooted in Worthington's expertise of manufacturing

cylinders and tanks for highly regulated markets.

SUPPORTING ENERGY MARKETS: WESTERMAN NUCLEAR

Worthington expanded its energy portfolio by acquiring **Westerman Companies** in September 2012, adding to Worthington's capabilities and experience of the oil & gas and nuclear sectors. One of the divisions acquired was **Westerman Nuclear**, the world's largest producer of enriched uranium hexafluoride (UF6) storage and transportation cylinders for the nuclear industry, and the only manufacturer in North America.

Westerman was founded in 1909 and has manufactured products for the nuclear market since 1986. In addition to serving nuclear markets, Westerman carries the distinction of being the oldest continuous manufacturer of oil and gas wellhead equipment in the Appalachian region, offering planning, design engineering and

precision manufacturing to both oil & gas and nuclear markets.

STRENGTH IN MANUFACTURING SYNERGIES

The acquisition adds to Worthington's footprint in the energy industry, and supports growth for the company's offering of UF6 cylinders and other nuclear power plant products. Worthington seeks to strengthen U.S. manufacturing of UF6 cylinders, and will complement Westerman's proud tradition of supporting U.S. private and public sector needs, including Westerman's historic role in manufacturing the UF6 cylinders used in the Megatons to Megawatts program. Combined with the heritage of Westerman Companies, Worthington is proud to serve the nuclear industry, supporting the nuclear fuel cycle with enriched uranium storage & transportation cylinders, radioactive waste containers and custom power plant components. For more information, call 1.800.338.8265.



- Nuclear Subassemblies
- Radwaste Containers
- Material Certifications
- Reactor Components
- Pressure Vessels
- Heat Exchangers

	NA, N, N3, NS NPT, PP, U	ISO 9001:2008, NQA-1 10 CFR 50 APPENDIX B ASME SECTION III & VIII	
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All nuclear certifications are currently held with Westerman Inc.

PHONE **800-338-8265** WEB www.worthingtoncylinders.com

Fairbanks Morse Engine Trusted Provider For Mission-Critical Applications

Fairbanks Morse is a cornerstone of the nuclear industry with over 100 engines providing critical standby power throughout the Americas. Four decades of dependable operation have built a lasting trust in the Opposed Piston, Colt-Pielstick, MAN and ALCO product offering. Fairbanks Morse is poised to offer the next generation of nuclear power plants the same quality, reliability, and service support that the industry depends upon today. Generator sets from Fairbanks Morse are backed by world-class service, factory-direct engineering and essential OEM replacement parts.

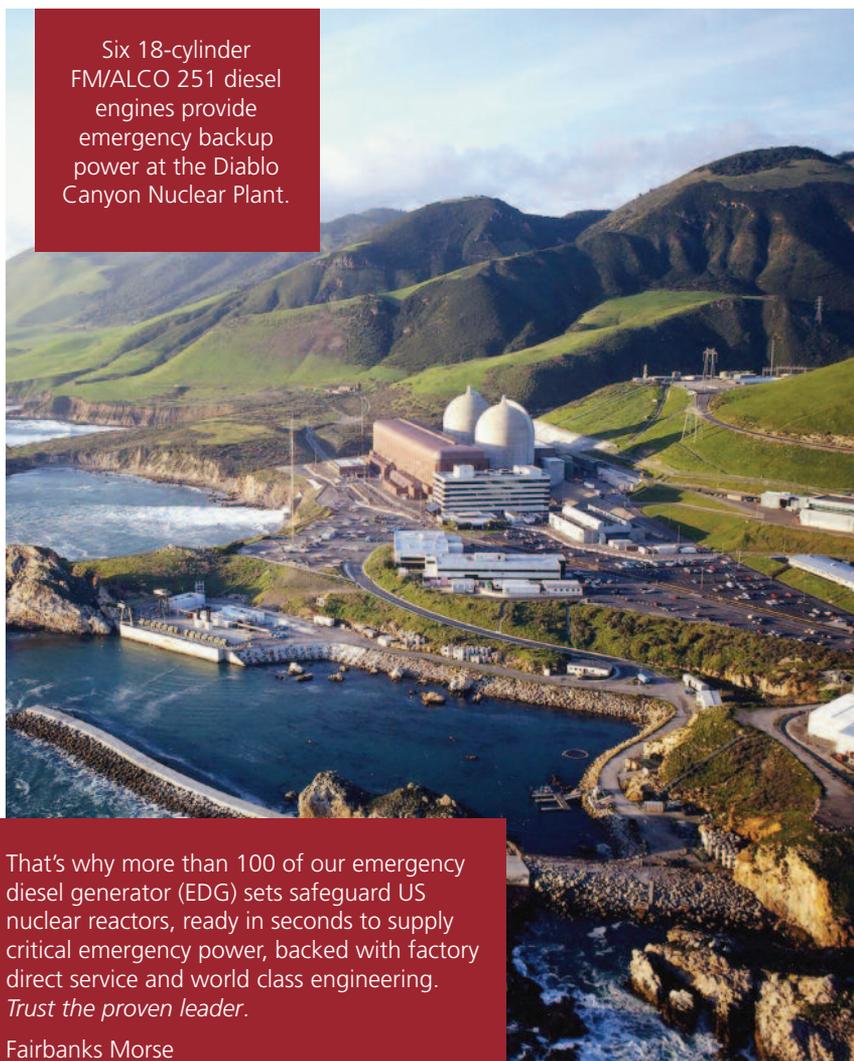
Fairbanks Morse Engine designs, manufactures and tests medium speed diesel engine generator sets to comply with Nuclear Regulatory Commission (NRC) requirements. Emergency Diesel Generator (EDG) sets supply electrical power to safely shut down the nuclear reactor in the event of a loss of normal offsite power, coolant accident or other operational anomaly. Typically installed in groups of two or more for redundancy purposes, the EDGs are designed utilizing the same stringent requirements as all other safety systems inside the plant.

Nuclear power plants are designed to shut down safely in response to electrical grid disturbances by using power generated on-site by the EDG.

However, an extra level of redundancy is required in the event that the EDG set cannot generate sufficient power to maintain safe conditions. A completely separate station blackout (SBO) diesel generator set provides this necessary power until safe operating conditions are restored.

Fairbanks Morse Engine maintains a commercial-grade nuclear dedication program, approved by the Nuclear Utility Procurement Issues Committee (NUPIC), and also satisfies the requirements of 10CFR50 Appendix B and 10CFR21.

Our EDGs are proven in places where normal is anything but



Six 18-cylinder FM/ALCO 251 diesel engines provide emergency backup power at the Diablo Canyon Nuclear Plant.

That's why more than 100 of our emergency diesel generator (EDG) sets safeguard US nuclear reactors, ready in seconds to supply critical emergency power, backed with factory direct service and world class engineering. *Trust the proven leader.*

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With five decades of proven engineering experience in nuclear power, let us help you take the next step in your nuclear project.

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- Owner's Engineer
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- Plant Permitting
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 - Schedule
 - Resource Integration
- Risk Management
- Construction Planning
- Quality Reviews
- Configuration Management
- EPC Technical Specification

SUPPLIER OVERSIGHT AND INTEGRATION

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- Issue Resolution
- Supplier Performance/Incentive Management
- Conformance Reviews

CONSTRUCTION AND START-UP SUPPORT

- Development & Construction Plan Review
- ITAAC Planning & Management
- Start-Up Testing
- System Turnover

LICENSING PROJECT MANAGEMENT

- Site Specific Engineering for Combined Operating
- License Application (COLA)
- License Application Reviews/Oversight
- EPC Technical Specification
- Independent Review & Verification of ITAAC
- Design Certification Development (DCD)
- DCD Departure Reviews

ENGINEERING

- Analysis
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- Commercial Grade Dedication & Equipment Qualification
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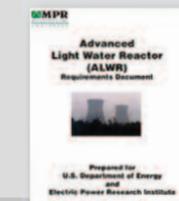


1964

Harry Mandil, Bob Panoff, and Ted Rockwell leave Admiral Rickover's Naval Reactors to start MPR.



Over the past 50 years, MPR has helped to improve plant operations and reliability at more than 600 plants in more than 70 countries.



Going forward, MPR continues the advancement of nuclear technologies from concept to implementation, bridging the gap between the A/E and OEM.

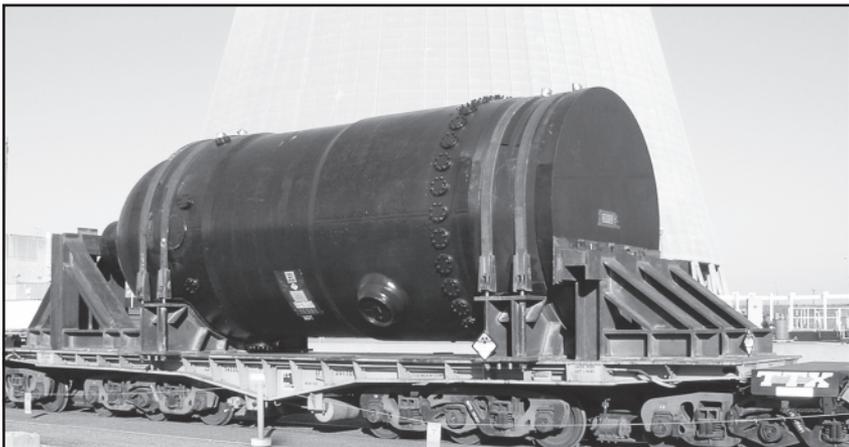
2014

Since its establishment in 1964, MPR has focused on delivering excellence and value to nuclear industry clients. Five decades later, MPR has remained true to its core values, providing solutions to overcome challenges that have a lasting impact on our clients' success.

MPR makes challenging projects successful, delivering safe and reliable technical solutions across the entire project or product life-cycle to benefit its clients and society as a whole.



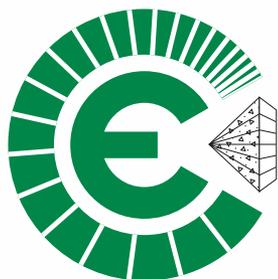
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Our Nuclear Commitment

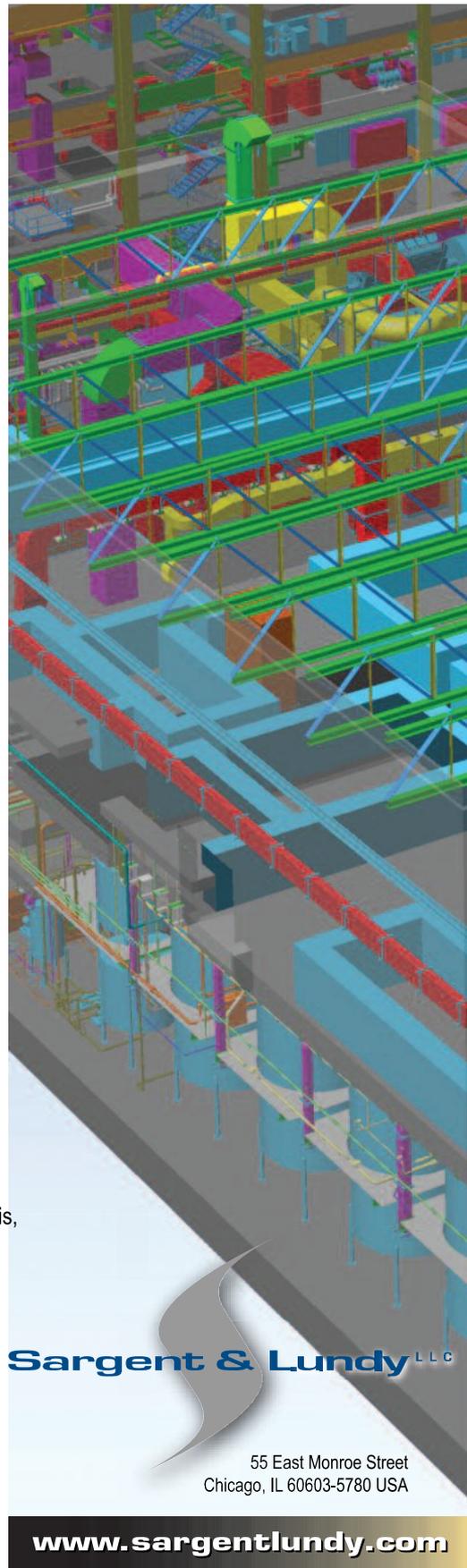
Nuclear power clients have been a primary part of our power focus since 1954, pretty much when it all started. Nuclear clients have good reason to have confidence in our capabilities, not only from our quality, expertise, and focus, but also from knowing we will be here for them when needed with what they need, as we have been for 60 years. Owners enlist our broad support as their preferred engineer and rely on our expertise for specialized problem-solving. Our ongoing and recent activities encompass emerging issues, leading edge initiatives, and nuclear plant design and licensing activities such as:

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Pathway to Success: How Project Management Can Help Nuclear Power Facilities Succeed



Across the United States nuclear utilities face fierce competition from low cost natural gas and subsidized renewable energy resources. In addition, flat demand growth and marginal electricity prices finds many nuclear utilities with limited capital to address increasing regulatory hurdles and growing project backlogs. The challenges facing the nuclear sector are further compounded by the loss of utility project management expertise due to aging workforces and retirements.

Viewed holistically, the negative impacts caused by the inability to properly manage capital project execution are now challenging the economic viability of some nuclear plants. A robust and rigorous project management process can significantly mitigate these negative impacts, freeing up resources to focus on operations and power generation.

Black & Veatch possesses the experience and required balance of economic and technical understanding to successfully manage large capital projects. With nearly 100 years of managing projects on-schedule and on-budget, our teams of seasoned professionals serve as strategic advisors to utilities while providing a full range of EPC capabilities.

Key features of Black & Veatch's project management capability include:

- Planning projects with the end user in mind
- Use of innovative tools, processes and team work create a culture of project success
- Seamless integration of project controls, project management, engineering management and construction management from project initiation through final acceptance

For nuclear power plant owners, Black & Veatch emphasizes the importance of managing the risks inherent to any project. Developing a fully defined project scope is critical to identifying risks that can ultimately derail a budget and timeline. Based on decades of global experience, Black & Veatch has developed a planning contingency model that considers project specific and systemic risk factors to quantify the uncertainties that remain.

"Calibrated with information gathered across our global footprint, final observed risk factors are often within 2 percent of the projections the model generates for contingency," states Jon Gribble, Nuclear Director. "These same tools can also be

applied for utilities that want us to manage projects, thereby creating opportunity for knowledge transfer to their personnel."

In addition to its experienced project professionals, Black & Veatch deploys a robust and rigorous project management approach necessary for success, including:

- Budgets tracked by individual procurements, as well as by category of work activities and labor type
- Skilled project cost controls professionals that accumulate cost updates on a weekly or hourly basis and provide feedback to track progress against the plan
- Advanced project software programs to develop intricate, resource loaded schedules
- Sophisticated reports and tools to anticipate adverse trends and analyze emerging events associated with a variety of solutions

"Black & Veatch prides itself on the skills and focus that our professionals bring to each and every clients' project," said Dean Oskvig, President of Black & Veatch's energy business. "Whether as a consultant, an owner's representative or contractor, we will help better position utilities with nuclear assets to succeed in this challenging market by reducing or eliminating their project risk."

“Whether as a consultant, owner’s representative or contractor, we will help position utilities with nuclear assets to succeed in this challenging market by reducing or eliminating their project risk.”

— DEAN OSKVIK, PRESIDENT,
BLACK & VEATCH'S ENERGY
BUSINESS

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Know the end result is success ... from the start.

From day one, you can expect your challenging nuclear project to be completed on time, on budget, with no surprises. Black & Veatch delivers the most complex projects – both new build and operating plants – with reliable, disciplined, tested processes that have earned clients' vote of confidence, time and time again.

We're building a world of difference. Together.



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COMMITTED TO THE NUCLEAR INDUSTRY

American Crane & Equipment Corporation, a privately held U.S. company with headquarters in eastern Pennsylvania, is proud to be celebrating its 40th year of business! Since 1972, American Crane has been one of the most innovative manufacturers of high quality specialty lifting equipment for nuclear applications. The design and manufacture of custom equipment, with special attention to the rigorous standards of nuclear quality assurance, has been the company's primary business focus.

American Crane's conceptual design for single failure proof cranes provides up to 350 tons capacity with the ability to meet requirements for design and manufacture of higher capacities through 1,000 tons. By successfully providing the majority of single failure proof crane upgrades for dry spent fuel storage in the United States, American Crane has proven its expertise in supplying equipment for the nuclear industry.

The SAFLIFT™, one of American Crane's patented products, is used for dry spent fuel processing operations. The SAFLIFT™ eliminates seismic stack-up stability risk and reduces ALARA concerns when transferring the canister to the cask. Extensive experience with nuclear power plant requirements has enabled American Crane to meet its customers' specifications and schedules. Over the years, customers have included nuclear utility businesses, Department of Energy sites and laboratories, military facilities, and aerospace companies.

American Crane has made other significant investments to meet the nuclear industry's demand for high quality cranes and next generation equipment design. For instance, to accommodate the demands of the specialty lifting equipment market, American Crane has increased its operations and work force to include three locations near Philadelphia, PA. This manufacturing expansion and increase in highly skilled labor has the scalability to meet future market demands.

As a supplier to the nuclear industry, American Crane has maintained a Quality Assurance Program since 1996 that meets both 10 CFR 50, Appendix B, and ASME NQA-1 standards. American Crane's quality program has been audited by commercial nuclear utilities, NUPIC, and DOE contractors.

Entrust your future crane needs to one of the nuclear industry's most innovative and committed leaders.



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- Manufacturing Support Division (100,000+ sq.ft.)

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Holtec International: a global leader in power generation technologies and nuclear waste management.

Holtec International provides engineered equipment and services under 10CFR50, 10CFR71, and 10CFR72 regulations and IAEA standards (where applicable) to nuclear plants around the world. Holtec prides itself on the substantial number of awarded turnkey contracts wherein Holtec engineers, manufactures, and installs the equipment.

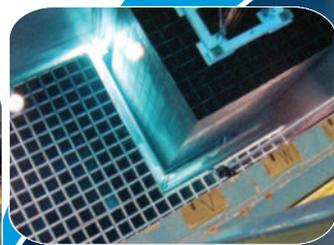
Holtec is a proven innovator that continually discovers how to stay a generation ahead. Holtec essentially invented the ultra-high-density wet storage technology during the 1980s and is credited with pioneering the Multi-Purpose-Canister (MPC) technology in the 1990s (Holtec was the first in the U.S. to license and manufacture systems that employ the MPC technology). The technical staff employed by Holtec formulates innovative solutions to operational and technological problems. The company secures, on average, five patents each year. One of our recent innovations is the HI-STORM FW, which is uniquely designed to maximize storage capacity and heat load, minimize occupational

dose, permit storage of severely deformed or canisterized fuel, and to be extremely resistant to deleterious flood and wind. The HI-STORM FW basket is manufactured entirely from METAMIC®-HT. This advanced material provides structural support, neutron absorption, enhanced heat transport, and is low weight. The basket is configured to hold either 37 PWR assemblies (MPC-37) or 89 BWR assemblies (MPC-89), in addition to VVER 440, VVER 1000, or RBMK fuel types. Holtec is also proudly licensing the underground storage system, HI-STORM UMAX, which is essentially impregnable to the post-9/11 terrorist threats. In addition to wet and dry systems for managing spent nuclear fuel, Holtec also provides custom engineered steam surface condensers, feedwater heaters, and safety related heat exchangers designed by Holtec's Heat Transfer Division (HTD).

Holtec's vertical integration allows control over quality, schedule, and cost and provides customers fully integrated solutions. It allows designers and fabricators to work closely during the

project development and manufacturing phases to incorporate lessons learned. Holtec Manufacturing Division is a wholly-owned plant in Pittsburgh, Pennsylvania with over 850,000 sq. ft. of manufacturing space, 400 tons of lift capacity, state-of-the-art machinery and all needed ASME nuclear and non-nuclear stamps (N, N3, NPT, R, U, NR). Holtec expanded its manufacturing capabilities with the purchase of two aluminum manufacturing plants in Ohio and the purchase of METAMIC® LLC. With these acquisitions, Holtec has synergized the ongoing R&D work in powder metallurgy and the manufacturing savvy of the Ohio plants to develop and offer a new generation of supermetals to users in need of advanced materials, fabricated and extruded at Holtec's Orrvilon Fabrication Facility.

Holtec International is headquartered in Jupiter, Florida with the Corporate Technology Center located in Marlton, New Jersey. Holtec has operational centers around the globe. To learn more about Holtec, call Joy Russell at 856-797-0900 Ext. 3655.



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DP ENGINEERING can satisfy all of your engineering needs with expertise in Digital Upgrades, HVAC, Mechanical, Electrical, I&C, Civil/Structural Engineering, and Project Management.

DP ENGINEERING is a full service engineering & consulting firm providing solutions to the Nuclear Industry. Our diverse teams of professionals possess the experience you can count on to thoroughly understand each project's unique challenges. Through strategic teaming with selected industry recognized EP&C and nuclear-component providers, we provide complete solutions for plant upgrades. You can depend on us to deliver the highest quality of engineering products, address current nuclear industry regulations, and deliver solid, successful service time and time again.

- Our growth continues with experienced and new graduate professionals.
- Many of our employees possess significant in-house utility experience.
- We are recognized for our quality and responsiveness.
- We understand your needs, and work as a team with your staff.

SUBJECT MATTER EXPERTS IN:

- Valves (AOV, MOV, SOV, Check, and Relief)
- Emergency Diesel Generators (obsolescence, regulatory compliance, mechanical and electrical controls)
- Large Motors
- Inverters and Battery Chargers
- Lost Phase Detection (Byron Event solutions)
- MasterPact Circuit Breakers
- Seismic Qualification
- Electrical System Analysis
- HVAC Design And Analysis



Mitsubishi Replacement Components and Services Extend the Operating Lives of Nuclear Power Plants

For more than fifty years, Mitsubishi Heavy Industries (MHI) has provided electric utilities with a wide range of reliable products and services designed to prolong the operating lives of nuclear power plants. Mitsubishi Nuclear Energy Systems Inc., (MNES), the U.S. operations office for MHI, brings a combination of U.S. and Japanese nuclear energy expertise to partner with the nuclear fleet utilities. Based in Charlotte, NC, MNES is positioned to provide state of the art engineering and technologies in cooperation with MHI.

Reactor vessel closure heads

Replacing the reactor vessel closure head (RVCH) on a nuclear power plants will extend its operating life and improve plant efficiency. Since 1996, the company has successfully designed, manufactured, and delivered 39 replacement reactor vessel closure heads (RRVCHs) with Alloy 690 penetrations to global customers. Mitsubishi has the facilities and expertise to manufacture replacement RVCHs using tools and processes the company has developed over the past half-century. Mitsubishi can support its utility customers during the full replacement project from initial design and planning to final testing.

Control rod drive mechanisms

Mitsubishi has designed, manufactured and delivered over 1,400 control-rod drive mechanisms (CDRMs) around the world in the past two decades, helping electric utilities prolong the operating life of nuclear power plants. At its modern factories, Mitsubishi fabricates and assembles head adapters, latch assemblies, latch housings and rod travel housings for replacement CDRMs. Mitsubishi's reliable and proven manufacturing technologies provide utility customers with the highest quality replacement components.

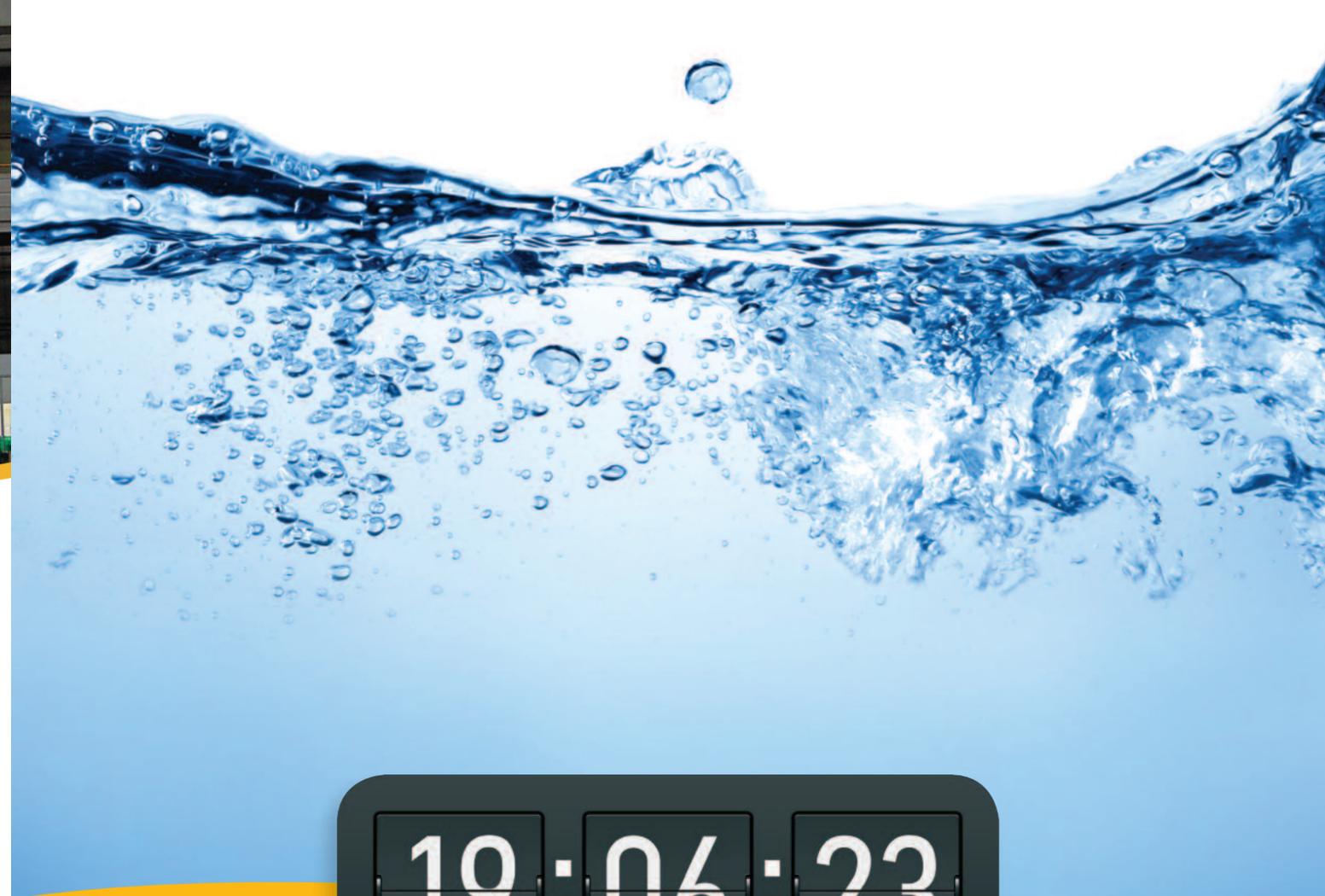
Water jet peening of alloy 600 materials

Mitsubishi's Water Jet Peening (WJP) technique mitigates stress corrosion cracking in the various nozzles contained within the reactor vessel and extends the operating life of a nuclear power plant. The entire WJP process is conducted underwater during plant outage, with no foreign materials or heat introduced into the reactor. Because the WJP equipment is controlled remotely, the occupational dose exposure is extremely low. Mitsubishi has successfully provided more than three dozen WJP applications and operates a complete training center for WJP services.

Please visit our website at www.mnes-us.com for more about these and other services designed to prolong the operating life of your utility's nuclear power plants.

Your Energy. Our Experience.

www.mnes-us.com



Extend Life

Mitsubishi's Water Jet Peening (WJP) technique mitigates stress corrosion cracking in the various nozzles contained within the reactor vessel and extends the operating life of a nuclear power plant. The entire WJP process is conducted underwater during plant outage, with no foreign materials or heat introduced into the reactor. Because the WJP equipment is controlled remotely, the occupational dose exposure is extremely low. Mitsubishi has successfully provided more than three dozen WJP applications and operates a complete training center for WJP services. Make Mitsubishi your plant renewal partner.

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Petersen Inc. has been the industry leader in custom steel manufacturing for the nuclear industry for decades. How? By creating solutions to difficult problem and helping our customers meet their high demand project timelines by producing high quality products efficiently and in-budget.

HISTORY

Petersen Inc., of Ogden, Utah opened its doors in 1961 and has been manufacturing products for industries worldwide since that time. For over 50 years Petersen Inc. has been the company to go to when custom fabrication, design, engineering, and field installation are required for difficult projects. Over the years we have become the industry leader in the field of fabrication and precision machined components.

Petersen Inc. has been chosen as a partner in high-profile projects such as the Department of Energy's Hanford Waste Treatment Plant, Savannah River MOX facility, WIPP, Zion, West Valley, Kewaunee, APS, ORNL, LANL, LLNL, INL, and others.

The Petersen Inc. fabricated Melters will be the heart of the Hanford Waste Treatment Plant which will be the world's largest chemical radioactive waste treatment plant.



Up to 53-million gallons of radioactive waste is anticipated to be processed through the melters.

Petersen Inc.'s participation in the Department of Energy's MOX Services project at the Savannah River Site is constructing storage components, gloveboxes, and other associated equipment for the facility which converts weapons grade plutonium into fuel for electricity generating power plants.

The Petersen Inc. involvement with Energy Solutions and NAC at the Zion, West Valley, Kewaunee, APS, locations is in providing Dry Fuel Storage casks and

equipment, including Vertical Storage Casks; a steel-lined reinforced concrete storage cask.

Petersen Inc., is a major supplier of containers for many industries including Nuclear, Aerospace, Commercial, Petrochemical, and is proud to be a



part of the clean-up of waste generator sites around the country, helping to make it a cleaner and safer environment for future generations. Petersen Inc. fabricates RLC's, SWB's, and TDOP's for Nuclear Waste Partnership LLC, (NWP) at the Department of Energy's WIPP site which allows us to provide storage containers of various sizes and specifications to anyone who purchases them through NWP.

CERTIFICATIONS

- ASME NQA-1
- ISO9001-2008
- NRC Subpart H of 10CFR71
- ASME {U} {U2} {S} {R}
- AS9100

CGD In-house Test Lab

- Commercial grade dedication of material for nuclear applications
- Spectrographic chemical analysis of low alloy steels, stainless steels, nickel base alloys – includes nitrogen and oxygen determination
- Rockwell hardness
- Certified penetrant, magnetic particle and visual examination
- Weld procedure testing
- Weld wire certification including welding of test coupons in accordance with filler material specifications



Brilliant

“Everything should be made as simple as possible, but not simpler.”

~ Albert Einstein

We agree. And in our business simple equates to efficiency. From Glove Boxes, to Melters, to Containers, and more, Petersen Inc. takes your plans and creates the most efficient way to build your project. With more than 53 years of experience, work and knowledge under our belts, it's no surprise we are still here and growing. We have the open capacity to complete your project efficiently, on-time and within budget.

Simply Brilliant

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Dry Fuel Storage Cask • IP Containers • Standard Waste Box • Standard Large Box • Glovebox
Process Equipment • Melters • Material Handling Equipment

THE NUCLEAR INDUSTRY'S RIGGING AND TRANSPORTATION EXPERTS

The unique nature of the nuclear power industry demands vendors with the skills and experience that can consistently perform at extremely high levels. Barnhart's Nuclear Services Group has proven its rigging and transportation expertise in seventeen years of working with the nation's leading nuclear energy producers, contractors, and engineers.

LIFE EXTENSIONS, UPGRADES, AND MAJOR MAINTENANCE REQUIRE THE HANDLING OF CRITICAL COMPONENTS WITHIN OPERATING PLANTS. To perform this work during planned outages, a thorough knowledge of major construction techniques, advanced structural engineering, and ALARA is required. It is also crucial that the company has practical working knowledge of the demanding requirements of nuclear protocol, such as NuReg 0612. Barnhart exceeds that criteria and has developed unique tools and methods to perform the movement of major equipment such as:

- RPV Closure Heads
- Feedwater Heaters
- Steam Dryers
- Moisture Separator Reheaters
- Condensers
- ISFSI Installations
- Pressurizers
- Transformers

RIGGING SUPERVISION, LIFT PLANNING, HEAVY RIGGING, AND CRANE SERVICES are provided through their team of professional supervisors, engineers, and project managers. Barnhart ensures the safety, quality, and timely completion of plant outages. Often they are called upon to participate in the "Readiness Planning" of various operating plants. These plans serve to limit downtime during emergency outages by coordinating the engineering, rigging plans, and transportation schedules. In some cases, heavy rigging in nuclear power facilities presents the challenge and opportunity for development of custom designed rigging tools. Barnhart's ISO9001 certified engineering and fabrication capabilities provide solutions, from concept through completion, to handle major components safely and on schedule.

EXPERIENCED AND CERTIFIED FOR HAZMAT SERVICE, Barnhart also brings a working knowledge to the transportation of contaminated components to burial or processing. Barnhart's Heavy Lift Terminal in Memphis serves as a transfer point and waste processing facility of Studsvik Energy Solutions. Barnhart provides transportation of such components by barge, rail, or road. Barnhart rounds out their experience by providing warehousing services to support the Pooled Inventory Management (PIM) program administered by Southern Company. The PIM program is a mechanism for nuclear plant owners to jointly procure and store critical plant spare equipment. Permanent PIM management resides at the Barnhart facility coordinating the maintenance and handling of the inventory by Barnhart personnel. To learn more about Barnhart's work experience in the nuclear industry, visit www.barnhartcrane.com.

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IMPROVES
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& SCHEDULE
FOR NUCLEAR
TURBINE
MAINTENANCE**



For more information email info@hytorc.com or contact your local HYTORC representative
The World's Most Trusted Industrial Bolting Systems

Optimizing Bolting Processes on ICI Flanges

HYTORC is the World's oldest and largest manufacturer of industrial bolting systems. With a focus on improving safety, quality and schedule, they are constantly developing innovating bolting systems and working with end users to streamline their bolting processes. In February of 2014, HYTORC worked together with a large nuclear power plant in the United States to optimize the bolting process on their In-Core Instrumentation (ICI) flanges. The ICI's on this Class 1 safety related application had 8 flanges with 8 bolts per flange. For the highest level of safety and speed, HYTORC recommended the use of the HYTORC Nut, which ultimately provided productivity improvements and dose reductions of over 50%.

The HYTORC Nut has also proven to increase productivity and safety during

removal and installation of casings on many nuclear steam turbines. For large fasteners, the HYTORC Nut is the only system that is verified to improved outage safety, quality and schedule through an efficient hands-free cold stretching process. This patented mechanical innovation uses hydraulic tooling to mechanically stretch studs with pure tensile load. Main stop valves, control valves, turbine casings, man ways and ICI flanges are a few of the many applications that have been optimized with HYTORC Nuts. More than 10,000 HYTORC Nuts are installed on critical path bolting evolutions in nuclear power plants around the world.

HYTORC Nuts reduce dose and make the bolting process safer by providing a hands free approach to bolting. With the HYTORC Nut

system an operator can simultaneously tension multiple studs from a safe distance. Additionally, this patented bolt stretching method guarantees elimination of galling by eliminating nut rotation on loaded studs; this can provide tremendous savings of time and money during the disassembly process.

