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A few bright spots

As important a topic as it is, let’s not talk about Summer for a moment. I’m of course referring to SCANA’s canceled AP1000 nuclear project in South Carolina. Instead, let’s enjoy a little good news for a change. In particular, two recent actions taken by Energy Secretary Rick Perry are worth recognizing (both of which will be covered more thoroughly in the November issue).

First, on September 28, Perry invoked a rarely used authority of the secretary of energy and requested that the Federal Energy Regulatory Commission (FERC) take up a rulemaking that would help nuclear power plants compete in the wholesale energy markets by fully valuing their contributions to a reliable and resilient electric grid. The rule, Perry told FERC, would ensure that coal and nuclear plants would be able to recover their “fully allocated costs and thereby continue to provide the energy security on which our nation relies.”

Then, on the following day, Perry announced that the department was issuing up to $3.7 billion in conditional loan guarantees to the owners of the Vogtle nuclear project. Again, Perry noted the important role Vogtle plays in supporting a reliable and resilient grid, promoting economic growth, and strengthening the country’s energy and national security.

The Vogtle loan guarantees bode well for the country’s new-build future and the long-term health of the nuclear industry. And the FERC rulemaking, if successful, should go a long way in helping plants that are struggling to compete in a faulty energy market keep humming along. With the industry struggling to bring new construction projects to the market, preserving the existing fleet is more important than ever if we want to continue to reap the benefits of clean, reliable nuclear energy.

The work that goes into keeping our fleet of nuclear workhorses going is the subject of the Special Section on Outage Management and Plant Maintenance in this issue of Nuclear News. Included are three articles about projects where efficiencies and innovations were used to reduce costs, shorten schedules, and lower worker dose. The articles feature an outage and contingency planning campaign to inspect and replace baffle-former bolts at PSEG Nuclear’s Salem-2 reactor (page 36), a record-breaking 29-day refueling outage at FirstEnergy Nuclear Operating Company’s Perry plant (page 42), and a recap of the first year of Ontario Power Generation’s refurbishment program for the four Darlington CANDU units, written by Nuclear News International Editor Dick Kovan (page 51).

In addition, Associate Editor Michael McQueen provides an extensive report on the ANS Utility Working Conference and Vendor Technology Expo, held August 6–9 at the Omni Amelia Island Plantation in Florida (page 56). If you couldn’t attend, McQueen’s report is the next best thing to being there. Included is a discussion of the industry’s implementation of Efficiency Bulletins, part of the Delivering the Nuclear Promise initiative, which is helping prevent premature reactor closures by improving plant operations and reducing costs.

Finally, it should be noted that this issue includes a little bittersweet news concerning the end of the Cassini-Huygens mission to Saturn (see Isotopes & Radiation, starting on page 84). Before the unmanned spacecraft met a fiery end in the planet’s hydrogen/helium atmosphere, it made numerous discoveries and collected an impressive amount of data during its 20-year mission. With its instruments having been powered by radioisotope thermoelectric generators, Cassini-Huygens demonstrates, in a very real and inspiring way, the ability of nuclear technology to not only power our lives, but to greatly contribute to the advancement of science and human knowledge.—Tim Gregoire, Associate Editor
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October


Oct. 20–22  International Conference on Nuclear Science and Engineering (CNSE 2017), a symposium within the 7th World Congress on Engineering and Technology (CET 2017), Guilin, China. Sponsored by the Nuclear Energy Institute, Open Access Library, Scientific Research Publishing, and others. Contact: Ms. Vivian, CET, phone +86 186 27737240; email <cet@engii.org>; Web <www.engii.org/conference/cet/>.

Oct. 21–28  2017 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), co-located with the 24th Symposium on Room-Temperature X- and Gamma-Ray Detectors (RTSD), Atlanta, Ga. Sponsored by the IEEE Nuclear & Plasma Sciences Society. Contact: Lorenzo Fabris (NSS), Oak Ridge National Laboratory, phone 865/576-2474; email <nss2017atl@umich.edu>; Lars Furenlid (MIC), University of Arizona, phone 520/626-4256; email <lars@radiology.arizona.edu>; or Michael Fiederle (RTSD), University of Freiburg, phone +49 761 203 4775; email <michael.fiederle@fmf.uni-freiburg.de>; Web <www.nss-mic.org/2017/news.asp>.


November

Nov. 7–9  10th International Symposium on Release of Radioactive Material from Regulatory Control, Berlin, Germany. Organized by TÜV NORD. Contact: Clarissa Jakubzig, TÜV NORD, phone +49 40 8557 2920; fax +49 40 8557 2958; email <cjakubzig@tuev-nord.de>; Web <www.tuev-nord.de/tk-rrm>.

Nov. 12–16  9th International Conference on Isotopes and Expo (9ICI), Doha, Qatar. Organized by the Qatar Physics Society and the World Council on Isotopes, with ANS and others. Contact: Alexander Sommerauer, 9ICI, email <alexander.sommerauer@9ici.org>; Web <www.9ici.org>.

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7182; email <chowlett@nuclearenergyinsider.com>; Web <www.nuclearenergyinsider.com>.


Nov. 20–23 1st International Conference on Radiations and Applications (ICRA’17), Algiers, Algeria. Organized by the Physics faculty at Houari Boumediene University of Science and Technology, the Algerian Association of Physics, and others. Contact: ICRA’17, email <icra.nov2017@gmail.com>; Web <www.usthb.dz/icra/>.

Nov. 26–30 International Symposium on Future I&C for Nuclear Power Plants (ISOFIC 2017), Gyeongju, South Korea. Sponsored by the Korean Nuclear Society. Contact: Man Gyun Na, Chosun University, email <magyna@chosun.ac.kr>; Web <www.isofic.org/>.

Nov. 27–29 15th Annual Nuclear Waste Management Forum, Nashville, Tenn. Organized by Perma-Fix Environmental Services, Inc. Contact: Autumn Bogus, Perma-Fix Environmental Services, Inc., phone 865/251-2088; email <abogus@perma-fix.com>; Web <http://events.constantcontact.com/register/event?llr=8n5x6gka8&amp;oeidk=a07ee5py0ww0f69969a>.

Nov. 27–30 International Conference on Nuclear Decommissioning 2017 (ICOND 2017), Aachen, Germany. Organized by the Aachen Institute for Nuclear Training GmbH. Contact: AINT, phone +49 0 2402 12 75 05 111; fax +49 0 2402 12 75 05 500; email <registration@icond.de>; Web <www.icond.de/>.

December


January


Continued
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February

Feb. 4–7  51st Midyear Meeting of the Health Physics Society, Denver, Colo. Sponsored by HPS. Contact: Neil Whiteside, email <2018hpsmidyear@gmail.com>; Web <http://hps.org/meetings/meeting48.html>.


March

Mar. 11–17  International Youth Nuclear Congress 2018 (IYNC2018) and the 26th Women in Nuclear Global Annual Conference, Bariloche, Argentina. Sponsored by IYNC and WinN. Contact: Denis Janin, IYNC, email <denis.janin@iync.org>; Web <www.iync.org/iync2018-bariloche-argentina/>.


April

Apr. 5–7  2018 ANS Student Conference, Gainesville, Fla. Sponsored by ANS and hosted by the ANS University of Florida Student Section. Contact: Conference cochairs, email <chair@ansstudentconference2018.com>; Web <www.ansstudentconference2018.com>.

Apr. 22–26  PHYSOR 2018, Cancun, Mexico. Sponsored by the ANS Reactor Physics Division and the Mexican Nuclear Society. Contact: Gustavo Alonso, Instituto Nacional de Investigaciones Nucleares, email <gustavoalonso3@gmail.com>; Web <www.physor2018.mx>.

And coming up (ANS meetings) . . .

2018 ANS Student Conference, Apr. 5-7, 2018, Gainesville, Fla.


2019 ANS Annual Meeting, June 9–13, 2019, Minneapolis, Minn.

Calls for Papers


Want to see your meeting in Nuclear News?

To place your meeting announcement in the Calendar section, contact Patricia Matas via email <pmatas@ans.org>, phone 708/579-8245, or fax 708/579-8204.

To place a paid advertisement for a meeting announcement or call for papers, contact Nuclear News Advertising Manager Jeff Mosses for information: email <jmosses@ans.org>, phone 708/579-8225, or fax 708/352-6464.

Deadlines: Meeting-related information to be published must be received by Nuclear News at least a month and a half prior to the month of publication. For example, for publication in the May issue (in accordance with the procedure outlined below), material must be received by March 15. There are three meeting-related sections in Nuclear News:

■ Calendar. Nuclear-related meetings are listed up to seven months before the date of the meeting. For example, if the meeting is being held July 27–29, then it is first listed in the January issue. The meeting will continue to be listed through the July issue. Note that because Nuclear News subscribers receive the magazine in the mail in the middle of the month (e.g., mid-July for the July issue), meetings that take place in the latter half of the month receive an extra month’s listing (the July 27–29 meeting will be listed in the January through July issues; if the meeting were being held July 5–7, a calendar listing would appear in the January through June issues).

■ Short Courses. Nuclear-related short course notices are listed only once. Depending upon when we receive notices, they are listed from one to four months in advance of the course date.

■ Calls for Papers. Nuclear-related calls for papers are listed only once, and are listed as soon as we receive notice (unless the deadline for abstracts occurs before the next issue’s mailing date, in which case the listing is not published).
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Molten Salt Reactors and Thorium Energy, edited by Thomas J. Dolan. This publication is a comprehensive reference on the status of molten salt reactor (MSR) research and thorium fuel utilization. Written in cooperation with the International Thorium Molten Salt Forum, it covers MSR-specific issues and various reactor designs and discusses such things as environmental impact, nonproliferation, and licensing of MSRs, using case studies and examples from experts around the world. (840 pp., HB, $310.25. ISBN 978-00-8-101126-3, or eBook, $310.25, ISBN 978-00-8-101243-7. Order from Elsevier: phone 800/545-2522; fax 800/535-9935; email <usbkinfo@elsevier.com>; Web <www.elsevier.com/books>.)

Routledge Handbook of Nuclear Proliferation and Policy, edited by Joseph F. Pilat and Nathan E. Busch. This handbook examines the numerous and complex issues of nuclear proliferation in the early 21st century. It presents up-to-date analysis and policy recommendations on these critical issues by leading scholars in the field. The book is divided into three parts: Part I presents detailed assessments of proliferation risks across the globe, including specific regions and countries; Part II describes the various tools developed by the international community to address these proliferation threats; and Part III addresses the proliferation risks and political challenges arising from nuclear energy production, including potential proliferation, and licensing of MSRs, using case studies and examples from experts around the world. (546 pp., HB, $245, ISBN 978-04-1-587039-9, PB, $53.95, ISBN 978-11-3-855499-3, or eBook, $41.97, ISBN 978-02-0-370952-8. Order from CRC Press: phone 800/272-7737; fax 800/374-3401; email <orders@taylorandfrancis.com>; Web <www.taylorandfrancis.com>.)

Thermal-Hydraulic Analysis of Nuclear Reactors, second edition, by Bahman Zohuri. This revised text covers the fundamentals of thermodynamics required to understand electrical power generation systems and the application of these principles to nuclear reactor power plant systems. The book begins with fundamental definitions of units and dimensions, thermodynamic variables, and the laws of thermodynamics, and progresses to sections on specific applications of the Brayton and Rankine cycles for power generation and projected reactor system designs. It reinforces the fundamentals of fluid dynamics and heat transfer, thermal and hydraulic analysis of nuclear reactors, two-phase flow and boiling, compressible flow, stress analysis, and energy conversion methods. Included are detailed appendices that provide metric and English system units and conversions, steam and gas tables, and nuclear reactor system descriptions. (835 pp., HB, $279, ISBN 978-3-319-53828-0, or eBook, $219, ISBN 978-3-319-53829-7. Order from Springer International Publishing: phone 212/460-1500; fax 212/460-1700; email <customerservice@springernature.com>; Web <www.springer.com>.)

International Safeguards in the Design of Fuel Fabrication Plants, IAEA Nuclear Energy Series No. NF-T-4.7. The third in a series from the International Atomic Energy Agency that provides guidance on the early consideration of safeguards requirements in the design and construction of nuclear facilities, this publication is primarily intended for designers and operators of nuclear fuel fabrication facilities, although vendors, state authorities, and investors may also benefit from the information provided. It expands upon the general considerations addressed in International Safeguards in Nuclear Facility Design and Construction, IAEA Nuclear Energy Series No. NF-T-2.8, April 2013. (52 pp., PB, €30 [about $36], ISBN 978-92-0-103315-4, or PDF, free download. Order from the IAEA: phone +43 1 2600 22529; fax +43 1 2600 29302; email <sales.publications@iaea.org>; Web <www-pub.iaea.org/books>.)

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GEORGIA POWER’S REVISED SCHEDULE FOR VOGTLE-3 AND -4 was approved by the Georgia Public Service Commission (PSC) on September 19. Under the approved schedule, by October 6, Georgia Power was to submit its justification as to why the PSC should verify and approve expenditures made from January 1, 2017, through June 30, 2017, and whether the commission should approve, disapprove, or modify the company’s proposed revisions to the cost estimates, construction schedule, and project configuration for the Vogtle nuclear power plant expansion project. Georgia Power, a subsidiary of Southern Company, submitted these expenditures and proposals to the PSC on August 31 for review as part of its 17th semiannual construction monitoring report for Vogtle-3 and -4 (NN, Sept. 2017, p. 17). Hearings regarding the submitted justifications, plans, and expenditures are scheduled for November 6–9 and December 11–14, 2017, and January 8–10, 2018, with filing deadlines for applications to intervene and other motions spaced accordingly between hearings. The PSC will then render a decision on February 6, 2018, regarding the fate of the Vogtle expansion project.

Also on August 31, co-owners Georgia Power and Oglethorpe Power separately filed recommendations that the two AP1000 reactors near Waynesboro, Ga., be completed (see p. 27). Georgia Power expects Vogtle-3 and -4 to begin commercial operation in November 2021 and November 2022, respectively.

A SUBPOENA FOR DOCUMENTS RELATED TO SUMMER-2 AND -3 was issued to SCANA Corporation and its subsidiaries on September 21 by the U.S. Attorney’s Office for the District of South Carolina. The subpoena requires the companies to submit documents relating to the now halted expansion project at the Summer nuclear power plant near Parr, S.C. “The company intends to cooperate with the government’s investigation,” SCANA stated in a press release, adding, “No assurance can be given as to the timing or outcome of this matter.”

Panels formed in the South Carolina Senate and House of Representatives continue to investigate the project’s failure. Testifying before the House Utility Ratepayer Protection Committee on September 15, SCANA’s chief executive officer, Kevin Marsh, insisted that SCANA did nothing wrong in keeping confidential a 2016 audit report by engineering, construction, and project management company Bechtel Power Corporation that identified problems long before the project’s cancellation (see p. 26). Marsh testified that the report was “never secret,” but was kept confidential “due to potential litigation with Westinghouse,” the main contractor for the Summer project.

Meanwhile, Santee Cooper President and CEO Lonnie Carter on September 18 testified before the Senate’s V.C. Summer Nuclear Project Review Committee that the utilities should not “walk away from this investment” and questioned whether it makes sense to sell off parts of the partially completed reactors to reduce debt now, only to have to buy them at full cost later. “At some point, I believe these units will be completed,” Carter said.

PALISADES WILL CONTINUE TO OPERATE UNTIL 2022 under the current power purchase agreement (PPA) between Entergy Corporation and Consumers Energy. “In light of the Michigan Public Service Commission’s [PSC] order issued September 22, which granted Consumers Energy recovery of only $136.6 million of the $172 million it requested for the buyout of the PPA, the parties have agreed to terminate the buyout transaction,” said Charlie Aronne, Palisades’ site vice president, in a September 28 press release. The PSC on September 22 approved Consumers Energy’s buyout plan for the remainder of its PPA with Entergy Corporation, allowing Consumers Energy to opt out of purchasing power from the Palisades nuclear power plant near South Haven, Mich. The PSC, however, approved just over $142 million for the securitization plan proposed by Consumers Energy, less than the $184.6 million requested in the original application Consumers Energy filed with the commission in February (NN, July 2017, p. 22). Securitization, a special kind of financing under Michigan law, allows a utility to “replace relatively high-cost debt and equity with lower-cost debt,” according to a September 22 press release from the commission. The PSC-approved total included roughly $5.5 million in transaction costs, leaving $136.6 million for Consumers Energy’s proposed payment to Entergy. The original application requested $12.6 million for transaction costs and $172 million for payment to Entergy.

The decision to terminate the buyout transaction reverses Entergy’s December 8 announcement of its intent to shut down Palisades in October 2018 (NN, Jan. 2017, p. 22). According to Entergy’s press release, however, the company “remains committed to its strategy of exiting the merchant nuclear power business.”

Continued
REVISIONS TO THE NRC’S DRAFT FINAL RULE ON LLW DISPOSAL

were approved on September 8 by the Nuclear Regulatory Commission’s three commissioners, who also approved the rule’s publication in the Federal Register as a supplemental proposed rule for a 90-day public comment period. The NRC has been working for years to revise its 10 CFR Part 61 regulations for the disposal of commercial low-level waste, which were first promulgated in 1982 and did not fully account for the possibility of disposing of large quantities of depleted uranium.

In September 2016, the NRC staff sent a draft final rule to the commissioners for approval (NN, Nov. 2016, p. 46). The changes approved by the commissioners include reinstating the use of a case-by-case basis (“grandfather provision”) for applying new requirements to only those sites that plan to accept large quantities of depleted uranium for disposal. The supplemental proposed rule would also reinstate the 1,000-year compliance period with a specific dose limit of 25 millirem per year and adopt a longer performance assessment period based on site-specific considerations and a “reasonable analysis.”

Further revisions would clarify that the rule’s safety case consists of the quantitative performance assessment, as supplemented by consideration of defense-in-depth measures; modify the draft final rule text addressing defense-in-depth to narrow its consideration solely to providing additional assurance in mitigating the effects of large uncertainties that are identified during the performance assessment; and be informed by a broader, more fully integrated analysis of the costs and benefits resulting from the rule changes.

The schedule for the NRC staff to prepare a regulatory basis for the disposal of greater-than-Class-C waste also was changed from within six months of the completion of the ongoing Part 61 rulemaking to six months after the publication of the supplemental proposed rule. As of this writing, the supplemental proposed Part 61 rule was yet to be published.

A BILL TO PROTECT RATEPAYERS AND SUPPORT MILLSTONE

was approved by the Connecticut Senate on September 15. Senate Bill 1501 was introduced by Sen. Martin M. Looney (D., Dist. 11) and Connecticut House Speaker Joe Aresimowicz (D., Dist. 30) during the June special session. Similar to SB 106, passed by the Senate earlier this year (NN, July 2017, p. 34), SB 1501 requires the state to implement changes to support the Millstone nuclear power plant “if determined to be in the best interest of ratepayers to provide energy stability, preserve the state’s largest carbon-free energy source, and keep energy rates down,” according to a press release from Sen. Paul Formica (R., Dist. 20). After SB 106 failed to pass the state House of Representatives, Connecticut Gov. Dannel P. Malloy on July 25 signed an executive order calling for the Department of Energy and Environmental Protection (DEEP) and the Public Utilities Regulatory Authority (PURA) to review Millstone’s “current and projected economic viability” (NN, Sept. 2017, p. 22).