HYTORC produces Q1 safety related nuclear components for domestic and international nuclear sites. HYTORC designs custom bolting solutions in New Jersey and facilitates design specification, training and installation with worldwide distribution and local support. For more information please email info@hytorc.com or call +1-201-512-9500.

Mike Dolan
Chief Engineer

ENERCON Ranked in Top 2 in U.S. for Nuclear Engineering Firms by ENR

ENERCON is a leading provider of licensing, environmental, and engineering services in support of new nuclear power plant deployment programs including siting, technology selection, owner's engineer, and diverse technical services for new nuclear power plants. On behalf of U.S. utility clients, ENERCON has written license applications for the siting, construction and operation of numerous NPPs, and has also performed a variety of other related strategic consulting services.



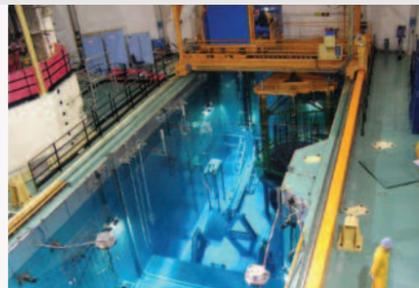
ENERCON has provided extensive support to clients in completing studies to select potential nuclear power plant sites, evaluating a broad range of issues and requirements associated with proposed plant locations including seismic and geotechnical design issues, access to water, population and demographics, ecology, access to transmission and rail corridors, and public acceptance.

ENERCON has performed engineering analysis, assessments and evaluations, and prepared system designs and modification packages, as well as provided licensing support and third party reviews for approximately 75% of operating U.S. NPPs.



As the first generation of commercial nuclear power plants ages, ENERCON has supported clients' efforts to obtain regulatory approval for the life extension of their plants.

ENERCON is a leading provider of detailed design engineering of security systems for the commercial nuclear fleet.



ENERCON performs a broad range of sophisticated safety analyses encompassing thermal hydraulics, finite element, criticality safety, transport, and radiological dose analyses.

ENERCON provides clients with support in the areas of Radiological/Health Physics and Emergency Preparedness, as well as Decommissioning and Site Remediation focused on facility characterization and demolition, environment and hazardous waste clean up, and license termination.



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Corporate Headquarters: Atlanta. **Other locations:** Albuquerque, Ann Arbor, Baton Rouge, Birmingham, Chattanooga, TN, Chicago, Dallas, Denver, Duluth, GA, Germantown, MD, Houston, Humble, TX, Kansas City, Northern New Jersey, Oakland, Oak Ridge, Oklahoma City, Orlando, Palm Beach Gardens, Pittsburgh, Sacramento, San Clemente, Tampa, Tulsa, Washington, DC, Wilmington, DE. Doing business internationally as ESI-Energy Consultants, with offices in Abu Dhabi. enercon.com/locations for details.



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**WE OFFER YOU A COMPLETE RANGE OF SERVICES.
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There are many professions that demand excellence during the workweek. That won't suffice for our industry. With nuclear power, there are no days off. And all the days have 24 hours. That's why we have 28 strategically located offices and over 1500 employees available to assist our clients 24/7 on a wide range of technical issues. This is just one example of our culture at ENERCON, and it is best summarized by our credo: *Excellence – Every Project. Every Day.* Our focus on excellence has helped us become one of the largest and most respected engineering and environmental firms serving the commercial nuclear industry.

With long term contracts in place to support most nuclear power plant operators, we have become known as the "go to company" for resources and technical expertise. ENERCON offers you unparalleled experience in licensing and construction of new nuclear facilities, operating and upgrading existing nuclear facilities, as well as the planning and activities required to shutdown facilities no longer required to operate.

Our recent acquisitions of TALISMAN and MARACOR have significantly expanded our resources and capabilities in the regulatory, licensing and PRA areas. TALISMAN specializes in providing support to licensees that are addressing complex issues before the NRC. MARACOR focuses on supporting the nuclear power industry to help manage plant risk activities. These two additions help set us apart from the competition.

Give us a call, visit our new website or email us directly. We are ready to respond to your needs. We are committed to *Excellence—Every project. Every day.*



Excellence—Every project. Every day.

info@enercon.com

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Service Performance Profile: TVA - Sequoyah Nuclear

Faced with an emergent need to replace a Reactor Coolant System primary check valve at the Sequoyah Nuclear Plant, TVA turned to Tri Tool to deliver quality services in an expedited time frame.

During a recent refueling outage, replacement was required of a critical 6" stainless-steel Reactor Coolant System primary check valve. The valve was approximately 24 inches long and 600 lbs. and was located in a tight, congested area. Special considerations were required as the valve and associated piping were very contaminated.

Because of successful prior project experiences, the utility called on Tri Tool Services. Working closely with the site Projects and Modifications Contractor, Tri Tool responded with a crew of pipefitters, machinists and welders within 24 hrs.

Alongside radiological control personnel, Tri Tool had to remove the old valve with a minimum of debris to remain within the plant requirements for Foreign Material Exclusion. Personnel safety considerations associated with the task were integrated into the Job Safety Analysis while

developing the action plan for mitigation of the project's operational and radiologic hazards.

Utilizing Tri Tool's Model 212B BevelMaster® ID beveler and Model 608 SB Clamshell lathe the existing valve cut-out and removal was precisely executed to exacting customer specifications.

Tri Tool's welders were tested and pre-qualified to TVA's Quality Program and the replacement check valve was installed through a teaming effort of Tri Tool and utility personnel. The fit-up was extremely critical and was closely monitored by the site's QC and QA personnel.

The project was completed with no safety or human error issues due to the diligent and thorough (albeit emergent and rapid) planning efforts of Tri Tool and the entire site team.

All work was performed with zero Safety or Human Performance issues. The valve was installed in compliance with ASME Section XI, Repair/Replacement requirements.

Post welding of all large bore welds required an In-Service Inspection of the final weld profile.



Tri Tool's welders at Sequoyah Nuclear were tested and qualified to TVA's Quality Program and welds performed by them exceeded all acceptable, prescribed standards.

Additionally, the welds were subjected to 100% radiographic testing acceptance criteria as called out in ASME Section IX, and all initial welds done under these requirements by Tri Tool's welders exceeded all acceptable, prescribed standards.

Contact TRI TOOL for rapid response, unequalled support, excellent equipment and our total commitment to safe, error-free performance.

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OUR ERROR-FREE COMMITMENT

Tri Tool is the trusted service partner to nuclear sites across the nation. With our culture of safety, integrity and hard work we consistently deliver error-free project results. Call today to speak with a Nuclear service expert.

"The professionalism of their project manager, machinists and welders was exemplary and the quality of their work was beyond compare... I will continue to work with Tri Tool and would highly recommend this company."

David Charles Haney
Modifications Manager, TVA - Sequoyah Nuclear

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INNOVATIVE SOLUTIONS



Built on the legacy and hard work of the Saulsbury family and its loyal employees “the next step” in the growth of Saulsbury Industries has led them in the direction of the Nuclear Power Industry. The mission will remain the same while the objective will be to provide the Nuclear Industry with the “Saulsbury Difference”.

The Saulsbury Nuclear Services team has set out to distinguish itself in the market by combining Saulsbury’s long established core values with the nuclear team’s deep history in delivering customer service and stakeholder value.

EPC Project Capability

- Civil
- Structural
- Mechanical
- Electrical

General Plant Maintenance

- Mechanical
- Electrical
- I&C
- Condensers
- Heat Exchangers
- Valves
- Pumps
- Motors
- Turbines
- Painting & Coating

Regulatory Upgrades

- Sump Pump Modifications
- Fukushima Modifications
- NFPA 805 Modifications
- Security Modifications

Support Services

- BOP Scaffolding, Insulation, etc.
- RP, HP and Decontamination
- Facilities Management
- Access Authorization
- In / Out Processing
- Sub-contractor Management
- Field Execution Management
- Work Package Development
- Estimating, Planning, Scheduling
- Project Controls
- Field Supervision and Engineering
- Labor, Safety & Procurement Management
- Professional, Technical, Clerical

Contract Models

- Time & Material Projects
- Managed Task Projects
- Incentivized Based Work Structure
- Seconded Labor Pricing
- Target Pricing
- Fixed Lump Sum Pricing

Transmission & Distribution

- Switchyard Distribution
- Sub-Stations

Life Cycle Modifications

- Service Water Piping
- Feedwater Heater Replacement
- MSR Replacement
- Reactor Head Modifications
- Extended Power Updates
- FAC Replacement
- Analog to Digital Modifications
- Condenser Life Extensions
- Wireless Control Systems
- Control Room Upgrades

Decommissioning

- Electrical and Mechanical System Modifications

Used Fuel Storage

- ISFSI Pads, Pathways & Fuel Building

“Do it Right or Make it Right”

Our Nuclear Services Division is founded on its unyielding commitment to:
SAFETY | EXECUTION | QUALITY | SCHEDULE & COST PREDICTABILITY
with the end goal being to meet and exceed customer expectations.



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Longevity

NAC is approaching a half-century of comprehensive experience in the design, licensing and deployment of technologies to manage the most radioactive contents on Earth.

Economical innovation

When your project requires packaging or transportation of challenging nuclear materials (including greater than class C (GTCC) waste, high level waste and spent nuclear fuel), NAC provides you innovative solutions with a commitment to nuclear packaging excellence – offering risk-mitigating, ALARA-friendly,

and operation-enhancing solutions. NAC's project objectives put safety, economic value and business integrity at the forefront of our solutions. This commitment to excellence has been exemplified with the development and implementation of the MAGNASTOR® (Modular, Advanced Generation, Nuclear All-purpose Storage) system, the first licensed and delivered multipurpose spent fuel dry storage technology that accommodates 37 PWR or 87 BWR spent fuel assemblies, exhibiting superior economics, safety and dose reduction on a per-assembly basis.

Transport excellence and assurance

Because of our immense worldwide spent fuel transport experience, NAC is able to incorporate unique operational and licensing features into our multipurpose storage systems, which assures licensing and transportability. In fact, NAC is the first vendor to submit a transport license application to the NRC for the ultra-high capacity category of multipurpose canister systems. MAGNASTOR's transport package, MAGNATRAN™, is well-ahead in the licensing queue, assuring early availability.

Building on our legacy

NAC's legacy of facilitating efficient management, transport and disposition of challenging nuclear materials is evident at nuclear sites worldwide. With the important role nuclear power plays in meeting increasing global energy needs, the safe packaging, storing and transportation of nuclear materials is more vital than ever before. Casting its progressive innovation strategy, NAC will continuously develop and license economical technologies to safely manage the nuclear fuel cycle in order to support a sustainable nuclear future.

For more information, please contact:

George Vaughan
Vice President Sales
404-775-5045
gvaughan@nacintl.com

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LAST-A-FOAM FR-3700: The #1 Protective Foam for Crash and Fire in Type A/B Containers

General Plastics Manufacturing Company has protected nuclear transportation packages from fire and collision since 1971. The company's polyurethane **LAST-A-FOAM® FR-3700** Series foam combines exceptional impact mitigation with excellent fire protection properties, making it ideal for insulating and isolating radioactive nuclear materials from shock, impact and fire damage in crash situations. In particular, this foam offers proven long-term performance as an insert in radioactive material (RAM) transportation packages.

"The regulations governing RAM packages often require energy absorption of 30-foot free drops and exposure to a 1,475°F, 30-minute fire under accident conditions," explained Rick Brown, PhD., nuclear packaging manager at General Plastics. "Our FR-3700 series foam is one of very few materials that can support the RAM package design in mitigating both mechanical and thermal energy."

The LAST-A-FOAM® FR-3700 formulation is specially designed to allow predictable impact absorption. In a fire situation, the foam produces an intumescent, insulating char layer that isolates and insulates hazardous cargoes from excessive heat, even when exposed to fuel, diesel fuel fire conditions.

Available in densities ranging from 3 to 40 pounds per cubic foot, these CFC-free, flame-retardant polyurethane foams are specified by nuclear package design engineers as among the best solutions for the protection of hazardous payloads.

If customers prefer to build their own inserts for Type A and Type B nuclear containers, General Plastics will CNC-machine FR-3700 Series foam to fit their particular design. In addition, the company offers foamed-in-place FR-3700 foam using the customer's container and specifications. Once the foam is cured, the container is shipped back to the customer.

"After 40-plus years of successful use, our FR-3700 series foam has proven to be the most effective material for impact mitigation and fire protection for these applications," Brown stated. "Customers worldwide rely on its unique properties, performance, quality and life cycle traceability to protect and transport their nuclear waste."

General Plastics is certified to ISO 9001:2008/AS9100C, and ITAR-compliant. Its extensive quality assurance program satisfies the demanding requirements of the aerospace industry, the Nuclear Regulatory Commission and the U.S. Department of Defense. General Plastics meets such demanding quality systems as NQA-1 and MIL-I-45208A.



Protective Performance Over the Long Haul

Four Decades of Proven Protection

General Plastics Manufacturing Company has produced more than 40 different designs of impact limiters, overpacks, impact pads and missile shock-isolation pads over the past four decades.



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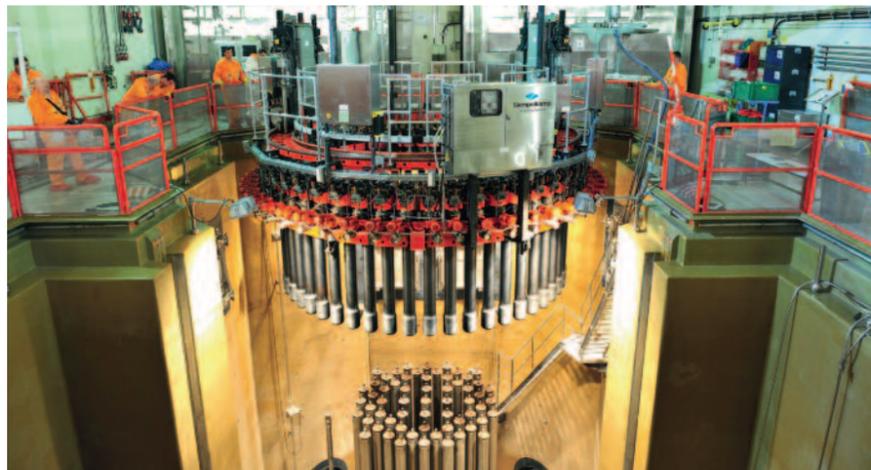
www.generalplastics.com/nuclear

Tailor-made product and service solutions for efficient and safe nuclear plant life time management

Countries such as Finland, China, Russia, Great Britain, France and the USA count on nuclear power and will increasingly secure their energy demand through a new generation of low CO2 emission nuclear power stations. Siempelkamp's nuclear technology business unit meets the highest safety standards all over the world with products and comprehensive services for the life cycle management of nuclear facilities. The basis: well over 40 years of experience in nuclear technology and many successfully completed projects distinguish Siempelkamp as a recognized partner for operators of nuclear plants.

Extensive product and service range

As a company of the Siempelkamp Group, Siempelkamp Nuclear Services, Inc. (SNS) offers operators of nuclear facilities state-of-the-art products which serve the purpose of improving cost-effectiveness and satisfying the highest safety requirements. The focal point of our extensive product and service range is the provision of equipment and products for use around the "Reactor Island", equipment support for operating plant maintenance and newly built, decontamination and decommissioning as well as comprehensive services for all life time phases of nuclear facilities.



Professional and experienced staff

SNS is located in West Columbia, South Carolina and has access to over 500 professional staff which is dedicated to products and services supporting the nuclear industry to meet the demands of the US based fleet. Siempelkamp's excellent reputation is not only owed to the product range, but also to staff. With their high level of specification, SNS develops solutions of the highest level worldwide which satisfy all technical and economic quality standards. The company places great emphasis on the continuous further qualification of its specialists in order to maintain all performances at the highest level.

High quality and tailor-made solutions

With respect to all tasks, from problem analysis to planning and execution, customer satisfaction is of the highest priority for Siempelkamp. That is why SNS offers tailor-made solutions and - using efficient resources which the company is able to expand at any time through the corporate link - guarantees fast execution with a high level of transparency and planning reliability for all projects. User-friend-

ly operation, operational reliability, environmental compatibility and the cost/benefit aspect are some of the decisive criteria for all of the processes and solutions developed by Siempelkamp.

Portfolio for nuclear installations

Siempelkamp offers numerous customized solutions for the safe operation, new constructions, as well as retrofits of nuclear facilities. Our products ensure efficient as well as optimized inspection and process flows in nuclear power plants:

engineering | stud turning and tensioning tooling | stud cleaning devices | refueling machines | cranes (incl. polar and refueling) | lifting devices | sealing heads | H2 recombiners | hot cell technology | shielding devices | core catcher cooling elements | casks/containers for radioactive waste | waste handling facilities | transport/handling systems | calculations e.g. design/service life evaluation | consulting | assembly/start up.

Even for the decommissioning and dismantling of nuclear power plants SNS provides a full range of technologies and proven equipment as well as services:

dismantling facilities | mechanical segmentation | thermal cutting | sampling facilities | engineering | project planning/execution | calculations: decommissioning cost determination / 3D activation process.



Siempelkamp

Nuclear Services

Contact us and learn more about:

Siempelkamp Nuclear Services, Inc.

3229 Sunset Boulevard, Suite M
West Columbia, SC 29169
Phone: 803.796.2727
Fax: 803.939.1083
sns@siempelkamp.com

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Components and services for nuclear facilities

Planning, manufacture and supply of a highly reliable equipment range for operating plants and new build:

refueling bridges | core internal and reactor head lifting devices | stud turning and tensioning tooling | cranes including polar | sealing heads | H2 recombiners | core catcher cooling elements | waste handling facilities



Siempelkamp

Nuclear Services

Products and Services for Nuclear Power Plants

Compliance with the highest requirements in safety and quality is our business. We supply services, equipment and life-time support within the nuclear power industry. Our extensive know-how and experience over many years forms the basis for our successful delivery.

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With more than 30 years of upgrading experience, CB&I is unrivaled in understanding the nuclear power life cycle. No matter your need, CB&I can help you accurately identify your plant's ideal uprate capability and tailor a strategy for modifications, while meeting today's environmental and regulatory requirements.

Whether the solution is building a new nuclear plant or increasing the efficiency of an existing one, CB&I puts the power of nuclear to work for you.

- ENGINEERING, PROCUREMENT AND CONSTRUCTION**
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- MAINTENANCE AND MODIFICATION**
- SPENT DRY FUEL STORAGE**



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As one of the largest nuclear engineering and maintenance contractors in the U.S., CB&I's diverse nuclear solutions are backed by a legacy of more than 60 years of industry leadership and an uncompromising commitment to safety. CB&I has been a pioneer in new plant design and support services to the operating fleet, supplying:

- Engineering and design
- Construction and maintenance
- Licensing
- Pipe fabrication
- Modularization
- Startup and test
- New plant services

CB&I leads the industry in power uprates, with a thorough understanding of the overall nuclear plant life cycle, including the nuclear steam supply system and balance-of-plant thermal cycle, original plant licensing bases, environmental impacts, equipment-aging impacts, margin use and regulatory requirements. With more than 70 uprate projects and studies completed, CB&I has added more than 4,000 MW to the U.S. grid.

CB&I Highlights

- NYSE: CBI
- 60+ year legacy in nuclear industry
- 55,000 employees worldwide

With expertise in comprehensive plant support, our staff is in tune with the nature and importance of nuclear plant needs at every level. CB&I offers the most complete suite of EPC services and is one of the only providers of fully qualified designers and fabricators of tanks, piping and systems to meet the new post-Fukushima requirements. In fact, we were called upon to design, fabricate, and install the Simplified Activated Water Retrieve and Recovery (SARRY) System currently in use at the Fukushima Daiichi site.

CB&I's nuclear services start at the preliminary planning phase and continue through post-construction testing and turnover to operations. Our designs can be qualified to meet seismic, missile and other post-Fukushima considerations.



Sanmen Units 1 and 2, China

Safety continues to be a CB&I core value. Our award-winning safety program promotes a culture of involvement and dedication with a goal of zero incidents for everyone involved in our projects.

CB&I Activity Highlights

- Plant licensing bases/configuration management verification
- Plant modifications including complex and significant impact mods
- Plant evaluations for power uprates and potential degraded or non-conforming conditions
- BWR and PWR plant projects
- Plant outage and continuous maintenance support for 50 of the 104 nuclear power reactors in the U.S.
- Independent spent fuel storage installations (ISFSI)
- Decommissioning and dismantlement projects
- Buried commodities replacement (piping, tanks, etc.)
- Plant structures, systems and components evaluations
- Emergency plant support via 24-hour hotline: 617-589-7827

GEL

problem solved

The GEL Group INC

Nuclear Services



- NUPIC Approved
- Chemistry
- Radiochemistry
- Radiobioassay
- RETS-REMP Support
- 10CFR61 Waste Characterization
- Certified in Over 25 States
- Supporting over 50% U.S. and Canada Nuclear Power Plants
- Secure Web Access to Data
- Consulting Services



- Groundwater Modeling
- Air Effluent Modeling
- ¹⁴C Gaseous Measurement
- Groundwater Assessment and Remediation
- Isokinetic Flow Evaluation
- Indoor Air Quality Studies
- REMP Program Support
- Stack Testing
- Hydrographic and Land Surveying
- Geophysical Services

Innovative Analytical and Environmental Services

Headquartered in Charleston, South Carolina since 1981, The GEL Group, Inc. provides streamlined solutions to the nuclear industry. From laboratory analysis and engineering, to geophysical services, GEL can save you time and resources and develop solutions and data that you can trust.

GEL Laboratories, LLC

GEL Laboratories, LLC offers one of the widest arrays of chemistry, radiochemistry, and radiobioassay services available in any single facility in the United States. In addition, GEL's quality program is one of the most highly audited programs in our industry. GEL Laboratories' clients include over 50 US Nuclear Power Plants.

GEL provides the nuclear industry with comprehensive chemistry and radiochemistry services including:

- NUPIC audited and approved laboratory
- NQA-1 programs
- Fully MARLAP compliant data packages
- Fully interactive "Web Based" sample management, data assessment and cost tracking system
- Environmental REM-RETS analytical support
- Rad-Waste analytical support as required under 10CFR61
- Radiobioassay for plant personnel

- Plant atmosphere testing for C-14 as required by NRC REG Guide 1.21
- Fast sample turnaround times for waste and analytical chemistry samples

For more information please contact:

Robert P. Wills, RRPT
 robert.wills@gel.com
 office: (843) 556-8171
 cell: (843) 906-5929

GEL Engineering, LLC

GEL Engineering, LLC offers environmental and engineering services for both interior and exterior operations and environments at nuclear facilities. These services include environmental support, engineering support, stack testing, and land and hydrographic surveying.

GEL also develops unique testing methods to assist facilities with creating programs specific to their plant's needs including isokinetic flow evaluation and ¹⁴C measurement.

GEL's ¹⁴C measurement method includes direct measurement and analysis of ¹⁴C samples. This sample collection and analysis protocol allows for differentiation and quantitation of organic and inorganic forms of ¹⁴C and can accommodate a wide range of ¹⁴C activities. GEL provides on-site sample collection from gas

decay tanks, containment atmospheres, and other discharge vents and stacks for ¹⁴C effluent samples. The samples are then transported to the GEL Laboratory for analysis. This turnkey service allows utilities to adequately support the reporting requirements of RETS/REMP programs.

GEL has successfully performed these services for many plants across North America which have produced very favorable dose modeling data.

For more information please contact:

Jim Posda
 james.posda@gel.com
 office: (843) 769-7378
 cell: (843) 697-2199



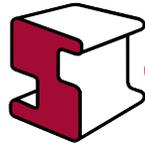
Nuclear power plant operating practices/experience and related decision making are highly scrutinized by many stakeholders. At the same time, your customers rely on you to keep the power on. Structural Integrity can provide engineering, NDE and training solutions to help you meet your demands so you can focus on delivering power.

With over 30 years in business in the power industry, you can rely on us to help you and take some of the burden off your shoulders. We're a company you can trust to work hard and to provide innovative, top quality, high value solutions on every project.

Your customers count on you for the energy that powers their lives. And you can count on Structural Integrity for solutions that will help you keep the power flowing.

There are many ways we can help your plant perform its best:

- **BWR and PWR Internals** programs, evaluations and inspections
- **Run/Repair/Replace Decisions** including component operability/JCO support
- **Fatigue Management** including analysis and monitoring
- **Seismic Re-evaluation** to address post-Fukushima issues
- **Underground Pipe & Tank Integrity** program development, data management, inspections, evaluations and monitoring
- **Materials and Corrosion** to assist in root cause evaluation
- **PWSCC/Alloy 600 and IGSCC** mitigation and repairs
- **Vibration** analysis and instrumentation
- **Nondestructive examinations** using state of the art equipment and techniques
- **License Renewal** programs and support
- **Nuclear Fuel** programs and analysis
- **Training** programs on-site or online from industry experts



Structural Integrity Associates, Inc.[®]
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F&J SPECIALTY PRODUCTS, INC.

The Nucleus of Quality Air Monitoring Programs

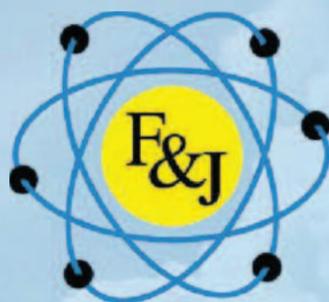
Company Profile

F&J endeavors to ensure its air flow measurement instruments are accurate, reliable and maximize automation for the convenience of the air sampling specialist.

F&J has a standard business strategy to implement current technology in the development of air sampling and air flow calibration instruments.

F&J combines advances in hardware and software technologies to simplify the data collection process for the benefit of its customers.

F&J is a certified ISO 9001 air sampling instruments provider whose contributions to air sampling design ensures the air sampling specialist has the best tools to meet the ever increasing regulatory challenges in a limited manpower environment.



F&J SPECIALTY PRODUCTS, INC.

The Nucleus of Quality Air Monitoring Programs

F&J Advanced-Technology Instruments



GAS-60810D Series
Ambient Air Monitoring System



WC-VFD
World Calibrator



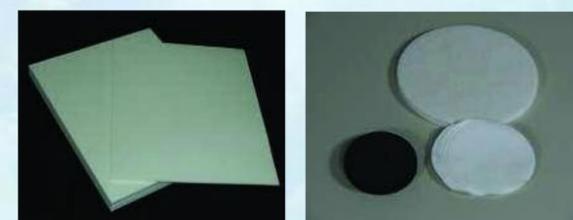
DF-EDL-1 Series
ELITE DIGITAL LIGHT (EDL)
Air Sampler



Member of TÜV NORD Group
ISO 9001: 2008
Quality Management System



DF-AB-40L
Emergency Response Air Sampler



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MCE Membrane Assortment, Glass Fiber,
Qualitative and Quantitative Media



Radioiodine Collection Filter Cartridges



Contact Information
Tel: 352.680.1177
Fax: 352.680.1454
fandj@fjspecialty.com

Physical Location
404 Cypress Road
Ocala, FL 34472
USA

Contact:
tel: 352.680.1177 / fax: 352.680.1454 / fandj@fjspecialty.com / www.fjspecialty.com

WHAT WE DO

RussTech Language Services, Inc. specializes in technical, legal, and commercial language support for more than 100 languages and dialects worldwide. RussTech provides:

- Translation
- Interpreting
- Transcription
- Proofreading
- Consulting
- Glossary Development
- Negotiation Support
- Desktop Publishing

WHAT SETS US APART

Unlike in some translation companies, every RussTech translator is a native speaker of the targeted language, and all draft translations are edited by a second linguist. Our language experts are able to offer 24-hour on-call support

for clients traveling internationally, as well as social courtesy training on best practices for your international business exchanges.

PROJECT MANAGEMENT

RussTech specializes in managing large and complex translation projects, distinguished by our ability to produce consistent terminology and style across multiple documents. As a RussTech client, you will have your own dedicated project manager who works specifically to meet your individual language support needs.

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At RussTech we stand behind our commitment to unparalleled customer service and dedication to every project. As a woman-owned small business now celebrating our 20th anniversary, we guarantee you will receive the very best language support at a competitive price.



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As an ISO 9001:2008 certified global leader in cutting edge lighting systems, we've been trusted to provide solutions for demanding nuclear applications since 1977. Today our innovative, rugged lights are used in more than 83% of the nuclear power stations in the U.S., and all across the globe. We deliver a full range of advanced lighting solutions, from brilliant Seismically-qualified Emergency lights, High Bay lights, and Fuel Pool lights, to Reactor Core Refueling lights and Underwater Camera lights.

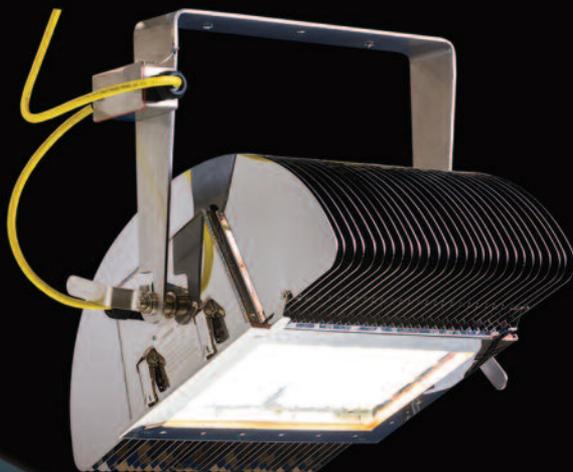
Our Quality System complies to the requirements of NRC 10CFR50 App. B., "Quality Assurance Criteria For Nuclear Power Plants and Fuel Reprocessing Plants," and our custom engineered products are stringently tested to enhance safety and radically decrease downtimes during fuel movement, inspection and maintenance.

Our new Emergency Lighting Fixtures (ELFs) are helping plants worldwide achieve B.5.b (EA-02-026) Post-Fire Safe-Shutdown. These powerful systems provide up to five times more standby illumination than required by the NRC and are seismically qualified.



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BIRNS Quantum™

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Designed in accordance with UL 1598 Luminaires and UL 8750 Standard for Light Emitting Diode (LED) Equipment for use in Lighting Products



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BIRNS' Quality Management System is
ISO 9001:2008 Certified;
NRC 10CFR50, App. B Compliant



Over 40 Continuous Years as a Nuclear Safety Related Fabricator & Installer

SSM Industries, Inc. (formerly Schneider Sheet Metal) is the largest Safety Related HVAC designer / fabricator / supplier / installer in the United States. SSM entered the nuclear industry over forty (40) years ago as the metal fabrication division of Schneider Power.

The Power Division of SSM Industries Inc. provides design, qualification, fabrication, and installation support to utilities in today's nuclear market. Over \$100 million of safety and non-safety related HVAC ductwork and components have been designed, tested and fabricated by our existing personnel at our facility. We have supplied equipment to virtually every Commercial Nuclear plant in the United States, as well as Nuclear Plants worldwide.

SSM Industries fabricates and installs an average of over 5 million pounds of ductwork a year to facilities including Commercial Nuclear Power Plants, Department of Energy (DOE) facilities, laboratories and hospitals.

Our nuclear qualified product line extends from the fan to the diffuser, and all the HVAC products in between.

Together with Westinghouse and CB&I, we were a part of the design team responsible for completing the AP1000 Containment Building HVAC Duct and Supports system. In addition, we are providing HVAC equipment for new ongoing nuclear construction.

SSM maintains a complete 10 CFR 50 / NQA-1 (including all Supplements) Quality Assurance Program. SSM is listed in the NUPIC data base as a pre-qualified vendor to supply Safety Related HVAC equipment and services, including the commercial dedication of components fabricated by others, to all commercial nuclear plants.

SSM is committed to maintaining a safe, incident-free work place. Whether at our offices, manufacturing facilities, client facilities, or the construction site, safety is the first priority. Established good safety standards and best practices are implemented and enforced to accomplish this. Safety is a shared responsibility at SSM in which each and every employee must take ownership of his or her own safety and the safety of their co-workers.

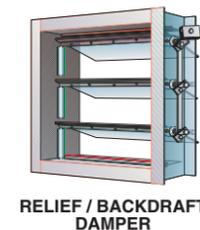
SSM INDUSTRIES, INC.
 3401 Grand Avenue
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 Phone: (412)-777-5101
 www.ssmi.biz



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- ☑ Air Handling Units
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 - ☑ Backdraft
 - ☑ Balancing
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- ☑ Diverter
- ☑ Fire & Smoke
- ☑ Guillotine
- ☑ HELB
- ☑ Isolation
- ☑ Tornado



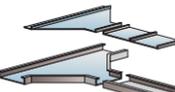
RELIEF / BACKDRAFT DAMPER



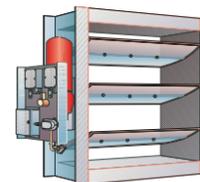
TORNADO DAMPER



HELB DAMPER



CABLE TRAYS AND COVERS



ISOLATION DAMPER



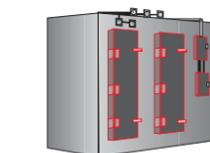
FLEX CONNECTION



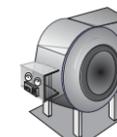
Grills, Registers & Diffusers

• SPECIALTY FABRICATIONS

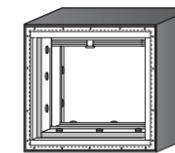
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- ☑ Heating Coils
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- ☑ Tanks



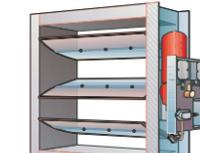
COMPLETE HEPA & ADSORBER UNITS (To ASME N-509, 510 & AG-1)



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- ☑ Sleeves

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- ☑ Penetration Seals

• MATERIAL PROCESSING

- ☑ Material Bins, Tanks & Chutes
- ☑ Ladders & Sorting Platforms

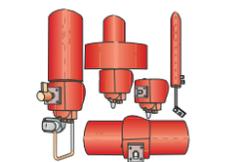
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- ☑ Field System Walk downs
- ☑ Engineering Support
- ☑ Installation Supervision & Craft
- ☑ Component and Total System Testing, Adjusting & Balancing
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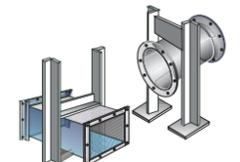
Complete Seismic & Environmental Qualifications

1E Qualified

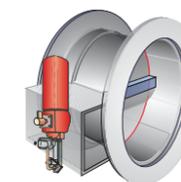
Complete 10 CFR 50 Appendix B NQA-1 Q/A Program



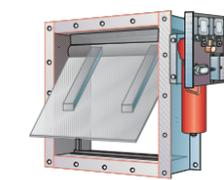
Actuators Pneumatic, Electric, & Electrohydraulic ("fail safe")



DUCTWORK & SUPPORTS



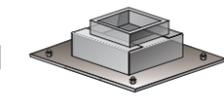
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SSM-PL/11

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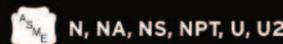
WHEN EVERY DETAIL MATTERS.