Unlike similar actions taken in New York and Illinois to establish zero-emission credits programs (NN, Sept. 2016, p. 12, and Jan. 2017, p. 33), SB 1501 does not provide any subsidies for nuclear power. It directs DEEP and PURA to complete an appraisal of the current and future condition of the region’s nuclear facilities in order to determine whether it is in the best interest of ratepayers to allow nuclear facilities to sell power directly to utilities to “lock in long-term stable prices through a competitive process,” according to Formica’s press release. The DEEP commissioner is required to report the results of the appraisal on or before February 1, and the state General Assembly must vote by March 1 to accept or reject the results. The bill now awaits review in the state House.

A FUNDING BOOST FOR PROMISING ENERGY TECHNOLOGIES

was announced by the Department of Energy on September 13. According to the announcement, a total of $19.7 million is being awarded through the Office of Technology Transitions’ Technology Commercialization Fund (TCF) to support 54 projects involving 12 national laboratories and more than 30 private-sector partners. The funding covers projects for which additional technology maturation is needed to attract private partners, as well as projects requiring cooperative development between labs and industry partners to bolster the commercial application of lab-developed technologies. The selected projects will also receive “at least an equal amount of nonfederal funds to match the federal investment,” the DOE said.

A portion of the funding will go toward the following nuclear-related projects:

- Argonne National Laboratory: NRC Qualification of Advanced Reactor Safety Analysis Software, $75,000; Joint Development of SAS4A Code in Application to Oxide-fueled LFR Severe Accident Analysis, $400,000 (with Westinghouse Nuclear, Pittsburgh, Pa.); Advanced Physics-Based Fluid System Performance Monitoring to Support Nuclear Power Plant Operations, $500,000 (with LPI Inc., Amesbury, Mass.).

Continued on page 91
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**At the ANS Nuclear Cafe . . .**

**Florida’s nuclear plants power through Hurricane Irma**

Posted on September 12, 2017

By Will Davis

Hurricane Irma shocked the country this week with images of wind and water that haven’t been seen in some time along the hurricane-wary coastlines of the United States. Although people in those regions always have preparation for these storms somewhere in their minds, the two Florida Power & Light (FPL) nuclear plants—both of which powered through the hurricane—had both a background of design and preparedness to stand on as well as some recent, last-minute preparations.

**Robust design, made readier**

According to FPL, both of its nuclear plants (two units at St. Lucie and two units at the Turkey Point power station) have been constructed 20 feet above sea level, in order to protect them against the dual threats of floods and storm surges. The plants have been designed for the rugged environment sometimes occurring along the hurricane coast and, according to FPL, the two plants “have been specifically built to withstand natural disasters such as hurricanes, tornadoes, earthquakes, and tidal surges.”

Both of these plants have multiple, redundant, large diesel generators in protected buildings—any one of which can provide enough power to protect the reactors (by maintaining cooling) after they’re shut down. However, because of the more recent push to add what’s called FLEX equipment to support the plant from outside the plant itself, extra emergency equipment is located on both nuclear plant sites. According to FPL, water injection and fire pump vehicles are on both sites, ready for deployment—and operators must periodically prove their ability to connect and operate this equipment. In fact, these two sites can operate safely by cooling the reactors for seven full days without the need for any electric power from off-site, or the need to bring in any additional diesel fuel.

**A tough history**

“Turkey Point successfully withstood the impact of Category 5 Hurricane Andrew in 1992,” FPL said in its background on the plant—and added on its website, “with no damage to its nuclear systems.” The U.S. Nuclear Regulatory Commission noted recently on its blog, “Twenty-five years ago, Turkey Point was directly in the path of Hurricane Andrew, a Category 5 storm, and although many of the plant’s structures were damaged and offsite power lines were lost, important safety equipment was safely maintained.” Not that St. Lucie has been ignored either—it hasn’t. According to FPL’s site, “FPL’s St. Lucie nuclear power plant safely withstood Category 3 Hurricane Jeanne and Category 2 Hurricane Frances in rapid succession in 2004 with no damage to its nuclear systems.”

**Inaccurate reporting leads to unrealistic fear**

The preparations above—the construction of the plants high, the protection against flooding, the provision of multiple emergency diesel generator backups as well as the on-site portable equipment that can inject cooling water, even using seawater—were further bolstered by rigorous, if rapid, preparation at the two nuclear plant sites, both assisted by and reported by the NRC.

This is an excerpt from an article posted at the ANS Nuclear Cafe. Read the complete article at: http://ansnuclearcafe.org/2017/09/12/floridas-nuclear-plants-power-through-hurricane-irma/#sthash.t0DHcHdb.dpbs
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Plants prepared for Hurricane Irma landfall

FPL chose to shut down only one of its four Florida reactors prior to the hurricane’s landfall.

Florida Power & Light Company, owner of Florida’s two nuclear power plants, chose to shut down only Unit 3 at the Turkey Point plant ahead of Hurricane Irma’s September 10 landfall on the mainland of Florida, despite hurricane warnings issued for the areas in which the Turkey Point and St. Lucie plants are sited. Turkey Point-3, located near Florida City, Fla., went off line on September 9, while the remaining Florida reactors remained on line to weather the storm. The day before, the Nuclear Regulatory Commission announced in a press release that it had dispatched additional inspectors to both plants and staffed the Region II Incident Response Center in Atlanta, Ga., to help deal with the aftermath of Hurricane Irma.

The National Oceanic and Atmospheric Administration issued a hurricane warning that included the Turkey Point site at Power St. Lucie.

Hurricane Irma ultimately tracked the western edge of Florida, but St. Lucie and Turkey Point were prepared for the worst. The colored circles along the track show the location of the storm at six-hour intervals, and the colors represent the storm’s maximum sustained wind speeds and the category designations, according to the Saffir-Simpson scale. The colors range from coral (Category 5) to light yellow (Category 1), to turquoise (tropical storm).
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11 p.m. (EDT) on September 7; this warning was extended to include the St. Lucie site near Hutchinson Island, Fla., at 5 p.m. on September 8. Hurricane Irma made landfall as a Category 3 hurricane on Marco Island, Fla., at 3:35 p.m. on September 10. The Marco Island Police Department at that time reported a wind gust of 130 miles per hour. Turkey Point-3 and -4 continued to face the threat of tropical storm force winds until 5 a.m. on September 11, and the sustained wind advisory was lifted around St. Lucie at 11 a.m. that day.

After Irma made landfall on the mainland, Turkey Point-4 experienced a manual trip on September 10 due to a valve failure. Then, on September 11 at 2:05 p.m., operators shut down St. Lucie-1 and placed it in hot standby mode to address issues of salt accumulation on insulators in the switchyard, according to Roger Hannah, NRC senior public affairs officer. At the time of this writing, FPL had not determined whether the Turkey Point-4 manual trip resulted from the hurricane. On September 13, Turkey Point-3 was operating at 70 percent power, Turkey Point-4 remained off line, St. Lucie-1 was operating at 81 percent power, and St. Lucie-2 remained at full power. According to Hannah, the NRC ceased staffing the Atlanta incident response center on September 11 and has returned to its normal inspection and oversight of Turkey Point and St. Lucie.

In the aftermath of the storm, 3.8 million electricity customers in Florida—over 36 percent of the state’s electricity customers—remained without power as of September 13, according to the Florida Division of Emergency Management. Of those, 1.9 million are FPL customers—39 percent of FPL’s electricity customers. FPL estimated in a September 12 press release that it would have restored power to “essentially all of its customers along the East Coast service territory” by September 17, and for its West Coast service territory customers by September 22, “with the possible exception of areas impacted by tornadoes, severe flooding, and other sections of severe damage.”

Turkey Point-3 and -4, pressurized water reactors with a combined operating capacity of 1,671 MWe, received their initial operating licenses in 1972 and 1973, respectively. In 2002, both were issued renewed licenses for an additional 20 years, allowing Unit 3 to operate until 2032 and Unit 4 until 2033. St. Lucie-1 and -2, PWRs with a combined operating capacity of 2,136 MWe, received their initial operating licenses in 1976 and 1983, respectively, and in 2003, both received renewed licenses for an additional 20 years, allowing Unit 1 to operate until 2036 and Unit 2 until 2043.

**Audit identified issues a year before cancellation**

A project assessment report released to the public on September 4 by South Carolina Gov. Henry McMaster provides evidence that co-owners SCANA and Santee Cooper knew in early 2016 of significant problems with Westinghouse Electric Company, the primary contractor for the new AP1000 reactors that were, until early August, under construction at the Summer nuclear site near Parr, S.C. The report on Summer-2 and -3 was completed by Bechtel Power Corporation in February 2016 but was not released to the public at that time.

Among the concerns raised in Bechtel’s assessment were that the expansion plan lacked the project management integration needed for a successful outcome; that the engineering, procurement, and construction plans and schedules were not reflective of actual project circumstances; and that the engineering design was not yet completed and was “often not constructible,” all of which delayed progress and increased the cost to complete the reactors.

*Continued*
Before the work of the conference began, nearly 100 attendees representing 57 utilities, vendors, and nuclear organizations participated in the 24th Annual UWC Golf Tournament. The networking and collaboration that took place during the event aligned with the theme of this year’s conference, “The Nuclear Option – Clean, Safe, Reliable & Affordable.”

In addition to bragging rights, the names from the winning group will be immortalized on the 2nd Annual “Schneider Cup” traveling cooling tower trophy (sponsored by Schneider Electric).

CONGRATULATIONS TO THE WINNING TEAMS

1st
Wade Watts
Chris Smith
Roy Ilich
DevonWay, Duke Energy, Laron

2nd
Mark Fenske
Steve Huntington
Rusty Dunlap
System One, System One, Allied Technical Resources

3rd
Chris Comfort
Bob Coward
Saulsbury Industries, MPR Associates, Inc.

For 2018 UWC golf sponsorship information, please email meetings@ans.org
Santee Cooper, following the denial of a request to delay the investigation into the cancellation of the Summer expansion project (NN, Sept. 2017, p. 14), provided the report to McMaster’s office on September 3, requesting that “any contents of the document not be released to the media or any business, legal, or financial entities.” McMaster, however, a former state attorney general, said that the report enjoyed no protection under attorney-client privilege and released it to the public, according to Charleston, S.C.’s Post and Courier newspaper. The report, dated February 5, 2016, was provided to the co-owners three months before SCANA requested an increase of more than $800 million for the final cost of its 55 percent share of the project (NN, July 2016, p. 30).

**Four new lawsuits filed**

In addition to the class action lawsuit filed on August 11 (NN, Sept. 2017, p. 14), four more lawsuits have been filed against the Summer-2 and -3 co-owners since the July abandonment announcement.

On August 22, a Santee Cooper customer filed a class action lawsuit in the Hampton County Circuit Court against Santee Cooper and the Palmetto Electric Cooperative, alleging that both “have known for years that the project was mismanaged and failing” and that despite that knowledge, they continued to pass on to customers the cost associated with “a project made futile, in part due to Santee’s own negligence.” The lawsuit also argues that Santee Cooper and Palmetto Electric “chose to charge these advance payments and therefore willingly created a legal obligation to deliver some benefit for which it has already been paid.”

On August 23, two Santee Cooper customers filed a class action lawsuit in the Berkeley County Circuit Court against Santee Cooper and its individual board members, alleging that the utility “exceeded its statutory authority” by raising rates and approving agreements pertaining to the Summer expansion without a formal timeline from Westinghouse. The

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**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 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; RAI, request for additional information; TBD, to be determined.

In many cases, detailed schedules for the Nuclear Regulatory Commission staff’s technical reviews are in effect, and the following abbreviations are used for the phases of the design certification process: 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); and 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).

Beginning in October 2016, the NRC has utilized the designation “Sufficient Information” to indicate that the owner of Vogtle-3 has submitted an incomplete ITAAC notification (UIN), per 10 CFR 52.99(c)(3). Prior to the August 2017 issue, NN had been including UINs as closed ITAACs. This has been determined to be incorrect, and the data included in this issue has been corrected to reflect a true count of closed ITAACs.

**Licenses received**

FERMI-3, ESBWR, DTE Energy; Monroe, Mich. CS: TBD. The COL was issued on May 1, 2015. The licensee has not signed an EPC contract, nor has it announced any commitment to build and operate the reactor.

SOUTH TEXAS-3, -4, Toshiba ABWRs, Nuclear Innovation North America; Palacios, Texas. CS: TBD. The COL was issued on February 12, 2016. An EPC contract was signed in February 2009. However, the design certification application for the Toshiba ABWR was closed by the NRC in January (NN, March 2017, p. 21).

LEVV-1, -2, API1000s, Duke Energy; Levy County, Fla. CS: 2024, 2025–2026. The COL was issued on October 26, 2016. The original EPC contract signed in January 2009 was canceled on August 1, 2013, and has not been reinstated. Duke announced on August 29 that it will not move forward with the reactors, pending approval by the Florida Public Service Commission (NN, Sept. 2017, p. 17).

LEE-1, -2, API1000s, Duke Energy; Gaffney, S.C. CS: 2024, 2026. The COL was issued on December 19, 2016. The licensee has not signed an EPC at this time. Duke announced on August 25 that it is seeking cancellation of the project, pending approval by the North Carolina Utilities Commission (NN, Sept. 2017, p. 17).

NORTH ANNA-3, ESBWR, Dominion Generation; Mineral, Va. CS: TBD, perhaps 2028. The COL was issued on May 31, 2017. Dominion and GE Hitachi Nuclear Energy have stated that they have agreed on all contract terms, but Dominion has not committed to building the reactor and so has not signed an EPC contract. The hearing record is closed.

**License applications**

Both to save space and to keep the focus on the most active projects, the following list excludes Duke Energy’s Harris-2 and -3 and Luminant Power’s Comanche Peak-3 and -4, which have been either slowed or suspended at the request of the applicants. Talen Energy’s Bell Bend application was withdrawn on August 31, 2016 (NN, Oct. 2016, p. 17).

Turkey Point-6, -7, API1000s, FPL; Florida City, Fla. CS: 2022, 2023; FSER: November 10, 2016; FEIS: October 2016; MH: October 5. EP2 completed, February 27, 2015. A request for a hearing and petition to intervene was submitted on April
board’s decision to move forward with these actions without a timeline “was not in good faith, inconsistent with the care an ordinarily prudent person in a like position would exercise under similar circumstances, and not in the best interest of Santee Cooper or its ratepayers,” according to the court filing.

■ On August 28, 10 South Carolina Electric & Gas (SCE&G) customers filed a class action lawsuit in the Fairfield County Circuit Court accusing SCANA and its subsidiary, SCE&G, which is the operator and majority owner of Summer, of increasing billing rates charged to hundreds of thousands of customers, totaling in excess of $1 billion “for the sole purpose of constructing the nuclear power plant,” according to court documents. The plaintiffs stated that SCE&G announced on July 31 that it was abandoning the project but would continue “to bill its customers the increased charges . . . without fulfilling the promised services to plaintiffs and hundreds of thousands of other SCE&G customers” (although on August 15, SCE&G retracted its request to abandon the construction of Summer-2 and -3).

■ On September 8, two customers filed a class action lawsuit in the Richland County Circuit Court against Santee Cooper and SCANA, alleging that “plaintiffs have paid money for nothing and will continue to pay money for nothing,” according to the court filing. The lawsuit references the Bechtel audit, stating, “Despite knowledge of the imminent failure of the project, defendants [SCANA and Santee Cooper] failed to resolve the problems and continued to use the project as a cash cow.”

VOGTEL

Oglethorpe Power agrees: Complete Units 3 and 4

Oglethorpe Power, which owns a 30 percent share of Vogtle-3 and -4, has joined co-owner Georgia Power, a subsidiary of

18 by the City of Miami, the Village of Pinecrest, and the City of South Miami.

Eastern Idaho, two or more NuScale Power Modules, Utah Associated Municipal Power Systems with Energy Northwest; on or near property of Idaho National Laboratory. Application submittal is planned for 2018.

Early site permits


Clinch River, reactor TBD, TVA; Clinch River, Tenn. TVA’s 2015 integrated resource plan does not include any nuclear capacity at this site but allows for further study of small modular reactors. TVA submitted the application on May 12, 2016, and submitted a proposal on August 11 to provide supplemental information to the NRC in support of its application. The NRC accepted the application for docketing and detailed technical review on December 30, 2016. Three groups filed petitions in June against TVA’s application, expressing concerns about safety and cost of the SMR plans. An ASLB was established in July, according to a July 3 Federal Register notice.

Blue Castle Project, two AP1000s, Blue Castle Holdings; Green River, Utah. The application is currently planned for submittal in 2019.

Design certification

ABWR, 1,350-MWe boiling water reactor, GE Hitachi. 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; Toshiba withdrew its application on June 9, 2016, and the NRC closed the application docket in January.

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 final certification rule was published on October 15, 2014, with an effective date of November 14.

U.S. EPR, 1,600-MWe PWR, Areva. Technical reviews have been suspended at the applicant’s request. P3 completed, May 2012; P4 due, TBD (six chapters completed, and part of one other).

US-APWR, 1,700-MWe PWR, Mitsubishi Heavy Industries. At the applicant’s request, technical reviews have been slowed but not halted completely. P1 completed, June 2009; P2 due, TBD (17 chapters completed).

APR1400, 1,400-MWe PWR, consortium led by Korea Electric Power Corporation. The certification target date is TBD, but the schedule has a P6 target of September 2018. P1 completed, February 2016; P2 due, May 2017.

NuScale Power Module, 50-MWe (gross) integral PWR, NuScale Power. The application was submitted to the NRC on January 12 and consisted of nearly 12,000 pages (NN, Feb. 2017, p. 15). The NRC released on May 22 its review schedule for the application, with the following target completion dates: P1, April 2018; P2, May 2019; P3, August 2019; P4, December 2019; P5, June 2020; and P6, September 2020. A draft set of design-specific review standards was issued in June 2015, and the release of sections of the final version began on June 24.

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

mPower, 195-MWe integral PWR, Generation mPower (BWX Technologies/Bechtel). The application submittal date is TBD, and in March 2016 it was announced that Bechtel has taken charge of development, with the goal of arranging outside financing by March 2017. On March 3, Bechtel informed BWXT that it had not secured sufficient funding to keep the project going and was invoking settlement provisions outlined in the framework agreement for terminating the program. As a result, BWXT will pay Bechtel a $30 million settlement as agreed to by both companies in the framework agreement. The established data will be archived, and BWXT and Bechtel will halt further action on the project.

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

Xe-100, 75-MWe high temperature gas-cooled pebble bed modular reactor (HTGR), X Energy LLC. The company announced on March 16 that it has commenced the conceptual design phase, with the goal of deployment within 10 years.

TEUSA IMSR400, 400-MWt, integral molten salt reactor, Terrestrial Energy USA Ltd (TEUSA). The company reaffirmed in January its intent to commence pre-application interactions with the NRC in 2017 and to submit an application by October 2019.

There are no other declared certification candidates at this time, but many other designs have been proposed. In January 2016, the Department of Energy chose two projects for new funding support: X Energy LLC’s Xe-100, mentioned above, and the Molten Chloride Fast Reactor from a team that includes TerraPower and Southern Nuclear.
NEI HAS RELEASED THREE NEW EFFICIENCY BULLETINS in support of the Delivering the Nuclear Promise initiative, according to an August 21 press release. EB 17-17, Standard Indicator Central Database, will provide a central database that will allow the Institute of Nuclear Power Operations and the industry to manage key performance indicator (KPI) data. All nuclear power plants will have the ability to upload performance information and download KPI reports directly from the database, reducing the resource requirements of individual plants. EB 17-18, Optimizing Strategic Engineering, Engineering Response Team, and Component Maintenance Support, focuses on redesigning engineering organizational structures to better focus on core responsibilities and to utilize resources more efficiently. EB 17-19, Optimizing Program and Design Engineering Organizations, presents optimal organizational structures and staffing levels for program and design engineering organizations at nuclear power plants.

The Nuclear Energy Institute has issued 62 EBs since the Delivering the Nuclear Promise initiative began in December 2015, with the purpose of identifying efficiency measures and adopting best practices and technology solutions in order to improve operations, reduce electricity generating costs, and prevent premature reactor closures. NEI surpassed its goal of releasing 37 EBs in 2016 (NN, Jan. 2017, p. 76), and 20 EBs have been released in 2017. The bulletins in their entirety can be found by searching for the bulletin number at <www.nei.org>.

THE U.S. GOVERNMENT SHOULD WORK WITH THE INDUSTRY to restore and develop the nuclear sector, according to an August 10 essay by Mark Hibbs, a senior fellow in the Carnegie Endowment for International Peace’s Nuclear Policy Program. Hibbs offers four reasons that nuclear power plant exporters and their governments in the United States and other Western countries should be “keenly concerned” about China’s and Russia’s forays into future nuclear power plant markets. He notes that Chinese and Russian companies responsible for exporting nuclear power plants are state-owned enterprises and therefore can offer financing terms that Western companies, bound by export credit rules, cannot match. Hibbs posits that countries that import nuclear power plants commit to managing this technology over a project life cycle of 100 years, and so will be less inclined to buy from partner nations that “do not inspire confidence that they will be using nuclear power for more than one or two decades.” For these and other reasons mentioned in the essay, the current administration “should have a structured conversation with U.S. industry about what steps Washington could and should take to enhance U.S. nuclear exports and encourage a level international playing field for exporting nuclear equipment, material, and technology,” Hibbs writes. The essay can be found on Carnegie’s Nuclear Policy Program website, at <www.carnegieendowment.org/programs/npp/>, Southern Company, in recommending the completion of the new reactors. On August 31, Oglethorpe announced that its board of directors has determined that “it is in the best interest of the corporation to support Georgia Power Company . . . and to proceed towards completion of the Vogtle project,” according to a company press release. Mike Smith, president and chief executive officer of Oglethorpe, said, “We believe we must take a long-term view and recognize the benefits of fuel diversity and the price stability of emission-free nuclear power over the next 60 to 80 years.”

Also on August 31, Georgia Power filed with the Georgia Public Service Commission its own recommendation to complete the two AP1000 reactors near Augusta, Ga. (NN, Sept. 2017, p. 17). Georgia Power’s most recent estimate places Vogtle-3 and -4 in commercial operation in November 2021 and November 2022, respectively.

On August 24, a few days before issuing its official recommendation to complete the units, Oglethorpe announced in an investor update that it is seeking an additional loan guarantee from the Department of Energy in the range of $1.5 billion to $1.6 billion to fund its share of the cost of completing Vogtle-3 and -4. “We have a loan from the DOE of $3 billion . . . of which we have advanced $1.7 billion,” said Betsy Higgins, chief financial officer of Oglethorpe. “Given the Westinghouse bankruptcy and disruption on the project, the loan was amended at the end of July to have some conditions to where advancements are suspended until a determination to continue construction on the project with the new budget and schedules is made, and we have an agreement with a new contractor in place.”

Before a new funding agreement can take place, however, the Georgia PSC must decide whether to allow construction of the Vogtle site to continue. The PSC will make a decision regarding the future of Vogtle-3 and -4 as part of the 17th Vogtle construction monitoring proceeding.

QUAD CITIES

Exelon to invest $20 million in construction projects

On August 31, Exelon Corporation announced that construction is under way on several new projects at the Quad Cities nuclear power plant near Cordova, Ill., “bringing hundreds of jobs and providing more than $20 million in new contracts for Illinois-based and diversity-certified suppliers,” according to a company press release. These projects were cancelled or put on hold as Exelon prepared to retire Quad Cities in June 2018. The projects are
Quad Cities: New construction projects are under way, now that the plant will remain in operation.

back on track, however, largely due to the Future Energy Jobs Bill signed into law by Illinois Gov. Bruce Rauner in December 2016 (NN, Jan. 2017, p. 33), which ensures the continued operation of Quad Cities for at least 10 years, according to Exelon.

The first project is a multimillion-dollar expansion of the Quad Cities Professional Learning Center that will nearly double the size of the current building and create a state-of-the-art training facility for Quad Cities employees, according to Exelon. The new addition will add over 36,000 square feet to the existing structure and will allow the station to retire older, temporary buildings that Exelon says require more frequent maintenance. It will also provide a “modern and professional learning” environment for the supplemental workers who support the plant, especially during annual refueling outages, according to the press release. Construction is expected to be completed in early 2018.

Other projects include the expansion of the Quad Cities used fuel storage pad; the construction of a new maintenance facility that will house numerous vehicles and lawn and snow removal equipment and will include a welding training shop designed for specialty training and qualification certifications required at the plant; and a number of facility upgrades and remodeling projects.

ENFORCEMENT

NRC shifts Perry, Hope Creek in ROP matrix

In an August 31 update to the Reactor Oversight Process action matrix, the Nuclear Regulatory Commission downgraded the status of FirstEnergy Nuclear Operating Company’s (FENOC) Perry reactor and upgraded PSEG Nuclear’s Hope Creek unit. According to the NRC’s August 24 letter to FENOC regarding the final significance determination of a “white” (low to moderate significance) finding at Perry, the utility failed to evaluate the effects of voltage suppression diode failure on the standby diesel generator (SDG) control circuit. More specifically, FENOC “failed to consider the effect of a shorted diode on the control circuitry of the SDG and, as a result, failed to recognize that installation of voltage suppression diodes across control relays, with no mitigation for diode failure, was not suitable for the SDG control circuit.” The introduction of the diodes led to the failure of the SDG control circuit, rendering the SDG unable to start on November 6, 2016, the NRC said.

Consequently, the agency has transitioned the 1,268-MW e boiling water reactor, located in North Perry, Ohio, to the matrix’s more heavily regulated second column, Regulatory Response, from the standard oversight of the first column, Licensee Response, effective the second quarter of 2017. In addition, the NRC issued FENOC a violation notice in regard to the matter.

In its August 30 assessment follow-up letter to PSEG, the NRC stated that it was closing a 2016 white finding at Hope Creek pertaining to PSEG’s inadequate implementation of its Adverse Condition Monitoring and Contingency Plan, established to deal with steam leakage from the high-pressure coolant injection steam admission valve (NN, Mar. 2017, p. 76). As a result of the finding’s closure, the 1,228.1-MWe BWR, located near Salem, N.J., has been returned to the Licensee Response column from Regulatory Response, effective August 30.

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DEPARTMENT OF JUSTICE

Engineer sentenced for selling nuclear secrets

Szuhsiung “Allen” Ho, a Taiwan-born naturalized U.S. citizen, has been sentenced to 24 months in prison for passing restricted U.S. nuclear technological information to China. The sentence, which is to be followed by one year of supervised release, was handed down on August 31 by U.S. District Court Judge Thomas A. Varlan in Knoxville, Tenn. Ho was also ordered to pay a fine of $20,000.

In January of this year, the 66-year-old nuclear engineer pleaded guilty to conspiring to unlawfully engage or participate in the production or development of special nuclear material (SNM) outside of the United States, without first obtaining Department of Energy authorization, a requirement of U.S. law (NN, Feb. 2017, p. 28). In return for his guilty plea, prosecutors took the more serious charges against Ho off the table, including that he had acted as a foreign agent, and reduced his potential sentence from a maximum of life in prison to a maximum of 10 years.

Ho had been named in an indictment that was unsealed in April 2016 (NN, May 2016, p. 18) and had initially pleaded not guilty to all charges. Also named in the indictment were China General Nuclear Power Company (CGN), for which Ho had worked as an advisor, and his own company, Energy Technology International.

According to an August 31 Department of Justice press release, Ho assisted CGN in procuring U.S.-based nuclear engineers to assist the company and its subsidiaries with designing and manufacturing certain components for nuclear reactors more quickly by reducing the time and financial costs of research and development. Ho specifically sought, among other things, technical assistance for CGN’s Small Modular Reactor Program and Advanced Fuel Assembly Program. In addition, Ho identified, recruited, and executed contracts with U.S.-based experts from the civil nuclear industry who provided SNM-related technical assistance for CGN in China. Further, the release stated, Ho and CGN facilitated travel to China and payments to the U.S.-based experts in exchange for their services. One such expert, former Tennessee Valley Authority senior manager Ching Ning Guey, admitted in 2015 to being recruited by Ho and to passing restricted documents to the Chinese government during a visit to China in November 2013 (NN, June 2016, p. 28).

“The U.S. Attorney’s office is committed to working to ensure that sensitive and controlled technology is not illegally obtained and exported from the United States,” said U.S. Attorney Nancy Stallard Harr in the press release. “Violations of our export control laws will be aggressively prosecuted in the Eastern District of Tennessee.”

Renae McDermott, special agent in charge of the FBI’s Knoxville Division, added, “Theft of our nuclear technology by foreign adversaries is of paramount concern to the FBI. Along with our local, state, and federal partners, we will aggressively investigate those who seek to steal our technology for the benefit of foreign governments.”

DEPARTMENT OF ENERGY

Funding for grid resilience and security announced

The Department of Energy announced on September 12 a multimillion dollar effort to bolster the resilience and security of the nation’s critical energy infrastructure, including the electrical grid, as well as oil and natural gas infrastructure. The announcement came just days after the
hurricanes that caused extensive power outages in Texas and Florida (see page 22), and only weeks after the DOE released its much-anticipated grid study, which examined a number of issues related to grid resilience and reliability (NN, Sept. 2017, p. 17). Up to $50 million will be awarded to national laboratories to support early-stage research and development of next-generation tools and technologies, with the final amounts being subject to negotiation and congressional appropriations.

“A resilient, reliable, and secure power grid is essential to the nation’s security, economy, and the vital services that Americans depend on every day,” said Secretary of Energy Rick Perry in a DOE press release. “As round-the-clock efforts continue to help communities recover from the devastation of Hurricanes Harvey and Irma, the need to continue strengthening and improving our electricity delivery system to withstand and recover from disruptions has become even more compelling. By leveraging the world-class innovation of the national laboratories and their partners, this investment will keep us moving forward to create yet more real-world capabilities that the energy sector can put into practice to continue improving the resilience and security of the country’s critical energy infrastructure.”

Seven Resilient Distribution Systems projects will be awarded up to $32 million over three years through the DOE’s Grid Modernization Laboratory Consortium, part of the DOE’s Grid Modernization Initiative. Idaho National Laboratory, Sandia National Laboratories, and Pacific Northwest National Laboratory, for instance, will be awarded $6.2 million to work on enhancing “the resilience methods for distribution grids under harsh weather, cyber-threats, and dynamic grid conditions, using multiple networked microgrids, energy storage, and early-stage grid technologies.” Included as project partners are Siemens Corporation, Washington State University, Florida State University, New Mexico State University, Microgrid Solutions, the City of Cordova, Cordova Electric Cooperative, the Alaska Center for Energy and Power, and the Alaska Village Electric Cooperative.

In addition, the DOE has earmarked over $20 million for 20 cybersecurity projects focused on six topic areas: partnerships to reduce risk through vulnerability mitigation, identification of energy delivery system (EDS) equipment inadvertently exposed to the public Internet to reduce the cybersecurity risk on the operational technology infrastructure, EDSs that can adapt to survive a cyber-incident, EDSs with verifiable trustworthiness, cybersecure communications for operating resilient grid architectures, and tools and technologies that enhance cybersecurity in the energy sector. In one such project, Argonne National Laboratory is partner-
A MAN CLAIMING TO HAVE EXPLOSIVES IN A VAN AT SONGS was arrested on September 12. According to a San Diego County Sheriff’s Department news release, 27-year-old Erik Jon Norman drove a delivery van past the entrance gate of the permanently closed San Onofre Nuclear Generating Station and into a restricted parking area, where he was detained by the facility’s security force. The van, it was subsequently learned, had been reported stolen earlier that day. After being informed by Norman that the vehicle contained electronic equipment and possibly explosives, plant security contacted sheriff’s deputies, requesting assistance. Also responding were personnel from the department’s bomb/arsen unit, who determined that the van contained only standard shipping parcels. Norman was later booked into jail on a stolen vehicle charge.

Security Briefs

NATIONAL SECURITY IS A KEY REASON TO EXTEND THE PTC for new nuclear, a report prepared for the Electric Reliability Coordinating Council (ERCC) states. “Domestic nuclear infrastructure and the educational base that supports it directly contribute to our national security and are increasingly left out of plans to expand the nation’s power base with a reliable and long-term clean energy source,” writes Kirk Lippold, an energy security expert and retired U.S. Navy commander, in the report. “Key to maintaining our primacy in the field of nuclear power is the pending extension of the nuclear production tax credit.” The House of Representatives on June 20 passed legislation that would, among other things, lift a requirement that nuclear facilities be placed into service by the end of 2020 in order to receive the PTC for electricity production (NN, July 2017, p. 17), but as of this writing, the Senate had not taken up the matter.

Lippold’s report, Nuclear Energy, the Production Tax Credit, and International Security, can be accessed from the ERCC’s website, at <www.electricreliability.org>, under “Studies, Reports and Commentaries.”

Chinese nuclear security is “strong,” says agency

On September 8, a team from the International Atomic Energy Agency completed a nuclear security advisory mission in China, finding “strong and sustainable nuclear security activities,” as well as “a number of good practices,” according to an IAEA press release.

The scope of the 10-day International Physical Protection Advisory Service (IPPAS) assessment included China’s legislative and regulatory framework for nuclear security and the physical protection of nuclear materials and facilities. The eight-member IPPAS team, led by Joseph Sandoval, of Sandia National Laboratories, visited the Fangjiashan nuclear plant, home to twin 1,012-MWe pressurized water reactors, to review security arrangements and observe physical protection measures. The team also examined China’s implementation of the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material, ratified by Beijing in 2009, and met with a number of entities involved with China’s nuclear security, including the China Atomic Energy Authority (CAEA) and the Ministry of Public Security.

“A strong commitment to nuclear security is a must for any state that uses nuclear power for electricity generation and that is planning to significantly expand this capacity by constructing new power reactors,” said Muhammad Khaliq, head of the IAEA’s Nuclear Security of Materials and Facilities Section, in the release. “China’s example in applying IAEA nuclear security guidance and using IAEA advisory services demonstrates its strong commitment to nuclear security and its enhancement worldwide.” The CAEA’s deputy director general, Shen Lixin, expressed satisfaction with the mission report and said, “I am very proud that the team could identify good practices to be shared with the international community.”

This was the 77th IPPAS mission to be conducted by the IAEA since the program was initiated in 1995.
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Outage Management and Plant Maintenance

A unique approach to long-term reactor internals management

Perry’s 29-day refueling outage is shortest in its operating history

Executing the Darlington refurbishment project—Year 1

Utility Working Conference

A closer look at Efficiency Bulletins
A unique approach to long-term reactor internals management

By Chaz McFeaters and Rob DeNight

PSEG Nuclear’s outage and contingency planning campaign for baffle-former bolt inspections and replacements saved time, reduced worker dose, and will benefit future outage planning.

During the spring 2017 outage for Unit 2 at the Salem nuclear power plant, PSEG Nuclear instituted a robust outage and contingency planning campaign for baffle-former bolt inspections and replacements. The unique approach saved time in the outage schedule, reduced dose exposure for personnel, and set the stage for the long-term health of the unit’s reactor internals.

Since the mid-1990s, baffle-former bolt cracking has been a known degradation mechanism in the reactor internals of pressurized water reactors. U.S. operating experience in 2016 demonstrated that some of the bolts may be subject to extensive degradation as those plants age. This was the case for Salem-1, where during the spring 2016 outage, PSEG Nuclear found through visual inspection that 18 baffle-former bolts exhibited indications of cracking. Although ultrasonic testing of the baffle-former bolts at Unit 1 wasn’t required until 2019 per the unit’s licensing commitments, PSEG extended the outage to conduct the ultrasonic inspection and replace the bolts as needed. As a result, 189 bolts were replaced, requiring a significant outage extension and additional costs.

Baffle-former bolts are made from stainless steel and are used to attach vertically oriented flat metal panels called baffle plates to horizontally oriented metal panels called former plates. The baffle-former plate assembly serves as a precisely configured support structure for the fuel assemblies, holding them securely inside the round core barrel. The baffle-former plates also direct the flow of coolant water through the reactor.

Baffle-former bolts are located around the core and become highly irradiated due to neutron flux during plant operation. In 1997, the Westinghouse Owners Group (now part of the Pressurized Water Reactor Owners Group) created a task force to evaluate the integrity of baffle-former bolts in PWRs and determined that they are at risk for irradiation-assisted stress corrosion cracking. This and other such plant aging–related concerns are closely monitored by the nuclear energy industry, which has established guidelines through the Electric Power Research Institute’s Materials Reliability Program (MRP), specifically for inspecting and evaluating long-term aging effects on reactor internals. The guidelines are documented in MRP-227, Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines, and MRP-228, Materials Reliability Program: Inspection Standard for PWR Internals.

One possible solution for addressing baffle-former bolt degradation includes modifying the core design from a traditional downward flow—or down-flow—where cooling water is directed between the core barrel and the baffle-former plates in a downward direction, to an up-flow configuration to reduce stresses on the baffle plate and baffle-former bolts. Another mitigation option is replacing original baffle-former bolts with improved-design bolts that minimize the concentration of stress between the bolt head and shank. PSEG chose the latter option and applied knowledge acquired through Westinghouse’s predictive analysis model to replace more bolts than had indications. This was done both to meet PSEG’s future inspection plans and to allow for conversion to an up-flow configuration in the future, if desired.

Outage planning

Anticipating similar baffle-former bolt findings as experienced with Unit 1, PSEG wanted to get ahead of the issue during the spring 2017 outage for Salem-2 and ensure the long-term viability of the unit’s reactor internals. In addition, PSEG wanted to establish an approach that would minimize the variability of baffle-former bolt inspection results and repairs in future outages.

PSEG contracted with Westinghouse, and the two organizations worked together to prepare for the baffle-former bolt ultrasonic inspection and bolt replacements during the outage. With the expectation of having to replace many of the bolts, PSEG created an innovative approach to completing that work while also achieving other outage goals. PSEG’s plan was to pull the core barrel out of the reactor and perform the bolt replacement work with the core barrel in the lower internals stand. This would allow personnel access to the reactor internals to complete other work in parallel with the bolt replacement. Outage planners from the site and Wes-
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ttinghouse crafted an innovative plan to achieve PSEG’s goals for the Unit 2 outage.

The planning process included consideration of how to minimize personnel dose exposure with the core barrel removed from the reactor, which elevates radiation levels over the refueling cavity; how to keep personnel dose low when performing the bolt replacements with the core barrel in the lower internals stand; and how to perform maintenance on the polar crane and allow it to be used for other outage tasks while still supporting the bolt replacements. The Westinghouse baffle-former bolt replacement system typically requires the crane to hold its large tooling.

PSEG’s preparation also included the use of Westinghouse’s predictive analysis model for baffle-former bolts to assist with the utility’s decision-making during the outage. PSEG wanted to pursue this path because the model provides the ability to predict the timing of baffle-former bolt wear, thereby facilitating decision-making regarding the timing of necessary bolt replacements and ultimately allowing the station to establish a long-term multi-outage plan.