Nuclear experience makes an infinite difference. With that experience comes attention to detail. With attention to detail comes predictability, capability and excellence. At Oregon Iron Works, Inc., (O.I.W.) we build first-class hardware, on time, as promised, with more than 2,000,000 manhours of production logged under nuclear Quality programs. Vast capabilities, combined with our strict Quality Assurance program, means we consistently deliver the oversight and detailed documentation the world's most critical customers demand. When it must be right, it must be O.I.W.

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- Mechanical Assembly, Integration, Controls
- EPRI Compliant Commercial Grade Dedication



OREGON IRON WORKS, INC.
NUCLEAR PRODUCTS DIVISION



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ASME NQA-1 • 10 CFR PART 50, APP B

Oregon Iron Works, Inc. (OIW) is an Oregon corporation founded in 1944 and has been under its current ownership and management since 1975. OIW's facilities are equipped with state-of-the-art manufacturing and fabrication equipment.

DIVERSITY FUELS THE FIRE

We continue to invest in capital expansion such as this new 8-meter, 5-Axis Horizontal Boring Machine. While other companies have struggled to survive in these tough economic times, OIW continues to grow and expand our capabilities. New machine capabilities, robotic welding cells, and facility improvements continue to help us serve industries as diverse as major bridge construction, water control equipment for the Army Corps of Engineers and specialty products for the Nuclear industry. This diversity gives us the experience to help our customers with out-of-the box solutions to a wide variety of problems while maintaining class leading Quality standards.



Innovate.



When the product demanded a high quality, vacuum tight, distortion free weld, OIW evaluated virtually all weld processes to produce parts correctly the first time. We developed specialty robotic weld procedures and techniques that precisely control the welding arc to minimize distortion and assure defect free results. Unique robotic programming techniques eliminated the need for precise positioning of the parts allowing fast set-up times with disparate products. The unique properties of this process allow us to maximize production and Quality benefiting everyone.

Fabricate.

No product is too big or too small for OIW. Our state of the art fabrication facilities regularly turn out products weighing from 100 lbs. to 1,000 tons in all metals including Stainless, Carbon and specialty alloys. Our customers can rely on our experience to build it right the first time, as promised.



Integrate.

When the product demands fabrication, machining, and integration into a complete operating piece of machinery, OIW is the right choice. Our experienced craftsmen integrate sophisticated products for the Marine industry, the Nuclear supply chain, Commercial products and critical launch support equipment for the Aerospace industry.



OREGON IRON WORKS, INC.
SMALL COMPANY SERVICE ... BIG COMPANY CAPABILITIES

Innovate. Fabricate. Integrate.

We are Fluor. Taking on tough challenges for more than 100 years.

Fluor is a global leader in engineering, procurement, construction, maintenance, and project management. Active across six continents, we work with governments and multi-national companies to design, build, and maintain many of the world's most complex and challenging projects.

We are a solutions-based company with the technical expertise and financial strength to meet the most difficult assignments. Fluor is known as a company that is reliable, delivers projects on time and within budget, has an outstanding safety record, and adheres to the highest ethical

standards. Our proven track record of overcoming engineering and environmental challenges has earned us the reputation of being dependable and resulted in well-established client relationships. Our contributions and achievements stimulate economic expansion and improve the quality of life for millions of people around the world.

For the past 70 years, Fluor has provided engineering, procurement, construction, and maintenance (EPC&M) services to the nuclear industry. In the United States, Fluor designed three nuclear power plants, constructed 10 nuclear power plants and supported construction on another 10 nuclear units during the 1970s and 1980s. Fluor expended its services in the 1990s at many of the operating commercial nuclear plants in the United States by providing major capital modification and maintenance services, as well as decontamination and decommissioning, resulting in more than 90 million hours worked. Our past and ongoing commercial experience includes the maintenance, modification, decommissioning, and related operating plant support services for 90 nuclear reactor units. All of this work was performed in accordance with the rigorous requirements of 10CFR50. Fluor currently supports the nuclear industry with full service EPC&M capabilities for nuclear new build projects, operating plant modifications, operations and maintenance services, and decommissioning services.



Where innovation meets retirement.

Fluor's Power business –
Nuclear, Operations and Maintenance,
Renewables, Alternate Technologies,
and Fossil Generation

Retiring Soon?

Fluor is committed to client life-cycle management.

As nuclear facilities approach retirement, Fluor provides utilities and government agencies with decommissioning services that enable clients to achieve aggressive closure goals.

We have an extensive nuclear experience portfolio and a team of veteran subject matter experts. Fluor is prepared to mobilize and address unique technical, human, political, and regulatory challenges with innovative solutions that work.

www.fluor.com

Contact us before time runs out.

power@fluor.com

FLUOR[®]

ENHANCED CLIENT TRUST AND ENGAGEMENT

Fluor is committed to our Clients' success. Since contract initiation, Fluor has closely aligned with Pacific Gas and Electric Company to foster an integrated culture of Client/contractor performance. Strong initial alignment and consistent communication has allowed Fluor to implement an effective program focused on safety excellence, quality, cost savings, supplier diversity, and sustainability. What's more, it led to enhanced Client trust in Fluor's capabilities and ongoing engagement.

Fluor team members like Curt Lefferts, director of nuclear operations and general manager of maintenance services, work hard for our Clients every day – aligning priorities and objectives and promoting a strong project culture.

Since 2010, Fluor has provided maintenance support to Pacific Gas and Electric Company's Diablo Canyon Power Plant in San Luis Obispo, California. Situated on the coast, Diablo Canyon is a safe, clean, reliable and vital energy resource for California providing low-cost, carbon-free electricity for more than three million people.

www.fluor.com

Fluor was recently honored by receiving the Pacific Gas and Electric Company Generation Supplier of the Year award.

Fluor's Power business –
Nuclear, Operations and Maintenance,
Transmission, Renewables, Alternate
Technologies, and Fossil Generation

FLUOR[®]



Pioneering Passive Fire Protection Systems in the Nuclear Industry for More Than Three Decades

PCI Promatec offers an unmatched library of products and designs qualified to meet the rigid standards of fire safety in the nuclear industry, from the development of our own line of penetration seals to the acquisitions of other industry leaders, including Bisco/Brand, ICMS, and Techsil.

We offer qualified systems for fire, pressure, radiation, security and flood seals. Additionally, through our exclusive agreement with 3M, we have qualified 1-3 hour electrical raceway fire barrier systems that fully comply with the most rigid USNRC requirements.

Our NQA-1 Quality Assurance program has passed the rigorous audit process of NUPIC every year since its inception. Our Target Zero safety program is the best in the industry.

As a wholly-owned division of Performance Contracting Group (PCG), we offer financial stability as "One of the Top 10 Specialty Contracting Firm in the USA," as ranked by *ENR Magazine*.

Our core staff averages 25 years experience in nuclear passive fire protection, making PCI Promatec "the authority" in this industry.

Our customer base includes the majority of nuclear plant owners in the USA, DOE, and a number of international utilities in Asia and Europe. In an average year, we do business with over 50 facilities with services ranging from technical support to full turnkey contracts. With contracts successfully completed from \$1,000-\$20,000,000, no job is too large or too small.

If you have a need, we have a solution. Call Mike Jordan at 281-933-7222, email PCI Promatec at info@promatec.com or visit us on the web at www.promatec.com.



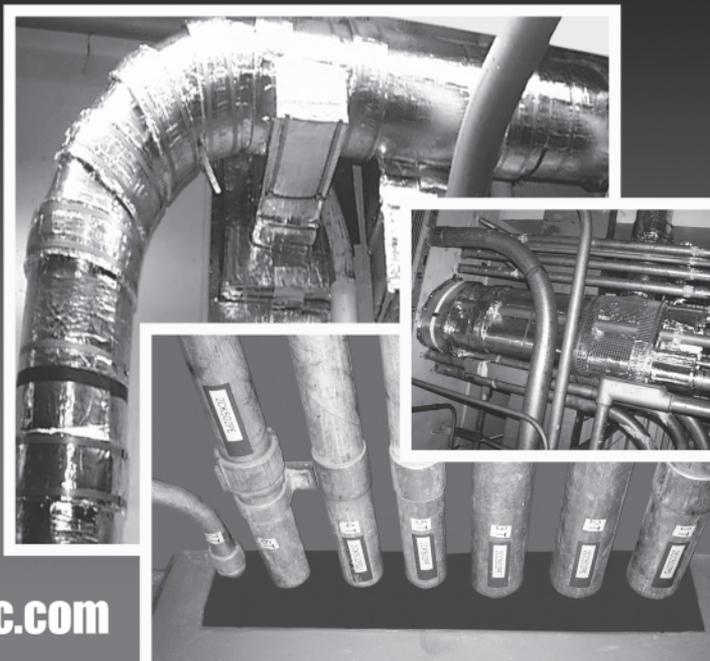
Your Complete Source for Passive Fire Protection Products and Services For More Than 30 Years!

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Project Management	Quality Assurance
Training/Certification	Fire Test Support

- Fire, pressure and radiation penetration seals
- 3M Interam™ flexible fire wrap systems for Appendix R circuit protection, fully qualified to USNRC Letter (GL) 86-10, Supplement I
- Fire, blast, moisture, and impact-resistant wall systems for zone separations and other applications
- Nuclear-dedicated greases, lubricants, compounds and other chemicals by Dow Corning® and others

Our innovative passive fire protection solutions are the nuclear industry standard, installed in 100+ facilities worldwide.

281-933-7222 www.promatec.com



- ✓ Immediate access to great nuclear talent
- ✓ Integrated managed staffing and quality solutions
- ✓ A team who knows the industry inside and out



With System One, you don't have to choose.

We're experts in nuclear.

When it comes to contingent workforce management solutions, System One has the experience you need – more than 30 years of it, in fact. We help nuclear utilities, service providers and OEMs address resource issues, assure compliance and get work done.

From startup and commissioning to vendor management and outage support, System One covers the full production lifecycle.

Choose the right partner.

Onsite or in the field, we combine high quality with rapid response to support a full range of recruiting needs and quality solutions.

system|one

Leaders in technical outsourcing solutions
systemoneservices.com

t 877.505.SYS1 (7971)
inquiry@systemoneservices.com

Services

- Licensing & Regulation, including Renewal
- New Construction, Startup & Commissioning
- Design Basis Evaluations & Modifications
- Operations & Maintenance
- Engineering
- Technology Implementations & Development
- Emergency & Outage Support
- Plant Condition Assessments
- Asset Management Strategies
- Quality Assurance & Quality Control
- Field Inspection
- Nondestructive Testing

Smart, Seamless Contingent Workforce Management

System One customizes nuclear solutions for complete coverage.

System One helps nuclear firms address critical challenges, including:

- workforce planning and recruiting
- safely maintaining infrastructure
- adopting and integrating the smart grid.

Much more than a technical staffing firm

For more than 30 years, nuclear has been the core of our business. Specializing in staff augmentation, managed staffing and VMS technology, System One offers fully-integrated energy solutions.

Building the future

We provide project management and resources for construction and capital expenditures. In addition to hands-on design-build support, System One specializes in owners' representation.

Condition assessments

We provide asset management to support critical decisions about maintenance, repair and upgrades.

- **Quality Assurance & Quality Control:** for key projects and ongoing programmatic support
- **Field Inspection:** in-house and mobile with integrated lab services
- **Nondestructive Testing:** NDE services across diverse methodologies

System One combines the flexibility to address short-term resource issues and the innovation to help nuclear firms plan for the future.

Rapid response outage support

Every year System One provides hundreds of specialized professionals

to support shutdown activities, all with complete procedural integrity.

Professional engineering support

System One delivers professional engineering support (mechanical, electrical, structural, I&C, environmental and more) across a full range of critical plant systems and components.

Optimizing your platform

System One helps utilities prioritize and integrate smart grid technology investments.

Choose the right partner.

Take the guesswork out of nuclear solutions with System One.

system|one

systemoneservices.com
inquiry@systemoneservices.com

Emerson Process Management raises the bar with the Rosemount 3150 Series of Nuclear Pressure Transmitters

The new series seamlessly replaces the Rosemount 1150 Series with improved performance

Pressure measurement is mission-critical in nuclear power plants, and for 40 years the Rosemount 1150 Series of nuclear safety related pressure transmitters has been an industry standard. The Rosemount 1153 was the first pressure transmitter on the market qualified to both IEEE Std. 323™-1974 and IEEE Std. 344™-1975, and together with the Rosemount 1152 and the Rosemount 1154, continues to be one of the most popular model families in nuclear plants around the world.

And now you can have the proven safety and performance of the Rosemount 1150 Series while taking advantage of the latest technological innovations to operate your plant even more confidently. Introducing the Rosemount 3150 Series of Nuclear Transmitters, the culmination of extensive, continued investments in improved core sensing technology, electronics design and overall transmitter performance. The series upholds a tradition of unmatched product quality in nuclear sensing and leverages the dependability, functionality and performance levels that you expect from Rosemount solutions.

FULLY ANALOG ELECTRONICS

100% analog, the Rosemount 3150 Series does not use microprocessor-based electronics. This analog design improves security and reliability

and helps the operator reduce risk. With no digital parts or connections, you have the ultimate in cyber security. In addition, the Rosemount 3150 Series provides superior radiation tolerance. With consistent, reliable performance even in the harshest environmental conditions, the Rosemount 3150 Series minimizes your exposure to risk factors like software verification & validation (V&V), and evolving regulatory requirements.

IMPROVED SENSOR TECHNOLOGY

With Emerson's patented floating capacitance sensor design, you can improve transmitter performance and reliability and extend calibration and maintenance cycles.

IMPROVED QUALIFICATION PEDIGREE

You can depend on reliable and accurate performance of the Rosemount 3150 Series in critical current and future safety applications because Emerson's extensive, robust testing meets higher qualification test profiles which envelope those of the legacy Rosemount 1150 Series. The transmitters have successfully completed fully sequential qualification test programs per IEEE Std. 323 and IEEE Std. 344. Versions are also available tested to meet RCC-E-2002 and KTA 3505-2005 standards for use in countries where those standards are used to license plants.



Rosemount 3154 Pressure Transmitter

IMPROVED CAPABILITIES FOR HARSH ENVIRONMENTS

With the Rosemount 3150 Series, you can operate confidently in critical safety applications. The transmitters are designed to operate in environments from mild to severe or harsh for both legacy and Gen 3 reactor technologies.

ELECTROMAGNETIC COMPATIBILITY

The Rosemount 3150 Series meets both USNRC Regulatory Guide 1.180 Rev 1 and EN 61326.

SCOPE OF THE CHANGEOVER

Designed as "drop-in" replacements for the Rosemount 1150 Series transmitters, the Rosemount 3150 Series has the same process connection dimensions, electrical connections, and mounting bracket hole dimensions as its predecessor.

All Models in the Rosemount 1150 Series, including the Rosemount 1159 remote diaphragm capillary system, will ultimately be superseded by the improved Rosemount 3150 Series.

TRANSITION SCHEDULE

The chart at left shows the schedule for replacement of each member of the Rosemount 1150 Series with the new Rosemount 3150 Series models.

GET ALL THE DETAILS ONLINE

To make sure you select the best model for your plant, check out the product comparison tool at www.RosemountNuclear.com. With it you can make model-by-model comparisons on qualification levels, design basis event profiles, EMC qualification tests performed, normal operating performance and physical and functional specifications. You can also find help with your equivalency documentation.

As always, Emerson stands ready to assist you with timely technical support and will continue to dedicate our organization to supporting your nuclear qualified measurement needs for the life of your plant.



Risks can come from any direction. I need to trust my instrumentation to perform reliably in both normal and accident conditions.

YOU CAN DO THAT

ROSEMOUNT® Stay prepared for anything with the Rosemount 3150 Series of 100% Analog Nuclear Pressure Transmitters. When it comes to your operation's safety, the stakes have never been higher. That's why we've taken the industry standard in nuclear pressure transmitters, and improved on it. The Rosemount 3150 Series builds on the trusted, proven performance of the Rosemount 1150 Series, yet offers enhanced capabilities and proficiency under all operating conditions. Count on Rosemount measurement to keep you moving in a safe direction. Visit www.RosemountNuclear.com to obtain product documentation.



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EMERSON. CONSIDER IT SOLVED.™

	2014	2015	2016
Rosemount 3152	Now Available		
Rosemount 1152 N	Orders No Longer Accepted		
Rosemount 1152 L	Oct. 2014	Apr. 2015	Last Shipments
Rosemount 3153	Now Available		
Rosemount 1153B	Oct. 2014	Apr. 2015	Last Shipments
Rosemount 3154	Now Available		
Rosemount 1154H	Oct. 2014	Apr. 2015	Last Shipments
Rosemount 1154	Oct. 2014	Apr. 2015	Last Shipments
Rosemount 1153D	Oct. 2014	Apr. 2015	Last Shipments
Rosemount 3159	Now Available		
Rosemount 1159	Oct. 2014	Apr. 2015	Last Shipments

Note 1: ● = Last order date for Rosemount 1150 Series product.
 Note 2: ◆ = Last quotation date for Rosemount 1150 Series product.

With Miller Pipeline, the leaks stop here.

Whether it's circulating water or safety related piping, Miller Pipeline has a cost effective solution that can be installed quickly and professionally. The flagship of Miller's service offerings in nuclear power plants has been our internal joint sealing product, WEKO-SEAL®, which is used to provide corrosion protection from brackish water or terminate troublesome leaks at joints.

The WEKO-SEAL is a cost effective solution that provides outstanding long-term results in part because of the installation techniques we use when placing them. Their design and the physical properties of the seal itself, which is made from a flexible EPDM (Ethylene Propylene Diene Monomer) rubber compound is held in place with hydraulically expanded stainless steel retaining bands that ensure a bottle tight installation.

The WEKO-SEAL® is installed via man-entry in pipelines with penetration

distances in excess of 1,000 feet. The WEKO-SEAL comes in a variety of widths but can also be used for continuous coverage of any distance through our Sleeve/Seal capabilities.

In addition to the WEKO-SEAL, we offer a cured-in-place pipe (CIPP) that is used to reline an existing pipeline of virtually any size or configuration.

The resins used in our CIPP can be designed to meet specific service requirements. Whatever the need might be, or whatever product used, our technicians work closely with staff engineering personnel to formulate and execute all desired outage objectives.

For over 25 years, Miller Pipeline has served the nuclear industry by providing inspection services, coating repairs, ultrasonic testing, internal joint sealing corrosion prevention, maintenance, video inspection and pipeline cleaning, pipe relining and replacement and

more. Miller Pipeline is an industry leader in a number of various trenchless technologies which ensure little to no disruption to above ground facilities or operations. All of Miller Pipeline's technicians are confined-space trained and certified to comply with all requirements of 29CFR 1910.146 Federal OSHA's Permit Required Confined-Space Regulations. Our technicians can quickly gain unescorted access and are able to perform all required activities with short notice.

At Miller Pipeline we understand the stress of refueling outages and view our role as an extension of plant personnel to achieve assigned tasks, on time and in a professional and safe manner.

For additional information regarding Miller Pipeline please visit our website at millerpipeline.com or call us at 800-428-3742.



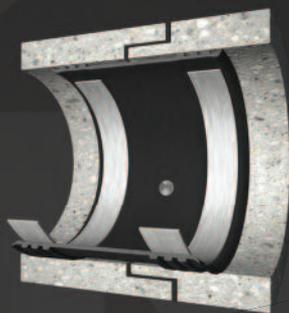
Miller Pipeline

The industry's leader in internal joint sealing.

millerpipeline.com

Specialized Outage Services:

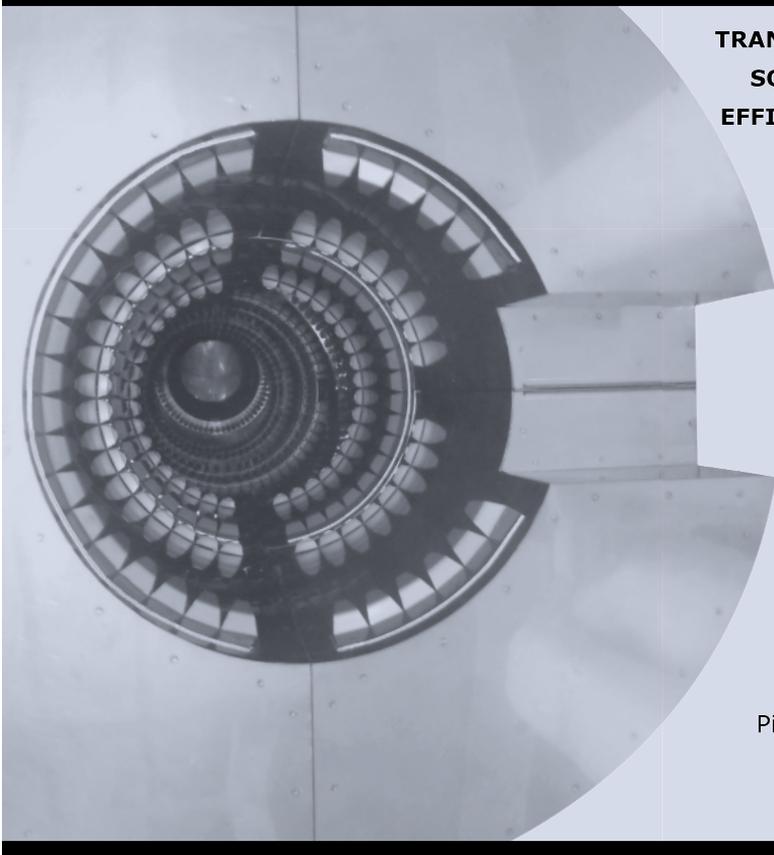
- WEKO-SEAL® Internal Joint Seal
- CIPP Installations
- Pipeline Assessment Services
- Certified Coating Applications
- Corrosion Prevention/Maintenance
- UT Testing
- Video Inspections
- Detailed Inspection Analysis



Cross section model of WEKO-SEAL®

Contact a representative in your area.
Call 800.428.3742 or email info@millerpipeline.com

HOW DO YOU SEE YOUR INSULATION NEEDS?



TRANSCO'S VISION FOR INNOVATIVE PRODUCT SOLUTIONS IS IMPROVING THE SAFETY & EFFICIENCY OF NUCLEAR PLANTS WORLDWIDE

Transco is deploying innovative new 3D field measurement techniques to provide:

- World class insulation fit up
- Efficient installation
- Reduced on-site modifications

Cutting-edge research and design processes result in rigorously tested products with proven field performance

Pioneering new product development initiatives are introducing unique solutions for difficult problems facing the nuclear industry

METAL REFLECTIVE INSULATION

Designed using proven testing, installation experience and lessons learned from decades of successful projects, Transco's insulation provides reliable thermal performance.

RADIATION SHIELDING

Transco has custom designed shielding solutions that address radiation concerns at the location of the source custom designed for any system configuration.



PASSIVE FIRE PROTECTION

Transco offers a full-line of products for sealing electrical, mechanical, and structural penetrations (fire, flood, ventilation, and/or radiation boundaries) as well as a full range of qualified radiant energy barrier materials.

TRANSCO'S MRI IS IDEAL FOR:

- GSI-191 Fiber Reduction
- Major Equipment Upgrades
- New Plant Construction
- Ongoing Maintenance/ Outage Activities

TRANSCO'S SHIELDING:

- For use on piping, vessels and equipment
- Optimizes valuable plant space
- Lowers dose exposure to plant personnel
- Reduces maintenance costs

TRANSCO'S FIRE PROTECTION PRODUCTS:

- Meets latest test standards for fire and flood
- Simplified Installation
- Consistent Quality
- Cost Effective



Transco Products Inc.

IMPROVING PLANT SAFETY AND EFFICIENCY THROUGH INNOVATION

Expert Nuclear Support / Unique Facilities



Kinectrics Head Office

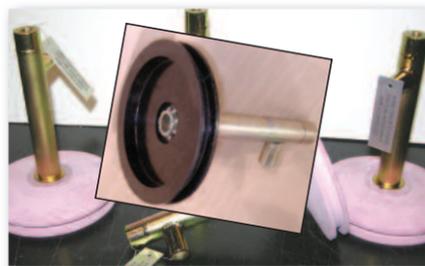
Kinectrics - Dedicated to Nuclear Reliability - Worldwide!

Kinectrics' expert teams of qualified experienced professionals provide comprehensive, specialized capabilities for the nuclear industry and OEMs supplying the nuclear fleet.



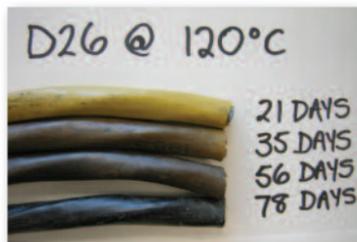
Ovens for Thermal Aging

Our Nuclear Products and Engineered Services, Generation Life Cycle Management, Environmental Technologies and Electrical / Mechanical Testing business areas deliver broad-based services from fully-equipped, accredited lab facilities, and on-site, to support reliable nuclear operations.



Reverse Engineering

Kinectrics' experienced technical specialists can accurately assess asset and component condition and remaining life, find, dedicate, and qualify replacement parts, and test / qualify components to rigorous regulatory standards.



Materials Testing



EQ Testing

Equipment Qualification (EQ) / Commercial Grade Dedication (CGD) / Reverse Engineering

Qualified nuclear components are essential to maintain safe plant conditions and, mitigate consequences in the event of an accident. Kinectrics' unique laboratory and analytical capabilities are employed in each qualification activity and CGD process.

We develop and optimize client EQ test programs. Kinectrics can also accurately evaluate critical characteristics of obsolete components and parts to provide a direct replacement that is the same in form, fit and function as the original. Excellence in core competencies in electrical engineering, analytical chemistry and related technical areas expand Kinectrics services beyond those of other international laboratories.



RIM Table for Seismic Testing

Kinectrics US Inc.

Based in Cincinnati, Ohio, **Kinectrics US Inc.** provides focused local EG and CGD support for the existing nuclear fleet and new build programs throughout North America, incorporating our team's long-established experience with US nuclear standards and regulations.

EQ and CGD specialists in both the US, and at our Canadian lab facilities, have qualified thousands of safety-related electrical and mechanical components.

A History of Technical Excellence

Kinectrics has earned an international reputation for excellence in supporting the commercial nuclear power industry since its inception over 50 years ago. In 2014, Kinectrics continues to build on over 100 years of success in the electricity generation industry.

Kinectrics Facts

- Over 400 highly-qualified staff in North America
- Over 25 independent test facilities, labs and, field inspection services
- Central state-of-the art facilities = 300,000 sq. ft.

Quality Assurance

Kinectrics is registered to ISO9001:2008, NUPIC-audited, and maintains a 10 CFR 50 Appendix B program. Our technical testing and certification services meet or exceed a wide range of national and international industry standards.



KINECTRICS



GENERATING SUCCESS—FOR OVER 100 YEARS

Kinectrics is celebrating over 100 years of success in providing advanced technical expertise to the electricity generation industry.

For nuclear, our unique engineering and testing capabilities include complete outage support, inspection and equipment qualification, nuclear plant chemistry and many other industry-accredited services.

- Life Cycle Management and Plant Life Extension
- Genuine Nuclear Parts and Equipment Qualification
- Inspection and Maintenance Systems and Services
- Materials Characterization and Forensic Analysis
- Plant Chemistry and Nuclear Waste Management
- Regulatory Affairs and Licensing
- Decommissioning Planning and Risk Management



KINECTRICS

KINECTRICS*USE



Division of Kinectrics Inc.



A Kinectrics Company

kinectrics.com

kinectrics.us

axiomndt.com

candesco.com

Rewinding a 13.8 kV, 93,000-lb. motor is easy —

Finding a service partner that has completed multiple quality audits based on the NUPIC checklist is the hard part



IPS has years of experience repairing safety- and non-safety related nuclear motors up to 13.8 kV and weighing over 93,000 lbs.



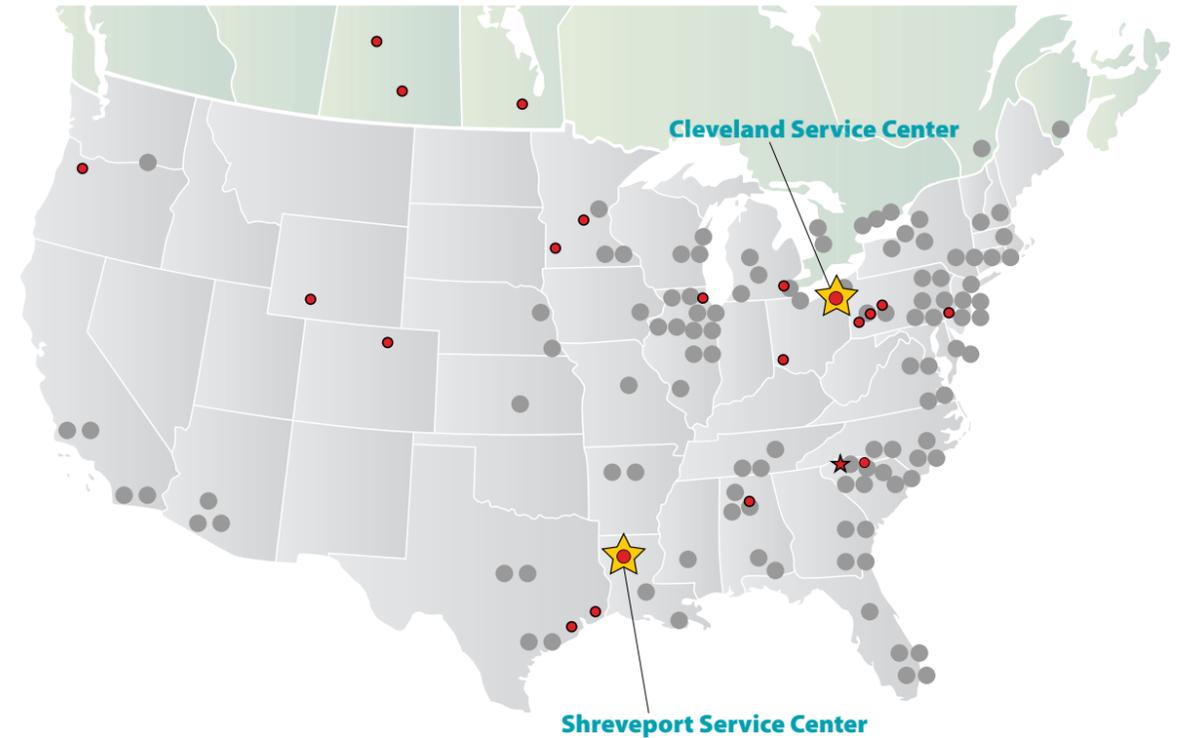
- Multi-location 10CFR50 Appendix B and 10CFR21 programs
- Unified Safety, Quality and Lean culture
- Engineered insulation systems to 15 kV
- In-house coil manufacturing up to 15 kV
- IEEE 429 underwater AC Hi Pot to 13.8 kV
- Experienced field service department
- Decontamination services and contaminated equipment repair available
- Dedicated motor storage facilities



To learn more about IPS Nuclear Services and our motor test and repair process, contact Tony Oubre, IPS Nuclear Services Project Director, at 864.451.5600 or nuclear@ips.us.

www.ips.us/nuclear

Nuclear Service Coast-to-Coast



★ IPS Nuclear Repair Centers ● Nuclear Reactors ● IPS Regional Service Centers



IPS nuclear repair centers in Cleveland and Shreveport have dedicated clean rooms for winding and repairing nuclear motors, applying best practices for Foreign Material Exclusion (FME).

IPS offers safety and non-safety related nuclear motor repair services, including radiologically contaminated motors, through its Cleveland and Shreveport nuclear repair centers. Both locations comply with applicable federal regulations and nuclear standards, including 10CFR50 Appendix B and ANSI N45.2, as well as 10CFR21.

The IPS Nuclear Services Quality Assurance Program offers one standard for safety, quality and repairs at both service centers, allowing IPS to service utilities with multiple

nuclear power plants to the same standards and specifications from either service center. The IPS Cleveland and Shreveport nuclear repair services are accessible through any of the eighteen IPS regional service centers coast to coast.



Our VPI and B-stage coils are manufactured in our environmentally-controlled clean room, using our automated taping process and CNC spreader to ensure uniform tape application and precise duplication of coil geometry.

Bigge Utilizes World's Largest – 7,500 Ton Capacity Super Crane

Bigge Crane and Rigging has manufactured the world's largest-capacity crane at radius that has forever change large scale modular construction. The first of Bigge's Super Heavy Lift Cranes have been deployed in the US at new Westinghouse AP1000 sites at both V.C. Summer and Plant Vogtle.

Bigge's Super Heavy Lift Cranes have unequalled capabilities - Bigge offers the only machine in the world capable of sitting in a single location and making every large scale super lift on a single or multi unit nuclear power plant site.

Imagine the flexibility of having a crane hook capable of lifting any load, anywhere, at any time on your project.

With a Bigge Super Heavy Lift Crane...