Preparation of the model began several months in advance of the outage. Westinghouse, as the original equipment manufacturer, was able to use its knowledge of the detailed inputs and design model for the Westinghouse-design four-loop plant reactor internals in operation at Salem-2. The company developed a finite element analysis model of the unit’s reactor internals, along with a neutron fluence projection, to create the Unit 2-specific predictive analysis model. The model was then ready to receive inspection results as inputs during the outage, allowing PSEG to make informed, timely, and strategic decisions on baffle-former bolt replacements while the outage was under way.

Inspection

The baffle-former plate assembly is fixed within the Salem-2 reactor core with 832 bolts. Inspecting these bolts presents a challenge, as their hexagon-shaped socket heads have a locking bar that is inserted into a groove in the head of each bolt to prevent it from loosening and backing out during operation. Working with WesDyne—the wholly owned nondestructive examination subsidiary of Westinghouse and developer of a technique to inspect this style of bolt—Salem planned 3.5 days for the inspection to be completed.

Salem and WesDyne personnel teamed to coordinate the equipment laydown and setup requirements and activities to complete the ultrasonic inspection, which is performed inside the core barrel under water. To reduce the overall inspection time, the outage team implemented a new approach, deploying two remotely operated mini-submarines, called MIDAS-VI, in parallel to deliver the inspection probes. Each MIDAS-VI engages the bolt head and locking bar so that ultrasonic signals can be projected through the bolts. Each is also equipped with cameras and lights, as well as suction cups for temporary attachment to the core barrel’s walls for stabilization.

The data files resulting from the inspection were reviewed by a minimum of two analysts before each bolt was designated as nondegraded or as having an indication. The team inspected and analyzed each of the 832 bolts, determining that nine had indications. They completed the ultrasonic examinations and evaluations in 2.2 days, which was 1.3 days, or 31.2 hours, ahead of schedule.

Deciding on the approach

Following the inspection, the predictive analysis model was employed to assess the results and provide projections of baffle-former bolt degradation for various possible replacement strategies over subsequent operating years.

PSEG made use of the predictive analysis modeling tool to determine a long-term aging management plan based on a realistic prediction of the baffle-former bolts’ integrity based on plant-specific design, up-to-date operating history, and inspection result details. This approach not only lowered the risk of finding future indications unexpectedly, it facilitated proactive decision-making and planning concerning replacement and future inspections.

From the time of inspection to the first bolt installation, Westinghouse was able to evaluate four potential bolt replacement patterns for PSEG’s consideration. PSEG’s first strategic objective for the replacement pattern was that it should provide a reasonable assurance of supporting Unit 2’s operation through four additional cycles without having to perform additional ultrasonic inspections, maximizing the time allowed in the Materials Reliability Program.

With confirmation via the predictive analysis model to support this objective, PSEG decided on an 89-bolt replacement pattern developed for installation by the replacement field teams. Reaching this decision required strong coordination by the PSEG and Westinghouse engineering teams. The decision included the consideration of inputs from the predictive analysis model concerning when additional replacements would provide only diminishing returns, and was made within 72 hours of the completion of the inspection. This prevented the station from unnecessarily spending critical path time replacing bolts that did not appreciably affect aging projections, saving outage time and replacement costs.

A second objective for the replacement bolt pattern was to preemptively replace bolts that would support a cooling water up-flow pattern, should PSEG decide to make up-flow modifications in the future. To take advantage of remaining outage time available following the efficient replacement process of the selected
89 baffle-former bolts, PSEG requested that the predictive analysis model again be employed. This time, the model was applied to aid in determining which, if any, additional bolts should be replaced to dovetail with a future up-flow pattern. An additional 40 replacement bolts were identified to support this goal, resulting in the installation of a total of 129 replacement bolts during the outage.

**Outage achievements**

PSEG originally had planned a 20-day outage window for the bolt replacement work. This was reduced to 13 days after the inspection results indicated that fewer bolts needed to be replaced than anticipated.

The outage teams pulled the core barrel as planned, and several new techniques were implemented by both teams to shield outage workers from the increased radiation. PSEG super-flooded the reactor cavity and placed a temporary head on the vessel in order to complete work on the steam generator, guide card wear measurement, and the reactor coolant pump and motor in parallel with the baffle-former bolt replacement work—and off the critical path schedule.

Knowing early in the outage planning that PSEG wanted to perform these other outage tasks in parallel with the baffle-former bolt replacement activities, Westinghouse retrofitted and transported to the site a motorized work bridge to hold the 50-foot-long baffle-former bolt replacement system. This freed the polar crane for preventive maintenance and also made it available for the performance of other duties in support of the outage. The teams also installed a shield ring manufactured specifically to shield workers replacing the baffle-former bolts with the core barrel in the lower internals stand, something Westinghouse had not done before. The Salem-2 health physics team also shielded the Westinghouse motorized work bridge, which reduced dose even more.

Completing the baffle-former bolt replacements in the lower internals stand proved to be more efficient: The replacement team averaged 10 bolts per day using only one replacement tool.

PSEG’s proactive ideas for completing more work in the outage window resulted in a very efficient outage, as well as reduced dose. The super-flooded reactor cavity condition allowed more water in the cavity to reduce dose in the general area. The installation of the shield ring for completing the baffle-former bolt replacement work in the lower internals stand reduced dose exposure rates from 5 milliroentgens per hour to 1–2 mR per hour; the shield ring will be a permanent fixture in the plant for future work. Shielding the motorized work bridge reduced dose exposure rates even more.

The team’s approach to the integrated outage planning supported PSEG’s outage maintenance goals as well as its long-term goals for Salem-2’s reactor internals. This has enabled PSEG to establish more predictable outage durations, minimize the cost impact of baffle-former bolt replacements, and consider options for up-flow modifications. PSEG is continuing this approach at Salem-1, which will undergo its first post–baffle-former bolt inspection/replacement outage this fall. The highly successful innovative planning and approach implemented during Salem-2’s spring 2017 outage could serve as a model for other plants as they consider strategic tactics for reactor internals aging management.

Baffle-former bolts become highly irradiated due to neutron flux while performing their function to hold the precisely configured baffle-former plate assembly (illustrated above), which is the support structure that secures the fuel assemblies inside the round reactor core barrel.

![Baffle-former assembly](image1)

![Baffle-former assembly (section view)](image2)

Baffle-former bolt replacement at Salem-2, with the core barrel in the lower internals stand and shielding in place, both within the stand and on the motorized work bridge.
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FirstEnergy Nuclear Operating Company’s (FENOC) Perry nuclear power plant—a 1,270-MWe boiling water reactor located in North Perry, Ohio—completed its 16th refueling outage on April 3, 2017. The 29-day outage, which began on March 5, marks the shortest refueling outage in Perry’s 30 years of operation (the previous record was 34 days in 2001).

More than 1,400 contract workers and FENOC employees from the company’s other nuclear plants supplemented Perry’s 700-person workforce during the outage. In addition to replacing 280 of the plant’s 748 fuel assemblies, workers completed more than 9,600 outage work activities. A new, massive transformer that provides power from the off-site transmission network was also installed.

On this and the following pages are photos showing some of the refueling and maintenance work that was carried out during the outage. (Photos: FirstEnergy)

New fuel for Perry’s reactor began arriving on site in late 2016. Upon its arrival, Maintenance, Engineering, Operations, and Radiation Protection personnel worked together to ensure that each new fuel bundle received a detailed inspection before it was channeled and placed in the fuel pool.
To reduce dose exposure and ensure that workers were prepared for safe, event-free outage work, pre-outage training was conducted for numerous projects. Maintenance personnel took advantage of salvaged parts to perform a mockup of work on a disc valve located atop the drywell. This prepared them for successful outage performance once the actual work was under way.

To minimize dose exposure for workers during the outage, Perry utilized a new underwater robot vacuum in the reactor cavity, reducing cavity decontamination collective radiation dose by approximately 80 percent from the last outage. An advantage of the new vacuum is its ability to clean curved surfaces like the drywell dome; in previous outages, only flat surfaces could be cleaned using a different robotic vacuum tool.

Perry’s 118-ton, 20-foot-diameter reactor pressure vessel head is shown lifted off the vessel early in the outage. Such lifts are considered infrequently performed tests or evolutions (IPTE), a designation that provides an additional level of oversight due to the inherent risks with heavy loads and high radiological environments.

Continued
A new strongback lifting device is moved into the plant through the containment equipment hatch. The strongback connects to a polar crane for stabilization during the lift of the refuel shield, which provides radiological shielding to the upper drywell during refueling. It also allows the refuel shield to be engaged and disengaged from the crane while remaining under water. The improved strongback and several other dose-saving projects will continue to result in lower dose during future outages.

The spent fuel handling machine lifts a fuel assembly out of the inclined fuel transfer system to place it in Perry’s spent fuel pool. The replacement of 280 fuel assemblies with new fuel was carried out during the outage.

A look at Perry’s refuel floor, with the drywell head on its stand in the background and the reactor pool in the center.
A member of Perry’s refueling team studies a map of the reactor core depicting the position of each fuel assembly. The refueling team performed 1,779 fuel moves during the outage, all of which were closely verified to ensure that each assembly was in the correct location.

Dry tubes that house nuclear instruments for monitoring reactor power output are moved into the plant for replacement. A new 12-tube strongback holds more dry tubes, resulting in less time and dose to perform replacements.
During the outage, Perry replaced one of two large transformers that provide power from the off-site transmission network to the plant’s on-site electrical systems. A Goldhofer transporter was used to move the 20-foot-tall, 115-ton startup transformer into place outside Perry’s inactive Unit 2 turbine building.

Design engineers watch as fire suppression testing is performed on the new startup transformer after its installation.
Perry’s operators perform scram-time testing to verify that the control rods, which control power in the reactor core, can be fully inserted within seconds to shut down the reactor. During each outage, the ability of each control rod to insert rapidly is verified by this testing.

Perry’s lead cooling tower engineer performs inspections inside the 516-foot-tall structure. The cooling tower is inspected and maintenance is performed during each outage to optimize the thermal performance of the tower and support optimum plant performance and efficiency during the upcoming operating cycle.

Continued
Contract workers replace the motor operator on one of the four central de-ice valves in the cooling tower. During freezing conditions, these valves are used to direct the flow of hot water in the cooling tower to the tower’s periphery, allowing hot air to migrate to and de-ice the center of the tower.

A view of Perry’s reactor core following the final fuel moves. Perry’s 1,270-MWe reactor will operate for approximately 24 months until its next scheduled refueling in spring 2019.
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Executing the Darlington refurbishment project—Year 1

By Dick Kovan

On October 15, 2016, Ontario Power Generation (OPG) shut down Unit 2 at its Darlington Nuclear Generating Station to begin the refurbishment of the first of the plant’s four CANDU units. As of the beginning of September 2017, the Unit 2 refurbishment was a quarter of the way through its planned 40-month duration, on budget and on schedule.

The station’s four units are 878-MWe CANDU 6 pressurized heavy-water reactors that began operation between 1989 and 1993—Unit 2 in November 1989, Unit 1 in October 1990, Unit 3 in November 1992, and Unit 4 in March 1993. For a CANDU reactor to operate beyond 30 years, it must undergo a major mid-life refurbishment to replace the main reactor components, doubling its service life. Each Darlington reactor consists of a large, heavily shielded vessel, or calandria, containing 480 horizontal fuel channels and 6,240 bundles of uranium fuel encased in Zircaloy sheathing. Each unit will be out of service for about three years to complete its refurbishment program.

The main refurbishment work is included in a retube and feeder replacement work package covering the removal and replacement of the reactor pressure tubes, calandria tubes, feeder pipes, and end fittings. This is the largest work package, accounting for about 60 percent of the total cost, and is central to the success of the project.

Other major activities include the renovation of steam generators, turbine generators, and fuel handling equipment, as well as a variety of system improvements and plant upgrades. The focus of these activities is to ensure operation for another 30 years, as well as to meet current regulatory requirements.

Project schedule and cost

The sequence of the refurbishment outages is Unit 2, 3, 1, and 4. OPG's target timeline chart shows that work on Unit 2 is to be completed before the start of work on Unit 3 to ensure that the lessons learned will be implemented during the second refurbishment. The chart also shows work on Units 1 and 4 starting before the previous one has been completed.

Prior to the start of each unit’s outage, OPG will develop detailed unit-specific cost, schedule, risk, and other plans. The initial defined schedule for each unit will be used to measure project performance. Funding will be released on a unit-by-unit basis, providing an opportunity to review project performance prior to proceeding to the next unit. According to OPG, this makes it imperative to succeed on each unit in order to obtain approval to proceed to the next.

In June, OPG reported that the cost to complete Unit 2 remains within the approved budget of Can$3.417 billion (about $2.77 billion), including contingencies.
Project prep, execution

The focus over the past five years has been on project planning and preparation. Considerable effort was made to develop tools, train personnel, prepare detailed work procedures, and produce detailed plans that are ready to execute.

“The up-front work—the planning and preparation—are the keys to success when it comes to project excellence,” said Scott Berry, communications manager for the Darlington refurbishment. “We are now reaping the benefits of the effort put in place long before the execution phase began.”

In planning the project, the execution phase was organized into five major work phases, or segments. Segment 1 focuses on preparing for the reactor refurbishment.

Starting with reactor shutdown, Segment 1 included defueling the reactor, draining the heavy water, and then isolating the plant from the station’s three operating units to allow the main refurbishment work to proceed at Unit 2 while the other units continue generating power. Isolating the plant, also referred to as “islanding,” involves putting up a system of physical barriers and controls to safely achieve the separation. In early April, the successful completion of a containment pressure test marked the end of Segment 1.

The start of Segment 2

With the unit safely isolated, the reactor vault’s two airlocks could be opened for the first time since the unit was connected to the grid to allow for the unhindered movement of tools, equipment, and personnel. Workers could then focus on preparing the reactor vault by removing any “interferences,” or obstructions, and installing the critical “work tables”—two massive retube tooling platforms (RTP)—in readiness for the first big refurbishment effort.

The 100-metric-ton RTPs, one for each reactor face, consist of an elevating work surface connected to four massive columns that allow the platform to move across the reactor face, transporting...
Executing the Darlington Refurbishment Project—Year 1

workers and tools. On the platform, specialized tools mounted on rails are able to move horizontally across the reactor face, providing access to each of the 480 fuel channels. The tooling platform is operated remotely from the retube control center.

Because of their size, the platforms must be brought into the reactor vault in pieces and assembled. To prepare for this critical activity, the RTPs were first assembled and disassembled in Darlington’s full-scale reactor mock-up, then set up in a replica of the Darlington reactor vault, allowing for extensive practice by the team involved. The components were subsequently taken to the station and into the actual vault through the airlocks.

“As always, safety is key,” said Ken Brown, director of retube and feeder replacement. “The team has planned and practiced for this work, which means the learning curve happened at the training facility, not on the reactor face.”

**Feeder pipe removal**

With the RTPs assembled and in operation, reactor disassembly could begin, starting with the feeder pipes and associated components. In total, there are 960 feeder pipes connected to the reactor, 480 on each face. These pipes feed water that is heated in the reactor to the boilers, and then back into the reactor. Removal of the feeder pipes requires removing other components as well, including the fuel channel closure plugs at each of the fuel channel lattice sites. Once these components are removed, the feeder pipes can be disconnected from the channel end-fittings. The pipes are then cut into pieces, placed in boxes, and shipped out of the vault to a waste storage area.

The feeder pipe removal was expected to be completed in late September. The remaining task to be carried out in Segment 2A is to sever the end fittings from the pressure tubes. This sets up the work to be performed in Segment 2B—the removal of the end-fittings, pressure tubes, and calandria tubes—which is expected to start in mid-November and to take 22 months.

While this highly repetitive work has been done before, those carrying it out have been practicing the procedures on the full-scale mock-up over the past year and a half.

**Training and testing**

The full-scale reactor mock-up is not only used for training, but also to test the use of more than 400 highly specialized tools during the refurbishment. These are first tested at the manufacturers’ facilities against performance requirements. Each tool is then taken to the mock-up to be tested, including the “human interface” aspect of using the tool. This provides
Overlooking the Darlington-2 reactivity deck, where shutdown safety systems are located.
information for determining procedures and work patterns for the tool’s use.

Having a full-scale mock-up also provides opportunities to optimize the use of the tools. For example, a tool that had needed to make 14 or 15 cuts to sever a pressure tube now requires only three cuts. Given the number of tubes at the plant, considerable savings can be expected. The mock-up has also provided greater confidence that the project schedules will be met and project goals reached, Berry said. The facility is also used for developing contingencies when an activity does not go as planned.

**Vendors and contractors**

The Darlington refurbishment project uses many highly qualified vendors and contractors from across Canada. There are now over 5,000 supplemental workers on-site, Berry said, with all of Canada helping to deliver the largest clean energy project in the country. The Darlington project is pulling workers without nuclear experience from the construction trades, including boilermakers, carpenters, welders, electricians, and pipefitters. OPG has a highly effective onboarding setup that includes training in nuclear safety culture. “It has been remarkable to see the diversity and skills coming from across Canada to help with this endeavor,” Berry said.

Given the time lapse since the plant was originally built, reinvigorating the supply chain to support the refurbishment project has been a challenge, according to Berry. However, many manufacturers across Ontario, he said, have had the courage to invest in new technology and expanded facilities and to hire more staff, believing that this will translate into success. “The project has tight deadlines, and they are being met,” Berry said. “Our vendors are fully with us in this project. We really do have a ‘one team, one approach’ here.”

**Risk: Lessons learned**

An important part of the preparation, as well as a vital element in good project management, is identifying and managing risk. Previous projects were studied—both those that went well and those that did not—including nonnuclear megaprojects around the world. The lessons learned have been applied, particularly to identify risks and minimize and mitigate them. Examples of these lessons include ensuring that sufficient front-end planning is done, using mock-ups for training, and engaging the supply chain early on to ensure that materials are on-site well in advance of when they are needed. Managing processes and having good controls in place are particularly important in order to avoid delays and cost surprises. “We have a lot of oversight on this project, which provides independent insights on ways to improve,” Berry noted. These are already being used in the existing project and in planning for subsequent refurbishments as well.

“We’re managing risks,” Berry stressed, “building in the right contingencies and having plans in place to put into action when things don’t go well.” An example he mentioned involved a problem that arose during the defueling of the reactor. Having pre-identified potential risks, there was a plan on the shelf that was put into play, resulting in the successful completion of the defueling days ahead of schedule.

At the same time, Berry said, “We are still looking for opportunities in our existing schedule to find possible innovations, efficiencies, optimizations, and other improvements.” As risk mitigation is still the priority, however, before accepting a new innovation, possible downstream effects must be considered. Any risk should be manageable, with safety being preserved, he said, and added, “But if there are opportunities to optimize schedules or costs, we want to take advantage of them.”

Good project management relies on good data, Berry said, and a “relentless focus on metrics.” Real-time data are collected at Darlington to identify emerging trends or issues, thereby allowing action to be taken before a bigger problem arises down the road, and performance is measured daily. “I think strong project management and excellence are really about vigilance, on having your eyes on the ball at all times,” he said. “We need to know where we are and where we should be all the time.”

A low-level waste container is placed inside a shielded container for shipment to a licensed facility for storage.
A closer look at Efficiency Bulletins

Industry experts view successful implementation of maintenance and work management EBs as key to ensuring nuclear’s long-term viability.

The ANS Utility Working Conference and Vendor Technology Expo registered another strong turnout this year, notwithstanding the barrage of discouraging nuclear industry news in the months leading up to the annual event. Drawing nearly 900 attendees and guests, the 2017 UWC, held August 6–9 at the Omni Amelia Island Plantation in Florida, featured some 60 educational sessions and workshops in 11 tracks, including six sessions devoted exclusively to maintenance and work management issues.

Not surprisingly, more than one of those sessions focused on Efficiency Bulletins (EB), the specific recommendations issued to plants as part of the industry’s Delivering the Nuclear Promise initiative. Launched in late 2015 by the Nuclear Energy Institute in collaboration with electric utilities, the Institute of Nuclear Power Operations, and the Electric Power Research Institute, Delivering the Nuclear Promise is a three-year program designed to identify measures and adopt practices to improve plant operations, reduce costs, and prevent premature reactor closures.

In one EB-related session, Tony Mueller Jr., FirstEnergy Nuclear Operating Company’s manager of fleet maintenance and work management, gave an overview of EBs that have been implemented, as well as EBs still “in the works.” He began his presentation with a discussion of two implemented EBs that deal directly with plant preventive maintenance (PM) programs: 16-16, High Cost Non-Critical PM Reduction, and 16-17, Optimizing FLEX Equipment PM Strategies. “Both of these are driving toward doing the right maintenance on the right equipment at the right time,” Mueller said. Implementation of 16-16, he noted, offers the potential for reducing the frequency of, or actually retiring, as many as several hundred preventive maintenance activities, which would reduce costs associated with existing activities and free available resources to be applied to components most important to safe and reliable operation. Implementation of 16-17, he added, ensures that appropriate resources are applied to FLEX equipment based on a value-added reliability focus. “The outcome will be performing the right tasks at the right frequencies that ensure the FLEX equipment is ready when needed,” he said.

Work management EBs that have been implemented, Mueller continued, include...
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16-15b, Utilizing Minor Maintenance, and 16-15c, FIN Team Efficiency. Prior to the implementation of 16-15b, he said, a substantial amount of work that could be performed using minor maintenance was instead performed using the extensive work management process with detailed work instructions. “As a result, planning, scheduling, and tagging resources were unnecessarily applied to simple tasks,” Mueller said. “This distracted resources from more important activities and delayed equipment repair.” In reference to 16-15c, Mueller said that the development and implementation of a Fix-It-Now staffing plan should result in the maximization of the FIN team’s effectiveness and efficiency. “The FIN team should ultimately be able to accept and complete up to 75 percent of all new incoming general work and 90 percent of all new high-priority work,” he said.

Other implemented EBs that have an impact on maintenance, Mueller said, include those on radiation protection (RP), such as 16-03, Align Personnel Contamination Event Response to Industry Guidance, which matches the level of effort and response for low-level personnel contamination events (PCE) with the risk. According to Mueller, under 16-03, the response to individual PCEs is determined by the categorical level of contamination.

“How many times do you have a level-one PCE where your craft worker in the field received minor contamination, had to come out, got put in the holding tank by RP, and you wasted half a day or a full day on getting clearance to go back to work,” he said. “This EB did away with that.” Another EB affecting maintenance, Mueller said, is 16-04, Source Checking Personnel and Tool Contamination Monitors, which changes the frequency for performing source checks at radiological exits on personnel and tool contamination monitors with enhanced technology from daily to weekly, consistent with industry standards. This change, he noted, should free up personnel and equipment for work of higher importance.

Mueller’s discussion of “in the works” EBs included two related preventive maintenance EBs, 17-03a, Value-Based Maintenance, and 17-03b, Embracing Cultural Shifts for Value-Based Maintenance. Value-based equipment reliability, according to Mueller, is the establishment and optimization of preventive maintenance tasks and frequencies in order to balance the maintenance performed on station equipment with its impact on station safety and production. “It’s the realization that changing out a component before it is needed is a detriment to safety, reliability, and costs,” he said. “Implementation of value-based equipment reliability will result in minimizing total combined maintenance costs in the preventive maintenance and corrective maintenance arena. Minimizing operation and maintenance costs will minimize equipment downtime. This allows station resources more flexibility to focus on needed corrective maintenance, reduction of corrective maintenance backlogs, and the implementation of items such as modifications and projects.”

Among the new work management EBs Mueller discussed is 17-12, Reducing Burden through Empowering First-Line Supervisors. Supervisors are often required to perform low-value activities and administrative duties that detract from their availability to coach and mentor field activities and influence desired behaviors, he noted, adding that supervisors should be empowered to set priorities and make decisions that best support the needs of the station and their staffs. “This EB,” Mueller said, “addresses the expansion of supervisor autonomy in the following areas: morning and pre-job briefing scope and content, worker qualification verification methods, work preparation and walk-down methods, work package revision methods, and industrial safety decisions.”

Mueller also pointed to EBs in the training category that affect maintenance and...
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work management, including 17-13, OJT/TPE Process. The goal of 17-13, he said, is to reduce the administrative burden of performing on-the-job training/task performance evaluation and reduce the overall time to qualify personnel.

Most important among upcoming EBs with an impact on maintenance and work management, Mueller said, is WM-E-00, Transform Maintaining the Plant Organization. The purpose of this EB, he said, is to (1) refocus the function of maintaining plant components and systems to a standard organization with a set of streamlined core functions that support plant safety and reliability using a graded approach, and (2) define and lay out an integrated team focused on effectively maintaining the plant with minimal hand-offs to external organizations.

**Improvements and cost savings**

In another session devoted to Efficiency Bulletins, John McDonald, Southern Nuclear Operating Company’s fleet work control manager, discussed improvements resulting from the implementation of maintenance and work management-related EBs at Southern’s three nuclear plants: Farley, Hatch, and Vogtle.

The very first EB issued, McDonald reminded the audience, pertained to maintenance. The goal of 16-01, Eliminate Administrative Changes to Preventive Maintenance Work Orders, he said, was to reduce the amount of paperwork associated with routine preventive maintenance. According to McDonald, as a result of the implementation of 16-01 at Southern’s plants, on-line work planning now completes most work orders 16 weeks prior to execution week, whereas previously, work orders were completed only nine weeks out. “This has reduced the amount of overtime needed to complete planning for both outage and on-line work activities,” he said, adding that the implementation of 16-01 has also resulted in a reduction of three planners per site. “The final goal is on-line PMs preplanned out to a three-year frequency,” he said. “This should improve on-line efficiency even more.”

Turning to 16-15a, Work Screening Process, McDonald noted that effective and efficient screening of incoming work is vital to the work management process. In addition to proper work classification and prioritization, he said, the identification of the most efficient and cost-effective process to prepare and execute work is required to maximize the reliability of plant equipment. “This EB has helped identify more work as tool pouch and minor maintenance,” McDonald said, “but we still need to improve here.”

In comments on 16-15b, Utilizing Minor Maintenance, McDonald noted that station supervisors are often distracted from focusing on more important activities by reviewing and approving detailed work instructions that the scope and risk of the work do not warrant. Minor maintenance, he said, should be used when the work is minor in scope and complexity, does not require detailed work-order planning, and does not increase the risk of a plant transient or other consequential event. “This EB is there to help us get the supervisors out in the field,” McDonald said. “Also, treat the craftsmen with respect. They don’t need a full-scope work order to change a filter. They know how to do that. There is this skill of the craft. If they are craftsmen, we want to make sure they are treated like craftsmen.”

According to 16-15b, plants should aim to achieve an industry benchmark target value of 60 to 65 percent minor maintenance. “We still have some work to do in this area,” McDonald said. “Farley is at 36.1 percent minor maintenance and 2.3 percent tool pouch, with Hatch at 36.5 percent and 4.9 percent, and Vogtle at 14...
percent and 3.3 percent. We’re not there yet, obviously. The biggest gap that I see is a lack of understanding that minor maintenance can be scheduled.”

McDonald also discussed 16-31, Pre-Approval Criteria for Work Execution, issued to allow work that has limited impact on the control room or the plant to be conducted without obtaining preapproval from the control room/work execution center. Under 16-31, he explained, operations personnel identify, review, and pre-approve such work, allowing workers to be dispatched more promptly to the field, improving productivity. Implementation of 16-31 at Southern is also a work in progress, McDonald added. According to statistics from the utility, as of July 28, about 70 percent of the work at Farley is pre-authorized (up from about 50 percent in early June), while those numbers at Hatch and Vogtle are about 45 percent (up from about 20 percent) and about 11 percent (up from 0 percent), respectively.

The session also featured a presentation on cost savings associated with EBs by Adam Dow, a manager in the nuclear consulting services practice at MCR Performance Solutions. While noting that there is not yet a sufficient amount of data available to determine the exact cost savings from EBs, Dow offered estimated savings for 13 maintenance and work management-related bulletins: 16-01, Eliminate Administrative Changes to Preventive Maintenance Work Orders; 16-02, Implement Graded Approach to Walkdowns; 16-13, Perform Self-Briefs for Low Radiological Risk Activities; 16-15a, Work Screening Process, 16-15b, Utilizing Minor Maintenance, and 16-15c, FIN Team Efficiency; 16-16, High Cost, Noncritical PM Reduction; 16-22, Implementing an Effective and Efficient Work Management T-Week Process; 16-25, Critical Component Reduction; 17-03a, Value-Based Maintenance, and 17-03b, Embracing Cultural Shifts for Value-Based Maintenance; 16-31, Pre-Approval Criteria for Work Execution; and 17-09, Industrywide Coordinated Licensing of 10 CFR 50.69.

Maintenance budgets at nuclear plants are expected to be reduced by at least 25 percent by the end of 2020, Dow said, referencing 17-03a’s value proposition. “Average work management and maintenance spending, overall, for a two-unit site is, let’s say, around $80 million,” he said. “So 25 percent of $80 million gives us a $20-million savings target.”

Using what he termed “conservative, high-level assumptions,” Dow calculated a total savings from the 13 EBs of $9,379,750, or 47 percent of the $20 million target. (Individual EB savings estimates were as follows: 16-01, $312,500; 16-02, $499,200; 16-13, $26,000; 16-15a, $16,515, and 16-15c, $3.12 million; 16-16, $281,250; 16-22, $124,800; 16-25 and 17-03a and 17-03b, $2.6 million; 16-31, $416,000; and 17-09, $2 million.) “We are coming up short,” he said. “The reason this is important is because future budgets will dictate loss of resources, assuming these efficiency gains have been realized. . . . At the end of the day, our success is measured in dollars per megawatt hour, not benchmarking metric and reliability indices.”

Additional actions in maintenance and work management are needed for the viability of the Delivering the Nuclear Promise initiative, Dow stated, such as participation in zero-based budgeting, staffing optimization, and process mapping and improvement.

The case for nuclear

UWC attendees were administered a strong and no doubt welcome shot in the arm on August 7 at the conference’s opening plenary session (the decision by South Carolina Electric & Gas to cease new-reactor construction at Summer had been...
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announced only seven days prior), with encouraging comments delivered by representatives from industry, the Department of Energy, and government. In keeping with the overall theme of the conference, “The Nuclear Option—Clean, Safe, Reliable, and Affordable,” introductory remarks by Brad Adams, vice president of engineering for Southern Nuclear and the meeting’s general chair, set the tone. “We are a critical component of the U.S. infrastructure,” he said. “We produce roughly 20 percent of the electricity in this country. . . . Each and every one of us should be proud of what we do. What we do is important.”

Bob Coward, the current ANS president and a principal officer at MPR Associates, echoed Adams’ comments, asserting his belief that the future of nuclear power is virtually unlimited. “Are we having some tough times right now? Yes, you can’t sugarcoat it,” he said. “There are aspects of our business right now that are tough. But we’re going to get through it. It’s what we do. We’re innovative. We’re smart. We do good work. We’ll get through it.”

Coward also noted that despite the current U.S. administration’s expressions of support for fossil fuels, most of the world’s industrialized nations have made the decision to decarbonize their energy systems. “This cannot be achieved without either increasing the role played by nuclear or making serious advancements in energy storage technology,” he said. “Energy storage is great, don’t get me wrong. It plays a very important role in our grid today, and it’s going to play a bigger role going forward. But a lot of us are technical thinkers who need a frame of reference, and we like numbers. So, in February, a new energy storage facility was commissioned outside of San Diego by San Diego Gas & Electric, in partnership with AES Energy Storage. MPR did most of the heavy lifting, so we know the project well. It’s the largest battery-storage facility in the world. One of the drivers for building it was the shutdown of San Onofre. Everybody involved is tremendously proud, as they should be. . . . But the largest battery storage facility in the world equals three-and-a-half minutes of [electricity production from] San Onofre. So if you want to store 12 hours of power from San Onofre, you need 200 of those largest battery-storage facilities in the world. . . . I hope they do make tremendous progress. It would be good for all of us. But the power system is too important to put all of our eggs in that one basket, and I believe policymakers are starting to understand that. They realize we have to be pursuing multiple paths.”

Support for nuclear among policymakers at the federal level is stronger than it has been in many years, Coward said, but, he added, most of that support involves the promise of advanced reactor technology. “Let’s be honest,” he said. “Our machines are rather complicated, and complicated means costly. I believe that sometime over the next five to eight years, the world is going to give us a chance. They’re going to call our bluff, and we need to deliver. They’re going to say, ‘We want you to be cheaper. We want you to be simpler. And we want you to be just as safe.’ We can do that. If there is any group on this planet that can do it, it’s this group. And when we do it, things are just going to turn on. I really do believe that this is an exciting time to be in nuclear power.”

Following Coward was the session’s first featured speaker, Steve Kuczynski, Southern Nuclear’s president and chief executive officer, who emphasized the
Kuczynski
importance of strategy. "Strategies are great, but once in a while you have to look at your results," he said, paraphrasing a quote often attributed (wrongly) to Winston Churchill. "And if you’re not getting the results, you’d better update the strategy." He pointed to the Nuclear Energy Institute's National Nuclear Energy Strategy, unveiled in May, which is designed to ramp up efforts to communicate nuclear's benefits. This new strategy, Kuczynski said, has four major tenets: preserving the current nuclear generation base; creating sustainability through an improved regulatory framework and reduced regulatory burden; innovating, commercializing, and deploying new nuclear; and expanding and thriving through international competition. "Clearly, from an economic standpoint, the global market is incredibly huge," he said. "We ought to compete. We developed this technology. We have the national labs supporting it. We have all this infrastructure base. It is time to leverage that from a more global standpoint."

Kuczynski encouraged the attendees to get behind the new strategy, noting that in his experience, the greater the consensus behind a strategy, the greater the progress made. "The more fractured we are," he said, "the more difficult it is for legislators, administrations, the Department of Energy, and academia to support the industry in the way it needs to be supported."

Kuczynski also expressed optimism regarding the Vogtle new-build project (the UWC was held three weeks before Southern subsidiary Georgia Power announced its decision to recommend the completion of Vogtle-3 and -4). "We’ve been working since the Westinghouse bankruptcy announcement anticipating the transition," he said. "We’re calling the shots now. We’re in full control of every decision. . . . This is really now just a commodity installation project. . . . The majority of the major equipment is installed. The rest of it is sitting on the site. This is just about executing work day in and day out. . . . We do work management very well, and there is no reason that level of excellence can’t be brought to this project. . . . If we’re given the opportunity to complete the plants, we will complete them in an excellent manner. There is no question in my mind."

Making the case for nuclear from a DOE perspective was Shane Johnson, deputy assistant secretary for nuclear technology demonstration and deployment in the Office of Nuclear Energy (NE). On June 29, Johnson noted, President Trump visited the DOE to announce a plan for an in-depth review of U.S. nuclear energy policy, saying, “We will begin to revive and expand our nuclear energy sector, which produces clean, renewable, and emissions-free energy. A complete review of U.S. nuclear energy policy will help us find new ways to revitalize this crucial energy resource.” Johnson also referenced pro-nuclear comments by Energy Secretary Rick Perry, including his statement at a May 10 press conference: “If you really care about this environment that we live in, then you need to be a supporter of this amazingly clean, resilient, safe, reliable source of energy.”

Johnson listed three goals of the current administration for the advancement of nuclear energy: remove regulatory roadblocks, including by collecting industry feedback; reform energy markets, including by building on findings from the department’s much-publicized grid study (NN, Sept. 2017, p. 17); and develop finan-
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Johnson also listed three specific DOE priorities: stabilizing and expanding the existing reactor fleet, establishing an advanced reactor pipeline, and reestablishing a national fuel-cycle infrastructure. “We are looking to continue to work with industry in addressing all three of these priorities,” he said. “With respect to the advanced reactor pipeline, we have adopted a broader definition of advanced reactors than some are used to. We find this more advantageous, because one of the things we don’t want to do is create competing factions within the community and have them essentially ‘warring’ with one another. We’re really looking at advanced reactors as a broad family of reactor designs that could include micro-scale, small modular, and large, baseload plants, and water reactor or non-water reactor technology. It’s those technologies that have yet to be put into commercial operation. That definition is kind of leading us to where we think we want to go with regard to opportunities for engagement with the commercial sector.”

Johnson also highlighted NE’s support for the nuclear workforce, noting that since 2009, $517 million has been awarded to 119 schools in 40 states and the District of Columbia. In fiscal year 2017, he said, $48 million has gone toward 66 research and development/infrastructure awards and $5 million toward 58 scholarships and 31 fellowships. “One of the things I’m most proud of in my time with the DOE has been our support of the nation’s university nuclear engineering programs,” he said. “There was a point in time where it looked like all of our nation’s universities were getting out of the nuclear business. That was back in the 1990s. But we pretty much hit a stabilized point in terms of the number of universities offering a nuclear curriculum. The number of research reactors in operation has stabilized down to 25 reactors at 24 institutions. The future is about the workforce. There is an enthusiasm for nuclear within the next-generation workforce that is just exciting. These folks see the promise, and they have a vision for a nuclear future. It is incumbent on us to continue to encourage the study and the application of nuclear engineering.”

Johnson provided a brief overview of NE research programs as well, including the Light-Water Reactor Sustainability Program (LWRS), Accident Tolerant Fuels Development Program, Advanced Water-based Reactor Development, Advanced Non-Water Reactor Development, Gateway for Accelerated Innovation in Nuclear initiative, Fuel Cycle R&D, and Used Nuclear Fuel Disposition R&D. Regarding the LWRS, Johnson said that it has been “very helpful in the move from the first round of license renewals and will be just as important as we move into the second subsequent license renewals for those stations continuing to operate.”

Johnson concluded his presentation with news of an upcoming industry-focused funding opportunity announcement (FOA) that supports innovation and competitiveness of the U.S. nuclear industry by directly sharing costs on cross-cutting applied R&D activities—specifically, all aspects of advanced reactor development; methods for improving the cost and schedule for the delivery of nuclear products, services, and capabilities; and resolution of regulatory/certification issues. According to Johnson, the FOA would cover early-concept technologies to more mature designs. “We are seeking to broaden our R&D activities and open up participation in those activities with the private sector through a new industry-driven technical and regulatory development execution mechanism,” he said. “It’s still somewhat ‘notional.’ We’ve been driving to try to have this ready for rollout in October. We’ll see if we’ll be successful in getting that timed, but I’m confident that we will get this rolled out and in place.”