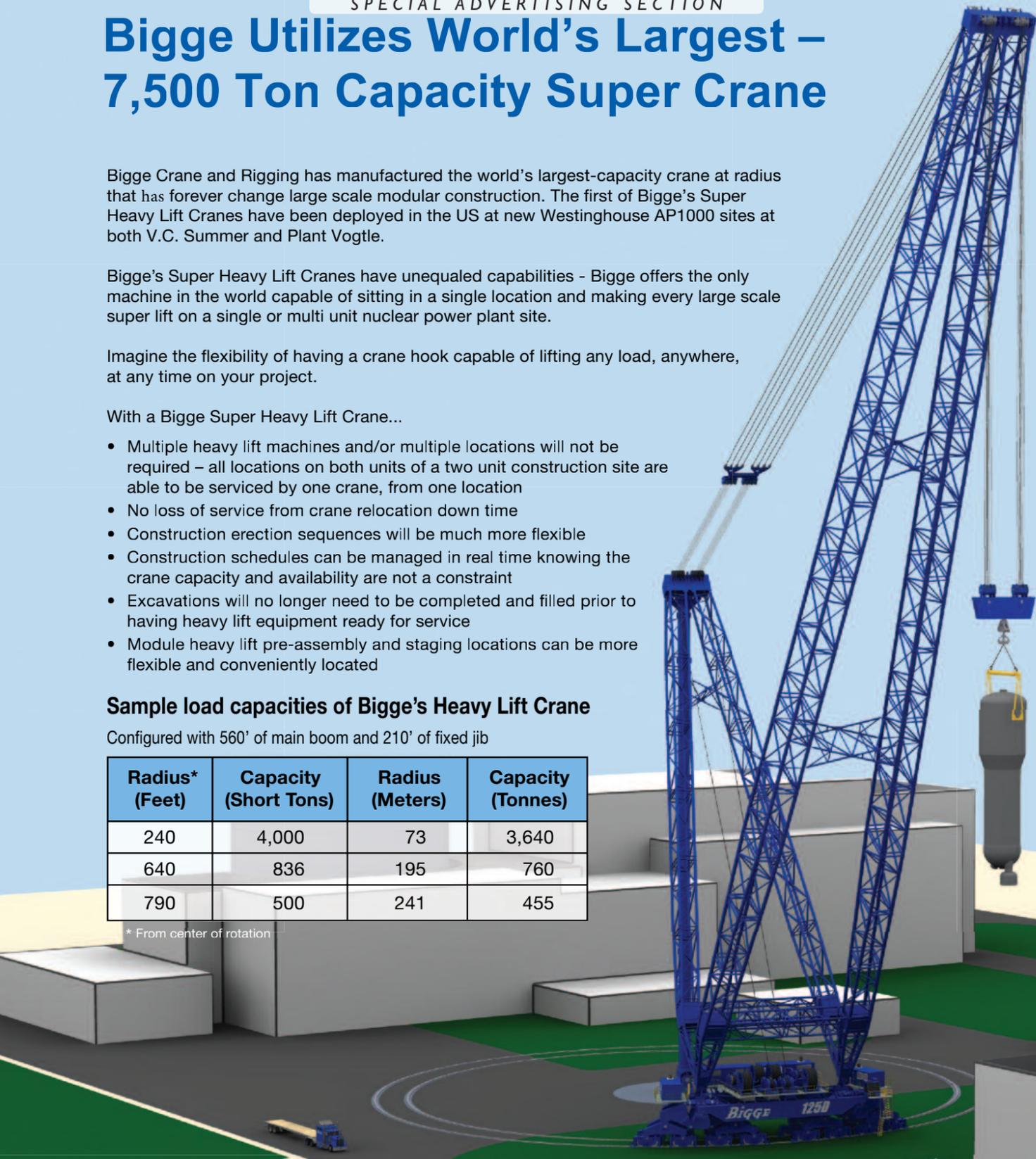
- Multiple heavy lift machines and/or multiple locations will not be required – all locations on both units of a two unit construction site are able to be serviced by one crane, from one location
- No loss of service from crane relocation down time
- Construction erection sequences will be much more flexible
- Construction schedules can be managed in real time knowing the crane capacity and availability are not a constraint
- Excavations will no longer need to be completed and filled prior to having heavy lift equipment ready for service
- Module heavy lift pre-assembly and staging locations can be more flexible and conveniently located

Sample load capacities of Bigge's Heavy Lift Crane

Configured with 560' of main boom and 210' of fixed jib

Radius* (Feet)	Capacity (Short Tons)	Radius (Meters)	Capacity (Tonnes)
240	4,000	73	3,640
640	836	195	760
790	500	241	455

* From center of rotation



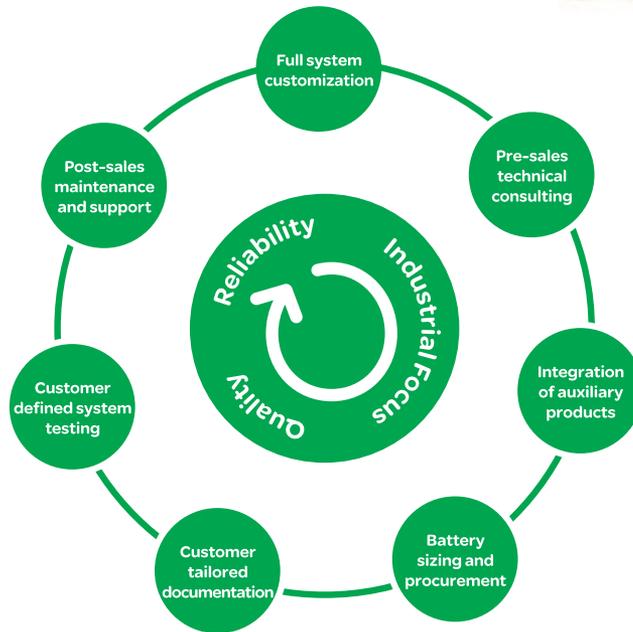
BIGGE
 CRANE and RIGGING CO.
 Established 1916

Please contact:
 Richard Miller, Vice President
 +1 510-638-8100
biggsolutions@bigge.com

www.bigge.com

Gutor
technology

Schneider
Electric



At Schneider Electric™, every step of your GUTOR™ UPS's life cycle – from pre-sales and design, through to final testing and after-sales services – is custom-tailored to meet your specific needs.

Providing in-depth expertise for nuclear projects: GUTOR supplies Class 1E systems

GUTOR Electronic LLC, a Schneider Electric company, is pleased to announce contracts with Westinghouse Electric Company to supply Class 1E battery chargers, inverters and voltage regulating transformers for four AP1000® reactors currently being built in the United States.

Serving the nuclear market over 30 years:

- GUTOR battery charger and inverter systems installed in over 100 reactors in 20 countries
- Contracts for 51 new build commercial reactors in the last 15 years
- Multiple contracts for QL1 systems for US DOE sites
- Dedicated nuclear industry team
- 10CFR50 Appendix B, 10CFR21 and ASME NQA-1 compliant

For many years a leading supplier of industrial UPS systems to the oil and gas sector, the GUTOR technology has become a leader in the fossil and nuclear power sectors as well.

GUTOR systems are highly regarded for their performance and reliability in critical industrial applications.

GUTOR Electronic LLC
www.schneider-electric.com/gutor

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CH-5430 Wettingen, Switzerland
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Fax: +41 (0)56 437 34 44

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tom.stomerski@schneider-electric.com

Michael May
635 Plainfield Rd, Knoxville, TN 37923
Phone: +1 (865) 230 - 3582
michael.may@schneider-electric.com

Industry Leading Activities in Digital Controls

Demonstrating Hurst Technologies continued leadership in nuclear I&C, noteworthy current and recent projects include:

- Gen IV reactor I&C design and licensing activities, development of digital-based protection.
- New plant licensing and design addressing safety related loss of phase essential power monitoring and protection.
- I&C for standard plant designs for NRC certification.
- Turnkey design/build digital control system for high-power research reactor.
- Margin recovery power increase based on improved ultrasonic flow meter.
- ERF computer system conceptual design for multi-unit plant addressing obsolescence and plant remaining life.
- Upgrade safety-related turbine-driven pumps with digital controls and electric actuators.
- Upgrade EOP setpoints to accommodate Fukushima-based requirements.

Part of Hurst's commitment to industry leadership involves leading or participating in numerous standards committees, technical conferences, and regulatory compliance workshops. In January, Hurst expanded on that commitment by conducting the benchmarking and training workshop, Instrument Setpoints and Uncertainties, and plans to conduct a second workshop, "Plant Computer and Digital Control System Configuration Management," in 2015.

Setpoints workshop a success. Representatives from ten nuclear plants gained an understanding of methodology, techniques, and

requirements in determining instrument loop uncertainties and setpoints. The first day consisted of learning and reviewing the basics – definitions, the relationship of setpoints to safety analysis and criteria, error sources, multiple loop error models, loop analysis, and uncertainty calculation techniques. The second day was devoted to practical examples from four of the basic plant measurement categories, pressure, temperature, level, and flow. Representatives from two nuclear plants delivered presentations on their experiences and practices.

Configuration Management (CM) is still an issue that many plants struggle with, even as its importance grows because of physical and cybersecurity concerns, NRC

regulations, NERC security and reliability rules, new grid and market management processes and organizations, and inadequate configuration management tools provided with OEM control systems.

Hurst's offerings in configuration management include evaluation of DCS vendor CM tools, conceptual strategy development, functional specifications, assessment of current practices, benchmarking of industry leading strategies, and project management.



For more information, contact Bill Sotos at Bills@hursttech.com, or call Bill or Timothy Hurst at 979-849-5068.



HURST

TECHNOLOGIES

Control Systems Engineering & Consulting

The road to success

CAPABILITIES

- DIGITAL SYSTEMS
- REGULATORY COMPLIANCE
- PROTECTION SYSTEMS
- BALANCE OF PLANT
- SECONDARY SYSTEMS
- MODIFICATION PACKAGES
- THIRD PARTY REVIEWS
- CYBERSECURITY
- OBSOLESCENCE PLANNING
- ELECTRICAL SYSTEMS
- INSTRUMENT SETPOINTS
- UNCERTAINTIES & SCALING

MODERN TECHNOLOGIES
TRADITIONAL VALUES

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The Evolution of Scaffolding



NO TOOLS REQUIRED!

Using the Excel Modular Scaffold System can reduce your plant's craft wrench time as much as **25%!**

BHI Energy Offers a **FREE** Excel Scaffold Material Program

- Scaffold Program Management & Rental
- Online and Outage Plant Labor Services
- Capital/Construction Project Support
- Custom Package Design Fabrication
- Formal Scaffold Reduction Program
- Permanent Seismic & Non-Seismic Scaffold Work Platforms
- Specialty Lead Shielding Structures



BHI Energy is the Exclusive Distributor of Excel Modular Scaffold

110 Prosperity Blvd., Piedmont, SC 29673

Positive locking design—Safest scaffolding in the industry

www.BHIenergy.com ■ www.ExcelScaffold.com ■ 864-622-2132



Different name, same quality services you've grown to expect since 1979.

MMC & Alliance Services



Power Services

- Turbine Services
- Valve Services
- I&C and Electrical
- Civil Maintenance
- Scaffolding
- Welding & Machining
- Facilities Maintenance



Technical Services

- Professional & Technical Staff Augmentation
- Radiation Protection
- Radiological Engineering



You may know us as Bartlett, PEM, SUN Technical, WeldTech or AMES. While our company name has changed, our brand remains synonymous with the quality services we have provided the nuclear industry for more than 35 years.

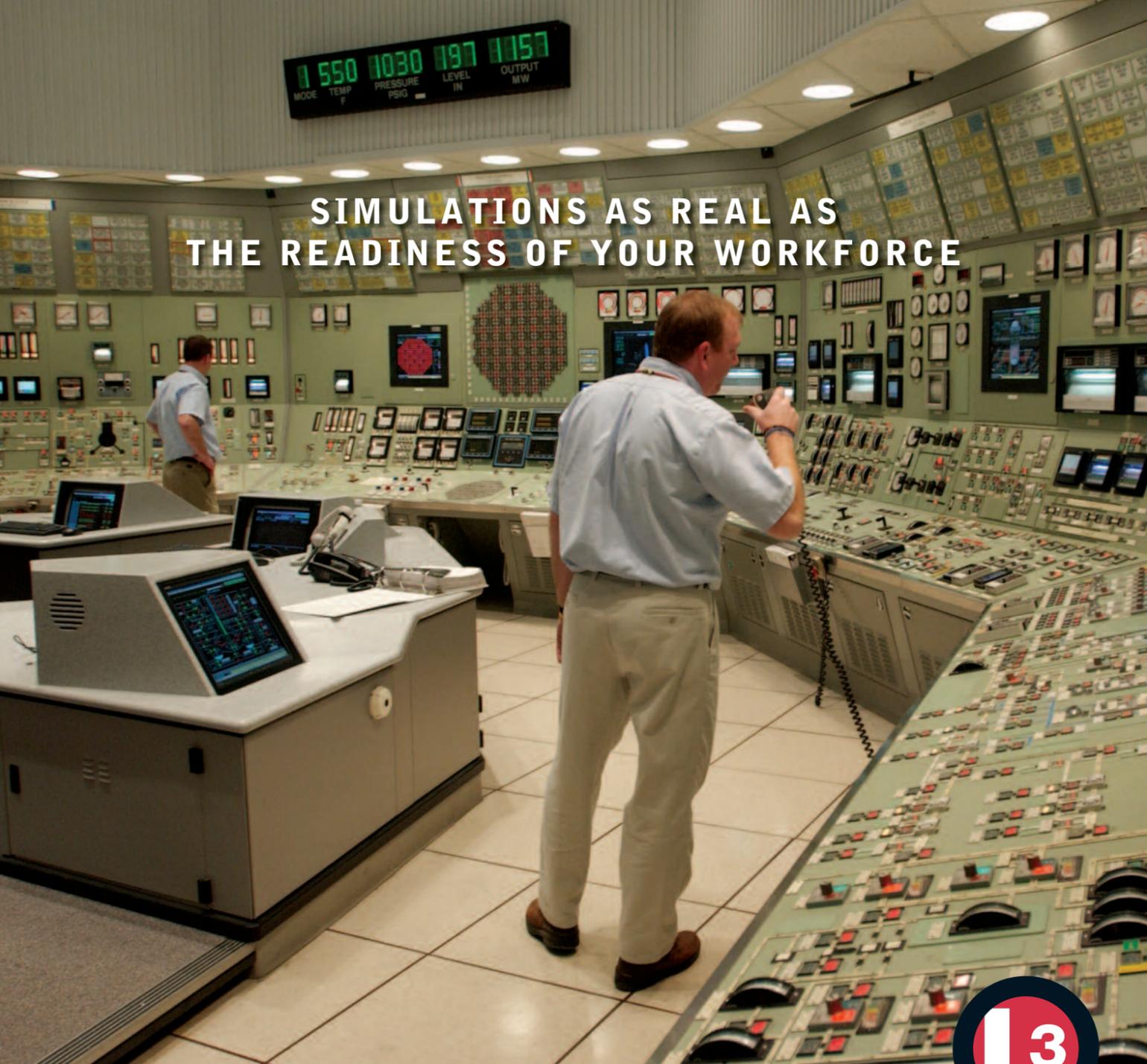
Our commitment to safety, customer service and delivering proven solutions to our customers reside at the core of our business.

www.bhienergy.com

High-fidelity Power Plant Simulators for Safe Operations Today and Tomorrow

When you're looking for improving your power plant's performance and reliability, you'll want the right simulation experience to get you there. One company has the dedication to produce true-to-life power plant simulators that ensure that your personnel have the knowledge required to safely and efficiently operate your power plant.

SIMULATIONS AS REAL AS THE READINESS OF YOUR WORKFORCE



For more than 40 years, L-3 MAPPS has worked with leading utilities, plant designers and research organizations to create superior training and engineering systems and has established itself as the world's pre-eminent manufacturer of power plant simulators. L-3 MAPPS is a company of people with ideas and vision, with a desire to create value through innovation and with the experience to achieve success.



Full Scope Power Plant Simulator

DOING IT RIGHT

Providing more than just training devices, L-3 MAPPS' simulator solutions - powered by the unparalleled Orchid® suite of simulation products - will elevate your operation and engineering teams to new heights in addressing plant design issues, procedural deficiencies and reliability improvements. L-3 MAPPS simulators provide superior real-world power plant training. L-3 MAPPS offers a variety of products and services, including full scope simulators, classroom simulators, engineering simulators, part-task trainers, severe accident simulation, simulator retrofits and upgrades, and more. L-3 MAPPS provides design to completion turnkey systems, specific components, and simulator design tools as required by the customer. The company's simulators offer the highest quality in modeling fidelity and training to provide trainees and instructors with user-friendly tools for learning, operating and mastering complex power plant systems.

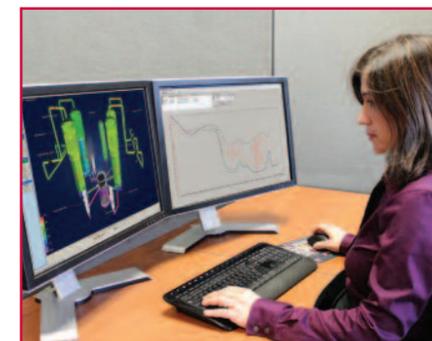
The superior training environments of L-3 MAPPS simulators provide clear advantages for obtaining operator licenses/certification, optimizing plant operating procedures and reducing costs. Operators trained on L-3 MAPPS simulator environments acquire the skills necessary to increase plant performance, minimize downtime, and provide confident emergency response. Real-time responses to operator actions

and interactive instructor controls ensure maximum training effectiveness and adaptability.

Simulator uses include interactive team training, severe incident management, plant design testing, and start-up/shutdown optimization. Any scenario, no matter how complex or dangerous in a real plant, can be reproduced, monitored and varied in real time, providing a highly valuable tool for training, plant engineering and emergency response.

YOU'RE IN CONTROL

L-3 MAPPS' unique knowledge transfer program allows customers to gain expertise and total confidence in the operation, modification and maintenance of the simulator using a state-of-the-art simulation environment. Users can directly implement simulator changes to reflect plant modifications, evolve their training programs and expand simulator use into other areas such as engineering training, emergency response organization training, etc.



Simulation-driven 3-D Trainer

USES AND ADVANTAGES

Cost-effective training for:

- Experienced operators and new recruits
- Overall plant and individual system operation and control
- Improving soft skills such as "command and control", three-way communication, team interaction and performance in the most realistic simulator control room environment
- Emergency plan implementation and incident management
- Skilled response to equipment malfunction and plant transients
- I&C familiarization through DCS and plant process computer operation



Orchid® Touch Interface Classroom Simulator

MORE BENEFITS

- Full visual implementation of whole plant simulation allowing users to have complete control over simulated plant design in an intuitive, easy-to-use manner
- State-of-the-art simulation environment for development, operation and management of your simulator with a fully visual, interactive graphic user interface including control room soft panels and plant system models
- Operations optimization with just-in-time training on plant start-up, shutdown and infrequently performed evolutions, etc.
- Fewer unplanned outages due to operator error or equipment malfunction
- Improved plant safety
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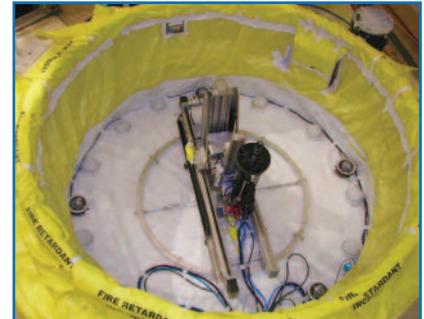
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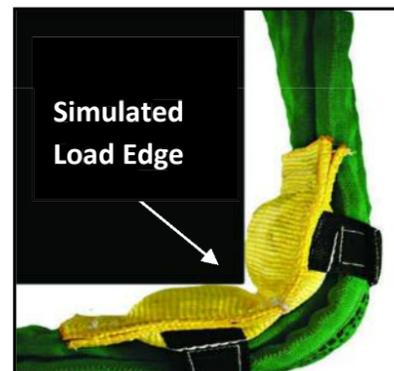
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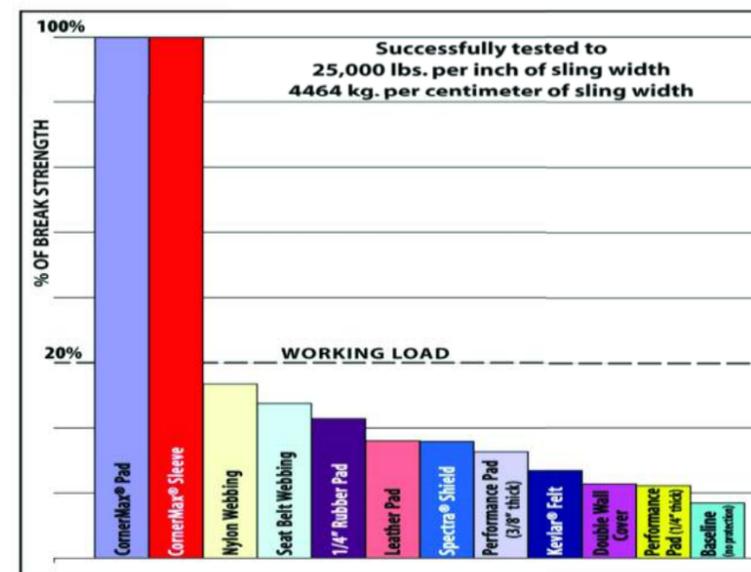
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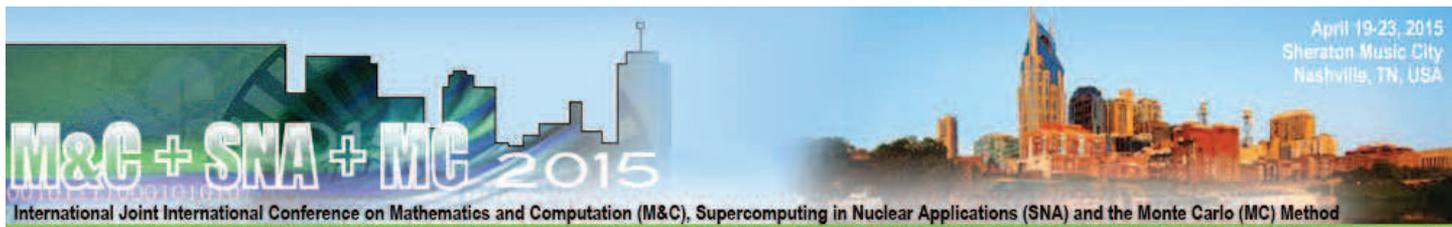
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April 19-23, 2015

The Oak Ridge/Knoxville Section of the American Nuclear Society (ANS) will host and sponsor the FIRST combined Mathematics and Computations (M&C) ANS topical, Supercomputing in Nuclear Applications (SNA), and Monte Carlo (MC) 2015. The joint international conference will be held at the Sheraton Music City in Nashville, Tennessee during the week of April 19-23, 2015. M&C is the latest in the series organized by the Mathematics and Computation Division of the American Nuclear Society. Prior to 2010, SNA and MC existed as separate conferences. In 2010, SNA and MC combined and held SNA+MC 2010 in Tokyo, Japan. This was followed by SNA+MC 2013 held in Paris, France.

The technical program will consist of plenary sessions, parallel oral presentation sessions, and poster sessions. There will also be several workshops, special sessions, and roundtable discussions as requested by and organized by participants.

Scope of the conference

The joint conference will provide an international review of the status and trends of research and applications in the field of numerical simulation and physical modeling for classical and advanced nuclear concepts, including the role and benefits of high-performance computing. Particular emphasis will be placed on deterministic and Monte Carlo methods and their applications.

Important dates:

Full papers due
October 31, 2014

Full Paper review completed
November 30, 2014

Information regarding the joint conference, including author's instructions, is located on the website:

<http://mc2015.org>

The organizing committee encourages the Young Members Group to participate and hopes that all practitioners will make plans to join us for this outstanding conference.

The main topics will be:

- Computational Methods Using High-Performance Computers
- Computational Reactor Physics and Particle Transport, Computational Thermal-hydraulics
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- Analysis, Radiation Physics, Particle Accelerator Physics, Computational Science, Deterministic and Monte Carlo Methods.

General Chair:

Bernadette Kirk
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ANS ANNUAL MEETING

The global nuclear energy enterprise: A changing landscape

The theme of the 2014 ANS Annual Meeting, held June 15–19 in Reno, Nev., was “The U.S. Role in a Global Nuclear Energy Enterprise.” For the opening plenary session, Adm. John J. Grossenbacher, director of Idaho National Laboratory (INL) and the general chair of the meeting, chose to address what is likely the top and most controversial aspect of that theme: the future influence of the United States in this global enterprise.

Grossenbacher noted that the United States led the development and deployment of nuclear energy technologies for many years, but today, the situation is quite different. The nuclear enterprise is global, with industrial and technical leadership found in Asia, in Europe, and elsewhere, as well as in North America. Some of the forces shaping the global nuclear enterprise today, he said, include the technology’s cost and complexity, public concerns over nuclear safety, and the significant role of governments with respect to nuclear materials and technologies, including proliferation risk.

This is the context in which this plenary was planned, Grossenbacher said. The session featured individuals representing a vendor with a historical perspective; a private sector institution that is developing highly innovative nuclear technologies; two research organizations, one American and the other British; and a leading Asian country with enormous energy requirements.

Kathryn McCarthy, director of the Light Water Reactor Sustainability Program Technical Integration Office at INL and the assistant general chair of the meeting, introduced the panelists, noting that they had been asked to have a candid exchange on the issues being discussed. She invited the audience members to submit questions on cards that had been provided



Grossenbacher

for that purpose. To start the session, each member of the panel provided a prepared answer to a specific question (submitted in advance) of particular relevance to his expertise and organization.

McCarthy directed the first question to Jiang Mianheng, a former president of the Chinese Academy of Sciences and currently the president of ShanghaiTech University, who has been engaged in directing high-technology research and development in many areas, including space technology, energy, and advanced materials, and who also served as the director of China’s thorium-based molten salt reactor program. The



Jiang

question for Jiang went to the heart of the session: What is your perspective on the U.S. role in the world nuclear market?

Jiang provided a look back to the beginning of China’s civil nuclear power story. In 1970, he said, during China’s Cultural Revolution, when normal industrial activities had been suspended, the leadership of Shanghai, at that time the primary economic engine of China, traveled to Beijing to ask Premier Zhou En-

lai to expedite the delivery of coal from western China to Shanghai, which is on the country’s east coast. With only three days of coal reserves remaining in Shanghai, the premier agreed to a special measure to ensure that Shanghai would receive its coal supply on a timely basis, and he also suggested that Shanghai leaders look into nuclear energy as a solution to securing its power. The ultimate result was the 300-MWe Qinshan I Unit-1 reactor near Shanghai.

This, however, did not initiate a major nuclear construction program based on Chinese technology, Jiang explained, mainly because the large-scale production of domestic oil began in the 1970s, with the mistaken belief that it would continue to meet the country’s energy needs. Only when the leadership realized that domestic oil production would not meet future demand did the country begin developing a nuclear program, but it was based on technology imported from Canada, France, and Russia.

Although U.S. nuclear technology was not brought into China’s nuclear program until 10 years ago with the signing of agreements for the construction of four Westinghouse AP1000s, China recognized the role of the United States as a world leader in nuclear technology, Jiang said. He noted that the United States remains the largest nuclear power producer in the world, de-

Meeting session coverage:

- ◆ *Perspectives on the U.S. role in the nuclear industry worldwide*
- ◆ *Sixty years of ANS history*
- ◆ *Issues in plutonium disposition*
- ◆ *Power reactor construction worldwide*
- ◆ *Small modular reactor status*
- ◆ *Reaching and informing the public*

spite 35 years of challenging commercial conditions and public misgivings.

Jiang also noted the U.S. nuclear industry's continued focus on improving safety and on the operation of existing nuclear plants after the Three Mile Island-2 accident in 1979, as well as on developing advanced technologies to maximize reactor safety and reduce financial risk. He said that he considers America's accomplishments in the

Over 80 percent of commercial nuclear plants worldwide are members of EPRI or participate in EPRI activities, Wilmshurst said, and this is because of the "reputation, credibility, and good work" of the U.S. nuclear industry. EPRI, therefore, has gained a perspective on its member organizations' needs, which differ by country. The United States, for example, is a mature market, he noted, while other countries are newcomers

to nuclear power and are searching for the best way to proceed. Asia, he said, is a growing, vibrant region that provides a huge opportunity for R&D as countries there try to establish nuclear programs. The challenge, he added, is how to transfer the experience of U.S. research and the resulting technologies to those countries.

Wilmshurst noted a number of things that EPRI members have in common. For example, he said, all countries want

to maximize the value of their assets in order to keep them running as long as possible. He mentioned "avoiding surprises" and reducing costs through technology as ways to help achieve plant longevity.

Wilmshurst said that avoiding surprises works on two levels: helping to gain public support, as people do not want to be surprised by their local nuclear plants, and maintaining the economic viability of a plant, as unexpected events—including new regulatory requirements—could necessitate multimillion-dollar unplanned investments. This, he added, drives research to understand the limitations of nuclear technologies, including areas such as materials aging, instrumentation and controls, and fuel performance, and, in the wake of the Fukushima accident, the impacts and likelihood of high-consequence external events.

Wilmshurst said he believes that there remain tremendous opportunities to improve and innovate within the naturally conservative approach taken with nuclear power, particularly in the areas of real-time plant monitoring and post-accident monitoring. One of the major problems at Fukushima, he said, was the lack of plant data available following the accident. Such monitoring will require a determination of what data are needed and how to deploy low-cost instrumentation to provide that data.

Wilmshurst also noted the following "holy grail" items that could have a profound impact in the future:

■ *Non-zirconium fuel.* "Imagine Fukushima without zirconium," he said, which, in his opinion, would have allowed more time to deal with the accident and lowered its consequences. A global effort is under way to "reinvent" nuclear fuel to make it more accident tolerant, he said.

■ *Low-dose health effects.* A globally coordinated research effort on low-dose health effects could eventually foster greater public acceptance of nuclear power, according to Wilmshurst, and the ability to explain low-dose effects to a doubtful public is needed. During the audience Q&A part of the session, Wilmshurst acknowledged that the industry will always be considered biased. He recommended a coordinated effort under the leadership of an independent international organization to carry out such a program—although he expressed the thought that such an undertaking "might even be too big" for the International Atomic Energy Agency.

■ *Decommissioning technology.* Nuclear decommissioning is becoming a growth industry, and more research is needed to develop better technologies and techniques for decontamination and decommissioning projects, according to Wilmshurst.

McCarthy's next question was for Ron Lewis, Westinghouse Electric Company's



Lewis

vice president of new plant product strategy and development: Given the recent liability lawsuit brought against General Electric in Japan and the nuclear liability laws passed in India, what risks do you see in building reactors in other countries?

He said that he was not particularly familiar with the lawsuit, but he noted that the amounts of money that have been mentioned related to it would mean bankruptcy for most companies. "That's something that should scare all of us," he added. Lewis focused his response on the challenge that liability issues present to innovation, as well as to the supply base for nuclear projects. With the need to deploy better and safer technologies and to create a sustainable industry, it is vital for the industry to address the rules related to liability, he said.

Regarding the possible consequences for the supply base, Lewis said that Westinghouse's suppliers cannot withstand the kind of financial "shock" that would result from these types of lawsuits. That is why channeling liability directly to the operator is critical, he said. If companies can expect to be confronted by a liability challenge similar to the one that GE is facing, they will simply not put themselves at risk. The issue is not new, of course, and it is why various international conventions and other liabil-

Jiang noted the U.S. nuclear industry's continued focus on improving safety and on the operation of existing nuclear plants after the Three Mile Island-2 accident in 1979, as well as on developing advanced technologies to maximize reactor safety and reduce financial risk.

area of safety during this period as providing the basis for the continuation of nuclear power post-Fukushima Daiichi, and that he sees U.S. technology as being in demand worldwide.

Based on the strength of U.S. universities and national laboratories, "which are among the most active in the world," Jiang said, the United States remains the world's "heart" for innovation in nuclear energy. With private companies and other organizations actively pursuing Generation IV advanced technologies, he said, the United States can play a significant role and lead the way in nuclear power. "I very much hope that the U.S. decides to play such a role," Jiang concluded, adding that he looks forward to future collaboration.

Neil Wilmshurst, vice president of nuclear for the Electric Power Research Institute (EPRI), started his career as a nuclear submarine engineer officer in Britain's



Wilmshurst

needs of the nuclear industry worldwide?

Royal Navy. He worked at nuclear power plants in the United Kingdom and in the United States before joining EPRI in 2003. The question McCarthy posed to him: Based on your experience at EPRI, what do you see as the research

ity protocols exist. The industry must continue to address this issue together, he declared, and he suggested that a global funding pool might be needed to provide protection to vendors/suppliers.

Lewis also put the question another way: Where will innovation be—and where will the accomplishments of U.S. scientists and engineers be—if the right legal system is not in place to protect companies and ensure that they can continue to create the next layer of innovation for the nuclear industry?

David McAlees, executive vice president



McAlees

of TerraPower, is part of the team that is developing a new type of reactor technology. The question put to him: What are the challenges to developing a nuclear energy technology in the United States with the intent to export?

McAlees started by explaining that TerraPower is focused on developing the technology of the traveling wave reactor (TWR), which is a fast reactor system designed to “breed and burn” its own fuel. A conceptual design for a 600-MWe prototype TWR is nearing completion, and the current schedule calls for construction to begin in about 2018 for operation in 2025, if a suitable partner can be found to continue development and to own and operate the prototype.

McAlees addressed the question by noting how important it has been for TerraPower to have access to a range of expertise in the United States and how difficult it may be to maintain that availability in the future.

In developing the TWR concept, he said, a number of technological improvements were needed in areas such as fuel burnup and material radiation damage performance. Since the company began operating in 2008, it has engaged dozens of specialists and suppliers, including Argonne National Laboratory (model development and performance of analyses); INL (fuel development and testing); Los Alamos National Laboratory and Pacific Northwest National Laboratory (study of irradiation samples); and the University of Michigan (ion irradiation testing). On the plant component side, Carpenter Steel is manufacturing custom alloys, and Curtiss-Wright is providing the design and supply of some unique components. TerraPower is also building a metallic fuel fabrication process development facility in Idaho.

TerraPower, however, has had to go outside the United States in a few cases. In particular, to gather materials and fuel data under fast reactor conditions, the company turned to Russia, where 2,000 materials samples are currently under irradiation in

the Bor-60 reactor at the Research Institute of Atomic Reactors in Dimitrovgrad. TerraPower is also working with Kobe Steel in Japan on the development of the HT9 specialty steel with appropriate characteristics. Of the 72 variations tested, the final four candidates are now under irradiation in the Bor-60 reactor and also in the Advanced Test Reactor at INL.

McAlees stressed that although the expertise needed to develop the TWR has largely been found in the United States, this has been possible because there are so few such innovative projects currently under way. He

added, however, that this may not be the case in 10 or 15 years.

Paul Howarth has been the managing director of the United Kingdom’s National Nuclear Laboratory since January 2011 and was a cofounder of the Dalton Nuclear Institute at the University of Manchester. His question: Britain has



Howarth

reengaged in the development and expansion of nuclear energy. What have been the drivers of this, and what can the rest of the world learn from its experience? Howarth said that he thinks the United Kingdom is the most exciting place to be for nuclear new build, and he described a dynamic environment in which many foreign companies are actively pursuing new-build projects. Besides Electricité de France, which is already a nuclear plant owner in the United Kingdom, companies from Canada, China, Japan, South Korea, and the United States want to participate, and many other countries are watching to see how successful this deployment program will be.

About 10 years ago, Howarth said, the United Kingdom’s nuclear program looked as if it would be phased out, as the government had basically concluded that it could rely on renewable technologies to provide needed power, as well as to fulfill the government’s ambitious plan for a significant reduction in carbon emissions without building new nuclear plants. In fact, a legally binding target of an 80 percent reduction in carbon dioxide emissions by 2050 is now in place.

The no-new-nuclear-plants scenario, however, did not pan out. In fact, Howarth said, the country’s energy position experienced “a perfect storm.” The operating ad-

Although the expertise needed to develop the TWR has largely been found in the United States, this has been possible because there are so few such innovative projects currently under way. This may not be the case in 10 or 15 years.

vanced gas-cooled power reactors were coming to the end of their lifetimes; other energy technologies had failed to penetrate the grid as expected; and the country was running out of natural gas from its North Sea reserves, which meant having to rely on importing more natural gas from Russia.

For the past few years, Howarth continued, he has worked with the government and a number of influential stakeholders to examine how to solve the energy problem and, in particular, to determine the best energy mix that can significantly decarbonize the country’s electricity production. Among other efforts, a computer platform was developed that allows anyone with an energy mix strategy to input a particular choice of technologies and other key elements of an energy policy designed to constrain consumption. The bottom line, he said, is that it was not possible to get close to a solution without including nuclear power.

“It was only by introducing nuclear into the equation that we could get to an 80 percent reduction in CO₂ emissions,” Howarth said. The result was a mix of about 130 GWe of fossil fuel (with carbon sequestration), 130 GWe of renewables, and 130 GWe of nuclear, and of those, only nuclear is likely to reach its target. And so, he said, the conclusion was clear: The United Kingdom would have to expand its nuclear program.