The session concluded with two state-government perspectives, the first provided by Boyd Rutherford, Maryland’s lieutenant governor, who extolled the virtues of Exelon’s two-unit Calvert Cliffs nuclear facility, located in Lusby, Md. “Calvert Cliffs provides 40 percent of Maryland’s in-state energy production,” Rutherford said. “It plays a substantial role in the state’s energy portfolio. Further, it accounts for 85 percent of Maryland’s emissions-free electricity generation. Since taking office in 2015, [the Hogan administration] has worked very hard to increase economic development, create jobs, and turn our economy around. In terms of jobs at Calvert Cliffs, there are approximately 900 full-time, well-paid jobs—an important economic generator for the state.”

According to Rutherford, however, Maryland had initially been concerned with Exelon’s 2012 purchase of Constellation Energy—the owner of both Calvert Cliffs and Baltimore Gas & Electric (BG&E), the state’s largest electric utility—given the potential for “the exercise of significant market power, possibly to the detriment of ratepayers.” To alleviate that concern, Rutherford said, the Maryland Public Service Commission approved the merger “with 40 conditions the companies were required to meet. For example, Exelon agreed to create a $113.5-million consumer investment fund to invest in energy efficiency and low-income energy assistance. Also, BG&E provided a $100 credit to all its customers.”

Rutherford also made mention of two “key state policies” relevant to nuclear power: the Greenhouse Gas Reduction Act (GGRA), which calls for a reduction in Maryland’s greenhouse gas emissions by 40 percent by the year 2030, and the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce carbon emissions from the power sector. “Without the clean energy provided by Calvert Cliffs,” Rutherford said, “meeting the GGRA emissions targets would be much more difficult and costly, if not impossible. And with RGGI, fossil fuel generators must purchase allowances for emissions they produce. This makes those generators comparatively more expensive than the clean sources from nuclear.”

The session’s final speaker, John Rosales, a member of the Illinois Commerce Commission, presented a detailed review of the Future Energy Jobs Act (FEJA), passed by the Illinois legislature on December 1, 2016, and signed into law by Gov. Bruce Rauner on December 7. Rosales characterized the law, which took effect on June 1, as the most sweeping overhaul of the Illinois Public Utilities Act and the Illinois Power Agency since the deregulation of the power market in 1997.

Among FEJA’s provisions, Rosales noted, is a Zero-Emission Standard (ZES), specifically designed to address the economic challenges faced by Exelon’s Clinton and Quad Cities nuclear plants. (In June 2016, Exelon officially announced that it would close Clinton and Quad Cities in 2017 and 2018, respectively, given the lack of progress on legislation recognizing the zero-carbon benefits of nuclear power. FEJA’s passing ensured the continued operation of both plants.) “In 2014, Illinois was faced with the possibility of losing one or more of its nuclear plants,” Rosales said. “An evaluation was conducted to determine what the impacts would be if the nuclear plants closed prematurely. The study concluded that if only the Quad Cities plant closed, carbon emissions in Illinois would increase by 2.6 million to 3.1 million tons and by 6.1 million to 7.2 million tons across the entire PJM footprint on an annual basis.”

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According to Rosales, FEJA requires the Illinois Power Agency to procure zero-emission credits (ZEC) on behalf of Ameren Illinois, Commonwealth Edison (an Exelon company), and MidAmerican Energy. “A ZEC is a tradable credit that represents the environmental attributes of 1 megawatt hour of energy produced by a zero-emission facility,” Rosales said. “A zero-emission facility is an electric generation facility that is fueled by nuclear power and is interconnected with one of the two regional electric transmission systems that Illinois is a part of.

“FEJA creates a target acquisition of ZECs in the amount of 16 percent of all electricity delivered to residential customers in 2014,” Rosales continued. “This is approximately 20 million ZECs per year. The law provides payments to zero-emitting nuclear facilities in return for the environmental benefits of those plants. So, the law pays certain nuclear plants an amount equal to the social cost of carbon based on the DOE’s estimated price of $16.50 per megawatt hour, which is the social cost of carbon established in 2016 by the U.S. Interagency Working Group on the Social Cost of Carbon. The price paid for ZECs will be reduced below the social cost of carbon if energy and capacity prices are projected to rise above 2016 levels.”

Rosales added that FEJA establishes separate caps for the various customer classes that limit FEJA-attributable electricity bill increases. For residential customers, the average bill increases from FEJA between 2017 and 2030 are limited to 25 cents per month for ComEd customers and 35 cents per month for Ameren customers, he said, while for small to medium commercial and industrial customers, average bill increases are limited to 12 cents per kilowatt hour.

Implementing the promise

The industry’s Delivering the Nuclear Promise (DNP) initiative was back in the spotlight at an August 8 plenary session devoted to examining the challenges and successes of implementing the DNP. Danny Bost, chief nuclear officer of Southern Nuclear Company, presented the utility perspective, enumerating the industry’s current troubles, including flat electricity demand, low natural gas prices, and tax credits for renewables. He clarified the gravity of the situation with a graphic showing recent nuclear plant closures (Duke’s Crystal River in 2013, Dominion’s Kewaunee in 2013, Southern California Edison’s San Onofre in 2013, Entergy’s Vermont Yankee in 2014, and Omaha Public Power District’s Fort Calhoun in 2016), as well as announced closures (seven reactors) and potential closures.

“Sometimes it’s all economics that closed those plants,” Bost said. “Otherwise, they would all still be operating. Half of those did have some material condition-type issues—equipment issues that helped drive closure—but the other half were good plants that were shut down based solely on economics. . . .

The at-risk plants are in areas where there’s a need for some kind of change or they’re not going to be able to continue doing what they’re doing. . . . I want to set a legacy so that we protect and continue to operate all the existing plants. Yes, we’re building a couple more. But let’s get some more on the books. We’re convinced that this DNP effort is one that’s going to keep us economically viable.”

Southern Nuclear’s approach to implementing the DNP program, Bost said, involves assigning fleet leads to review DNP Efficiency Bulletins (EB) within peer groups, assess the risk or impact, develop and implement an action plan, implement change management, and evaluate cost savings. Oversight by the Southern Nuclear executive team is also provided, he added, based on a bulletin’s risk or complexity. “We’ve found that this doesn’t work on autopilot,” he said. “We have to watch it. We’re looking very closely at how this program is working for us.”

Some EB successes to date, according to Bost, include in-processing and common training, security elimination of handguns, common engineering design processes, component reclassification, and the corrective action program. “We started the CAP program at Southern about three years ago, and with DNP, we’re taking it to the next level,” he said. “I’ll use Vogtle as an example because I know their numbers. They were writing between 25,000 and 30,000 condition reports every year. That’s a huge number. You have to wade through all of those and find out which ones are important and which ones you need to be paying attention to. And that was the issue. So they’re still writing a whole bunch of them, but all we’ve done in this program is said, ‘If it’s true safety, it needs to be in the CAP program, and if it’s not, you need to take it out and address it somewhere else.’”

DNP challenges remaining for Southern, Bost noted, include those in the areas of communication—change in management plans were not well communicated throughout the organization—and the identification of true savings. “We’re looking for bottom-line savings, and what I’ve found is that our hard savings are far exceeded by the soft savings at this point,” he said. “We have gotten an awful lot of soft savings, but we need to be able to convert and hit the bottom line.”

Kim Maza, a senior vice president at the Institute of Nuclear Power Operations, began her presentation by stressing that INPO’s involvement with DNP does not conflict with the organization’s stated mission, which is to promote excellence in the operation of commercial nuclear power plants. “I’ve gotten questions about whether INPO continues to evaluate to standards of excellence,” she said. “Yes, we still evaluate to standards of excellence. I’ll submit to you, and I think it makes sense, that excellence and efficiency go hand-in-hand. They are not contradictory. . . . Every time we run the data, we see the same thing: Plants that are [rated] INPO 1 and have achieved excellence are also the most cost-effective.”

Maza explained INPO’s role in DNP as a supporter of the EB development and approval process and a monitor for unintended, adverse consequences. During development and approval, she said, INPO identifies potential safety and reliability risks with draft bulletins, incorporates guidewords, and identifies and resolves conflicts with INPO documents. During the monitoring phase, she added, “every plant evaluation report and accreditation report is looked at to see if there is anything that might be an early sign that a bulletin isn’t being implemented correctly.”

To date, no identified adverse consequences related to EB implementation have been identified, according to Maza. INPO has found a few EBs that have not been implemented as directed, she said, but even...
A Closer Look at Efficiency Bulletins

...for these, there have been no resulting consequences. INPO has also identified several strengths in work management related to EB implementation, Maza said. “We have seen at several sites decreases in backlogs and improved equipment reliability, and when you look a little further, you find more effective FIN teams and more minor maintenance, and those are both related to EB work management,” she said.

Maza concluded with answers to some frequently asked questions. INPO does not require the industry to implement the EBs, she said, nor does it evaluate EB implementation. “We don’t come in with a check list,” she said. “But we are looking at results—both positive and negative, to see if there is something we can learn about an EB. We still evaluate against standards of excellence. That has not changed.”

Also speaking at the session was Joe Pollock, the Nuclear Energy Institute’s interim CNO, who made the observation that DNP is about more than just efforts to rein in costs at nuclear sites. “It’s also about the efforts the industry is putting together to try to influence our federal or state counterparts to recognize the value of nuclear and the attributes we bring to the table,” he said. “It’s about learning to get congressional support to help us right-size regulation. It’s about everyone in this room—every utility, every vendor that’s working in the industry.”

Pollock listed a number of recent positive signals coming out of Washington, D.C., including President Trump’s and Secretary of Energy Rick Perry’s remarks in favor of nuclear power. “[Secretary Perry] has made more policy statements on nuclear power and why we need it in the U.S. than his predecessors, probably in the last 10 years combined,” he said. In addition, Pollock pointed to Nuclear Regulatory Commission Chairman Kristine Svinicki’s reconfirmation and to the likelihood of having a fully staffed NRC by this fall. Also, used-fuel legislation is moving forward, he said.

On the industry front, Pollock noted the efficiency gains that have taken place at nuclear plants over the past few years, due, at least in part, to the DNP EBs. The industry was at about $40 per megawatt hour on average in 2012, he noted, whereas by 2016, that had dropped to about $34, a 15.5 percent decrease (the DNP target is $28 per MWh). “Our goal is to drive the behavior, the thought process throughout the industry on lowering costs and being more efficient,” Pollock said. “Throughout the industry today, DNP is part of the discussion at the sites on why we are doing that, why we are incurring that cost. It’s part of the partnership that the vendors are working on with the utilities: How do we lower our costs? How do we become more efficient? We’ve issued about 59 efficiency bulletins and have estimated a potential $1.2 billion in enabled savings.”

According to Pollock, the DNP initiative has helped start a conversation with new allies to move the nuclear industry forward. “We’ve always thought that just because we do a good job and we’re valuable to our communities, people should recognize that. We’ve changed that by working with groups that we haven’t worked with before. We know there are many groups in Washington that have similar desires to improve and change, and they all have their particular drive. It may be about jobs, or national security, or innovational leadership. But there are people out there who, aligned with us, can help us move our agenda forward. We’re working very closely with those groups. There are many nongovernmental organizations that support reducing regulations, reducing the size of the federal government, so we’ve capitalized on those. We’re moving in the right direction, both in government support and at the sites.” —Michael McQueen
UNITED ARAB EMIRATES

Final major components installed at Barakah

With the installation of Barakah-4’s two steam generators and pressure vessel, all of the major components at all four units of the Barakah nuclear power plant are now in place. To celebrate this major achievement, the Emirates Nuclear Energy Corporation (ENEC) organized a special event that was held on August 14 at the station, which is located in Abu Dhabi, the largest Emirate of the United Arab Emirates.

For the occasion, invited guests were taken on a tour of the site, which highlighted ENEC’s focus on quality and safety during plant construction and operational readiness activities in preparation for the units to start generating electricity. Those attending the event included senior government officials, as well as representatives of ENEC, Korea Electric Power Corporation, ENEC’s project partner and prime contractor; and associated companies.

During the event, ENEC Chief Executive Officer Mohamed Al Hammadi told guests that achieving the latest milestone “is testament to the dedication of our teams” to the project. “These achievements are showcasing our commitment to delivering a world-class nuclear energy program, from construction through to operations,” he added.

Khaldoon Al Mubarak, chairman of ENEC’s board of directors, further stressed how the nuclear program contributes “to a diversified energy mix and sustainable, long-term economic growth” of the UAE.

Jassim Mohammed Buatabh Al Zaabi, chair of the Abu Dhabi Executive Committee Office and a member of the UAE’s Executive Council, led the government delegation. “I am proud to be here in Barakah today to witness this extraordinary milestone in the UAE Peaceful Nuclear Energy Program,” he said. “Nuclear energy plays a strategic role for the future of our nation, enabling economic and industrial growth, as well as careers in nuclear energy for Emirati youth.”

The guests concluded their visit inside Unit 4, where they observed the installation of the steam generators and had an opportunity to sign a specially prepared panel on a steam generator to commemorate the important milestone.

The Barakah project is progressing steadily, according to the announcement,
with Unit 4 now more than 52 percent complete. Unit 1 is over 96 percent complete; Unit 2, over 85 percent; and Unit 3, over 75 percent. Overall, construction of the four units is now more than 82 percent complete.

**BRAZIL**

**MOU signed with CNNC on completing Angra-3**

Eletronuclear, Brazil’s nuclear operator, has signed a memorandum of understanding with China National Nuclear Corporation aimed at completing Unit 3 at the Angra nuclear power plant site and undertaking new projects. The MOU was signed by Wang Shoujun, chairman of CNNC; Bruno Campos Barretto, president of Eletronuclear; and Pedro Luiz de Oliveira Jatobá, international superintendent of Eletrobras, Eletronuclear’s parent company. The signing ceremony, which was held on September 1 in Beijing at the Great Hall of the People, was attended by Brazilian president Michel Temer and Chinese president Xi Jinping.

According to Eletronuclear, the MOU, the third that it has signed with CNNC, creates an opportunity for deepening bilateral nuclear cooperation, including the establishment of a partnership for completing Angra-3. Earlier this year, the government indicated that it was looking to restart construction of the long-delayed project with an international partner, and China, as a major investor in the country, seemed the most likely candidate.

The first nuclear cooperation MOU between Brazil and China was signed in May 2015 during Chinese Premier Li Keqiang’s visit to Brazil. Then, in December 2016, Eletronuclear President Barretto was in Beijing for meetings with CNNC and major Chinese banks that were likely to provide financing for the Angra-3 project, as well as for future projects. During that visit, a bilateral MOU was signed between Eletronuclear and CNNC providing guidance for resuming work on the project.

Angra-3 was one of two reactors to be built in Brazil by German vendor Siemens/KWU in the 1970s. Work was halted during the 1980s, however, due to funding problems. In the 1990s, Brazil resumed construction work on Angra-2, which began commercial operation in February 2001. In 2006, the government announced plans to complete Unit 3, which is essentially a replica of Angra-2, and in May 2010, a construction permit for Angra-3 was issued.

In 2015, the situation changed again, due not only to financial issues but also to a police probe into corrupt contracting practices involving state-controlled organizations. Those investigations included Eletronuclear, with allegations made against the company’s chief executive officer. Among the companies named in the press as being under investigation for handing out bribes were some that had won contracts for the Angra-3 project (NN, Sept. 2015, p. 30).

**SOUTH KOREA**

**IAEA team reviews seismic safety at two nuclear plants**

An International Atomic Energy Agency team of experts has carried out a Site and External Events Design (SEED) mission in South Korea to review methods and criteria for evaluating seismic safety at the Wolsong and Shin-Wolsong nuclear power plants, which are operated by Korea Hydro & Nuclear Power Company (KHNP). The SEED mission, which was completed on August 18, was requested by the government, as the two plants share a site on Korea’s southeastern coast, where an earthquake measuring 5.8 on the Richter scale struck in September 2016.

According to an August 24 IAEA press release, over a five-day period, the SEED
team examined the results of inspections carried out after the earthquake, as well as the technical basis of the hazard assessments and risk analyses. It also reviewed KHNP’s mid-term action plans that had been established in response to the 2016 earthquake.

While operation of the nuclear plants and other Korean power generation facilities was not affected by the event, the four Wolsong nuclear units—all CANDU 6 heavy-water reactors—had to be manually shut down, as the tremor that hit the plant was above the internally set quake ground acceleration threshold of 0.1g. KHNP noted, however, that the units were built to withstand much higher seismic levels (up to 0.2g). (As explained in the press release, seismic waves are assessed for each power plant. Once the result of the assessment is above the threshold of 0.1g—which is lower than the design specification—in this case, 0.2g—requirements call for plant operation to be halted within four hours after the onset of the quake to allow for a thorough inspection.) As for the two Shin-Wolsong units, according to the company, the threshold was not reached due to features of the site, such as the building foundation and geological characteristics.

To carry out its review, the IAEA team was provided with information on the process conducted by KHNP and the results obtained over the past four decades for assessing seismic hazards and safety at the two plants. Talks were also held with managers and experts at KHNP’s headquarters in the city of Gyeongju and at the site. According to Shin Morita, head of the IAEA’s External Events Safety Section, “The team was impressed by the positive attitude and concrete actions taken by KHNP and partly coordinated with the government to continuously improve safety against natural external events.”

Among the good practices identified, the team noted the government’s nationwide plan for assessing seismic hazards, which has enabled KHNP to update parameters of site-specific external natural hazards. KHNP has also established a new organization, the Seismic Engineering Office, aimed at continuously improving safety against seismic hazards at all nuclear sites in the country. This office will be leveraging the relevant lessons learned and knowledge gained at the two plants.

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Among its recommendations, the team suggested that as South Korea further develops seismic hazard assessment measures, it should enhance their alignment with IAEA safety standards.

The press release also noted a comment from KHNP Executive Vice President Cheong-ro Yoon that a detailed plan for implementing the IAEA’s recommendations will be developed. Also, he said, “KHNP will expand upon the experiences and knowledge it has gained to all nuclear power plants.”

In accordance with IAEA practice, the final mission report will be delivered to the South Korean government within three months.

JAPAN

Pre-restart inspection applications submitted

On August 25, the construction work plans for Kyushu Electric Power Company’s Genkai-3 and Kansai Electric Power Company’s Ohi-3 and -4 were granted regulatory approval by Japan’s Nuclear Regulation Authority (NRA). Three days later, the two utilities submitted applications to the NRA for pre-service inspections of their units. According to the Japan Atomic Industrial Forum, these inspections are required to confirm that the equipment and facilities at each unit comply with the approved designs and meet the new post-Fukushima Daiichi safety standards. Once the inspections are completed, the plants will be ready to begin startup procedures.

All three units had already received their basic design approvals—the first stage of the NRA’s post-Fukushima reactor restart process under which changes can be made to the reactor installation—after confirming that the agreed upon design complies with the latest safety standards. Genkai-3 received its basic design approval in January, and both Ohi units received theirs in May. The receipt of approval of the units’ construction work plans completed the second stage of the restart process, while the third stage requires a review of a plant’s operational safety program.

In addition to completing pre-service inspections, the utilities must obtain local consent before beginning startup procedures. Although this is not a legal requirement, it is considered necessary before restart begins. Kansai Electric, which did not yet have local consent, plans to have the two Ohi units back on line in January and March 2018, respectively. Kyushu Electric, which has received local consent, expects to begin operating Genkai-3 in January 2018. The three units, each of which is a 1,127-MWe four-loop reactor...
Final freezing of “ice-wall” at Fukushima Daiichi OK’d

Japan’s Nuclear Regulation Authority (NRA) on August 15 officially approved the freezing of the remaining 7-meter section of the 1,500-meter-long underground frozen-soil shielding wall, often referred to as the “ice wall,” built around the perimeter of Units 1–4 at the Fukushima Daiichi nuclear power plant.

The ice wall project (NN, July 2014, p. 56) was among several carried out by Tokyo Electric Power Company (Tepco) to reduce the amount of groundwater flowing into the damaged reactor buildings and becoming contaminated by mixing with existing contaminated water and by coming in contact with radioactive materials, including melted fuel from the March 2011 accident. By creating a frozen underground wall of soil, most of the groundwater will be forced to flow around the buildings and eventually into the sea without becoming contaminated.

The soil freezing system uses a refrigerant that circulates through pipes sunk to a depth of about 30 meters, freezing the surrounding soil all the way down to the bedrock. Tepco has been carrying out the freezing incrementally since the end of March 2016. According to the Japan Atomic Industrial Forum (JAIF), Tepco was hoping to complete this final freezing operation early this fall.

According to JAIF, authorization to complete the operation has been delayed due to concerns that when the entire wall is frozen, the level of groundwater around the buildings could drop below the level of the water in the buildings, reversing the flow of water. That would mean that contaminated water would then flow into the buildings. During an NRA meeting in June, Tepco allayed those concerns by explaining that this reverse flow would be prevented by controlling groundwater levels using the subdrain wells previously drilled around the buildings. As a result, the NRA agreed to the freezing of the final section of the ice wall.

Pakistani Prime Minister Shahid Khaqan Abbasi addresses attendees at the inauguration of Chashma-4.

New prime minister inaugurates Chashma-4

Speaking at the inauguration of Unit 4 of the Chashma nuclear power plant on September 8, Pakistan’s new prime minister, Shahid Khaqan Abbasi, stressed the contribution of nuclear power in providing Pakistan with low-cost electricity, as well as helping the country overcome load-shedding problems, both of which remain top priorities for the government.

According to state broadcaster Radio Pakistan, Abbasi also said that the government is committed to providing an additional 8.8 GWe of nuclear capacity to the national grid by 2030. He also praised the contributions of the Pakistan Atomic Energy Commission in the areas of power generation, health, and agriculture.

Abbasi was elected interim prime minister by the Pakistani parliament on August 1 to replace his predecessor and mentor, Nawaz Sharif, who was disqualified from office by the country’s Supreme Court over corruption allegations and forced to resign.

It was only last December that Sharif inaugurated the third unit at the Chashma plant—also referred to as Chasnupp—which is located at Mianwali in Punjab Province (NN, Feb. 2017, p. 41). Both units are 315-MWe CNP-300 reactors supplied by China National Nuclear Corporation (CNNC). Construction of Unit 4 began in December 2011. Initial criticality was achieved on March 17, 2017, and the reactor was connected to the grid on July 1.

The construction of the next two units in Pakistan, which are located at the Karachi nuclear site, are being completed by CNNC “at a fast pace,” Abbasi noted. Both of those units are 1,014-MWe Generation III reactors.

Abbasi also remarked that the benefits of these and other large projects constructed under the China-Pakistan Economic Corridor (CPEC) program are now becoming visible. The government, he added, wants greater private sector participation in the CPEC projects. He also noted that the Chinese government has expressed interest in funding more projects in Pakistan.

Ukraine

Nuclear to remain key part of energy mix

Nuclear power will continue to provide about half of Ukraine’s electricity supply to 2035 under an energy strategy approved by the Cabinet of Ministers of Ukraine, according to an August 19 announcement by Vice Prime Minister Volodymyr Kistion. The essential task of the new strategy—set out in the document Safety, Energy Efficiency, Competitiveness—is to reduce Ukraine’s energy consumption by half and to boost Ukrainian production of both traditional and alternative energy sources, Kistion said.

According to the announcement, the document stipulates an energy structure in which by 2035, nuclear power will provide 50 percent of the country’s electricity; renewable sources, 25 percent; and hydro-power, 13 percent. The remaining demand will be covered by thermal power stations.

Various versions of the document were drafted over the past two years, with input from national scientific centers, including the National Institute for Strategic Studies, other public organizations, and international and domestic experts. According to Kistion, “The foundations for the sustainable energy future of our country are laid. The energy strategy only envisages goals, the implementation of which should be reflected in a step-by-step approach. Given the above, there is still much work to do.”
**United Kingdom**

**NuScale launches SMR action plan for Britain**

U.S. nuclear technology developer NuScale Power on September 5 launched an action plan for the near-term deployment of its small modular reactor (SMR) in the United Kingdom. The plan describes how NuScale will partner with British industry to deliver a multibillion-pound SMR venture, with U.K. companies potentially supplying more than 85 percent of the content required for U.K. deployment.

The plan builds on the collaboration NuScale has been developing over several years with British organizations, including Sheffield Forgemasters, the Nuclear Advanced Manufacturing Research Centre, and Ultra Electronics.

Tom Mundy, NuScale Power’s chief commercial officer and managing director for the United Kingdom and Europe, said that the plan sets out a vision for NuScale’s technology to be rolling off production lines in the 2020s “and transforming the U.K. into a hub for export into a lucrative global market.” But, he noted, “The window of opportunity is closing, and for the benefits of our U.K. vision of near-term SMR deployments to be fully realized, decisions must be taken by government now.”

Also, Mundy stressed, “NuScale’s SMR is credible for near-term deployment and will help ensure that the U.K. meets its future energy challenge head on.”

NuScale’s vision for the deployment of its SMR technology in the United Kingdom is set out in the following five-point plan:

- **Meeting Britain’s energy challenge**—The United Kingdom needs SMR deployment in the 2020s as a low-carbon replacement for retiring coal-fired power stations, a replacement for an aging nuclear fleet, and to meet future growth in demand from, for example, electric vehicles.
- **Bringing an opportunity for U.K. leadership and international partnership**—The United Kingdom could become a global leader in the development and deployment of innovative nuclear technology, seizing first-mover advantage of a U.K.-U.S. partnership on SMRs.
- **Boosting the U.K. economy**—A multibillion pound SMR venture will boost U.K. economic growth, productivity, and wealth creation by providing high-value jobs, intellectual property rights, and export opportunities for the United Kingdom’s 65,000-person-strong civilian nuclear workforce.
- **Realizing a large near-term opportunity**—U.K. SMR deployment could be achieved within the next decade, through leveraging NuScale’s mature design, U.S. government support, and a pipeline of customer interest.
- **Providing government an opportunity to enable a successful SMR program**—The U.K. government can seize this once-in-a-generation SMR opportunity by providing long-term political support, the right market conditions, clarity on the regulatory review process, identification of sites, and continued support for U.K. nuclear capabilities.

The launch of NuScale’s U.K. action plan follows the acceptance of the company’s design certification application (DCA) by the U.S. Nuclear Regulatory Commission earlier this year. This was the first ever SMR DCA to be submitted to the NRC. It is expected that regulatory approval in the United States will be granted in the early 2020s and will support an initial deployment project for NuScale’s first customer from a site in Idaho by the mid-2020s.

Fluor Corporation is the majority investor in NuScale, whose technology was initially developed and tested at Oregon State University. The basic NuScale Power Module is a fully factory-fabricated 50-MWe (gross) nuclear unit consisting of an integral reactor vessel surrounded by a high-pressure steel containment. NuScale foresees power stations housing up to 12 modules.

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SAN ONOFRE

SCE settles lawsuit over spent fuel storage

Southern California Edison, majority owner of the closed San Onofre Nuclear Generating Station, has agreed to spend up to $4 million on efforts to move its spent nuclear fuel off-site in order to settle a lawsuit challenging its permit to temporarily store spent fuel at the reactor site on the Southern California coast.

To settle a lawsuit filed by the activist group Citizens Oversight and signed by a second plaintiff, Patricia Borchmann, SCE agreed to make “commercially reasonable” efforts to relocate San Onofre’s spent nuclear fuel to an off-site, inland location. The settlement was filed on August 28 with the San Diego Superior Court, which retains jurisdiction to enforce the settlement terms.

Citizens Oversight and Borchmann sued SCE and the California Coastal Commission in November 2015 after the commission approved a permit allowing SCE to build an additional independent spent fuel storage installation (ISFSI) at the site to store spent fuel from San Onofre-2 and -3, which were permanently retired in 2013. One-third of San Onofre’s spent fuel is currently in dry cask storage and the remaining two-thirds is stored in spent fuel pools. While SCE is continuing with its plans for transferring the spent fuel from wet storage to the ISFSI by 2019, the plaintiffs have agreed to dismiss the lawsuit in light of SCE’s commitments to move the fuel elsewhere.

SCE said that it has committed to spending up to $4 million to maintain an “experts team” to advise the company on any relocation of the spent fuel, develop a conceptual plan for off-site transportation, and develop a strategic plan to support the development of an off-site storage facility. SCE also will explore the possibility of moving the spent fuel to the Palo Verde nuclear power plant in Arizona, of which SCE is a partial owner.

News reports indicated that sites in New Mexico and Texas are also being considered for storing the spent fuel. Working with the Eddy-Lea Energy Alliance, Holtec International submitted a license application to the Nuclear Regulatory Commission in March for a consolidated interim storage site for commercial spent nuclear fuel in southeastern New Mexico (NN, May 2017, p. 49). Holtec has said that if the facility is approved, it could be operational as soon as 2022. Waste Control Specialists was seeking a license to build a similar facility at its site in Andrews County, Texas, but the company suspended its application with the NRC in April for financial reasons (NN, May 2017, p. 17).

In 2014, SCE contracted Holtec to construct a HI-STORE UMAX underground storage facility to store 2,668 spent fuel assemblies in approximately 72 dry storage canisters. The Holtec facility would be adjacent to San Onofre’s existing, horizontal dry cask storage vault that was built by Areva.

Closure settlement

SCE announced on August 15 that it was unable to reach an agreement with Citizens Oversight and others regarding a separate settlement over the costs of prematurely closing the San Onofre plant. SCE said that it had notified the California Public Utilities Commission

SCE has agreed to explore the possibility of moving San Onofre’s spent fuel off-site in order to settle a lawsuit by an antinuclear group.

Photo: Edison International
(CPUC) that the parties could not come to an agreement on possible changes to the settlement, which split the San Onofre closure costs between utility investors and customers. SCE urged the CPUC to affirm the existing settlement, which the commission approved in 2014.

In December 2016, the CPUC directed SCE and the other parties in the San Onofre closure proceeding to meet and consider the changes to the 2014 agreement. According to SCE, the parties met three times directly and then four times with a mediator, and also talked by phone multiple times, but were unable to agree on changes to the settlement.

Ron Nichols, president of SCE, said in a statement, “The settlement is appropriate and should stand. It ensured our customers do not pay for the faulty steam generators from the time they failed and the plant was no longer providing power.”

PORTSMOUTH SITE

DOE tests robot for Portsmouth D&D work

The Department of Energy’s Office of Environmental Management (EM) announced on August 17 that it is leading a collaborative project to explore the use of a uranium-sensing robot to inspect several hundred miles of pipes at the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio. The project is helping EM evaluate the robot, named PipeDream, for possible deployment to help deactivate and prepare two massive process buildings for demolition by identifying uranium left over from enrichment operations.

The PipeDream project is part of EM’s Science of Safety initiative, which is intended to deploy advanced, remote-system technologies throughout the DOE complex. The DOE’s Portsmouth/Paducah Project Office (PPPO), contractor Fluor-BWXT Portsmouth (FBP), Carnegie Mellon University (CMU), the University of Nevada at Reno, Savannah River National Laboratory (SRNL), Sandia National Laboratories (SNL), and Los Alamos National Laboratory (LANL) have joined EM in the PipeDream collaboration. CMU designed and built PipeDream, while PPPO and FBP provide program management and implementation.

The Portsmouth plant, which enriched uranium for commercial nuclear power plants and the military until operations were discontinued in 2001, is currently being decommissioned. Before the plant’s process buildings can be demolished, pipes that transported uranium need to be characterized to identify contamination. Workers inspect each foot of piping to determine whether uranium levels are above predetermined limits. According to the DOE, the majority of the plant’s piping falls below those limits and can be safely left in the buildings for demolition. Segments with potential deposits above those limits are removed and cleaned of the deposits before disposal.

According to EM, PipeDream could potentially serve as an alternative or complement to external nondestructive assay methods, which can be time-consuming and costly. Using spiraling sensors, the robot can accurately model the volume of uranium deposits on pipe walls. PipeDream combines optical triangulation, which measures the top of the deposit, and inductive sensors, which assess the pipe’s metal surface. The robot can determine the thickness of deposits as thin as 0.4 millimeters.

In July, CMU tested PipeDream at its Pittsburgh campus in a pipe mockup. The robot repeatedly traversed the test pipe to quantify the location, dimension, and constituency of surrogate deposits. The surrogates included volumetric, visual, radiation, and fluorescent simulants of the deposits. Representatives from EM, the Portsmouth Site, FBP, SRNL, SNL, and LANL reviewed the testing.

A demonstration of the PipeDream robot at Portsmouth using the plant’s actual pipes was scheduled for September.

CANADA

CNSC reviews draft EIS for Chalk River disposal facility

The Canadian Nuclear Safety Commission announced on August 31 that it has completed its technical assessment of the draft environmental impact statement (EIS) from Canadian Nuclear Laboratories (CNL) for a proposed low-level radioactive waste disposal facility at the Chalk River Laboratories site in Ontario.

CNL, a private-sector company that manages and operates nuclear sites, facilities, and assets owned by Atomic Energy of Canada Limited, intends to build a near-surface disposal facility for current and future radioactive waste. According to CNL, the facility will enable the revitalization of the Chalk River site through improved environmental management of Canada’s legacy waste liabilities and the decommissioning of outdated infrastructure at Chalk River.

The CNSC said that it has identified a number of areas where additional information will need to be included in the final EIS and other supporting technical documentation. The CNSC staff’s assessment is reflected in a series of comments that have been consolidated with those of other federal authorities participating in the review. According to the CNSC, nearly 200 information requests and comments have been submitted to CNL for action.

CNL will submit a final EIS after it addresses all the federal and public comments it received on the draft document. The CNSC will then determine whether the information provided in CNL’s submissions is complete or if further information is required. CNL is expected to submit its final EIS to the CNSC in January 2018, and a public hearing on the license is expected in July 2018 following the release of the commission’s environmental assessment.

The disposal facility will have a planned operating life of at least 50 years and will include a wastewater treatment plant.
Radwaste Solutions

and supporting infrastructure. According to CNL, 99 percent of the waste to be emplaced in the facility will be low-level waste. The facility may also accept less than 1 percent by volume of intermediate-level waste, as well as mixed radioactive and chemical waste.

WIPP

GAO says DOE should plan for possible expansion

The Government Accountability Office is recommending that the Department of Energy develop a plan for expanding the Waste Isolation Pilot Plant (WIPP) in New Mexico before the repository’s existing space is full. The recommendation came in a GAO report, released on September 5, that examines the capability of WIPP to dispose of 34 metric tons of surplus weapons-grade plutonium. WIPP is the underground repository for U.S. defense-related transuranic (TRU) waste.

Under the Plutonium Management and Disposition Agreement with Russia, the surplus plutonium was to be converted to mixed-oxide nuclear fuel at the MOX Fuel Fabrication Facility being built in South Carolina. Claiming that rising construction costs made that option unaffordable, the DOE began investigating an alternative disposition path for the plutonium in 2014. The proposed alternative would involve diluting the plutonium and disposing of it in a geologic repository, with WIPP being the likely candidate.

According to the GAO report, disposing of the plutonium at WIPP may not be feasible, as the DOE has not adequately planned for all possible waste that it may be expected to dispose of in the repository. Furthermore, the GAO said that the DOE does not have sufficient space at WIPP to dispose of all of the DOE’s TRU waste. Based on its analysis of the DOE’s 2016

Waste Management Briefs

PGE HAS APPLIED FOR RENEWAL OF THE TROJAN ISFSI LICENSE for an additional 40 years. Portland General Electric’s current license for the independent spent fuel storage installation at the closed Trojan nuclear power plant expires on March 31, 2019. PGE submitted a license renewal application in March to the Nuclear Regulatory Commission, which is providing an opportunity to request a hearing or petition for leave to intervene by October 17. Located in Columbia County, Oregon, the Trojan plant operated from 1976 to 1992. After being shut down, the pressurized water reactor’s fuel was moved to the ISFSI, and the decommissioning of the plant was completed in 2006. Notice of the NRC’s review of the license renewal application was published in the August 18 Federal Register. More information is available on the federal rulemaking website, at <www.regulations.gov>, with a search for Docket ID NRC–2017–0178.

DRAFT REVISIONS TO FUKUSHIMA’S DECOMMISSIONING ROAD MAP were released on September 1 by Japan’s Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF), according to an announcement by the Japan Atomic Industrial Forum (JAIF). According to JAIF, the revisions to the mid- to long-term road map for decommissioning the disabled Fukushima Daiichi nuclear power plant did not change the overall framework for decommissioning, which sets a target date of 2021 for the start of fuel debris removal from the Unit 1 reactor. Based on a technical proposal by NDF, however, workers will attempt to remove fuel debris from the reactors’ primary containment vessels without flooding the vessels. Initially, a shielded, water-covered approach was to be used during debris removal. That approach may still be reconsidered based on experience and new information, according to JAIF. NDF, which oversees the decommissioning of Fukushima on behalf of the Japanese government, also intends to have all of the contaminated water that accumulated in the reactor buildings treated by 2020.

THE PILE FUEL CLADDING SILO AT THE SELLAFIELD SITE in the United Kingdom is being decommissioned, and on September 5, Sellafield Ltd. and the U.K. Nuclear Decommissioning Authority announced that the first of six holes has been cut into the wall of the silo to allow radioactive waste to be removed. After the section of concrete was removed in a single piece, a steel containment door was placed over the opening. The removal of the radioactive material is expected to start in 2019. The work is being carried out by Sellafield Ltd., which is responsible for the management and cleanup of the Sellafield site, along with Bechtel Cavendish Nuclear Solutions and Babcock Marine Technology. The silo, the world’s oldest nuclear waste storage facility, was built in the 1950s and is one of the Sellafield site’s most hazardous buildings.
annual TRU waste inventory report, the GAO said that the DOE will have 43,000 cubic meters more waste (not including the proposed surplus plutonium or higher-level remote-handled waste) than can be stored at WIPP, which is permitted to hold 175,565 m³ of TRU waste. Under current plans, the DOE will fill the existing disposal space at WIPP by 2026.

While additional space will need to be excavated at WIPP, the GAO said that DOE officials have not analyzed or planned for the facility’s expansion because the department’s focus has been on resuming operations at WIPP, which had been suspended in 2014 after two separate accidents at the facility. The GAO said that without a long-term plan and schedule for obtaining regulatory approval and excavating new space before the repository reaches capacity, the DOE does not have reasonable assurance that it will be able to expand the repository before waste shipments must be slowed or suspended.

The GAO recommended that the DOE develop such a plan for disposing of its TRU waste, along with an integrated schedule for completing the regulatory approval process. The DOE would need approvals from the Environmental Protection Agency and the New Mexico Environment Department to expand WIPP, a process that could take several years. The GAO also recommended that the DOE develop a schedule for deciding whether potential waste identified in the DOE’s annual TRU waste inventory report can be disposed of at WIPP and develop guidance that helps waste-generating sites better estimate the volumes of TRU waste that may be generated in the future.