Another part of the challenge was to convince the government that a significant amount of investment in research—in areas such as fuel and reprocessing, reactor systems (including fast reactors and small modular reactors), and other advanced technologies—was needed to help understand the consequences of various nuclear scenarios. Over the past 10 years, Howarth

said, virtually no public investment had been made in nuclear fission research, and a significant ramp-up was needed. The government also agreed to reestablish its involvement in Generation IV activities to regain the United Kingdom's previous position as one of the leading nations in the area of nuclear research.

Regarding the lessons that may be relevant to other countries, Howarth admitted to being hard on renewables and fossil fuels. In fact, he said, in Britain, "We actually [ended] the debate of nuclear versus renewables versus sequestration versus shale gas. [It] doesn't matter, it is an irrelevance. You need everything."

Furthermore, the U.K. government realized that the framework that was in place for siting, approving, and licensing nuclear and other major infrastructure projects discouraged investors from risking their money. To encourage investment in nuclear, Howarth said, investors need clarity on the decision-making processes and assurance that they will see a return on investment in a reasonable time frame. He noted three actions that have now been instituted: Simplify the licensing system; provide some level of off-take guarantee to reduce investment risks; and clarify the long-term spent fuel and waste management policy.

During the audience Q&A period, Howarth was asked why Germany—which decided to phase out nuclear power after the Fukushima Daiichi accident—and the United Kingdom have such different views on their future energy mix. Howarth described the German decision as purely political and noted that Britain's situation is unique in that all the main political parties were able to take a long-term view of energy requirements and saw the need for nuclear expansion. This, he said, makes the nuclear issue in the United Kingdom "apolitical": It is no longer the subject of a politically charged debate.

Howarth also said that if it is not possible to take the politics out of energy decision making, the result will be as in Germany, which he believes will not be able to meet its energy policy goals under its now largely renewables program.

Plenary redux

The Chairman's Plenary Session carried over the format and theme from the opening plenary session, but with different speakers. The session began with each speaker answering a question from the moderator, John Carmack, national technical director of the advanced fuels campaign under the Department of Energy's Fuel Cycle Research and Development program. The speakers were clearly prepared to speak on these topics, although there were no presentation slides. Most of the remainder of the session consisted of audience questions

sent to the dais on cards and filtered by the moderator.

On the panel were Nathan Faith, manager of nuclear fleet cybersecurity at Exelon Corporation; Joachim Knebel, chief science officer at Karlsruhe Institute of Technology in Germany; John Kotek, managing partner of Gallatin Public Affairs, who had served as staff director of the Blue Ribbon Commission on America's Nuclear Future (BRC); Lara Pierpoint, special advisor on energy policy and systems analysis at the U.S. Department of Energy; José Reyes, chief technology officer of NuScale Power; and John Welch, president and chief executive officer of USEC Inc. What follows are some of the more significant statements that arose from the questions posed to the speakers.

Germany's ongoing nuclear phaseout has become a frequent punching bag for nuclear advocates in the United States, and Knebel was put in the unenviable position of having to address the topic, if not actually explain or defend it. Knebel said that Karlsruhe, for many years a world-class nuclear



Knebel

research facility, will continue to work on future nuclear energy systems and fusion energy. He added that he believes that nuclear education and training are of the utmost importance, and that students are still enrolling to study for the nuclear professions, but he added that he is not sure whether this will be the case in five years.

As for the effect of the phaseout on the country, Knebel said that more fossil-fuel use means dependence on Russian natural gas. He said that the people of Germany will have to change their consumption behavior and will have to face honestly what a massive shift to renewable energy sources will cost.

Asked about the Quadrennial Energy Review (QER) that was established for the United States by the White House in January, Pierpoint said that it will be done in stages. The first stage is under way, with two



Pierpoint

others to be conducted in the next two years. One of those will probably be on generation. The current stage—on transmission, storage, and distribution infrastructure—is likely to include topics of immediate interest to nuclear professionals: the role of nuclear power in grid stabilization and security, and the balance be-

tween baseload electricity and intermittent sources. Pierpoint said that fresh-fuel transportation may also be addressed in this QER.

Kotek was asked what would be needed



Kotek

to move forward the recommendations of the BRC, which was established by the energy secretary at the request of President Obama to review policies for managing the back end of the nuclear fuel cycle and to recommend a new waste management strategy. His reply: realism and courage, or at least a commitment to fixing the problem. In Kotek's view, the DOE is motivated, but the White House is not. He said that this year, Congress may take a step toward establishing one BRC-recommended item, a consent-based process to site facilities for spent fuel storage or high-level waste disposal. He said that he does not, however, see progress this year on another BRC proposal, the establishment of a separate federal agency to take responsibility for high-level waste.

Knebel was asked how Germany will maintain its nuclear safety culture and expertise in the nine years until the phaseout is complete. As it happens, he heads Germany's Alliance of Competence in Nuclear Engineering. There are eight universities with full nuclear curricula, along with the network of laboratories. He said that he believes that about 500 people will be maintained in key roles for the next five years.

On the question of whether nuclear power can continue to advance without resolution of the waste issue, Kotek said that there is not a clear yes or no answer. Decisions such as these are local, he said, and economics matter more than waste. Even so, he said that he believes some progress needs to be made on the BRC's recommendations.

Pierpoint responded to a question on investment in energy storage, noting that it is being addressed in the QER, and that there is not a complete database on how much storage there is, and how much it is used. There are technology costs and performance issues, she said, and added that storage does not seem to be valued very highly, nor is it well compensated.

Also somewhat related to storage was Knebel's reply to a question on whether France will tax the (mostly nuclear generated) electricity it exports to Germany. He said that currently, Germany is a net exporter of electricity from wind turbines and solar photovoltaics. Knebel conceded that storage is the real challenge for this amount of intermittent electricity, and added that old fossil-fired plants will be kept running and new ones will be added. Also, more

costs will add up because of the need to make improvements to the grid.

On a general question challenging whether governments should subsidize wind power and storage, Pierpoint said that solutions will depend on regions, especially where storage can provide grid stability. Underscoring the regional aspect of this, Knebel told of a Greek island where photovoltaics and electrochemical storage are being phased in this year and are expected to be cheaper than the only other option, the burning of oil.

It seemed that only a few minutes ever passed without questions or statements on whether the United States still has influence in nuclear power worldwide, and if not, what could be done to regain influence. Reyes said something to suggest that it helps not only to innovate, but to take responsibility. He recalled that at many conferences on small modular reactors that have been held in recent years, he sat on panels with other SMR developers and fielded questions from several people, some of them from other countries. When he was asked whether his NuScale reactor would be built first in his own country, he said yes. From that point on, he said, all further questions and expressions of interest were directed at him.

Past perspectives

In recognition of ANS's 60th anniversary later this year (the society was founded in December 1954), the President's Special Session at this year's Annual Meeting looked back at the past. The session, "60 Years of ANS—A Retrospective," was organized and chaired by 2013–2014 President Donald Hoffman and featured a panel of four ANS past presidents—Ronald Stinson (1987–1988), Ted Quinn (1998–1999), James Lake (2000–2001), and Eric Loewen (2011–2012)—representing four decades of ANS leadership.

Hoffman began the session by expressing gratitude for his own year as ANS president, a position he characterized as both demanding and rewarding. "It gives you a chance to be a part of influencing the things that mean so much to you," he said, "and I'm honestly sorry that it has to come to an end. I have thoroughly enjoyed working with the ANS staff, the membership, the leaders, the volunteers—all those individuals who are so committed and dedicated. I was trying to petition [incoming ANS President Mikey Brady Raap] to let me have a couple more years, but she reminded me that I had to run as a petition candidate, so I was lucky to get the year I had."



Hoffman

Before introducing the panel, Hoffman touched on a number of highlights from the first 60 years of ANS, including the society's first Annual Meeting (held at Penn State University) and the first student branch (at the University of Michigan) in 1955; the first ANS journal (*Nuclear Science and Engineering*) and the first local section (in Pittsburgh, Pa.) in 1956; the first issue of *Nuclear News* in 1959; the second ANS journal (*Nuclear Applications*, now *Nuclear Technology*) in 1965; the first overseas local sections in 1970; the first ANS public policy statement ("High-Level Radioactive Waste Disposal") in 1979; the third ANS journal (*Nuclear Technology/Fusion*, now *Fusion Science and Technology*) in 1981; the first plant branch (at Diablo Canyon) in 1988; the first strategic plan in 1997; the Seaborg Congressional Fellow Program in 2000; the Special Committee for Government Relations in 2001; the Young Members Group in 2005; and the Center for Nuclear Science and Technology Information in 2010.

The session's first speaker, representing the decade of the 1980s, was Stinson, who recounted a number of his experiences in the nuclear field, from his years with General Electric at Hanford and elsewhere to his many years of involvement with ANS, which included work on the society's code committees and trips to China for the Sixth Pacific Basin Nuclear Conference and to Moscow following the 1986 Chernobyl disaster. "At the time, Chernobyl was behind the Iron Curtain, and we had no way of getting real information regarding what caused the accident," Stinson said. "Four of us were invited to go to Moscow in December of that year—Bertram Wolfe [the 1986–1987 ANS president], myself, and two other ANS members. We met with some of the top Russian scientists there. Bert Wolfe negotiated an agreement with the Russians at that meeting, a memorandum of understanding, which was blessed by our State Department. Bert and I often dis-



Stinson

cussed whether or not Chernobyl initiated the opening up of Russia. I think it had a lot to do with it. The American Nuclear Society truly has been active in more than just building nuclear. We have been active on a political basis throughout much of the world."

Speaking next was Quinn, representing the 1990s. On the international front during that time, he said, nuclear plant construction was taking place all over the world. As an example, he pointed to Units 6 and 7 at the Kashiwazaki Kariwa plant in Japan, "which were built by GE-Hitachi and



Quinn

Toshiba, on schedule and on cost." Quinn added that in the early and mid-1990s, ANS greatly expanded its agreements with nuclear-related organizations in other countries.

The domestic nuclear situation, however, was less sanguine during much of the decade, Quinn

“Bert and I often discussed whether or not Chernobyl initiated the opening up of Russia. I think it had a lot to do with it. The American Nuclear Society truly has been active in more than just building nuclear. We have been active on a political basis throughout much of the world.”

said. He referenced the high-profile problems at Connecticut's Millstone plant that led to the permanent shutdown of Unit 1 and noted that by 1997, the budget for new nuclear research and development programs had been reduced over a period of three years to essentially zero. "We had many good people in the Department of Energy's Office of Nuclear Energy at the time," said Quinn, "but the message was coming from the top."

According to Quinn, that sorry domestic status started to improve in October 1997, when then-senator Pete Domenici, disappointed with the U.S. position on nuclear research and development, gave a speech at

Harvard titled “A New Paradigm for Nuclear Energy.” “It made a vast sea change,” he said, “even affecting what we do today.”

Quinn also praised the work of William Magwood (now with the Nuclear Regulatory Commission, but to become director general of the OECD Nuclear Energy Agency in September), who in 1998 became the head of the Office of Nuclear Energy, as well as the work of the Nuclear Energy Institute, formed in 1994 from other industry organizations. “NEI is a very effective institute that has partnered with us on so many occasions in which we’ve been successful,” Quinn added.

The 1990s also saw a number of changes at ANS, Quinn noted. In addition to the passage of the society’s first strategic plan in 1997, the number of ANS board and executive committee members was reduced, and the Nuclear Operations and Power divisions were combined to form the Operations and Power Division. In 1999, the ANS board passed a proposal to establish the Glenn T. Seaborg Congressional Science and Engineering Fellowship program. “Since then, as you are well aware, there have been many successful Congressional Fellows, including one ANS president, Eric Loewen,” he said.

Quinn was followed by Lake, representing the first decade of the new century. “Things really started to crackle in 2000,” he said. “The very pronuclear George W. Bush was elected president, and the Congress was largely pronuclear. Bill Magwood began moving away from just the Nuclear Energy Research Initiative and Nuclear Energy Plant Optimization programs, which were



Lake

very small research programs, to something more broad and international called the Generation IV International Forum. If you come to these meetings often, you know that at the last one, Bill Magwood talked a lot about that program, which has been going successfully now for 10 years.”

Also in 2000, Lake said, the NRC granted the first 40-year license extension at Calvert Cliffs, and California experienced a severe summer energy crisis. “It was very interesting to get a lot of the national press and even the liberal press in California interested in energy issues,” he said. “It opened up a lot of opportunities for them to understand different energy sources and how nuclear fit into the picture.”

Echoing Quinn, Lake praised the ANS Congressional Fellow Program for its efforts to disseminate nuclear science and technology information to Congress. “The program is also a unique opportunity to learn how Congress works and to help influence legis-

lation, as happened with the 2005 Energy Policy Act, which promoted nuclear reactor construction,” Lake noted. In addition, he said, with ANS’s increased emphasis on government policy, the society formed a Special Committee on Government Relations in 2001. “Each year, the incoming president appoints a group of advisors—including past presidents—who advise the new president on issues of public policy,” he said. “That committee, I think, has been quite helpful.”

Also during Lake’s tenure, the society continued the practice of regular visits by the ANS president and vice president with senior DOE, NRC, and administration officials and congressional leaders. “I don’t know that we keep the statistics on these things, but in my year as president, I think I visited more than 40 senior government officials in the State and Energy departments, the NRC, etc., and about 30 congressional offices,” he said. “I was pleased that about half of those congressional visits were with the senators or congressmen themselves and not just the staff. ANS was welcomed and actually sought after by these government offices because people wanted to know about nuclear issues.” Lake also said that during his term in office, he visited 11 countries and conducted more than a dozen TV, newspaper, and magazine interviews with such major media outlets as CNBC, the *Washington Post*, the *Wall Street Journal*, *U.S. News & World Report*, and *Business Week*. “Because of the California energy crisis, we even got a pronuclear article in the *San Francisco Chronicle*,” he said.

Lake also mentioned the 2005 hiring of Craig Piercy, ANS’s Washington representative. “We hired Craig to upgrade our D.C. office, and I think it’s been a very positive hire,” he said. “Craig has taken the lead in organizing Hill visits at each meeting in Washington and working with the congressional staffs.”

Throughout the decade, Lake said, ANS members worked very actively with the DOE’s Magwood to rebuild the department’s nuclear commitment to include greatly expanded budgets, industry programs, a strong university R&D program, and substantial laboratory R&D programs, and by decade’s end, things had turned around. “The DOE nuclear energy project had recovered rather spectacularly from essentially zero to something on the

order of \$750 million a year,” he said. “It goes up and down for a variety of reasons, but it’s still in that neighborhood. A strong DOE nuclear R&D budget is, I believe, an essential part of a healthy nuclear science and technology enterprise.”

Lake concluded by stating that ANS “very purposefully and diligently upped its game” in the decade, especially in the area of government policy. “I’m proud to say that this activity is continuing to make impressions,” he said. “I think it’s a necessary service that the society provides to help keep things going.”

The session’s final speaker, representing the current decade, was Loewen, who set the stage for his remarks with a quote from the book *Thinking, Fast and Slow*, by Daniel Kahneman. “Although humans are not irrational, they often need help to make more accurate judgments and better decisions, and in some cases, policies and institutions can provide that help.” Loewen took issue



Loewen

with those who claim they “knew” that an event like the 2011 Fukushima Daiichi accident would eventually occur. “We at ANS heard, post-3/11, from organizations opposed to nuclear science and technology that they ‘knew’ a reactor accident was inevitable,” Loewen said. “It was just a matter of time. I think we should all be worried by the word ‘knew,’ especially when

“We at ANS heard, post-3/11, from organizations opposed to nuclear that they ‘knew’ a reactor accident was inevitable. I think we should all be worried by the word ‘knew,’ especially when used to describe major events. In our scientific lives, we know only what is known—what can be shown to be true.”

used to describe major events. In our scientific lives, we know only what is known—what can be shown to be true. That’s why we publish technical papers, conduct conferences like this one, and organize our meetings around technical tracks.”

Loewen called for ANS to actively resist what he referred to as the “hindsight bias” against nuclear power that has resulted from the Fukushima accident. “As Kahneman stated in his book, ‘The worse the consequence, the greater the hindsight bias,’” Loewen said. “If we let this sort of hindsight bias to nuclear power go on, it will foster an attitude of risk aversion toward nuclear projects.”

Loewen also spoke about a former mentor of his, ANS member Ted Rockwell, a leading critic of the linear no-threshold hypothesis (the assumption that no level of radiation exposure is safe and that risk from radiation increases proportionately with the dosage received), who passed away in March 2013. “As ANS president, I had the opportunity and privilege to work with Ted Rockwell and Dr. Jerry Cuttler on the President’s Special Session on Fukushima and low-level radiation, and why much of the administratively evicted population [of the area around the Fukushima Daiichi nuclear power station] should be allowed to return safely to their homes,” Loewen said. “When we look forward to the next century to advance nuclear science and technology, we must get over our theory-induced blindness regarding low-level radiation health effects, specifically the theory of linear no-threshold.”

Plutonium disposition

Twenty years have passed since the publication of the National Academy of Sciences (NAS) report, “Management and Disposition of Excess Weapons Plutonium,” which characterized the world’s stockpiles of separated weapons-grade plutonium as a “clear and present danger to national and international security.” In recognition of the anniversary, ANS’s Nuclear Nonproliferation Technical Group and Fuel Cycle and Waste Management Division organized a panel discussion on the history and current state of plutonium disposition. “Plutonium Disposition—The Clear and Present Danger, 20 Years Later,” featured Steve Nesbit, of Duke Energy, organizer and cochair of the session; cochair Carl Mazzola, of CB&I; Robert J. Budnitz, of Lawrence Berkeley National Laboratory; Everett Redmond, of the Nuclear Energy Institute; Ken Canady, of MOX Services; and Frederic Bailly, of AREVA.

In his introductory remarks, Nesbit reviewed the major U.S. plutonium disposition milestones, beginning at the end of the Cold War in 1991 and including the 1994 NAS report and the related 1995 report on reactor-based options for plutonium disposition, as well as the following:



Nesbit

- The Department of Energy’s 1995 request that asked commercial nuclear power utilities about their interest in using plutonium-derived MOX fuel in reactors as part of the nation’s nonproliferation initiative with Russia.

- The DOE’s 1996 programmatic environmental impact statement that looked at plutonium disposition options.

- The DOE’s 1997 nonproliferation assessment that examined how well the various disposition methods performed.

- The selection in 1999 of MOX Services as the DOE’s provider for plutonium disposition services, including the development of a fabrication facility for producing commercial reactor fuel.

- The 2000 Plutonium Disposition and Management Agreement (PDMA) between the United States and Russia, which called for each nation to dispose of 34 metric tons of the material.

- The United States’ decision in 2002 to dispose of plutonium via the MOX fuel route only.

- The 2005 start of both the MOX fuel lead test assembly program at Duke’s Catawba nuclear power plant and MOX Services’ site preparation for the MOX Fuel Fabrication Facility (MFFF) at the Savannah River Site.

- The start of safety-related construction of the MFFF in 2007.

- The 2010 amendment to the PDMA.

- The DOE’s 2012 cancellation of the Pit Disassembly and Conversion Facility at SRS, a facility that was to take the surplus weapon warheads and convert them into oxide as feed for MOX fuel fabrication.

- The DOE’s re-assessment of the MFFF in 2013.

- The DOE’s decision in 2014 to put the MFFF into “cold standby.”

“There were, of course, a number of stakeholders who objected to the cold standby course of action,” Nesbit said, “including the state of South Carolina, which sued the DOE over the decision. As most of you know, after the suit was filed, DOE reevaluated its actions, and they’ve recently announced that they are going to continue construction of the MFFF at least through the end of this fiscal year, which has led South Carolina to drop its lawsuit. Just yesterday [June 17], the Senate Appropriations Committee appropriated, I believe, \$400 million for MFFF construction in the next fiscal year, and the

House Appropriations Committee has already appropriated a similar sum for it. So the story is not over. Paraphrasing Mark Twain, ‘The death of the MFFF has been greatly exaggerated.’”

Next, Budnitz, an expert on nuclear reactor safety and radioactive waste management, spoke on the plutonium disposition situation at the time of the NAS reports. (Budnitz was one of seven members of the panel that produced the 1995 report.) He reminded the audience that



Budnitz

in 1994, the Soviet Union had collapsed just three years earlier, and Belarus, Kazakhstan, Russia, and Ukraine still held substantial nuclear weaponry. Between the two sides, Budnitz said, there were some 250 metric tons of plutonium for nuclear weapons, 80 to 90 metric tons in arsenal storage, and 650 metric tons of reactor plutonium (120 metric tons separated and 530 metric tons in spent fuel). “The Russians were with us on doing something about this,” he said. “Yeltsin was in the Kremlin. They were willing to talk to us about this. The understanding was, ‘Boy, that hasn’t happened before at the top. Let’s take advantage of it.’”

It was deemed vital to work on disposition in parallel with Russia, so that one side would not be seen at any point as having an advantage over the other. “People understood that the programs didn’t have to be exactly in parallel, but they had to be roughly in parallel.”

While the 1994 NAS report calculated the cost that would likely be associated with developing a disposition program to address the excess plutonium, the cost was seen as being far less important than taking action, according to Budnitz. “The costs were thought to be a few billion dollars, and we were spending way more than that every year just watching the stuff, and so were they,” he said. “And we were spending a lot of money helping them watch their stuff.”

Continued

At the same time, however, it was deemed vital to work on disposition in parallel with Russia, Budnitz said, so that one side would not be seen at any point as having an advantage over the other. “We weren’t going to destroy any weapons unless they were,” he said, “and they wouldn’t unless we were. People understood that the programs didn’t have to be exactly in parallel, but they had to be roughly in parallel. That was seen as a way of defusing two groups—the group in the U.S. that didn’t want to do this and the group in Russia that didn’t want to do it.”

The NAS study determined that the endpoint for a disposition program would be ensuring that the surplus plutonium ended up with a composition that met the “spent fuel standard,” Budnitz said, meaning that the plutonium in its final dispositioned form should be approximately as difficult to acquire, process, and utilize in nuclear weapons as is the plutonium in typical spent fuel in civilian power reactors. The primary goals of the spent fuel standard were to impede the material’s reentry into nuclear arsenals and to deter access to it by non-state actors, he said.

Budnitz also discussed the recommendations of the 1995 NAS report for the most promising disposition technologies: MOX in light-water reactors, and vitrification. “These technologies were selected because it was thought at the time that both could move ahead expeditiously, meaning that in a decade [they] could be going, and none of the other options we evaluated at the time were thought to be able to move that fast,” he said. “Of course, it’s been 20 years, and not much has happened. But that was the thinking.”

The costs for each technology, Budnitz said, were evaluated in the report and judged to be comparable. “A detailed evaluation of how much it would cost to build a MOX plant determined that it would be a few billion dollars,” he said. “It was thought to be \$1 billion on the low side and about \$5 billion on the high side—certainly not as much as \$10 billion. But remember, these were 1994 dollars, and you would have to double that today. And the costs of vitrification were about the same. We also noted in the report that there was a worry, either technically or politically, that either the MOX option or the vitrification option might not work out. So we recommended working on both in parallel for the first few years.”

Following Budnitz was Redmond, who provided an overview of NEI—the nuclear industry’s trade association—and its nonproliferation efforts. Over the past few years, he said, NEI has endeavored to engage the nonproliferation community more actively than in the past, and is a willing participant in weapons-grade plutonium disposition. NEI also supports the MFFF, Redmond said, stating, “We view it as an investment in the future.”

Regarding the current lack of customers for MOX fuel—a major criticism of the proposed facility—Redmond remains unconcerned.



Redmond

“The industry, I’m convinced, will use MOX fuel,” he said. “There is work that needs to be done before they can use MOX in reactors, however, and there will be a cost to that. So that will have to be figured out. At the end of the day, utilities will have to be able to get MOX fuel cost-competitive with UO₂, including the cost of modification for their facilities in the license applications. But again, I’m convinced that can be done.”

The real challenge, Redmond said, is that utilities must be assured on-time delivery when purchasing fuel. “The last two years, and especially this year, have not exactly given utilities confidence in the Department of Energy,” he said. “Why would you have a contract or get a contract right now to supply fuel from a MOX fuel fabrication facility?”

On that point, Redmond quoted from a letter that NEI sent to Energy Secretary Ernest Moniz: “To cancel, suspend, or simply reduce funding for the project will unfortunately validate those critics of the Department of Energy who claim it simply cannot complete complex projects, particularly those concerning nuclear materials disposition. Unfortunately, DOE’s history with this and other large complex projects does not instill confidence in the commercial industry that the MOX program will be able to deliver commercial fuel to utilities on an agreed-to schedule. However, DOE can and should begin to reverse this trend and begin to restore confidence by following through with the construction and operation of the MOX facility on a set schedule.”

Failure to do so, Redmond believes, will likely be viewed as a retreat from U.S. international commitments. “The industry, being a supportive partner of the government, certainly does not want that to happen,” he said. “We must lead the world in nonproliferation efforts, and the industry is there to support the government. Without collaboration, the nonproliferation goals will not be met.”

The next speaker, MOX Services’ Canady, also endorsed the completion of the MFFF.

His presentation included a detailed look at the evolution of the project from 1994 to the present, including the April 2010 amendment to the PDMA.



Canady

“The amended PDMA was important for two reasons,” Canady said. “It allowed the Russians to burn MOX in their fast reactors, and it identified MOX as the only disposition option. So now, unless we go back to the Russians, there are no other options available for plutonium disposition in the United States. It’s MOX.”

Canady also pointed out that in March 2014, after years of hearings and other discussions, an Atomic Safety and Licensing Board issued a decision on whether or not the MFFF met Nuclear Regulatory Commission regulations for nuclear material control and accounting. “The ASLB agreed with MOX Services that the material accountability and control was excellent,” he said. “The intervenors’ contentions were dismissed, and a favorable decision was issued.”

Among other aspects of the MOX project that Canady discussed were the highly publicized cost and delay issues. The facility, which uses NRC quality assurance processes, contains over 400,000 feet of piping, 31,000 pipe supports, 7 million feet of cable, over 1 million pounds of HVAC, 330 gloveboxes, 170,000 cubic yards of concrete, and 35,000 tons of steel, he said. “The biggest issue, which I think led to cost and schedule increases, has been the ability to find QA-qualified vendors,” Canady said. “When we started this plant, the nuclear industry in the United States had essentially been dormant for 15 to 20 years. People who had a QA program had let it lapse or

“We must lead the world in nonproliferation efforts, and the industry is there to support the government. Without collaboration, the nonproliferation goals will not be met.”

put it on the shelf. So when we solicited bids from vendors for gloveboxes, tanks, concrete, rebar, whatever, it was difficult to find people to bid. In many cases, MOX Services was forced to hire QA engineers on its pay-

roll to make sure that a quality product was received that would stand up to the scrutiny of NRC inspectors.”

The DOE’s cold standby announcement has also had an impact on the project, Canady said. “Our turnover rate has increased and our ability to attract workers, both labor and engineers, has decreased,” he said. “Even though we have funding for the rest of this year, and we have bipartisan support in Congress for funding next year, it is still difficult in the current situation to attract and keep good talent for this plant.”

The session’s final presenter was AREVA’s Baily, whose presentation focused on the experience with plutonium disposition and MOX fuel use outside of the United States. Worldwide, he said, there are 43 reactors that use MOX fuel—39 in Europe and four in Japan—with roughly 7,000 fuel assemblies used to date. Further, according to Baily, six countries have analyzed the use of MOX fuel and have found that it meets the same licensing standards as UO₂ fuel. “These countries have used fuel with a very high level of reliability,” he said. “Very few fuel assemblies have been identified as leaking MOX fuel. Plus, none of the leaking or other failures was attributed to the fact that it was MOX inside the tubes. It was actually fuel assemblies with some particles in the primary that led to the failed fuel. There has been no impact on operation. And there have been no early outages subsequent to the detection of the leaking fuel assemblies.”

In addition, Baily said that the burning of plutonium in MOX fuel contributes to nonproliferation objectives, as it consumes approximately one-third of the plutonium and controls overall plutonium inventory. “It also significantly degrades the isotopic composition of the remaining plutonium and thus the potential attractiveness for nonpeaceful usage,” he said.

Reactor construction worldwide

The panel session titled “New Nuclear Construction Around the World” was the first joint session of the ANS Operations and Power Division and the ANS International Committee. The session was co-chaired by ANS past president Ted Quinn and Corey McDaniel, chair of the International Committee.

The first speaker was Sal Golub, associate deputy assistant secretary for nuclear reactor technologies at the Department of Energy. Golub began by noting the role that nuclear power can play in ensuring a secure and diverse energy supply. As a non-carbon-emitting source of electricity, nu-

clear power is an important element in President Obama’s climate action plan released last year, he said. The plan includes cutting carbon emissions, preparing for climate change, and leading international climate change efforts. Under this plan, he said, the United States will not only continue to promote nuclear power worldwide but will also expand those efforts.

Nuclear expansion, Golub said, will certainly require dealing with the fundamental issues of public confidence in the safety of nuclear plants, finding a long-term solution to nuclear waste, and providing protection from the risk of nuclear weapons proliferation and from terrorism. In addition to all of these things, he said, the economics must be right. On this point, he focused on the “historical cost drivers” of high capital costs, high financing costs, and the lack of standardization. The particular issues associated with these that must be addressed include the cost of commodities, long and delayed schedules, quality problems, and design changes.

The 1979 accident at Three Mile Island had particularly profound effects on the nuclear enterprise, Golub said. It initiated many significant changes to plant structures, systems, and components, to the safety basis, and to regulatory review processes, which led to extended construction schedules, higher costs, and project cancellations. Today, with the first new plants being built in the United States in 30 years, it is essential, he said, that good cost and schedule performance are achieved for the Vogtle-3 and -4 and the Summer-2 and -3 AP1000 projects. So far, he noted, both construction projects are performing reasonably well.

Modern construction techniques have significantly improved construction times and quality, Golub said, while new technologies, such as small modular reactors (SMR), offer a potential new model for nuclear expansion, overcoming some of the obstacles to deployment. The potential economic benefits of SMRs include a smaller financial commitment for utilities, shorter construction schedules due to modular construction, and improved quality and costs due to replication in a factory setting.

To jump-start an SMR capability, the DOE established the SMR Licensing Technical Support Program to support first-of-

a-kind SMR certification and licensing activities through cost-shared partnerships with industry. The DOE has now signed two partnership agreements.

Looking to the future, Golub said, the DOE’s research and development program is pursuing various opportunities to reduce

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capital costs through, for example, design simplification and improved materials, the use of advanced high-performance computing, modeling, and simulation, and advanced energy conversion technologies. Regarding this last item, Golub said that the DOE sees great promise in a supercritical CO₂ Brayton energy conversion cycle to replace the conventional steam Rankine cycle, potentially improving efficiency by up to 50 percent, as well as reducing the size of mechanical equipment and the plant footprint.

On the policy front, Golub noted that incentives for promoting nuclear deployment, such as loan guarantees and tax credits, were included in the Energy Policy Act of 2005, and that the DOE will be exploring other possible incentives with stakeholders.

Golub also stressed that the expansion of global nuclear energy cannot occur without effective international collaboration. The United States no longer has a suite of facilities in which to conduct needed research, nor does it have a monopoly on the technical expertise needed to address the challenges facing the long-term sustainability of nuclear power. In this regard, Golub said, the United States also needs to be engaged as a player in the global nuclear industry if it is to have any meaningful influence over safety and proliferation norms.

The next speaker, Larry Burkhart, of the Division of New Reactor Licensing in the Nuclear Regulatory Commission’s Office of New Reactors, had spoken on this topic at the 2012 ANS Winter Meeting, but he said



Baily

that he has noticed changes since then. There are more reactors under construction now, he said, and many more are being licensed and designs are being reviewed, although the activity is distributed unevenly around the globe. He also noted that in some countries, such as Canada, the Czech Republic, and France, politics and finance have become important factors, causing these countries to put expansion activities on hold.

Among new reactor trends, Burkhart noted that the pursuit of standard designs has provided unique opportunities for international cooperation. He pointed to the formation of the World Nuclear Association's Cooperation in Reactor Design Evaluation and Licensing Working Group, the Multinational Design Evaluation Program (MDEP), and the OECD Nuclear Energy Agency's (NEA) Working Group for the Regulation of New Reactors (WGRNR).

The MDEP was established in 2006 with 10 countries (it now includes 14) to cooperate on new reactor design reviews and to explore opportunities for harmonization and convergence on approaches to licensing and safety reviews, Burkhart said. The MDEP created design working groups and issues working groups that are intended to develop common positions. The regulators in the MDEP invite stakeholders, including vendors, operators, standards development organizations, and others, to attend meetings and help them understand the designs and the reasons for differences among them. At the NEA, the WGRNR looks at other issues, such as siting and construction regulations.

Regarding new reactor issues, Burkhart started with Fukushima, which "everyone has to address." It is clear at the MDEP, he said, that all countries are focused on the same concerns that came out of the Fukushima Daiichi accident, such as the loss of heat sink and the continued loss of off-site power. Individual countries, however, may address these issues differently.

As for trends in the United States, Burkhart said that after the Office of New Reactors was established, 18 combined construction and operating license applications were submitted to the NRC under 10 CFR Part 52. Currently, only eight are actively under review. The others were suspended, but none for regulatory reasons. In any case, the NRC will not issue any new licenses or license renewals until the waste confidence issue is resolved, which should be later this year. In the meantime, Burkhart said, experience with the procedure for introducing changes to the design/licensing basis during construction is being gained at Summer and Vogtle. He added that the applications for design amendments that have been processed so far have not had a negative impact on project schedules.

The view from a newcomer country was given by Bill Travers, director general of the

United Arab Emirates' Federal Authority for Nuclear Regulation (FANR), which is responsible for planning and implementing nuclear regulations. Travers was previously the executive director of operations at the NRC.

When the Emirates Nuclear Energy Corporation received its first construction license in July 2012, Travers said, the UAE became the first new country to begin building a nuclear power plant since China some 30 years ago. When asked why the nuclear program of the UAE, a country with no history in nuclear technology, has been so successful over such a short time, he answered that the UAE "really did its homework." This included undertaking an extensive review of international experience. Even before the decision was made to embark on a nuclear program, he said, a set of principles was laid out that represented best practices in a host of areas relevant to undertaking a nuclear program.

One of the earliest and most important measures was to develop the legal framework for undertaking nuclear activities. This included the establishment of an independent regulatory body with the means and resources to do an independent assessment of nuclear safety, security, and safeguards. Another important element in devising a national nuclear program, Travers said, was addressing the commitments that the world expects from a newcomer, particularly in regard to safety, nonproliferation, and transparency. The UAE now participates in all relevant international nuclear conventions, such as the Convention on Nuclear Safety and the Vienna Convention on Civil Liability for Nuclear Damage, and has signed on to other legal instruments, such as the Comprehensive Safeguards Agreement with the International Atomic Energy Agency. Currently, he said, the UAE program is viewed as a model for other countries that are interested in developing a nuclear program.

FANR has classic regulatory responsibilities, Travers explained, but as nothing existed before, the agency has had to build a regulatory regime from scratch. While making use of the work of others, he said, its regime is not a copy of the NRC's or anyone else's. It draws upon the 50 years of world experience, using the IAEA's safety standards and its security regime. FANR, however, has adopted regulatory guidance avail-

able from the NRC and other regulators, rather than writing its own. "If it exists and is good enough," FANR will not try to reinvent it, he said.

The strategy applied was to create a team within FANR with enough expertise across a broad spectrum of technical areas that FANR could confidently take ownership and responsibility for its work, Travers said. Technical support organizations in other countries, including two in the United States, were contracted to carry out detailed reviews of parts of the construction license application. He noted, however, that all of the decisions based on the reviews are "owned exclusively by FANR."

FANR has signed up for every one of the IAEA's review services, which provide an independent assessment and recommendations for improvement. An independent advisory group, headed by former NRC chairman Richard Meserve, advises the FANR Board of Management, which is made up of nine Emirate citizens who make all final decisions. Another important activity is the development of Emiratis to work in this area. The goal is that over time, FANR will become an Emirati-led organization.

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Kannan Iyer, of the Indian Institute of Technology in Bombay, gave a presentation on India's nuclear program. He is the chair of the ANS India Section and a member of the ANS International Committee. Iyer started by noting two important considerations: Because of the international nuclear industry's concerns over third-party liability legislation, reactor projects involving foreign vendors are in limbo, and a new government was elected just a few weeks prior to the ANS Annual Meeting.

As originally conceived, Iyer said, energy security was the priority for India's nuclear program, which was to be self-contained and independent from outside forces. A three-stage program was subsequently developed, based on India's lack of uranium resources but extensive deposits of thorium.

Thermal uranium-fueled reactors, he said, would be built in the first stage to generate plutonium for fueling fast reactors in the second stage. In the third stage, the fast reactors would be used to breed fissile material (U-233) from the country's thorium reserves to create a thorium fuel cycle. India expects its prototype fast breeder reactor to be ready to start operation by the end of this year, he noted.

Iyer explained that the first nuclear units built in India were General Electric boiling water reactors (Tarapur-1 and -2). However, as light-water reactors require enriched fuel, the decision was made to develop natural uranium-fueled systems, and a contract was signed with Atomic Energy of Canada Limited for two CANDU pressurized heavy-water reactor units (Rajasthan -1 and -2). In 1974, he continued, India exploded a nuclear device, which led Canada to halt its support of India's program. This meant that India had to develop the capability to build PHWRs completely indigenously. While this took a long time, he said, India eventually created a complete nuclear design and construction capability along with the fuel cycle.

As India's regional grids were developed, it became possible to increase reactor capacity from 220 to 540 MWe (gross), Iyer said. This was soon uprated to 700 MWe, which is the size of the PHWR that is now being built by Nuclear Power Corporation of India Limited (NPCIL). Because of the country's lack of uranium reserves, the government decided to import reactors and the necessary fuel. Iyer noted that India already had an arrangement with Russia for the construction of two VVER units at the Kalpakkam site, with more expected. The possibility of using other foreign designs was opened up once India concluded a high-level nuclear cooperation agreement with the United States in 2008. This led to the start of negotiations between NPCIL and General Electric, Westinghouse, and AREVA, while NPCIL also identified specific greenfield sites for foreign units.

According to Iyer, all of these projects have been subject to varying degrees of opposition from a number of factions in India, which became even more contentious after the Fukushima Daiichi accident. Little progress has been made since then, he added.

Following the May election of a new government, a presidential address before India's parliament on June 9 included a promise to implement the international civil nuclear agreements. Because the new prime minister, Narendra Modi, had successfully delivered large infrastructure projects when he was the chief minister of the state of Gujarat, there is an expectation in the nuclear industry that the projects may soon be moving forward.

The title of the presentation by T. Jay Harrison, of Oak Ridge National Laboratory,

was "The New Opportunity for Nuclear," which, he said, would offer an optimistic look at the future economics of nuclear power. While the nuclear renaissance in the United States has not panned out as hoped, he said, the Environmental Protection Agency's recently announced goal to reduce carbon emissions by 30 percent by 2030 may turn market forces in nuclear's favor. Nuclear has tough competition, he said, but it has a unique advantage in providing emission-free baseload generation.

In the early 2000s, electricity demand was increasing significantly—by about 1.8 percent annually. Since 2008, annual power production has dropped by about 100 TWh, and at the same time, cheap natural gas started coming on the market. At the moment, according to Harrison, the current CO₂ reduction figures are on track to hit the EPA target, thanks in part to natural gas, which produces about half the emissions that coal generation does.

Looking a bit deeper into this situation, Harrison said, he found some encouraging signs. Since 2008, coal's share of total electricity production is down from 50 percent to 40 percent. The lost coal-generated power has been made up mainly by natural gas and wind generation. He said that he believes that in the future, however, the EPA's carbon reduction goal will constrain the growth in the use of natural gas for electricity production.

To reach the 30 percent target, Harrison said, the United States is going to have to replace 10 percent of coal-produced electricity, which equates to about 400 TWh. Harrison said he expects that carbon-emitting production will not be used and that other options to replace the lost coal electricity production—notably wind, solar photovoltaic, and nuclear generation, which he lists as the three cheapest—will have a good opportunity to expand. In his opinion, however, it is unlikely that the renewable options can provide the amount and the necessary level of secure generation needed to fill the gap, while nuclear power, as a major baseload carbon-free source, can. Harrison further calculated that to replace 400 TWh with nuclear by 2030 means bringing about 50 GW of additional nuclear capacity on line, which he said is certainly possible.

Finally, Harrison argued that the EPA proposal provides an opportunity for the

U.S. nuclear industry to reestablish capacities, capabilities, and supply chains. And because the world nuclear market considers NRC-licensed plants to be the "gold standard," a growth in the nuclear industry in the United States will likely extend beyond its borders. This, therefore, is a chance for a global nuclear renaissance, with the United States as a prime mover.

Small modular reactors

The session on small modular reactors showed that even designs that have gained approval for federal support are still subject to hard looks and revisions by their creators. Both José Reyes, of NuScale Power, and Sandra Sloan, of Babcock & Wilcox's Generation mPower, said that their companies' integral pressurized water reactors (iPWR) have recently gone through "optimization" processes, in the case of NuScale with the intent to cut the cost of the reactor and perhaps improve safety, and in the case of mPower to improve "cost and constructability." Whatever benefits there may be in having the Department of Energy share the cost of design certification and licensing, it appears that SMR vendors are also trying to pursue customers.

Reyes, chief technology officer of NuScale Power, summarized recent developments on the NuScale 45-MWe iPWR. Under the current plan, the first NuScale-based application for combined construction and operating licenses would come from Utah Associated Municipal Power Sys-



Reyes

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tems (UAMPS), although the operator would be Energy Northwest (which owns and operates the Columbia power reactor in Washington state), and the site would be in Idaho, most likely on the property of Ida-

ho National Laboratory. This involvement of organizations or facilities in four western states (Utah, Washington, Idaho, and Oregon, where NuScale Power is headquartered) seems to be in keeping with the larger regional effort for NuScale deployment, the Western Initiative for Nuclear. There are potentially as many as six projects, which could be located in the previously mentioned four states, Arizona, or perhaps Montana or New Mexico.

Reyes said that the current low price of natural gas that potentially affects nuclear economics in the eastern and central parts of the country is not a significant factor in the Northwest, because of gas transport costs. But while this may give the NuScale reactor a chance to be economically viable for UAMPS, there is a time frame in which NuScale would be of the greatest value. UAMPS wants to begin retiring its coal-fired generation in 2023, Reyes noted, and NuScale reactors would have to be ready by then to become the replacements.

As a company established to develop a reactor concept, NuScale Power does not have an existing industrial base from which to develop a full infrastructure, Reyes said. With Fluor now its parent company, NuScale has access to expertise in areas such as balance-of-plant, but a NuScale plant will need some hardware from elsewhere. Reyes said that the company is establishing specifications for a skid-mounted turbine generator but will not manufacture it. NuScale Power is working with vendors who will produce the qualified hardware.

Having the smallest of the small modular reactors currently in development in the United States makes possible some practices that even other SMRs might not adopt. Reyes said that when a NuScale reactor needs to be refueled, the reactor itself will be moved to a refueling station within the plant structure, and then back to its operational base.

According to Reyes, the optimization study led to a number of design changes, including reduction in the tube length and overall height of the helical coil steam generator, integration of the steam generator steam header into the pressurizer baffle plate, and revision of the generator's tube support structure. These changes have made it possible for the reactor module height and pool depth to be reduced by about 7 feet. The reactor building wings have also been eliminated, and the control room, technical support center, and related systems are now to be housed in a building physically separate from the reactor building. Reyes said that the NRC staff was briefed on these changes during a meeting in May and that he did not expect them to affect the agency's regulation of the reactor.

The critical heat flux test has been completed, Reyes added, and testing of the full-scale helical-coil steam generator will begin

in January. An eddy current probe for steam generator inspection has also been tested.

As he looked ahead to the certification process, Reyes noted the difficulty in getting nontechnical people to understand low core damage frequency, and he said that he would like ANS to help show how low the consequences of an accident in a NuScale reactor would be. He wants to be able to tell the public that no accident in a NuScale plant would ever lead to the permanent evacuation of any residents near the plant or anywhere else.

Sloan, manager of design integration and licensing for mPower, filled in as the mPower speaker in addition to her role as chair of the session. Babcock & Wilcox and its partners in Generation mPower have been developing the mPower reactor (a 180-MWe iPWR) for a while longer than NuScale Power has worked on its own SMR, so the main recent developments



Sloan

with the mPower have been in the testing program. Sloan provided an update on the work that has been completed and work that is under way.

For the reactor coolant pump, hydraulic confirmation has been completed, and cold and hot design verification tests are planned; critical heat flux testing has been completed, and correlation development is in progress; planning and fabrication are under way for vessel model flow testing of reactor internals and control rod drive mechanism feed-through penetrations; fuel assembly mechanical tests are ongoing; cold static tests of fuel and control rod drop time and drag coefficient are done, cold flow fuel assembly tests are in progress, and hot flow tests are yet to be conducted. The company's Integrated Systems Test Facility in Virginia has been used for steady-state steam generator and plant performance tests, and loss-of-inventory transient testing is under way; further transient tests are planned to validate safety analysis methods.

Sloan noted the announcement in April that the development of the mPower reactor was being slowed down, and her presentation referred to this as "restructuring" intended to "revalidate market require-

ments and market timing." This could be taken as a belief that the market for mPower does not exist now or in the immediate future. Sloan said that the company is focusing on the preparation of the design certification application, for which there is not currently a target date for submittal.

The NRC side of SMR development was presented by Stewart Magruder, chief of SMR Licensing Branch 1 in the Office of New Reactors. He stated the established NRC position that designs that are not light-water reactors are not considered near-term prospects. Nonetheless, Magruder said, the NRC is open to non-LWRs and has reviewed them to some extent in the past. In his presentation, he noted that non-LWRs would be addressed in a two-phase strategy. In the first phase, the Department of Energy would oversee research and deliver technical reports to the NRC. In the second phase, the NRC would develop the necessary regulatory process.

As for the LWRs that the NRC is already examining through pre-application meetings and reviews, Magruder noted that a NuScale plant, as envisioned by the company, would have fewer control room operators than reactors at critical mass. He said that while this would not be in keeping with current NRC regulations, it is "not incredible" and could perhaps be worked out. He also conceded that no SMR plant could op-

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erate economically with a security guard force of 300 people.

Many of the issues that have been raised about SMRs for about the past five years have yet to be resolved. Magruder said that in order for SMRs to be allowed to have smaller or less demanding emergency planning zones than those used for current LWRs, there will have to be agreement on the source term and the dose to an individual at the site boundary in the event of an accident. He also noted that plant components that have hitherto been in different locations are often inside the SMR reactor

vessel, raising questions about ASME code case applicability.

What seemed to be a recurring bullet point at this ANS meeting was the United Kingdom's effort to revitalize its nuclear power program, at least to the extent of bringing in foreign-developed reactors (and generally foreign-based plant owners or investors). This carried over even to the SMR session, with a presentation by Fiona Rayment, director of fuel cycle solutions at the United Kingdom's National Nuclear Laboratory. She said that while the near-term work is focused on Generation III+ LWRs, an assessment of SMRs is also in progress. The draft report has not yet been released, so she declined to go into specifics. She did say that perhaps 10 reactor designs will be explored in the full review, perhaps starting in September.

One key difference between the United Kingdom's new nuclear program and the one that gave rise to the power reactors that are now within a few years of closure is that very little of the design, development, and funding for new reactors is British in origin. Rayment hinted that this may change if the United Kingdom introduces SMRs. One prospect that is being explored is whether British interests might buy shares of selected SMR vendors.

During the question-and-answer session, responses from Reyes suggested that NuScale Power has had to pull back from what might be possible with SMRs, with the optimization process perhaps addressing some of these issues. He said that the NuScale design now calls for one control panel and one turbine generator per reactor, even though multiplexing could be done. Customers, he said, prefer to have one turbine hooked up to one reactor.

Reyes and Magruder were also cordial when asked about the NRC's preference to slow down the development of the NuScale draft design-specific review standard (DSRS), because the company had deferred the submittal of its design certification application to 2016. Reyes maintained that the design is now essentially finished and the draft DSRS would make it possible for the company to address the standard in its application. Magruder said that there would probably be more design changes, which would then feed in to the DSRS. The two men, in effect, agreed to disagree.

Getting the message out

ANS's Education, Training, and Workforce Development Division sponsored two back-to-back panel sessions on communicating the benefits of nuclear energy, both of which were organized and chaired by Mimi Limbach, of Potomac Communications Group.

The first session, "Focus on Communications: Communicating with Communities," explored strategies and tactics that can



Limbach



Cameron

be used to build support in local and regional communities for nuclear facilities and operations. The session kicked off with a presentation by Chip Cameron, of the Zero Gravity Group, a former assistant general counsel and conflict resolution specialist with the Nuclear Regulatory Commission, on the National Environmental Policy Act (NEPA)—the 1970 legislation that created the environmental impact statement (EIS)—and how the act's public participation requirements can be a resource for both communities and policymakers.

The two fundamental objectives of NEPA, according to Cameron, are to analyze, consider, and disclose environmental information as criteria for agency decision makers and to inform the public of the alternatives considered in NEPA analyses of EISs and the potential impact of those choices. "I believe NEPA can serve as a foundation for launching innovative public engagement efforts in communities," he said. "NEPA can be particularly useful because it applies to a broad range of federal activities, including construction, financial assistance, licensing of facilities, legislation, etc."

NEPA encourages public engagement and collaboration through the Council on Environmental Quality's (CEQ) regulations for implementing the act's provisions, Cameron explained, specifically 40 CFR 1506.6, which calls on agencies to make diligent efforts to involve the public in NEPA's implementation and to provide public notice of NEPA-related hearings, public meetings, and the availability of environmental documents to help inform interested parties. "That's the minimum that NEPA requires," he said. "But there is also something fairly new—it's probably about seven years old now—which I call 'aspirational': an Of-

fice of Management and Budget and CEQ memorandum on environmental conflict resolution that encourages agencies to engage in collaborative problem solving with the public, in an attempt to achieve better outcomes by working together with effective and interested parties in seeking information and ideas for agreement."

These collaborations can occur at any stage in the NEPA process, Cameron said, such as when determining the proper methodology to be used to gather and analyze data or when determining the alternatives to be examined. He said that he had participated in a number of collaborative events while at the NRC. "We'd get a group of representatives of the affected interests together around a table and try to establish new rules or policies," he said. "It's always

“We’d get a group of representatives of the affected interests together around a table and try to establish new rules or policies. It’s always amazing what you can accomplish when you have people sit down and talk with one another. You often might find the activist community agreeing with the industry on a particular issue.”

amazing what you can accomplish when you have people sit down and talk with one another. You often might find the activist community agreeing with the industry on a particular issue. So even if you don't get agreement, it's worth doing."

Cameron listed a number of other ways to involve communities, such as conducting interviews with local and state government agencies as part of the basis for the NEPA-mandated environmental analysis, establishing advisory committees or *ad hoc* collaborative processes, and designating a local government as a "cooperating agency" in the preparation of an EIS. "There is something called a 'cooperating agency agreement,' where a local government or another federal agency or state agency might have some particular expertise or knowledge that will help the lead federal agency in developing an EIS," he said. "So in that event, a cooperating agency agreement might be signed. It's another thing for an

agency to explore under NEPA in getting the community involved.”

Cameron also mentioned “state-of-the-science” workshops that explain to interested stakeholders “what’s known, what’s not known, and what can be easily studied,” focused workshops, which can offer detailed information and discussion, and town hall meetings. “The town hall meeting tends to be about discussion or information sharing, but it does serve two important purposes,” he said. “One is a forum for people in the community to come out and comment. Although that might not be helpful to the agency in preparing the EIS, it does provide a forum. The second thing—and this is what I really think is important—is that it’s a context for building relationships among the agency staff and the people in the community so that there is contact that can be followed up on in terms of a phone call, an e-mail, an address. It can often lead to what I like to do a lot, and that is meeting with individual groups to explain the agency process to them. You sit down with them for a few hours—there might be 10 or 15 people in attendance—and you just talk about what the agency process is. It gives them a much better understanding of it than they could get in a public meeting.”

Following Cameron was Nicole Stricker, senior science writer and nuclear communications lead at Idaho National Laboratory, who spoke on the potential benefits of taking an “informal approach” to communicating with communities, as opposed to a legally obligated one. “If you can communicate when you want to and because you want to rather than because you have to, that can help a lot in building relationships with the community,” she said. “It helps the company or agency to be seen as more approachable. They’re getting out there voluntarily and are willing to communicate with people. This voluntary sharing of information can help build credibility, transparency, and awareness.”

As one example, Stricker pointed to INL’s practice of inviting the media to the lab every few years in order to provide them with information on emergency response procedures. “We do this a few months in advance of fire season just to help familiarize them with how it works and how we respond,” she said, “so that if and when a wild-fire does occur, they will be a little less frustrated with the speed at which we are able to provide them with information. It tends to make the emergency communications go a little bit more smoothly.”

Stricker also mentioned that the DOE’s Idaho Operations Office puts together a

summary of its occurrence reports approximately every other month and sends it out to stakeholders and the media in an effort to increase transparency. “When it’s done in that way, it really helps to build trust and credibility,” she said.

Stricker described proactive communication efforts undertaken by INL in the aftermath of the Fukushima Daiichi accident as well, including organizing a series of open houses both at the state level and in neighboring communities to answer questions from the public. “At these open houses, we had experts available to answer questions,” she said. “We had displays and handouts. It was very much an informal situation, which I think helps build a lot of credibility. It almost immediately took a lot of the vitriol out of people saying, ‘This could happen here.’ It also demonstrated openness and a desire to communicate the fact that we’re doing this because we want to.”

In Stricker’s view, informal communication practices often provide the public with a greater sense of participation than do legally mandated meetings. “Some of these public town hall forums or some of the stuff required by NEPA can end up with a giant room full of people, with someone giving them some talking points, but not much of a sense of a conversation,” she said. “The mandated meetings can also arm your opponents, making it easier for them to claim that this is just the bureaucracy trying to push something down peoples’ throats. One of the new things we’ve been hearing about is antinuclear groups that have been showing up at NRC meetings with laugh tracks. Every time the NRC person says something, they hit the recorded laugh track. It creates quite an adversarial situation.”

Stricker noted the importance of working with community organizations that can act as foils to antinuclear groups. “INL works with the Partnership for Science and Technology, a group created specifically to counter antinuclear rhetoric, especially the nonfactual, unscientific stuff,” she said. “They are a group that advocates for science-based decision making, technology advancement, and sound energy policies.” Stricker also stressed the importance of INL’s efforts to provide its employees with factual information in order to make them, in effect, community ambassadors. “There are a lot of ‘friends and neighbors’ discussions that go on,” she said. “A lot of community members who might be on the fence or looking for more information are more likely to ask someone they know. That can be really effective for us as well.”

The session’s final speaker was John Kotek, a partner with Gallatin Public Affairs and former deputy manager for the DOE’s Idaho Operations Office, who began his talk with a reference to Princeton’s Peter Sandman, creator of the “risk equals hazard plus outrage” formula for risk communication



Kotek

strategies. While the nuclear industry may like to characterize itself as low hazard, he said, it nonetheless creates a substantial amount of outrage, and as a result, it needs to be mindful of that unfortunate fact when attempting to communicate.

“Don’t rely on NEPA as the only way to communicate with the public,” Kotek said. “It can sometimes be a platform for people to stand up on a soapbox and take a shot at you. You have other opportunities before that. My firm does a lot of work with energy companies, utilities, transmission companies, natural resources companies, and the like, and there is an advantage to being a project proponent: You know what you want to do and where you want to do it. Maybe the people who will be your opponents are not going to like what you want to do, but they might not have that information yet. You’ve got an opportunity to get out there and tell your story first—if you take it. You need to talk to your congressional delegation, your state officials, your governor, the media as you see fit, and certainly interested communities. You have an opportunity to get out there and tell your story in your words before somebody tries to tell it for you. You need to take advantage of that.”

Having a credible spokesperson is also extremely important, Kotek noted, as the public tends to trust people rather than institutions. “I see we have John Grossenbacher here, the director of INL,” he said. “I’ll never forget when his team first came out to the lab 10 years ago. We were at a public presentation introducing the new team when I was at DOE. My wife came to the presentation, and afterward she said, ‘You know, I don’t know all of what you guys do out there, but after listening to him speak, I don’t worry about it, because he won’t let them screw it up.’ Having a credible spokesperson like that can mean a world of difference.”

Policy support

The second communications session, “Building Policy Maker Support for Nuclear Facilities,” followed after a short break, with the addition of two panelists, Harsh Desai, previously a senior nuclear engineer with Knolls Atomic Power Laboratory and currently the ANS Congressional Fellow, working in the office of Sen. Dianne Feinstein (D., Calif.), and ANS’s Washington representative, Craig Piercy, of Bose Public Affairs Group.

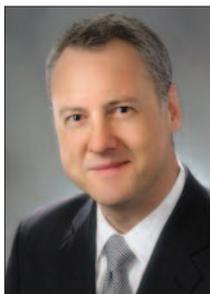
In his opening remarks, Desai described a communication method that he has found to be effective when dealing with policymakers on Capitol Hill. “A lot of these folks don’t have time to know everything about



Desai

10 seconds, state the

anything,” Desai said. “They just need to know enough to be able to get by, make the decisions they need to make, and leave all of the details to their staffers. So a quick thing I’ve developed is a 30-second approach to communication: In the first 10 seconds, state the



Piercy

pick it up. The bloggers

pick it up. The bloggers pick it up. In two hours, you have constituents calling and asking why you voted for or against a particular project. The response is almost instantaneous.”

As for the polarization in Washington, Piercy said, it is probably more intense now than it has ever been. “When you have 85 percent of House members in the 2012 election win their general election by more than 10 points, the only real election that matters, as Eric Cantor can tell you, no doubt, is the primary,” he said. “As long as you win the primary, you’re in for another two years. And since

members of Congress and their staffs. “Relationships are still everything in D.C.,” he said. “There’s an old saying in Washington that you don’t make a friend when you need one. You always have to be up there maintaining those relationships with people who have an impact on the policies that affect your industry or your concern.” According to Piercy, there are three important aspects of relationship maintenance: being knowledgeable, being credible, and being available. “You need to be willing to go out and find that piece of information they need and get it back to them in a couple of hours,” he said. “That is the currency of the relationship in D.C.”

An extensive question-and-answer period followed Piercy’s remarks, engaging panelists from both sessions. In response to a query regarding communication efforts targeting groups less disposed to be automatically pronuclear, INL’s Stricker said that as a member of the National Association of Science Writers, she strives to build relationships with those members on the other side. “While a lot of them are really adamant about the science behind climate change, listening to and believing those scientists, when you talk about nuclear, it kind of goes the other way,” Stricker said. “Not all of them, obviously, but a lot of them. They tend to disbelieve the pronuclear scientists as some sort of biased group. But whenever I’m at those meetings, I am trying to talk to them. And I think that is what everyone in this room can do.”

“I’ve developed a 30-second approach to communication: In the first 10 seconds, state the problem; in the next 10 seconds, tell them why they should care; and in the last 10 seconds, tell them what you propose.”

10 seconds, tell them why they should care; and in the last 10 seconds, tell them what you propose. You have about 30 seconds of their time—and that’s if they’re actually interested in the first 10 seconds. Otherwise, forget it. That is one of the things I picked up very quickly working on the Hill.”

Desai added that in order for nuclear energy proponents to communicate effectively in Washington, they need to be cognizant of the fact that the nuclear industry is often in competition with itself. “We’re always saying that we should be focusing on this or on that, but if I were to take a poll here, I would get a wide variety of answers as to what the industry should be focusing on,” he said. “It’s very hard to get everything passed through and pushed through. For example, with DOE funding, if you give funding to one program, that money has to come out of some other program. Policymakers hear all sorts of answers, and trying to figure out what is most important can be difficult. If you recognize that, you can start prioritizing things better.”

Piercy centered his opening comments on the “noise and polarization” of today’s Washington, which force policy advocates to be more creative in their communication techniques. According to Piercy, the noise is in large part the result of the advent of social media and the 24-hour news cycle. “I know when I was on the Hill 20 years ago, postcards and phone calls were the way people communicated,” he said. “Generally, as a House member, you had two years to make

only real election that matters, as Eric Cantor can tell you, no doubt, is the primary,” he said. “As long as you win the primary, you’re in for another two years. And since 85 percent of House members don’t care about the general election, they may well not care about listening to the other side of the aisle. You walk into any Republican office and they’ll have Fox News on a flat screen in the corner. You walk into any Democratic office and they have MSNBC on in the corner. It’s like there are parallel universes. You have to recognize that whatever message you bring up there, you’re bringing to a very polarized environment. In many ways, you have to tailor your proposal to the ears upon which your message will fall.”

Piercy also pointed out the importance of “knowing your reach.” “If you’re not a constituent, you’d better be an expert. You’ve got to bring something to the table. Are you a donor? Are you a volunteer for the campaign? If you’re none of those things, then nobody up there really cares what you think. It’s crass, but it’s true.”

In addition, Piercy stressed the value of building and maintaining relationships with

Piercy stressed the value of building and maintaining relationships with members of Congress and their staffs. “Relationships are still everything in D.C.”

Limbach agreed with Stricker, noting that Westinghouse Electric Company has begun investing more of its communication dollars in such activities. “They looked at their budget a couple of years ago and decided they were spending a lot of money speaking to the converted, and if they were going to sell more plants in this country, they would need to help change public opinion,” she said. “Southern Company also does a really good job of going into forums that might not be particularly comfortable. This is important. It’s important that all of us talk to those friends and neighbors who may be skeptics about nuclear energy. You can change minds.”—*E. Michael Blake, Dick Kovan, and Michael McQueen*

TOPICAL MEETING

Current and future trends in D&D

“Decommissioning and Remote Systems (D&RS 2014)” showcased some of the newest technology available in nuclear remediation work, along with an overview of some of the tried-and-true methods. The meeting also provided a chance for attendees to receive updates on decontamination and decommissioning projects around the world. David Moody, of the Department of Energy’s Savannah River Site (SRS) in South Carolina, was the general chair of the D&RS meeting, while Sue Aggarwal, of New Millennium Nuclear Technologies International, served as the technical program chair for decommissioning and Steven Tibrea, of Savannah River National Laboratory (SRNL), served as the technical program chair for remote systems.

Moody, who is the manager of the Savannah River Operations Office, kicked off the opening plenary session with an update on the D&D work taking place at SRS. He highlighted the DOE’s success in completing *in situ* reactor decommissioning projects at SRS, including the decommissioning of the Heavy Water Components Test Reactor and the P and R Reactors.

Moody also emphasized the importance of SRNL in advancing D&D work at the site, calling the lab a “spark plug” for doing cleanup work. SRNL, he said, has extensive experience with waste characterization and treatment, as well as experience in engineering, integrating, testing, and deploying robotics, systems, and tools for use in radioactive, hazardous, or inaccessible environments. SRNL is also a leader in formulating grouts used to immobilize radionuclides, he said.

The Decommissioning and Remote Systems topical meeting provided a look at new D&D technologies and updates on projects around the world.

Bruce Watson, chief of the Nuclear Regulatory Commission’s Reactor Decommissioning Branch, discussed issues the NRC is facing in light of the recent wave of commercial nuclear power plant closures, which he said has caught everyone off guard and has caused his branch to become “very busy.”

“It’s very difficult to plan for plants that shut down prematurely,” Watson said, noting that in cases such as San Onofre, Kewaunee, and Vermont Yankee, utilities had made large investments in those plants for extended operations before suddenly deciding to close them.



Watson

Watson noted that it typically takes one to two years for a nuclear plant to be ready for decommissioning after being shut down. Not only must the plant owner apply to the NRC for the necessary license amendments and exemptions, the plant also must be made physically ready for decommissioning. That means, Watson said, that the plant must be defueled, systems drained, radioactive waste removed from the site, and used nuclear fuel allowed time to cool. Also, some modifications may need to be made

to the plant before decommissioning can begin.

Currently, Watson said, NRC regulations for power reactors that are transitioning from an operating status to decommissioning remain incomplete. In 2000, the NRC staff sent the commissioners SECY-00-145, an outline of the options for developing the regulations for taking a reactor from operations to decommissioning. “However, the events of 9/11 got in the way,” he said, causing the commission to put a hold on the D&D rulemaking to focus on security and emergency response issues.

Early this year, the NRC staff began an internal proposed rulemaking process for reactor transition regulations, Watson said, adding that while the decommissioning rulemaking is in the pipeline, the NRC’s regulatory approach for reactor D&D is to follow established precedent.

Watson also touched on emergency response issues and how they affect plant decommissioning. He noted that a large portion of the public is unwilling to allow changes to a plant’s emergency response level after it closes. “Basically, they can’t accept the fact that there is a reduced risk because the plant is no longer fueled,” Watson said. Historically, the NRC has issued emergency planning exemptions on a case-by-case basis, he said, but the commission now requires exemption approval for any reduc-

tion in emergency response, which delays the exemption process.

Another issue that may affect emergency response exemptions is proposed legislation in the U.S. Congress. In May, three bills were introduced in the Senate that would alter regulations for nuclear power plants that have shut down. Introduced by Sens. Edward Markey (D., Mass.), Barbara Boxer

that end state, and when those actions are best undertaken.

As for the parties responsible for D&D, Nokhamzon said France's main decommissioning owners are Électricité de France (EDF), AREVA, and CEA. He noted that EDF's decommissioning strategy changed in 2000, when the company set up the Centre d'Ingénierie de Déconstruction et Environnement to oversee

nuclear power plant D&D and environmental safety. AREVA, as both a nuclear owner/operator and a supplier of engineering, procurement, and construction services, has an "acute" understanding of methods used for improving D&D performance, Nokhamzon said. And CEA, which has a large diversity of facilities, including reactors, accelerators and irradiators, laboratories, workshops,

fuel cycle processing units, and effluent treatment stations, faces unique dismantling challenges.

Nokhamzon listed the following key factors for completing a successful D&D project:

- An efficient industrial organization.
- Clear and stable regulations and licensing processes.
- Waste management from production to final disposal.
- Available and adequate funding.
- Communication and transparency.
- A shared experience.

Next, Kenji Tateiwa, manager of Nuclear

Power Programs in the Washington Office of Tokyo Electric Power Company (Tepco), provided an update on decommissioning activities at Japan's Fukushima Daiichi nuclear power plant. Tateiwa said that he first visited the Fukushima Daiichi site with an International Atomic Energy Agency delegation on April 6, 2011, three weeks into the accident. Seeing the damage, he said, "was truly a sobering experience."

Updating the audience on the progress made in remediating the plant, Tateiwa noted that Tepco has made heavy use of robots

and remotely operated machines to inspect the Unit 1 reactor. Using a remotely operated boat, Tepco identified two leaks in the reactor containment, while a different robot was able to help identify a leaking expansion joint, he said. Tepco, however, will need to identify all leak points before it is able to flood the containment and remove the core debris, which, he said, "will be a very difficult task."

At Unit 2, which remained largely intact during the accident, Tepco currently is investigating conditions on the reactor's refueling floor and is preparing to decontaminate the area to allow the removal of fuel and core debris. Tateiwa noted that a robot equipped with a gamma camera identified high radiation doses on the refueling floor on the order of several hundred millisieverts per hour. Robots have also been used to take core samples of the floor to better understand contamination characteristics and plan decontamination efforts, he said.

While Unit 3 was badly damaged by a hydrogen explosion, Tateiwa said that since October 2013, Tepco has removed all the rubble from the refueling floor and is now removing rubble that fell into the spent fuel pool. "We are being very careful, obviously, when removing such rubble," he said. Remotely operated clamps and cutters are used to handle the rubble to ensure that it doesn't drop onto the pool's fuel racks. He said that in May they were able to identify the location of a water leak from Unit 3's drywell into the reactor building.

Unit 4 is where Tepco has made the most progress, Tateiwa said. The company completed the installation of the fuel removal structure in 2013 and is making progress in removing fuel assemblies from the spent fuel pool. As of June 16, Tateiwa said, Tepco had removed two-thirds of the unit's fuel assemblies and has moved them to the site's common fuel pool. Tepco also has rein-

Historically, the NRC has issued emergency planning exemptions on a case-by-case basis, but the commission now requires exemption approval for any reduction in emergency response, which delays the exemption process.

(D., Calif.), and Bernard Sanders (I., Vt.), the bills include the Dry Cask Storage Act of 2014, which requires that used fuel be moved from wet to dry storage within seven years; the Safe and Secure Decommissioning Act of 2014, which expands the 10-mile emergency planning zone to 50 miles; and the Nuclear Plant Decommissioning Act of 2014, which requires the NRC to approve the post-shutdown decommissioning activities report submitted by the plant's owner. Currently, the NRC simply accepts the report after determining that it meets all principal criteria. The future of the proposed bills, however, remains uncertain, as there appears to be little support for them among Republicans, Watson said.

Turning to the other side of the Atlantic Ocean, Jean-Guy Nokhamzon, assistant director in the Nuclear Energy Division of the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), offered France's perspectives and experiences in D&D and waste management.

According to Nokhamzon, since 2000, both nuclear facility operators and regulators have been in favor of immediate dismantling when feasible, with immediate and total dismantling being recommended by the Autorité de Sécurité Nucléaire.

In France, the primary strategies for decommissioning nuclear facilities are characterized by reference to the timing of their dismantling, Nokhamzon said. On a more detailed level, however, the selection of a decommissioning strategy involves key questions, including what the site's desired end state is, what actions are required to achieve

Tateiwa first visited the Fukushima Daiichi site with an International Atomic Energy Agency delegation on April 6, 2011, three weeks into the accident. Seeing the damage, he said, "was truly a sobering experience."

forced the bottom of Unit 4's spent fuel pool to ensure the building's integrity, he said.

Continued

Tatewa also discussed the challenges Tepco faces in managing groundwater at the site. Every day, about 400 cubic meters of groundwater infiltrates the reactor buildings, he said. That water must be pumped out, treated, and then stored on-site. Tepco has been able to divert some of the groundwater, but the company intends to construct a frozen soil wall to impede groundwater flow. The wall will be about a mile long, with freezer pipes buried up to 30 meters deep, and will be completely impermeable, he said. Once the frozen wall is operable, however, the groundwater level must be carefully managed so as not to create a pressure differential that would cause contaminated reactor water to flow out of the buildings and into the environment, Tatewa said.

One place to look for lessons learned for the decontamination and decommissioning of Fukushima Daiichi is the Chernobyl nuclear plant, and Al Sturm, chief technology officer of PaR Systems, gave the audience an overview of a unique crane system his company is developing for the decommissioning of Chernobyl-4.

The crane system is part of Chernobyl's New Safe Confinement (NSC), the enormous arch-shaped structure that is being built to cover the sarcophagus that encases the destroyed reactor. The NSC will protect the sarcophagus, prevent radioactive releases, and provide the infrastructure to support the cranes and equipment needed for the decommissioning work, Sturm said. In 2010, PaR Systems was awarded the contract for the main cranes system, which is to be delivered to the site this fall.

According to Sturm, the most interesting part of the main cranes system is what the company calls the mobile tool platform (MTP), which is composed of two triangular platforms connected by six wire ropes, providing six degrees of freedom. The MTP, Sturm said, is much more than the standard anti-sway technology used in the crane industry. "It really has the same properties as a structural truss element," he said. "In fact, we call it the tensile truss."

The MTP will be used to deliver the remote tooling needed for dismantling. A hydraulic robot arm will be installed on the underside of the lower platform for deploying fragmentation tools, such as plasma arc cutting torches, diamond circular cutting wheels, diamond wire saws, concrete crushers, and cutters. In addition, the MTP will use a 10-ton vacuum to recover debris.

According to Sturm, the MTP has a number of advantages over a telescopic mast manipulator, including greater stability for side loads and offset loads, as well as no possibility of damage due to earthquake loads and excessive side loads or accidental collisions. The MTP also is a lighter system, is easier to decontaminate, and has a

greater depth of reach and coverage area, he said.

As a demonstration of the technology, PaR Systems built what Sturm called "basically a miniature version" of the MTP and delivered it to Fukushima Daiichi for use in removing debris from the spent fuel pool of Unit 3. The crane system will later be used to remove the Unit 3 fuel assemblies.

Returning to the United States, Tom Palmisano, vice president of nuclear engineering and chief nuclear officer at Southern California Edison's (SCE), San Onofre Nuclear Generating Station, described the plant's transition from operating to decommissioning status. Echoing Watson's earlier comments on plant closings, Palmisano said, "We are very much one of these plants that wound up with a very unexpected condition that caused us to permanently cease operations." When SCE decided to shut down the plant, he said, it did not have a decommissioning plan in place for San Onofre.

When SCE announced that it was closing San Onofre in June 2013, Palmisano said, the plant had a staff of 1,500. A year later, he said, the staff is less than a third of that. To maintain the safety of the plant and ease the transition, he said, most of SCE's focus in the first six months was on its staff. SCE kept San Onofre workers actively focused on their work, preparing for the transition by defueling the reactors and depressurizing, draining, and deenergizing reactor systems. "That worked out very well," he said. "It gave the people something to do to keep them focused as we began the destaffing process."

According to Palmisano, SCE established a 20-year decommissioning plan for San Onofre in January. SCE, however, has not yet submitted a post-shutdown decommissioning activities report to the NRC. The company expects to submit that report this fall.

Under the decommissioning plan, Palmisano said, SCE does not intend to put San Onofre into SAFSTOR condition, but will proceed with a "fairly immediate dismantling." SCE intends to begin plant dismantling as early as 2016, he said. "It makes sense to us to decommission safely but as quickly as we can, to offload the fuel pools as promptly as we can," he added, noting that SCE is in the fortunate position of having a well-funded decommissioning fund.

Palmisano also said that SCE plans to have all of San Onofre's spent nuclear fuel transferred to dry storage by the end of

2019. The plant's independent spent fuel storage installation, which will be the only remaining structure after decommissioning is completed, will need to be approximately doubled in size, he said, with an additional 150 fuel casks and 10 to 12 Greater-Than-Class-C waste casks.

The last speaker at the D&RS plenary session was Mary Flora, of Savannah River Nuclear Solutions (SRNS), who discussed establishing a final end state for retired nuclear weapons production reactors.



Flora

According to Flora, stakeholder buy-in was critical to the upfront planning of the decommissioning of SRS reactors. Gaining that buy-in involved regular consultation with stakeholder groups and numerous public meetings. The approach SRNS used to involve stakeholders included providing education, history, and technical details on the site's reactors, as well as producing "stakeholder friendly" communication tools, she said. Also, the DOE's candid and informed reactor end-state evaluations allowed the decision-making process to evolve, she said.

Expanding on comments made earlier by Moody, Flora noted that the *in situ* decommissioning of Savannah River's P Reactor and R Reactor established the strategy for all of the site's nuclear reactors and hardened facilities. The early involvement in the D&D planning process proved the validity of *in situ* decommissioning as a safe and cost-effective approach to isolat-

Under the decommissioning plan, Palmisano said, SCE does not intend to put San Onofre into SAFSTOR condition, but will proceed with a "fairly immediate dismantling."

ing and containing residual radioactivity, she added.

3-D printing

The session titled "Robotics and Automation Research Topics" featured some cutting-edge technology, including two discussions of the current state of 3-D printing, which is also known as additive manufacturing (AM).

William Sames, a research fellow at Oak Ridge National Laboratory (ORNL), provided an overview of the currently available AM methods, technologies, and applications. The process, he said, begins by using computer-aided design software such as SolidWorks to design the desired part or product, which is then used to generate the machine code for the AM printer. Then, depending on the 3-D printing technology used, material is deposited in layers and fused together to form the item. Once the part has been printed, additional processing may be required to finish and refine the object, he said.

Used extensively in the aerospace industry, AM is currently restricted to smaller parts due to the limited size of the printing machines, Sames said. As an example of a current application, he pointed to a fuel injector made by General Electric using AM technology. Whereas the part was previously made from around 20 pieces using traditional manufacturing methods, the AM part was printed as one piece, making it both more durable and less costly to make, he said.

So, how does AM apply to the management of radioactive waste? Sames pointed out that the technology could be used in nuclear applications, including the building of hot cell robotics, shielding that uses 3-D plastic extrusion technology, and encapsulation of nuclear waste by using AM to encase waste in large volumes of polymers.

Following Sames, Mark Noakes, a senior engineer at ORNL, demonstrated how his department is using AM to build a hydraulic manipulator arm. While the arm he has been working on was designed to be used on U.S. Navy submarines, it appears to be readily transferable to hazardous nuclear work applications.

Noakes explained that AM was used to build many of the manipulator arm's hydraulic parts, which would have been impossible or impractical to build using traditional methods. "[There are] a lot of things you can do that you couldn't do before," he said.

Revising MARSSIM

During the session titled "Final Status and Radiation Measurement Technology," Kathryn Snead, of the Environmental Protection Agency, updated the audience on Revision 2 of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), which provides guidance to federal agencies, states, site owners, contractors, and other private entities on how to demonstrate that a site meets the release criterion. The Department of Defense, the DOE, the NRC, and the EPA developed the MARSSIM document, which was published in 1997 and was last updated in 2001.

According to Snead, the planned revisions will include measurement quality ob-

jectives and measurement uncertainty. Also, noting that radiation instrumentation has improved since the last MARSSIM revision, Snead said that the new revision will update survey instrumentation information and expand measurement methods to include scan-only surveys.

Other planned MARSSIM tasks Snead discussed are the following:

- Include scenario B, which assumes that a site is clean until proven otherwise.
- Increase emphasis on regulator interface during survey design.
- Improve description of the lower bound of the gray region.
- Update and use consistent terms and

language.

- Expand information on survey requirements for areas of elevated activity.
- Include information on survey requirements for discrete radioactive particles.
- Use MARSSIM with Uranium Mill Tailings Radiation Control Act requirements.
- Include an appendix on Ranked Set Sampling for hard-to-detect radionuclides.

Snead said that updates on the revision will be posted on the MARSSIM working group website, at <www.epa.gov/radiation/marssim>. The EPA plans to issue a version of the revised document for internal review this year.—*Tim Gregoire, Editor, Radwaste Solutions*

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Advances in thermal hydraulics

“Advances in Thermal Hydraulics 2014” included eight technical sessions on topics related to a long-standing central issue for water-cooled or -moderated reactors, the motion of hot fluid. In something of a change of pace, however, the opening plenary session and



Zuber

one of the technical sessions were devoted to the career and contributions of Novak Zuber, who died last year at the age of 90. Speakers at the opening plenary session included colleagues and former students of Zuber’s, and while their presentations included personal reminiscences, there was also a wealth of technical detail on Zuber’s work in two-phase flow, code scaling, and other efforts to understand hot fluid in motion.

Zuber was born in Yugoslavia in 1922. During World War II, he flew with the Balkan Air Force, which was under the oversight of the United Kingdom’s Royal Air Force. After the war, he was a merchant sailor on an Italian ship, and when the ship made port in San Pedro, Calif., Zuber stole ashore and did not return to the ship. Thus, he was an illegal immigrant who managed to avoid deportation while studying at the University of California at Los Angeles. Eventually, with the help of UCLA professors and administrators, he gained legal status.

While his original goal was to become an aeronautical engineer, Zuber had moved into the hot-fluid realm by the time of his Ph.D. thesis, “Hydrodynamics of Boiling Heat Transfer,” in July 1959. His early career was in academia, but he was hired by the na-

The opening plenary session was a tribute to the life and career of Novak Zuber as a technical innovator, a regulator, and a teacher.

tional nuclear regulator in 1974, just as it was switching over from the Atomic Energy Commission to the Nuclear Regulatory Commission. He retired in 1991, but remained an active contributor to his field.

Ivan Catton, a professor in the Department of Mechanical and Aerospace Engineering at UCLA, summarized Zuber’s thesis, which he called an example of modeling at its best, covering almost the entire field of boiling and giving understandable explanations, citing experimental results and getting to a mathematical description for the boiling curve. As other speakers indicated later, this insistence on grounding a model in experimental results and physical-world observations would remain a hallmark of his work and a criterion by which he judged the merits of modeling by others.

Mamoru Ishii, a professor in the School of Nuclear Engineering at Purdue University and a former student of Zuber’s, listed his mentor’s technical accomplishments: mechanistic modeling of boiling heat transfer and critical heat flux; the drift flux model for transient two-



Ishii

phase flow; accurate prediction of void fraction; and, when on the faculty of New York University and Georgia Institute of Technology, guiding doctoral thesis research for density wave instability analysis; two-fluid

model development; liquid film stability analysis; scaling method for transient two-phase flow; and subcooled boiling analysis.

When Zuber was at the AEC/NRC, he worked in advanced code development; constitutive models for the two-fluid model; loss-of-coolant accident analysis methodology; code scaling applicability and uncertainty (CSAU); the best estimate code for the revision of 10 CFR 50 Appendix K (emergency core cooling system [ECCS] evaluation models); and severe accident thermal hydraulics scaling method. In addition to Zuber’s rigor, as noted by others, Ishii noted his use of relevant nondimensional parameters in mechanistic or phenomenological models.

Pradip Saha, principal engineer for thermal hydraulic methods at GE Hitachi Nuclear Energy, spoke on his work with Zuber in subcooled boiling, which led to the development of the Saha-Zuber correlation.



Saha

Published in a 1974 paper on the point of net vapor generation and void fraction in subcooled boiling, the correlation became a central factor in research on subcooled boiling from then on. Saha also showed that Zuber’s influence can date from even earlier: In a 2005 Ph.D. dissertation at the Massachusetts Institute of Technology, Jiyun Zhou cited a 1966 final report

for NASA by Zuber on thermally induced flow oscillations in the near-critical and supercritical thermodynamic region.

Stephen Bajorek, senior technical advisor in the NRC's Office of Nuclear Regulatory Research, traced Zuber's work at the agency. Along with Zuber's involvement in the 2-D/3-D test program and ECCS research in general, Bajorek called attention to CSAU, which integrated findings from 2-D/3-D and other research to produce a worldwide standard for the application of

scaling analysis; and further development of the latter in light of the Einstein/de Broglie equation.

Wolfgang Wulff, formerly a researcher at Brookhaven National Laboratory and now retired, enlarged somewhat on fractional scaling. He noted that the American Society of Mechanical Engineers had already presented its own Zuber tribute session. Wulff said that Zuber regretted the lack of closure of the two-fluid model, which nonetheless is used. The drift-flux model,

however, has been closed. Wulff said that power oscillations in 1988 at the LaSalle-2 power reactor exceeded what the TRACG code indicated would be their peaks. Years later, the drift-flux model showed that it was possible for the oscillations to have been as much as 20 times the peak power level, and it described the LaSalle-2 event accurately.

The overall theme of the annual meeting was the United States' role in a global nuclear energy en-

terprise. Zuber's life and career can be seen as the expression of a kind of American influence that seems to have been overlooked and that could still exist. Zuber himself came to America (in his case, without any official permission) because of what this country had to offer. Many of his students who made major contributions in thermal hydraulics, as shown by the participants in this panel, came from all over the globe because of the opportunity here to pursue their careers at the highest level and the relative lack of societal restrictions based on who they were and where they came from. Meritocratic America still exists, and it remains an exception among most societies. The nuclear field is one in which getting the best result has come to matter more than who got the result and whether the result is deemed unacceptable by entrenched higher authority.

In the aftermath of Fukushima Daiichi, nuclear programs worldwide look to the NRC and the Institute of Nuclear Power Operations as examples of true nuclear safety and accountability, and the leaders of those programs are grappling with their governmental and corporate power structures to put themselves in the position held by U.S. nuclear operators and regulators. Those leaders may need a Novak Zuber to insist on technical rigor and to expose weak reasoning.—*E. Michael Blake* **NW**

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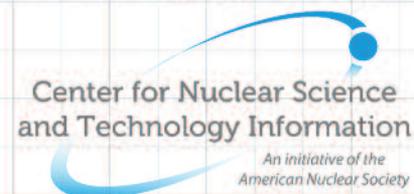
thermal-hydraulic computer codes to nuclear power plant analysis. CSAU is made up of three elements: requirements and code capability, assessment and ranging of parameters, and sensitivity and uncertainty analysis.

An audience member pointed out that while CSAU is still being used, it has been criticized by some—including, later on, Zuber himself. Bajorek explained that Zuber thought that CSAU's phenomena identification and ranking table was being misused. Consistent with Zuber's skepticism of computer codes that were developed without recourse to experimental results, Zuber wanted the few phenomena that were truly significant (hence the ranking process) to be understood, and he argued that this could be done only if experimental data were used, and not just the output from entirely abstract codes.

José Reyes, chief technology officer of NuScale Power, had Zuber on his Ph.D. dissertation committee, and he later worked with Zuber at the NRC. Reyes gave a presentation on Zuber's legacy in the field of scaling analysis. His published papers on scaling, often relevant to analysis of codes and models for loss-of-coolant accidents, date from 1980 all the way to 2010. The methods developed by Zuber include hierarchical two-tiered scaling; fractional change, scaling, and analysis; fractional



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HISTORY CAPTURED!

"I have tried so far to describe how one of the greatest discoveries in the history of science has been achieved. It involved unlimited possibilities for applications of nuclear energy and other characteristics of the fission products."

Pavle Savić

"I estimated that, if one considers every plausible moderator, coolant, fuel, neutron spectrum, and reactor configuration, one could identify at least 900 different possible reactors none of which is obviously impractical . . ."

Alvin Weinberg

"Another error was not to pay enough attention to an article by I. Noddack who criticized our chemistry and pointed to the possibility of fission . . . if any of us had really grasped its importance it would have been easy to discover fission in 1935."

Emilio Segrè

"The discovery of elements 95 and 96 was announced for the first time on "The Quiz Kids," a radio program.

I was a guest on the program in Chicago on November 11, 1945, Armistice Day . . ."

Glenn Seaborg

"Our committee began work in early 1948 with the firm and unanimous conviction that nuclear power could not survive a significant damaging accident."

Edward Teller

"In a certain sense the actual event of December 2nd was anticlimactic. During the last week of construction it became evident that self-sustaining criticality would be reached well before the full vertical diameter and that the balloon to remove air would not be needed."

Walter Zinn



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BUSINESS DEVELOPMENTS

Westinghouse to acquire Mangiarotti; other news

On July 2, **Westinghouse Electric Company** announced its intention to purchase **Mangiarotti SpA**, an Italy-based manufacturer of components for the nuclear, oil, and gas industries. Through the acquisition, Westinghouse hopes to gain additional manufacturing capacity for reactors, pressure vessels, modules, and heat exchangers used in the nuclear energy industry, while also expanding into the oil and gas markets. Operations at Mangiarotti's Monfalcone and Pannellia facilities will continue. Terms were not disclosed, and Westinghouse said that it expected to close the sale by early August.

■ **Alstom's** board of directors recommended an offer from **General Electric** for the purchase of Alstom's power and grid businesses on June 26, following June 20 updates to GE's proposal and a competing proposal from Siemens and Mitsubishi Heavy Industries. GE's proposal was initially announced by Alstom on May 6 (*NN*, June 2014, p. 92). If the purchase goes ahead, GE will acquire Alstom's thermal power, renewable power, and grid sectors, as well as corporate and shared services, as previously announced, for a fixed and unchanged price representing an equity value of €12.35 billion (about \$16.8 billion) and an enterprise value of €11.4 billion (about \$15.5 billion). After completion of the transaction, Alstom and GE would establish joint ventures in grid and renewable power, with each company holding a 50 percent stake. In addition, Alstom and GE would create a 50/50 global nuclear and French steam alliance for the production and servicing of Alstom's Arabelle steam turbine equipment for nuclear power plants, as well as steam turbine equipment and servicing for other applications in France. The French state would hold a preferred share in the alliance, giving it veto and other governance rights over issues related to security

and nuclear plant technology in France. Alstom's investment in these alliances would represent about €2.5 billion (about \$3.4 billion). The companies have also reached agreements that will help Alstom refocus its activities in the rail industry.

■ **Rolls-Royce** announced on June 17 that it has signed a memorandum of understanding with China's **State Nuclear Power Technology Corporation**, a nuclear reactor vendor, that will allow the companies to cooperate on civil nuclear power both in the United Kingdom, where Rolls-Royce is based, and overseas. The MOU will allow the companies to explore possible collaboration in areas such as engineering support, provision of components

and systems, supply chain management, and instrumentation and control technology, according to Rolls-Royce.

■ **Northwire Inc.**, a U.S. specialty manufacturer of wire and multiconductor cable and retractiles for industrial markets, including the energy market, has been acquired by **LEMO**, a Swiss producer of precision custom connectors, LEMO announced in June. Both companies' existing structures will not be altered, according to Alexandre Pesci, LEMO Group's chief executive officer and president, but additional processes will be implemented to integrate Northwire into LEMO group and to promote services to their mutual customers.

Section continued

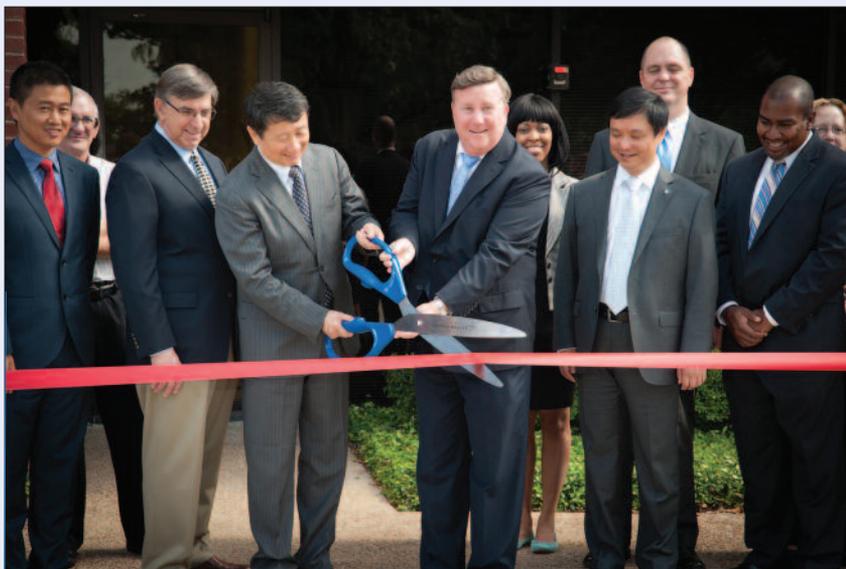


Photo: Lockheed Martin

A RIBBON-CUTTING CEREMONY FOR LOCKHEED MARTIN'S new facility in Fort Worth, Texas, was held on June 23. Cutting the ribbon are Wang Binghua (center left), chairman of China's State Nuclear Power Technology Corporation (SNPTC), and Rick Edwards, an executive vice president at Lockheed Martin. The new "cooperative development facility" will house project leaders and engineers from China's State Nuclear Power Automation System Engineering Company, a subsidiary of SNPTC, and their Lockheed Martin counterparts as they work to develop a reactor protection system for China's Generation III nuclear power plants.

CONTRACTS

B&W receives multiyear contract; other news

Babcock & Wilcox Nuclear Energy Inc. (B&W NE) has been awarded a multi-year fleet services contract from Dominion Generation, B&W reported on June 19. Under the contract, the value of which was not disclosed, B&W NE will provide comprehensive steam generator inspection, repair, and cleaning services for three operating nuclear stations: North Anna in Mineral, Va., Surry in Surry, Va., and Millstone in Waterford, Conn. The planned services include eddy current testing, visual inspections, and water lancing for steam generators at a total of six units—two at each of the three plants. Work under the contract will begin this fall, according to B&W.

■ On June 23, **CB&I** announced that it has been awarded a five-year contract by Exelon Generation, valued at \$800 million, for long-term maintenance, modification, and construction services for five nuclear power units in New York and Maryland. CB&I already services 17 other Exelon nuclear power units, and the contract represents an expansion of CB&I's existing scope of work. Under the terms of the agreement, CB&I will also provide temporary staffing, painting, and insulation services at all 22 of the nuclear power units that Exelon owns and operates.

■ **AREVA** announced on June 10 that it has signed a long-term contract with German utility RWE to provide inspection services during planned outages at the Emsland nuclear power plant. The inspection activities include the nondestructive examination of the plant's steam generators, reactor pressure vessel, and other primary components utilizing ultrasonic inspection and eddy current testing. The value of the contract was not announced.

Also on June 10, AREVA announced that it has been selected to provide services for the safety instrumentation and control and electrical systems for Bulgaria's Kozloduy-5 and -6 VVER-1000 reactors. AREVA will also replace or adapt the plant's main electrical generators to provide a 10 percent increase in the electrical power output of each reactor. AREVA has already installed its Teleperm XS digital safety I&C platform at both reactors. The value of the contract was not disclosed.

NOTE: *Nuclear News* publishes news about nuclear industry contracts—but only about contract awards. We generally do not publish announcements that the work is under way or announcements that the work has been completed. Send your new contract award announcements to: Industry Editor, *Nuclear News*, 555 N. Kensington Ave., La Grange Park, IL 60526; fax 708/579-8204; e-mail <nucnews@ans.org>.

Industry Briefs**DOW CHEMICAL'S RESEARCH REACTOR LICENSE WAS RENEWED**

by the Nuclear Regulatory Commission on June 18. Dow Chemical Company has been operating the 300-kWt TRIGA (Training, Research, Isotope Production, General Atomics) reactor at its Midland, Mich., facility since 1967. It is one of only three licensed research reactors in the United States that is owned by a private company. The others, both in California, are owned by Aerotest and GE Hitachi Nuclear Energy. The Dow renewal allows for operation of the reactor to continue until 2034.



AN API1000 "SPECIALIZED SEISMIC OPTION" was presented by Westinghouse Electric Company to Nuclear Regulatory Commission staffers at a meeting on June 25. The API1000 pressurized water reactor design has been certified by the NRC, but the reactor vendor and its majority owner, Toshiba Corporation, have been working collaboratively to develop customized materials and/or reinforcements that would allow the reactor to be built in locations that have a higher seismic spectrum. Westinghouse stated that the standard API1000 reactor will be used in most of the new opportunities it pursues worldwide. The meeting with the NRC was referred to as "pre-submittal," but neither Westinghouse nor the NRC stated what was to be submitted and what the approval process would entail.

**A NEW 9,000-TON HYDRAULIC PRESS AT AREVA'S CREUSOT FORGE**

site was inaugurated on June 20 by France's Prime Minister Manuel Valls. The press was introduced at the site in an effort to modernize production capacity to meet the international market's demand for heavy components for power reactors. Featuring state-of-the-art equipment, such as accelerated tool loading and laser measurement, the new press will make forging operations faster and more precise, according to AREVA, one of the few suppliers worldwide capable of producing forgings for large reactor components, such as reactor pressure vessels and steam generators.



BABCOCK & WILCOX'S NEW ARCHER ROBOT has earned the qualifications necessary to allow it to be used to perform inspections of nuclear reactor vessel closure heads, the company announced on June 12. The ARCHER robot was designed by INETEC, and it is being offered by Babcock & Wilcox Nuclear Energy to provide eddy current and ultrasonic examinations of reactor vessel closure head nozzles and J-groove welds through the use of a variety of test modules. It can also perform automated surface repairs of J-welds and nozzles. The qualifications were granted through a demonstration program administered by the Electric Power Research Institute, according to B&W.

AREVA announced on July 10 that it has been awarded a contract by reactor operator ANAV to supply filtered containment venting systems to the Asco-1 and -2 and Vandellos-2 nuclear reactors in Spain. The technology is designed to maintain the integrity of the reactor containment building and ensure the confinement of radioactive materials in the event of a serious accident.

■ **L-3 MAPPS** announced on June 12 that it will replace the computing environment and plant models for Susquehanna-1's full scope simulator. According to the company, the work is already underway, and the upgraded simulator is to be in service by the third quarter of 2016. L-3 MAPPS will apply its Orchid simulation environment, and the simulator will use PC/Windows-based tools for the plant models and instructor station. The simulator will also be equipped with 2-D and 3-D animated, interactive visualizations of the reactor vessel, containment building, and spent fuel pool to provide operators with a real-time understanding of the boiling water reactor's behavior during

normal and abnormal operations and during severe accidents. The value of the contract was not disclosed.

■ On June 16, **Servelec Group plc** announced that it has been selected to design, implement, test, and commission new drive systems at EDF Energy's Torness and Heysham nuclear power plants in the United Kingdom. The fueling machine at both plants will be upgraded with a hoist drive system that will replace the existing 1980s-vintage control systems, which are nearing the end of their operating life, according to Servelec. Also, at Torness, a stepper motor and gear box will be replaced with a modern servo drive and linear actuator designed to interface with existing controls after modification. The actuator will control the speed of the boiler feed pump. The value of the contract was not disclosed.

■ **AMEC**, an engineering and project management company based in the United Kingdom, has been awarded a strategic framework contract by the Emirates Nuclear

Continued on page 177

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Continued from page 18

WATTS BAR-2 FUEL LOADING WILL BE DELAYED UNTIL MARCH at least, according to a schedule update posted online by the Nuclear Regulatory Commission on July 16. Earlier in the month, a spokesperson for TVA Nuclear said that the three-month delay in the forthcoming release of the supplemental final safety evaluation report had not affected the target dates for the remaining milestones for reactor completion (see page 25). It was later stated, however, that TVA now expects fuel loading in the March/April time frame and maintains the goal of the start of commercial operation in December 2015. The other TVA target changes are as follows: a “substantially complete” letter in December (previously October); completion of hot functional testing in January (September); and certification of readiness to load fuel in January (December). The NRC milestones have been delayed in most cases by about two months, with the Atomic Safety and Licensing Board ruling in December, the commission voting process to begin in January, and the decision on license issuance in March.



Peach Bottom: Final NRC action is expected in September.

► **THE ACRS ENDORSED POWER UPRATES FOR PEACH BOTTOM** in a July 18 letter report to Nuclear Regulatory Commission Chairman Allison Macfarlane. Exelon Generation applied in 2012 for extended power uprates for Units 2 and 3 at the Peach Bottom site near Delta, Pa. The uprates would raise the ceiling for each reactor’s peak power by 12.4 percent, to 3,951 MWt, corresponding to an electrical peak of about 1,325 MWe. Because of earlier uprates, the extended uprates will use up all of the uprate capability allowed under current regulations (a total increase of 20 percent over the initially licensed level). In its report, the Advisory Committee on Reactor Safeguards noted that Exelon had modified the reactors so as to eliminate reliance on containment accident pressure and thus enhanced their safety margins, and that the license conditions for power ascension give reasonable assurance that unanticipated vibration in the replacement steam dryers will be noticed and addressed. The ACRS further noted, however, that the acceptability of the Unit 3 dryer assumes that acoustic pressure loadings can be predicted from strain gauge measurements on the main steam lines, because the dryer is not instrumented. According to the report, “This assumption needs to be validated.”

The NRC expects to reach a final decision on the uprates in September. Unlike license renewals and new reactor licenses, for which final actions are blocked until the resolution of the waste confidence court decision, power uprates can be approved by the NRC at any time. Exelon plans to put the uprates into effect this year at Unit 2 and next year at Unit 3.

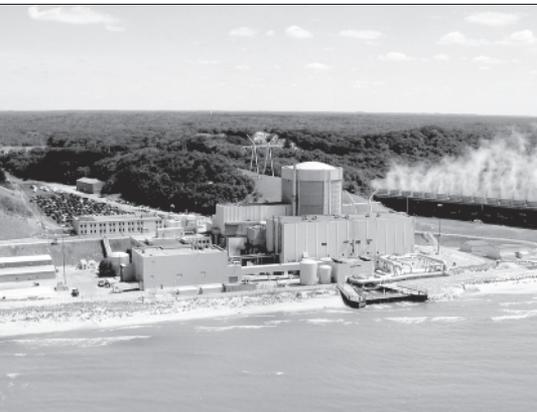
OMB RIPPED THE HOUSE’S ENERGY BUDGET BILL in an unusual “Statement of Administration Policy” issued on July 9. The House of Representatives nonetheless passed its Energy and Water Development and Related Agencies Appropriations Act, designated H.R. 4923, the following day. In the energy realm, the Office of Management and Budget criticized the bill’s funding levels for being too low for energy efficiency and renewable energy, the Advanced Research Projects Agency–Energy, the Department of Energy’s Office of Science, and the Naval Reactors program; opposed the requirement that the construction of the Mixed Oxide Fuel Fabrication Facility be continued; objected to the prevention of nonproliferation assistance to Russia; and objected to the funding provided for the high-level waste repository at Yucca Mountain in Nevada. An underlined passage declares, “If the President were presented with H.R. 4923, his senior advisors would recommend that he veto the bill.” On July 14, H.R. 4923 was introduced in the Senate and referred to the Appropriations Committee.

NEARLY 90 LB OF URANIUM COMPOUNDS HAVE BEEN SEIZED by the Islamic State in Iraq and Syria (ISIS), following the extremist group’s takeover of the northern Iraqi city of Mosul in June. The material, which was reportedly stored at a university where it was used for scientific research, is not believed to be usable in improvised nuclear or radiological dispersal devices, according to experts. “On the basis of initial information, we believe the material involved is low-grade and would not present a significant safety, security, or proliferation risk,” International Atomic Energy Agency spokesman Gill Tudor was quoted as saying in a July 10 Reuters story.

The United Nations was notified of the situation by Iraq’s ambassador, Mohamed Ali Alhakim, on July 8, one day after his country officially acceded to the Convention on Physical Protection of Nuclear Material.

THE ESBWR SUPPLEMENTAL FINAL SER HAS BEEN FINISHED by the Nuclear Regulatory Commission staff. On July 17, the NRC sent the supplemental final safety evaluation report on the ESBWR boiling water reactor design to GE Hitachi Nuclear Energy to review for proprietary information. This is the last piece of staff

documentation related to the certification of the 1,520-MWe boiling water reactor design, incorporating steam dryer audit information and other material that completes the safety review. The most recent schedule called for the staff to send notation vote papers to the commissioners before the end of July and for the commissioners to complete their voting by September on the issuance of the final rule, which would certify the ESBWR as a standard design that can be used in license applications to resolve all nuclear safety issues in advance.



Palisades: A security manager was found to have failed to verify a supervisor's qualifications.

► **THE NRC HAS ISSUED A CONFIRMATORY ORDER TO ENTERGY** for a December 2012 security-related incident at the Palisades nuclear power plant in Covert, Mich. After completing an investigation into the matter in January of this year, the Nuclear Regulatory Commission concluded that a Palisades security manager wilfully violated NRC regulations when he assigned a security supervisor to a security post without first verifying the supervisor's qualifications. The investigation also determined that the supervisor's failure to ensure that he was qualified to perform the assigned security duties constituted a violation as well.

Following a March 25 notification from the NRC to Entergy Nuclear Operations regarding the violations (deemed to be of very low security significance), the utility agreed to an alternative dispute resolution session, which resulted in the July 22 order. The order outlines the corrective actions Entergy has committed to taking to address the violations. These include ensuring proper verification of training credentials for both management and staff across the Entergy fleet, taking actions to strengthen Entergy's safety culture, making presentations on the incident to the reactor community, and developing specific requirements for the selection and development of security managers. For its part, the NRC has agreed not to issue a notice of violation or propose a civil penalty in the matter.

THE NRC HAS ISSUED AN ORDER TO JAMES CHAISSON, a former employee of Texas Gamma Ray LLC (TGR), prohibiting him from engaging in Nuclear Regulatory Commission-licensed activities for a minimum of three years. According to the July 11 order, the ban is the result of Chaisson's failure to uphold the terms of a September 2012 confirmatory order that banned him from NRC-related work for a period of 18 months.

The NRC issued an initial order to Chaisson, then an area supervisor and lead radiographer for TGR's Wyoming operations, in May 2012 after finding that he had engaged in deliberate misconduct by storing a radiographic exposure device at an unauthorized storage location, causing TGR to be in violation of its NRC license requirements (*NN*, June 2012, p. 83). That order called for a three-year ban against Chaisson, but following an alternative dispute resolution session, the NRC issued its confirmatory order on September 10, 2012, reducing the ban to 18 months and requiring Chaisson to perform certain actions, including undergoing 80 hours of special training and writing an article addressing the importance of adhering to NRC regulations (*NN*, Nov. 2012, p. 66). According to the new order, which was published in the July 18 *Federal Register*, Chaisson failed to perform either action by the March 2014 deadline.

MORE ACTION IS NEEDED TO INCREASE SOURCE SECURITY in the U.S. industrial sector, according to a report from the Government Accountability Office that was released in June by the Senate Homeland Security Committee. The GAO found that licensees continue to face challenges in securing mobile and stationary radiological sources and in protecting those sources from insider threats. For example, the GAO identified four incidents from 2006 to 2012 in which radiography cameras that use high-risk sources were stolen, despite the establishment of increased security controls by the Nuclear Regulatory Commission, and two cases in which employees with extensive criminal backgrounds—including one who had been convicted of terroristic threats against two individuals—were granted unescorted access status. The GAO also found that the NRC and two other federal agencies that play major roles in nuclear and radiological security—the National Nuclear Security Administration and the Department of Homeland Security—are not collaborating as effectively as they could to secure mobile industrial sources.

Among its recommendations, the report calls for the NRC to review its trustworthiness and reliability process to determine whether it provides adequate assurance against insider threats, and for the NRC, the NNSA, and DHS to “review their collaboration mechanism for opportunities to enhance it, especially in the development of new technologies.”

The report, *Nuclear Nonproliferation: Additional Actions Needed to Increase the Security of U.S. Industrial Radiological Sources*, can be accessed from the GAO website, at <www.gao.gov>, with a search for report number 14-293. **NN**

Continued from page 172

Energy Corporation (ENEC) to provide services for the nuclear new-build program in the United Arab Emirates, AMEC announced on June 17. The value of the contract was not disclosed, but AMEC is to provide consultancy support to ENEC for the four planned reactors in Barakah in the western region of Abu Dhabi, the first two of which are already under construction. Included is a range of strategic planning nuclear engineering services.

■ **Caverion**, a Finnish firm that designs, builds, and maintains energy-efficient building systems, has been chosen by Fortum to carry out installation work on the steel structures, pipelines, and electrical and automation systems in the four cooling towers of the Loviisa nuclear power plant in Finland. The work is to be completed by February 2015 under a contract valued at over €2 million (about \$2.7 million). In addition, Caverion and Fortum have reached an agreement on valve maintenance and mechanical installations at Loviisa over the next three years.

10 CFR PART 21

Issues with actuators, component irradiation

On June 12, Entergy personnel at the Waterford-3 reactor reported a defect in Dresser Masoneilan Model 47 Sigma-F pneumatic actuators for a steam generator emergency feedwater valve. During actuator replacement, it was found that the actuator had been set to fail closed, instead of fail open. Masoneilan's Model 48 actuator is intended to fail closed, and Model 47 to fail open. It was possible to switch the actuator to fail open, with no added parts and only a handwheel indicator correction. Dresser Masoneilan was notified of the defect (which may have been in the labeling of the actuators) on May 12.

■ Preferred Metal Technologies (PMT) reported on July 3 that it was notified by Steris Isomedix Services—which provides gamma irradiation services to qualify nuclear components for lifetime and accidental radiation exposure—that the radiation dose reported on the component irradiation certificates that accompanied certain PMT components was incorrect. Steris informed PMT that the dose reported on the certificates did not account for all uncertainties, including the density of unrelated products in carriers, off-carrier location within the irradiator, and cobalt-60 source decay. PMT has determined that the applied radiation dose may have failed to meet the minimum required dose to ensure that the safety-related equipment would operate satisfactorily during and after an accident. The affected items are in use at two plants: six electric spring return actuators at Browns Ferry, and 32 damper assemblies at the Laguna Verde plant in Mexico. **■**

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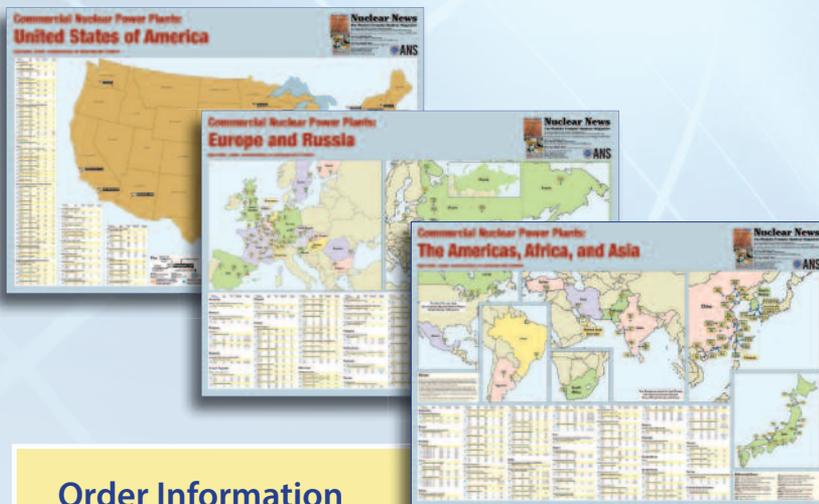
Wall Maps of Commercial Nuclear Power Plants

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Produced by **Nuclear News**, these maps show the location of each commercial power reactor that is operable, under construction, or ordered. Tabular information includes each reactor's generating capacity (in net MWe), design type, date of commercial operation (actual or expected), and reactor supplier.

Red stars on the **United States** map indicate the locations of 11 potential new reactor projects (four of which have signed engineering, procurement and construction contracts); blue stars indicate the locations of six new reactor projects that have been suspended. For all 17 projects, applications for combined construction and operating licenses have been submitted to the Nuclear Regulatory Commission; boxed information for each project provides the plant name, the city and state of the site, the reactor model (if known), and the owner.

Also, new versions of the worldwide maps are still available. They have been redesigned by region, in easier to read formats of **Europe and Russia** and **The Americas, Africa, and Asia** (which includes Canada, Mexico, South America, Africa, and Asia).



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Nuclear News

August 2014

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FOUR MILE PROJECT

Alliance proposes sale of its 25 percent stake

Alliance Resources Ltd., which through its subsidiary, Alliance Craton Explorer Pty Ltd., owns 25 percent of the recently operational Four Mile *in situ* recovery mine in South Australia, announced on June 17 that it was seeking to sell its interest in the project. To that end, Alliance has appointed Deloitte Corporate Finance to lead a global marketing process. If a sale were to go ahead, it would free up funds for further exploration by the company in countries including, but not limited to, Australia and Chile.

Any sale will be subject to shareholder approval, consent from Itochu Corporation (with which Alliance has a strategic partnership), and a decision by Quasar Resources Pty Ltd., the project manager and 75 percent owner, not to exercise its preemptive right.

Mining operations began at the Four Mile project on April 14. On June 25, the mine was officially opened by South Australian Premier Jay Weatherill and Minister for Mineral Resources Tom Koutsantonis. In a government press release, Weatherill highlighted the mine's role in job creation.

"Following on from the successful mining method of the nearby Beverley and Beverley North deposits, the new Four Mile mine represents another important chapter in continuing uranium mining in this world-class region," Weatherill said. "The project has already involved a private sector investment of more than [Aus]\$120 million [about \$112.6 million] and demonstrates the strength of the South Australian mineral resources and energy sector." According to the government, the Four Mile mine could produce up to 1.6 million lb of uranium in 2014.

According to the press release, the initial stage of mining operations will involve collecting information and assessing mining conditions at the Four Mile East section. The uranium will be processed at the near-

If a sale goes ahead, funds will be freed up for Alliance to conduct exploration in other countries.

by Beverley facilities, which are owned by Heathgate, an affiliate of Quasar Resources. According to the government, Heathgate employs 140 people and actively promotes employment opportunities for the aboriginal Adnyamathanha people; over the past decade, 20 percent of employees at Beverley have been aboriginal.

On June 30, Alliance announced that it has entered into a confidential settlement agreement with Quasar Resources and Heathgate Resources to settle federal court litigation concerning project costs, and that the agreement will allow the company to sell its share without the impediment of the litigation.

BUSINESS DEVELOPMENTS

Energy Fuels to sell Piñon Ridge project; other news

On July 3, Energy Fuels Inc. announced that it has entered into definitive agreements to sell some of its noncore uranium assets to a private investor group led by Baobab Asset Management LLC and George Glasier, who was president of Energy Fuels from its founding in 2006 until March 2010.

The assets to be sold include the Piñon Ridge mill license and related assets, and other mining assets located along the border of Colorado and Utah, including the Sunday Complex, the Willhunt project, the San Rafael project, the Sage mine, the Van 4 mine, the Farmer Girl project, the Dunn project, and the Yellow Cat project.

Energy Fuels expects the sale, which is subject to regulatory approvals, to close on

or before October 15, earning the company approximately \$2.05 million in a combination of cash, secured promissory notes, and the assumption by the purchasers of certain existing company debt. The purchasers will also assume all reclamation obligations and will reimburse Energy Fuels for some costs incurred from March 19 through the closing of these transactions. Energy Fuels will retain a throughput royalty on the Piñon Ridge project equal to \$3.00/ton of ore, and a 1 percent royalty on the market value of all minerals recovered from the other mining assets.

■ On June 16, European Uranium Resources (EUU) announced that it has signed a binding letter of intent with Forte Energy whereby Forte will take a 50 percent interest in European Uranium's uranium projects in Slovakia, including the Kuriskova and Novoveska Huta projects, which are held by subsidiaries Ludovika Energy and Ludovika Mining. Forte Energy had announced on April 4 that a binding term sheet had been agreed upon that could have led to its acquisition of all of European Uranium's uranium assets (*NN*, May 2014, p. 62).

In its announcement, European Uranium stated, "The agreement with Forte Energy provides EUU with its necessary short-term cash infusion and allows EUU to maintain a 50 percent interest in the Kuriskova project without needing to contribute cash until Can\$3.5 million [about \$3.3 million] has been spent on the project by Forte." Forte must expend a total of Can\$4 million (about \$3.7 million) to acquire its 50 percent interest in the projects.

Continued

Fuel Briefs

THE URANIUM SPOT PRICE CONTINUES TO LANGUISH as of this writing in early July. Market-watching firm UxC announced a weekly spot price as of July 7 of \$28.35/lb U_3O_8 , which represented an increase of \$0.10 from the previous week's value. On July 4, TradeTech posted a price of \$28.20/lb, which it said represented no change from the previous week's price. The spot price has stayed below \$30/lb since May. TradeTech and UxC offer delayed spot price updates to the public at <www.uranium.info> and <www.uxc.com>, respectively.

STRATECO IS SHUTTING DOWN ITS MATOUSH CAMP in Northern Quebec, the company announced on June 12. Following the Quebec government's refusal to issue the final permit needed to start advanced exploration at Matoush, Strateco Resources Inc. decided to shut down the camp to cut costs. In a press release, the company stated, "The damages arising from the liquidation of the Matoush camp, and any cost associated with reopening the camp in the future, add to the damages incurred by Strateco and its shareholders following the Quebec government's refusal to issue the certificate of authorization." The camp has been on standby since March 2013, when a moratorium was imposed on Quebec's uranium industry (NN, May 2013, p. 79). According to Strateco, the company has already finalized the sale of some of its facilities and equipment, and it plans to carry out exploration in Saskatchewan in the coming months through its subsidiary, SeqUr Exploration Inc.

DENISON'S PHOENIX DEPOSIT HOLDS OVER 70 MILLION LB OF U_3O_8 , according to an updated mineral resource estimate announced by the company on June 17. Phoenix is located on Denison Mines Corporation's Wheeler River project in northern Saskatchewan. Compared to a 2012 estimate, the site's total indicated mineral resource estimate has increased by 34 percent, from 52.3 million lb to 70.2 million lb U_3O_8 , based on 166,400 metric tons of mineralization at an average grade of 19.13 percent U_3O_8 . The total inferred mineral resource is now estimated to contain 1.1 million lb U_3O_8 . Denison is the operator of Phoenix and holds a 60 percent interest in the project, while Cameco Corporation holds 30 percent, and JCU (Canada) Exploration Company Ltd. holds the remaining 10 percent interest.

LOUISIANA ENERGY SERVICES CAN LOAD MORE UF_6 at its National Enrichment Facility in Eunice, N.M. In the June 24 *Federal Register*, the Nuclear Regulatory Commission announced that after conducting inspections of the facility, its staff had authorized the introduction of uranium hexafluoride into cascades 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, and 4.12. In addition, the NRC verified that the systems, structures, and components of the Cylinder Receipt and Dispatch Building Liquid Effluent Collection and Transfer System and Small Component Decontamination Train Authorization at the facility have been constructed in accordance with the requirements of LES's license.

THE FIRST SHIPMENT OF U-LOADED RESIN FROM NICHOLS RANCH has been sent to Cameco Resources' Smith Ranch uranium processing facilities, Uranerz Energy Corporation announced on June 16. The Nichols Ranch *in situ* project in Wyoming began operations in April (NN, June 2014, p. 96). At the site, uranium is pumped to the surface in a solution that passes through ion-exchange columns containing resin beads. The uranium attaches to the beads, which are then shipped by truck to the Smith Ranch facilities. Cameco is processing the uranium-loaded resin beads into uranium concentrate under a toll processing agreement and shipping the stripped resin back to Nichols Ranch for reuse.

USEC INC.'S DISCLOSURE STATEMENT HAS BEEN APPROVED and its plan of reorganization under Chapter 11 of the United States Bankruptcy Code is proceeding as expected, the company announced on July 7. The disclosure statement, which describes the company's plan of reorganization, was filed with the U.S. Bankruptcy Court for the District of Delaware in March and was updated in June. Following the July 7 hearing and order, USEC stated that it would ask holders of its convertible notes, as well as its two preferred stockholders, Babcock & Wilcox Investment Company and Toshiba Corporation, to vote in favor of the reorganization. The 30-day voting period began in mid-July. Following the vote, the plan of reorganization will be reviewed by the court at a confirmation hearing. Meanwhile, USEC is pushing forward on the American Centrifuge project and is preparing to return the Paducah Gaseous Diffusion Plant to the Department of Energy in October, according to the company.

■ Paladin Energy Ltd. announced on June 30 that China Uranium Corporation Ltd., a subsidiary of China National Nuclear Corporation, has received all required regulatory approvals and has satisfied the conditions for the purchase of a 25 percent joint venture interest in the Langer Heinrich mine in Namibia for \$190 million. Paladin expected the transaction to be completed on July 23.

NUCLEAR FUEL SERVICES

Dropped container results in contamination event

In June, two events occurred at Nuclear Fuel Services' uranium fuel fabrication facility in Erwin, Tenn., both of which were classified as nonemergencies.

On June 17, according to a notification from the company to the Nuclear Regulatory Commission, an employee was observed improperly operating two spring return valves identified as items relied on for safety and safety-related equipment. "The spring return valves were observed to be 'propped' open," the report stated.

The spring return valves are intended to be manually operated to prevent a chemical solution from overflowing a column, spilling to the floor, and causing an acute chemical exposure. Although the operator was observing and monitoring the filling of the column, the spring return valves were not being operated properly.

The following morning, the company submitted a report to the NRC, stating, "There were no actual or potential safety consequences to the public or the environment. There were no actual safety consequences to the workers. The potential safety consequences to the workers include exposure to [a hazardous chemical] solution."

In a separate event on June 25, an employee dropped a container of radioactive material solution after removing it from a glovebox enclosure. The 2-liter poly container split, releasing the contents to the floor and surrounding equipment, according to Nuclear Fuel Services' report to the NRC. The solution was uranyl nitrate, containing 540 g of uranium-235. Operations were placed in a safe condition, radiological controls were implemented for personnel protection, and decontamination was initiated.

The area was released to normal access by the following evening. On June 27, however, contamination was discovered to be "weeping" out of some facility and equipment surfaces in the area of the spill. In response, radiological controls were reestablished, decontamination efforts were resumed, and enhanced monitoring was implemented. The event was reported to the NRC because the cumulative time for access restrictions exceeded 24 hours.

NRC

Extra staff guidance provided on post-Fukushima orders

The following documents have recently been issued by the Nuclear Regulatory Commission. Some are available for download from the agency's website, <www.nrc.gov>, through the ADAMS document retrieval system; their accession numbers are given in parentheses after the titles.

Comments from the public on draft documents may be sent by mail to Cindy Bladey, Chief, Rules, Announcements, and Directives Branch, Office of Administration, Mail Stop: 3WFN-06-44M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; or electronically to <www.regulations.gov>, with a search for the Docket ID listed for each item.

Regulatory Basis

Draft, for comment

Rulemaking for Enhanced Security at Fuel Cycle Facilities; Special Nuclear Material Transportations; Security Force Fatigue at Nuclear Facilities (ML14113A468). Docket ID: NRC-2014-0118. Comment deadline: August 4.

Regulatory Guides

Final, issued

RG 8.22, Revision 2, *Bioassay at Uranium Mills* (ML13350A638). Issued June 17.

Draft, for comment

DG-1141, proposed Revision 4 of RG 1.105, *Setpoints for Safety-Related Instrumentation* (ML14149A361). Docket ID: NRC-2014-0163. Comment deadline: September 9.

Withdrawn

RG 1.37, *Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants*. Withdrawn July 2. The relevant guidance is now provided in RG 1.28, *Quality Assurance Program Criteria (Design and Construction)*, and RG 1.33, *Quality Assur-*

ance Program Requirements (Operation).

RG 10.1, *Compilation of Reporting Requirements for Persons Subject to NRC Regulations*. Withdrawn June 26. According to the NRC, the guide is no longer accurate or current.

Interim Staff Guidance

Draft, for comment

FSME-ISG-102, *Guidance for Conducting the Section 106 Process of the National Historic Preservation Act for Uranium Recovery Licensing Actions* (ML14163A049). Docket ID: NRC-2014-0142. Comment deadline: September 2.

Supplemental Staff Guidance

Final, issued

Supplemental Staff Guidance for the Safety Evaluations for Order EA-12-049 on Mitigation Strategies and for Beyond-Design-Basis External Events and Order EA-12-051 on Spent Fuel Pool Instrumentation (ML14161A643). Issued July 1.

Emergency Preparedness Frequently Asked Questions

Draft, for comment

EPFAQ 2014-004: "Since the emergency preparedness function associated with the fire brigade will be maintained by meeting 10 CFR 50.48 objectives for a decommissioned site, can the changes to the fire protection plan associated with brigade staffing and offsite fire protection support also be reflected in the emergency plan without NRC preapproval using the 10CFR 50.54(q) process?" (ML14153A318). Docket ID: NRC-2014-0136. Comment deadline: July 10.

EPFAQ 2014-008: "May a licensee that has submitted certification confirming cessation of operation and removal of fuel from the reactor vessel remove certain emergency plan implementing procedure statements/processes/steps/actions that do not implement programmatic elements described in the emergency plan?" (ML14156A316). Docket ID: NRC-2014-0139. Comment deadline: July 16.

NUREGs

Final, issued

NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition*, Section 17.4, Revision 1, "Reliability Assurance Program" (ML13296A435). Issued May 30. Effective date: July 10.

■ Section 19.3, Revision 1, "Regulatory Treatment of Non-Safety Systems for Passive Advanced Light Water Reactors" (ML14035A149). Issued June 23. Effective date: August 1.

Draft, for comment

NUREG-1556, Volume 14, proposed Revision 1, *Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Well Logging, Tracer, and Field Flood Study Licenses* (ML14148A165). Docket ID: NRC-2014-0119. Comment deadline: July 11.

■ Volume 18, proposed Revision 1, *Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Service Provider Licenses* (ML14175A526). Docket ID: NRC-2014-0124. Comment deadline: August 7.

Information Notices

IN 2014-09, *Spent Fuel Storage or Transportation System Misloading* (ML14121A469). Issued June 20. Occurrences from 2000 to 2012 at Grand Gulf, Indian Point, North Anna, Oconee, Palisades, Sequoyah, South Texas, Surry, and Zion are described.

TSTF Travelers

Draft, for comment

Generic Technical Specification Travelers for the Development of AP1000 Standard Technical Specifications (ML14129A393, a package with 115 documents). Docket ID: NRC-2014-0147. Comment deadline: September 22. The Technical Specifications Task Force "Traveler" series provides content that can be adopted by power reactor licensees under the NRC's Consolidated Line Item Improvement Process. **IN**



Smith

MORGAN SMITH has been named chief operating officer of Consolidated Nuclear Security LLC (CNS), the Bechtel-led consortium that last year was awarded the combined management and operating contract for the Y-12 National Security Complex and the Pantex Plant. He replaces JIM ALLEN, who has retired. Previously, Smith was general manager of Knolls Atomic Power Laboratory and co-manager of Bechtel Marine Propulsion Corporation in partnership with the general manager of Bettis Atomic Power Laboratory. Prior to that, Smith served as president of Bechtel Bettis Inc. and general manager of Bettis Atomic Power Laboratory.

Also at CNS, BRIAN REILLY, ANS member since 2000, has been named director of the Uranium Processing Facility project at Y-12. A senior vice president in Bechtel's government services unit, Reilly has served as the company's nuclear power operations manager and has led a number of nuclear projects from conceptual studies and design through all aspects of the project life cycle. He succeeds CARL STROCK, who has retired.

JOHN D. WOOLERY has been named president and general manager of Babcock & Wilcox Conversion Services (BWCS), replacing JEFF STEVENS, who had assumed the position of acting BWCS president and project manager after President GEORGE E. DIALS, ANS member since 1995, resigned at the end of March. Woolery was most



Woolery

recently president and general manager of Babcock & Wilcox Technical Services Pantex LLC.

Also at BWCS, BRENDA G. MILLS has been named director of environment, safety, and health, replacing MARK B. MATTHEIS, who had been acting director. Mills was previously director of the Department of Energy's Office of Safety and Quality Assurance at the Savannah River Site.



Mills

Japan's parliament, the Diet, has approved the appointments of SATORU TANAKA, ANS member since 2011, and AKIRA ISHIWATARI as commissioners for Japan's Nuclear Regulation Authority. Tanaka, a professor of nuclear power at the University of Tokyo, and Ishiwatari, a geology professor at Tohoku University, will replace KENZO OSHIMA and KUNIHICO SHIMAZAKI, respectively, when their terms expire on September 18.

MATTHEW MCCORMICK has joined Kurion Inc. as project director and will lead the deployment of the new Kurion Mobile Processing System at the Fukushima Dai-ichi nuclear power plant. Previously, McCormick oversaw the Department of Energy's cleanup efforts at the Hanford Site. He has also served in leadership positions at the Savannah River Site and the Rocky Flats Plant.



McCormick

PETER J. K. "JEFF" WISOFF has been named principal associate director of Lawrence

Livermore National Laboratory's National Ignition Facility and Photon Science Directorate, after serving as acting principal associate director since



Wisoff

October 2013. Prior to joining LLNL in 2001, Wisoff spent more than 10 years as a NASA astronaut, participating in four space shuttle flights and three spacewalks. He has also served as a member of the faculty at Rice University, where he led a laser research program as assistant professor of electrical and computer engineering.

WILLIAM DEAN has been appointed director of the Nuclear Regulatory Commission's Office of Nuclear Reactor Regulation (NRR), replacing ERIC J. LEEDS, who retired on June 30. As NRR director, Dean will be responsible for the regulatory oversight of the nation's 100 operating commercial nuclear power reactors, in addition to research and test reactors. Dean had been serving as the NRC's regional administrator in the Region I office since October 2010. DANIEL H. DORMAN, currently NRR's deputy director for engineering and corporate support, will serve as acting director until Dean assumes his new duties at NRC headquarters.



Dean

JACEK CICHOSZ has been appointed chief executive officer of Polska Grupa Energetyczna's nuclear energy subsidiary, PGE EJ1. Cichosz had been acting CEO of the company since February, when former Polish

Treasury Minister ALEKSANDER GRAD stepped down from the position. Cichosz previously worked for Accenture on energy sector projects.

The Nuclear Regulatory Commission has made a number of resident inspector appointments recently, including, as senior resident inspectors, ERIN CARFANG at Pilgrim, DAVID HARDAGE at Hatch, JAMES KRAFTY at Beaver Valley, FRANCES RAMIREZ at Waterford-3, and MAX SCHNEIDER at Fort Calhoun, and, as resident inspectors, TIMOTHY CHANDLER at the two units under construction at Summer, CLINTON JONES at Surry, GREGORY F. STOCK at Nine Mile Point, and DAVID YOU at Palo Verde. Carfang was most recently a resident inspector at Beaver Valley; Hardage, a resident inspector at Hatch; Krafty, a resident inspector at Mill-



Carfang

stone; Ramirez, a resident inspector at Braidwood; Schneider, a senior resident inspector at Pilgrim; Chandler, a resident inspector at Vogtle; Jones, a project engineer in the Region II Office's Resident Inspector Development Program; Stock, a re-



Hardage



Krafty



Chandler



Jones



Stock



You

actor engineer in the Region I office; and You, a project engineer in the Region IV Office's Division of Reactor Projects.



Perez

ValvTechnologies Inc. has appointed OLIVER PEREZ as industry director of service. Prior to joining the firm as North American service manager, Perez held various service and operations management positions in the Fisher Controls' Instru-

ment and Valve division of Emerson Process Management. Earlier in his career, he worked at Flowserve, Parker, and McDonnell Douglas Space Systems.

Kudos

To LANCE L. SNEAD, associate division director of Oak Ridge National Laboratory's Materials Science and Technology Division and ANS member since 2001, who has been named an ORNL Corporate Fellow in recognition of his significant accomplishments and continuing leadership in his field. In 2012, Snead received the ORNL Director's Award for Outstanding Accom-

Faculty Positions Available Department of Nuclear Engineering Texas A&M University

The Department of Nuclear Engineering at Texas A&M University invites applications for the tenure-track position(s) of assistant professor, associate professor, or professor with a specialization in nuclear engineering, with the position rank dependent on the applicant's qualifications. Exceptional candidates should possess a doctoral degree in nuclear engineering or a closely related discipline, with particular interest and scholarly accomplishments in the areas of nuclear security and nonproliferation; however, applications from all areas of nuclear science and technology will be considered. Successful candidates will be expected to conduct research, teach both graduate and undergraduate courses, and contribute to the department's service mission. Preference will be given to applicants demonstrating success in developing research programs which complement existing departmental, college or university strengths in areas of national priority. For applicants with higher academic rank, experience in multidisciplinary research programs is desirable, along with a demonstrated research and publication record and proven excellence at teaching. Applicants with experience in academia, national laboratories or industry will be highly valued. The qualified applicant should forward, preferably electronically, a curriculum vitae (including a publication listing, research interests and personal achievements), at least two representative peer-reviewed publications, and contact information for at least three references to:

Yassin A. Hassan, Ph.D.

Department Head and Sallie & Don Davis '61 Professor
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The Texas A&M University System is an affirmative action/equal opportunity employer (www.tamus.edu/offices/eo). The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities, and covered veterans.



NUCLEAR ENGINEERING
TEXAS A & M UNIVERSITY



Snead
4,450 citations.

plishments in Science and Technology, and in 2010, he was named a Fellow of both ANS and the American Ceramic Society. Snead has served as guest editor for a number of journals within his field, publishing more than 210 papers with

To KRIS SINGH, chief executive officer of Holtec International and ANS member since 1979, who was presented with the George Washington Medal by the Engineers' Club of Philadelphia on May 29. The medal, established in 1967, is awarded to individuals who have made outstanding contributions to technological progress through engineering management.



Singh

ical progress through engineering management.

To COL. EMIL KABBAN, who was presented with the National Nuclear Security Administration's Defense Programs Excellence Award at a June 20 ceremony honoring his retirement from military service. Kabban, chief systems engineer and executive director in the NNSA's Defense Programs Systems Engineering and Integration Office, served nearly 27 years in the U.S. Air Force.



Kabban

ion Office, served nearly 27 years in the U.S. Air Force.

To UPENDRA ROHATGI, senior mechanical engineer at Brookhaven National Laboratory, who has been awarded the ASME Technical Communities Globalization Medal for his work helping to steer scientists formerly engaged in designing weapons of mass destruction toward more peaceful pursuits in science and technology. The official citation recognized Rohatgi's "career efforts devoted to reducing the risk of the proliferation of WMD and increasing global security through the engagement of scientists and engineers from former Soviet Union countries and Iraq, previously involved in WMD development, in the creation of new technologies for U.S. industries under the Global Initiatives for Proliferation Prevention program, and for institutions in the European Union, Japan, and Canada; and through scientific collaborations at the International Science and Technology Center, based in Moscow." The award includes a \$10,000 honorarium.



Rohatgi

er efforts devoted to reducing the risk of the proliferation of WMD and increasing global security through the engagement of scientists and engineers from former Soviet Union countries and Iraq, previously involved in WMD development, in the creation of new technologies for U.S. industries under the Global Initiatives for Proliferation Prevention program, and for institutions in the European Union, Japan, and Canada; and through scientific collaborations at the International Science and Technology Center, based in Moscow." The award includes a \$10,000 honorarium.

To CHRIS FISCHAHS, who has received the Department of Energy's Safety System Oversight (SSO) Award. At the time of the



Waltzer

To KARL WALTZER, acting deputy manager of the National Nuclear Security Administration's Production Office, who has received the NNSA Gold Medal Award in recognition of his achievements in support of national security programs.

Waltzer, who is retiring after 35 years of government service, was instrumental in the creation and startup of the NNSA Production Office, which began operation in June 2013 and replaced the Pantex Plant and Y-12 National Security Complex site offices.

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award's presentation, Fischahs was an SSO staff member of the Safety Evaluation Team at the National Nuclear Security Administration's Los Alamos Field Office. The SSO award was given to Fischahs in recognition of the extensive safety systems oversight he performed in 2013 and the resulting improvements in operational safety at Los Alamos National Laboratory.



Fischahs

Obituaries

THOMAS INTRATOR, 62; received a doctorate in physics from the University of Colorado at Boulder in 1982, later joining the University of Wisconsin's Nuclear Engineering and Engineering Physics Department; in 1999, began work at Los Alamos National Laboratory as a fusion scientist; was responsible for building up several significant experiments there, including the Relaxation Scaling Experiment and the Magnetized Shock Experiment; was elected a Fellow of the American Physical Society in 2012; authored more than 140 publications; died June 3, after a long battle with cancer.



Intrator

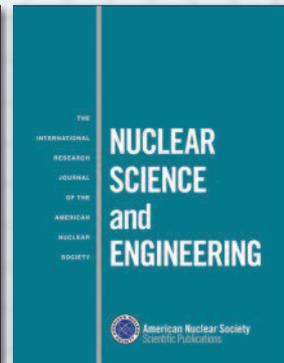
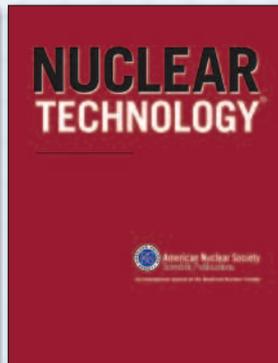
VITALI SHAFRANOV, 84; a pioneer of the world fusion research effort; graduated from Moscow State University in 1951; in 1952, began work at the Laboratory of Measuring Apparatuses of the Soviet Academy of Sciences (now the Kurchatov Institute); joined the theoretical group there under M. A. Leontovich and began a distinguished career in fusion research; many key theoretical foundations of fusion plasma physics bear his name, including the Kruskal-Shafranov criterion, the Grad-Shafranov equation, and the Shafranov shift; his first work, with Leontovich, titled "On the Stability of a Flexible Conductor in the Presence of a Magnetic Field" (1952), provided the basis for the experimental fusion program that began in the Soviet Union under A. D. Sakharov; honors received include the Lenin Prize (1984) and the European Physical Society's Hannes Alfvén Prize (2001); died June 9.



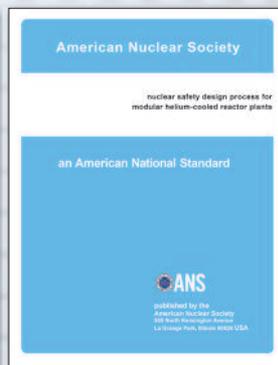
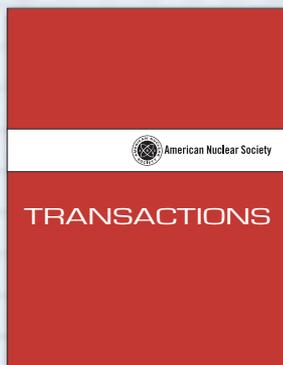
Shafranov



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Backscatter

MINKLER

Robo conscience

Do you know any people who have kept their New Year's resolutions into mid-August? I don't. Most folks I know (including me) didn't keep them past mid-January, but wish they had.

And not only New Year's resolutions, but ordinary things we should or should not do, we don't follow the "should." Following the "should" takes effort.

Most of us have a conscience to help with such things, but consciences are notoriously weak, some weaker than others. Like mine, for example. I can easily avoid punching people who irritate me, but if I resolve not to eat any more snacks until supper, well . . . in 10 minutes I'm back to the fridge, grabbing another handful of salted almonds. To not do that, I have to resist the call from my psyche saying, "Those salted nuts are sooo good. Another handful won't hurt."

Fortunately, scientists and grad students in Nuke University's Neuroscience Department and Robotics Department have been working on this pervasive human problem. I asked Dr. Iris Nervenda and Dr. Otto McKonak, of the joint Neuroscience/Robotics Lab, for the latest information. We met for coffee in the Faculty Club.

Dr. Nervenda said, "For centuries, scientists, psychologists, and theologians have thought that the human conscience was a vague property of the mind that helps a human make moral decisions. Should I do this? If I do, what are the potential consequences, and are they worth it?"

Dr. McKonak said, "Recently, some experimental psychologists at Oxford University learned where the conscience actually is in the brain. Franz-Xavier Neubert, first author of Oxford's paper on the subject, said that it's a region the size and shape of a Brussels sprout, and it's in the lateral frontal pole prefrontal cortex. Only humans appear to have this, no other animal. And humans seem to have not just one conscience Brussels sprout, but two of them, one behind each eyebrow."

Dr. Nervenda said, "We don't know if the two sprouts act as angel and devil, or whether they're both on the same page and send their messages in stereo. But in our lab here at Nuke University, we've developed a

way to communicate with these conscience sprouts through cranial Wi-Fi and program them to be little electronic robots so that (1) they're together on every issue, and (2) the owner doesn't have to think should I or shouldn't I. Just do what your conscience bot tells you, and you can turn your actual thinking to the crossword puzzle or the baseball standings or what to have for lunch."

According to Dr. McKonak, "Different people have different moral standards, different nuances and details of what one ought to do or not do. Cranial Wi-Fi programming allows us to offer different flavors of conscience tuning accordingly. We have apps available, including, but not limited to, the main branches of Judaism; various types of Catholic and Orthodox Christianity, including Roman, Greek, Serbian, and Russian; at least 40 different flavors of Protestant Christianity; various branches of Islam, Hinduism, Buddhism, and Shinto. We also have Unitarian, agnostic, and atheist, and within each of the above, a great number of variations in practice and observance, such as do you eat meat, and when or when not? Do you dance? Drink alcohol? Do you treat men and women equally? How covered up should women be? Do the men wear hats?"

Dr. Nervenda said, "You select the variations that suit you. Our conscience bots do the rest through connections to your brain's motor control areas.

"You and only you can install a conscience bot in your own brain. Nobody can force one on you. But we have a special deal for convicted criminals. When offenders get out of jail, they're supposed to go straight. That's often difficult for them. Many make it, but others are soon back behind bars.

"So prisoners, upon discharge, can choose to receive one of our conscience bots that will guide their actions and keep them from committing further larceny, robbery, graft, fraud, mayhem, DUI, or whatever their weakness is.

"We're still in the experimental stage on this, but so far, 20 ex-cons from Blightsburg State Correctional Institution have chosen one of our devices, and none has returned for further correction."—*Bill Minkler*



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