The DOE concurred with the GAO’s recommendations, saying that they are consistent with the department’s commitment to improving the management of the national TRU waste program. The 71-page report, Plutonium Disposition: Proposed Dilute and Dispose Approach Highlights Need for More Work at the Waste Isolation Pilot Plant (GAO-17-39-0), can be found on the GAO website, at <www.gao.gov>.

The Government Accountability Office is recommending that the DOE develop a plan for expanding the Waste Isolation Pilot Plant repository, which resumed waste operations in January.

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Lightbridge/Areva and X-energy/Centrus form partnerships

Two industry partnerships have been formed for the development and manufacture of advanced nuclear fuel.

On September 6, Lightbridge Corporation and Areva NP in North America (Areva Inc.) announced that they have signed a binding agreement that summarizes all material terms and conditions for their joint venture to develop, manufacture, and commercialize Lightbridge’s advanced metallic fuel technology. The joint venture will be owned on a 50-50 basis.

According to Lightbridge’s press release, its technology is designed to improve the economics, efficiency, and safety of existing and new nuclear power plants. Through the joint venture, the two companies will research, develop, demonstrate, fabricate, license, market, and sell nuclear fuel assemblies that utilize Lightbridge’s proprietary metallic fuel designs and other advanced nuclear fuel intellectual property contributed by both companies.

Areva NP and Lightbridge announced a joint development agreement for next-generation fuel in March 2016. The parties expect to finalize a definitive operating agreement in the fourth quarter of 2017 and to launch the joint venture in the first quarter of 2018.

Seth Grae, president and chief executive officer of Lightbridge, said, “Over the last year and a half, our teams in the United States and around the world worked together and with government authorities to reach this major milestone, which holds great promise for the growth of nuclear energy around the world.”

Lightbridge is conducting preparatory work for the fabrication and irradiation testing of metallic fuel samples under commercial reactor operating conditions at the Halden research reactor in Norway and is working with four U.S. nuclear utilities to acquire feedback on the development of its fuel technology.

X-energy LLC and Centrus Energy Corporation announced on September 6 that they have signed a memorandum of understanding that could lead to the development of a fuel fabrication facility for uranium oxycarbide (UCO) tristructural isotropic (TRISO) fuel for advanced reactors.

X-energy is developing the Xe-100, a 76-MWe high-temperature gas-cooled pebble bed modular reactor, and is also producing TRISO-based fuel forms. The company plans to implement pilot-scale fuel manufacturing in 2018. X-energy’s CEO, Kam Ghaffarian, said, “X-energy is focused on both our high-temperature gas-cooled reactor development and the fuel needed to power our reactors. The Department of Energy has spent close to $400 million in developing and qualifying the UCO TRISO particle in preparation for advanced reactor commercialization.”

The Xe-100 is being designed for relatively quick construction with factory-produced components, according to X-energy, which says that the reactor is “walk-away” safe without operator intervention.

“Our technical and engineering teams are eager to help X-energy develop TRISO fuel for their reactor,” said Daniel Poneman, Centrus Energy’s president and CEO, “We agree that American leadership in the global nuclear market requires that we develop an end-to-end domestic capability, from high-assay low-enriched uranium enrichment through fuel production, for next-generation reactors.”

Under the MOU, the companies will prepare a plan to deploy X-energy’s TRISO fuel technology, design a fuel manufacturing process line, and seek funding for a future commercial fuel production facility.

IAEA

Fuel bank storage facility completed in Kazakhstan

On August 29, a facility for the storage of low-enriched uranium in Kazakhstan
was inaugurated during a ceremony attended by Yukiya Amano, director general of the International Atomic Energy Agency, and Nursultan Nazarbayev, the president of Kazakhstan.

The IAEA LEU Bank Storage Facility, built at the Ulba Metallurgical Plant in the city of Ust-Kamenogorsk, is part of a project “aimed at providing confidence to countries about the availability of nuclear power fuel,” according to the IAEA.

The IAEA Board of Governors decided to establish the fuel bank in December 2010 (NN, Jan. 2011, p. 86) to serve as a supplier of last resort for IAEA member states that experience a supply disruption due to exceptional circumstances that prevent their obtaining fuel from the commercial market, state-to-state arrangements, or other means. Owned and controlled by the IAEA, the bank will be the first of its kind not to be under the control of any individual country.

“I am confident that the IAEA LEU Bank will make a valuable contribution to international efforts to ensure the availability of fuel for nuclear power plants,” Amano said.

The fuel bank was jump-started over a decade ago with an initial investment of $50 million by Warren Buffett, a member of the board of the Nuclear Threat Initiative (NTI), which inspired the fuel bank project. The bank will provide a physical reserve of up to 90 metric tons of LEU suitable to make fuel for a typical light-water reactor, enough to produce the fuel needed to power a large city for up to three years.

“The launch of the IAEA LEU Bank is an unprecedented international effort that will reduce nuclear dangers and make the world safer,” said former U.S. Secretary of Energy Ernest J. Moniz, cochairman and chief executive officer of NTI. “I believe that today’s event gives us additional impetus to build upon this step with a much more comprehensive and energetic approach to the broad set of fuel cycle questions.”

Construction of the 880-square-meter steel structure began in September 2016 after the signing of a partnership agreement between the IAEA and the Ulba Metallurgical Plant in May 2016 (NN, July 2016, p. 64), and it was completed on schedule and on budget. The project was funded by voluntary contributions from IAEA member states and others totaling about $150 million, which will fully fund estimated project costs for about 20 years of operation. In addition to NTI, the donors include the United States, the European Union, Kuwait, the United Arab Emirates, Norway, and the Republic of Kazakhstan.

While the facility currently does not contain any LEU, the IAEA noted that
On August 30, Berkeley Energia announced that it has entered into an agreement with the sovereign wealth fund of the sultanate of Oman that will fully fund the Salamanca uranium mine in Spain into production.

The sultanate has agreed to invest up to $120 million in the form of an interest-free loan of $65 million, which could be converted into ordinary shares, resulting in the fund owning approximately 28 percent of Berkeley Energia, and three options that together would contribute a total of $55 million to development costs and increase the fund’s ownership by an additional 9 percent.

“The project benefits from a rare combination of low up-front capital cost and very low operating costs, and due in part to its location in the heart of the European Union, we are able to contract supply at prices well above the current spot price,” said Managing Director Paul Atherley. “The fund’s interest in matching our future off-take contracts will further enhance our revenue stream.”

Silex Systems Limited and GE Hitachi Nuclear Energy have agreed to extend a term sheet announced in May 2016 to facilitate the restructuring of GE Hitachi Global Laser Enrichment LLC (GLE), which is the exclusive licensee of Silex’s laser enrichment technology.

GE Hitachi is looking to sell its 76 percent interest in GLE, and the term sheet was developed to support Silex’s efforts to acquire a majority interest in GLE. Silex continues to hold an exclusive assignable option over GE Hitachi’s interest in GLE and is working to attract new investors to the project.

According to a Silex press release, “Whilst the current market conditions are not helpful, Silex believes that quality investors can be found to help support the completion of the Silex technology commercialization program and to enable GLE to take the technology to market.” In the meantime, Silex is reimbursing GE Hitachi its pro rata share of the 2017 budget for GLE operations in Wilmington, N.C.

On August 18, Silvermet Inc. announced that it has entered into a definitive agreement with Global Atomic Fuels Corporation that will allow Silvermet to acquire all of the outstanding common shares of Global Atomic Fuels Corporation and change the name of the consolidated company to Global Atomic Corporation. Upon completion of the transaction, former Global Atomic shareholders will own 50 percent of the combined company.

Silvermet is primarily engaged in producing zinc oxide concentrate, while Global Atomic holds six uranium exploration permits in the Republic of Niger. Global Atomic signed a memorandum of understanding with Areva Mines S.A. in July to advance the development of its most significant deposit, known as DASA, which contains indicated resources of 21.4 million lb U₃O₈ equivalent and inferred resources of 49.8 million lb U₃O₈.

**BUSINESS DEVELOPMENTS**

**Full funding for Salamanca uranium mine; other news**

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**URANIUM RESOURCES HAS CHANGED ITS NAME** to Westwater Resources, effective August 21. The decision can be attributed in part to the continued downturn in the uranium market. “As our lithium business grows to support the rising demand for energy storage, we believe that our name and identity needed to reflect this broader market focus,” said Christopher Jones, the company’s president and chief executive officer. “Westwater Resources is now focused on supply for both the power generation and energy storage markets and is poised to take advantage of green energy power implementation around the world.” The company’s strategy, according to a press release, “includes developing its new lithium business while maintaining optionality in the case of a future rising uranium price.” The company holds two licensed and idled uranium processing facilities and a number of prospective in situ recovery (ISR) projects in the United States, but its Temrezli ISR project in central Turkey would be the first uranium project to be developed in the event of a market recovery.

**A NEW RESOURCE ESTIMATE FOR ENERGY FUELS’ CANYON MINE** in Coconino County, Ariz., was announced on August 23. The new estimate includes an increase in total uranium resources of about 1 million lb U₃O₈ and upgrades a large portion of resources from the inferred category to the measured and indicated categories. In total, Canyon’s measured and indicated resources are now estimated at 2.434 million lb U₃O₈, and inferred resources total 134,000 lb U₃O₈. Approximately 12 million lb of measured and indicated copper resources have been identified in the main zone of the deposit, with an average grade of 5.9 percent copper. According to Energy Fuels, “The copper resources have the significant potential to add by-product credits and lower the U₃O₈ cost per lb at the Canyon mine.”

**Fuel Briefs**

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CASSINI-HUYGENS
After two decades in space, mission completed

The Cassini-Huygens spacecraft provided scientists with an enormous amount of data and images during its 20-year mission, with its instruments powered by radioisotope thermoelectric generators.

The Cassini-Huygens unmanned spacecraft, using radioisotope thermoelectric generators (RTG) to power its instruments, was a success by almost any reasonable measure. Its mission of nearly 20 years completed, it was steered into the planet Saturn’s hydrogen/helium atmosphere at about 77,000 mph on September 15, burning up like a meteorite. This was done to avoid possible contamination of Saturn’s moons.

Among its many achievements were discovering seven previously unknown moons of Saturn, landing the first probe on a moon in the outer solar system, showing that Saturn’s rings are active and dynamic, and revealing that Saturn’s largest moon, Titan, has rain, rivers, and seas. As recently as April 2017, NASA announced that molecular hydrogen—which could support microbial systems—was detected in the plumes of water on the surface of the moon Enceladus. In the same month, Cassini became the first spacecraft to fly between Saturn and its rings.

Consisting of an orbiter (Cassini) and a lander (Huygens), the spacecraft was launched on October 15, 1997, and went into orbit around Saturn on July 1, 2004. The Huygens lander separated from the orbiter and successfully landed on Titan on January 14, 2005.

There was substantial controversy before Cassini-Huygens was launched. Because of the impracticality of using solar power at Saturn’s distance from the sun, the probe’s instruments were powered by 72 pounds of plutonium-238 in its RTGs, using heat from the plutonium’s decay to generate direct-current electricity.

The spacecraft used gravitational-assist flybys of Venus, one in 1998 and another in 1999, and of Earth, in 1999. These flybys provided momentum for the probe’s trip to Saturn.

Opponents of the launch claimed that the risks of spreading Pu-238 contamination over large areas were too great and that such a situation could occur from a launch failure or from the probe’s accidentally reentering Earth’s atmosphere during the 1999 flyby. The launch and the flyby, however, went as planned, and Cassini-Huygens proceeded safely to Saturn.

The Jet Propulsion Laboratory managed the mission for NASA’s Office of Space Science. The European Space Research and Technology Centre managed the development of the Huygens probe, and Aerospatiale (now Alcatel) assembled it. Lockheed Martin provided the launch vehicle, the spacecraft propulsion module, and the RTGs.

LITIGATION
Lawsuit against owners of closed fuel plant dismissed

A federal appeals court has upheld a lower court ruling that rejected a lawsuit tying radiation from a former nuclear fuel facility in Pennsylvania to cancer cases. The U.S. Court of Appeals for the Third Circuit on August 23 ruled in favor of the defendants, which included the current and past owners of the Nuclear Material and Equipment Corporation (NUMEC) facility in Apollo, Pa.
The ruling upholds a district court decision that found the plaintiffs in the case—including more than 70 individuals who claimed that radiation from uranium effluent from the plant caused them to develop various forms of cancer—failed to provide enough evidence to legally link their illnesses to the plant. Babcock & Wilcox, which currently owns the site, and former owner Atlantic Richfield were named as defendants in the case.

The Apollo facility operated from about 1953 to 1983, with the manufacture of uranium fuel beginning in 1958 and decommissioning beginning in 1978. During uranium enrichment operations, the facility emitted radiation, which the plaintiffs claimed was in excess of regulatory limits.

The site also includes the Shallow Land Disposal Area, where NUMEC disposed of uranium waste. The area is currently being remediated by the U.S. Army Corps of Engineers under the Formerly Utilized Sites Remedial Action Program.

In comments on the decision, Circuit Judge Theodore McKee agreed with the district court’s ruling in favor of the defendants, but noted that existing laws do not adequately address claims based on exposure to excess radiation and place “an almost insurmountable burden on plaintiffs” to try to prove their illness was caused by their exposure. McKee said that this likely will continue “until state supreme courts, state legislatures, and/or Congress devise a way to more fairly address the very real and substantial dangers posed by activities that increase the risk of exposing communities to ionizing radiation.”

**Isotopes & Radiation Briefs**

**ALLEN COUNTY CARDIOLOGY FACES A $7,000 CIVIL PENALTY from the Nuclear Regulatory Commission.** On September 7, the NRC announced that it has proposed fining the company for failing to perform daily surveys and weekly tests while handling licensed radioactive material for use in medical procedures.

The violations—ranked at Severity Level III, meaning of moderate safety concern—were identified during an NRC inspection last year and a subsequent investigation. The NRC said that a medical technologist willfully failed to perform daily ambient radiation exposure rate surveys and weekly area radioactive contamination surveys. The technologist also willfully provided inaccurate and incomplete records to the agency. According to the NRC, Allen County Cardiology, based in Fort Wayne, Ind., has taken corrective actions, including ensuring adequate time for completing the required tasks, conducting audits, and committing to have an independent health physics service perform semiannual audits. The NRC concluded that the company’s actions are effective and will prevent a recurrence.

The site also includes the Shallow Land Disposal Area, with a search for Docket ID NRC–2017–0159.

In August, the NRC issued a violation notice to Geo-Engineering & Testing, a geotechnical engineering and construction materials testing firm based in Guam, for four violations of agency requirements. Three of the violations were categorized as Severity Level IV violations, and one was rated at the more serious Severity Level III. That violation, according to the NRC’s August 18 notice, involved a Troxler Model 3411-B portable nuclear gauge (containing approximately 7 millicuries of cesium-137 and 40 mCi of americium-241/beryllium) that was improperly transferred to a member of the public who was not authorized to receive by-product material. On or about July 22, 1998, the NRC stated, an employee at the company’s Saipan facility either sold or gave the gauge to someone who intended to bring it to the Philippines. The NRC inspector in the case was unsuccessful in locating any documentation pertaining to the ultimate fate of the gauge.

The NRC was barred from considering a civil penalty against Geo-Engineering & Testing by the statute of limitations, which requires the agency to initiate an action imposing a fine within five years of a violation’s occurrence.

**THE NRC IS BEING PETITIONED TO ADD RADIONUCLIDES to its list of “Quantities of Licensed Material Requiring Labeling.”** As published in the August 23 Federal Register, the Nuclear Regulatory Commission has docketed a petition for rulemaking from Matthew McKinley, on behalf of the Organization of Agreement States (OAS), requesting that the agency amend its existing regulations to add certain radionuclides and their corresponding activities to the list found in Appendix B of 10 CFR Part 30. OAS believes that patient health and safety is being compromised due to licensing delays for diagnostic and therapeutic products that use radioisotopes that are not listed in the Appendix B table. The NRC is examining the issues raised by the petition to determine whether they should be considered in a rulemaking and is accepting comments on the petition until November 6. Further information is available on the federal rulemaking website, at <www.regulations.gov>, with a search for Docket ID NRC–2017–0159.

The ruling upholds a district court decision that found the plaintiffs in the case—including more than 70 individuals who claimed that radiation from uranium effluent from the plant caused them to develop various forms of cancer—failed to provide enough evidence to legally link their illnesses to the plant. Babcock & Wilcox, which currently owns the site, and former owner Atlantic Richfield were named as defendants in the case.

The Apollo facility operated from about 1953 to 1983, with the manufacture of uranium fuel beginning in 1958 and decommissioning beginning in 1978. During uranium enrichment operations, the facility emitted radiation, which the plaintiffs claimed was in excess of regulatory limits.

The site also includes the Shallow Land Disposal Area, where NUMEC disposed of uranium waste. The area is currently being remediated by the U.S. Army Corps of Engineers under the Formerly Utilized Sites Remedial Action Program.

In comments on the decision, Circuit Judge Theodore McKee agreed with the district court’s ruling in favor of the defendants, but noted that existing laws do not adequately address claims based on exposure to excess radiation and place “an almost insurmountable burden on plaintiffs” to try to prove their illness was caused by their exposure. McKee said that this likely will continue “until state supreme courts, state legislatures, and/or Congress devise a way to more fairly address the very real and substantial dangers posed by activities that increase the risk of exposing communities to ionizing radiation.”

**Nuclear News**

**2017 World List of Nuclear Power Plants**

The World List of Nuclear Power Plants, a reprint from the March 2017 issue of Nuclear News, provides data on nuclear plants worldwide that are operable, under construction, or on order as of December 31, 2016. 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.
NUCLEAR ENGINEERING DEGREES

ORISE releases results of 2016 survey

The survey found a slight decrease from the previous year in the number of undergraduate and master’s degrees awarded, while the number of doctoral degrees increased.

The annual survey conducted by the Oak Ridge Institute for Science and Education found that the number of bachelor’s and master’s degrees awarded by nuclear engineering programs fell slightly in 2016 following a rebound in 2015. Nuclear Engineering Enrollments and Degrees Survey, 2016 Data, reports the results of a survey of 35 U.S. universities with nuclear engineering programs and includes degrees granted between September 1, 2015, and August 31, 2016.

According to the report, 621 students received bachelor’s degrees in nuclear engineering in 2016, a 5 percent decrease from 2015 and 1 percent lower than in 2014. This is the fourth-highest number of bachelor’s degrees reported since 1984. The number of master’s degrees in nuclear engineering awarded in 2016 decreased by 2 percent from 2015 but is 10 percent higher than the number awarded in 2014. The number of master’s degrees—355—is the third-highest since 1984.

The survey data show that the number of doctoral degrees granted in 2016 rose to 161, a 9.5 percent increase over 2015. This continues a trend of increases since 2010 after a one-year decrease in 2015. Doctorate numbers reported in 2016 are the second-highest reported since 1972.

Of the 35 universities surveyed, Pennsylvania State University awarded the most nuclear engineering degrees in 2016, with 90 bachelor’s degrees, 30 master’s degrees, and four doctoral degrees, followed by the University of Michigan and the University of Tennessee.

In 2016, nuclear engineering enrollment overall for undergraduate students was up 9 percent compared with 2015. This approaches levels reported from 2011 through 2013, and undergraduate enrollment appears to have recovered after the decline experienced in 2014. The 2016 undergraduate enrollment is the fourth-highest number reported since 1978. Graduate enrollment in 2016 remained similar to numbers reported in 2014 and 2015, although these remain below those reported from the mid-1970s. The increase in undergraduate enrollments will likely result in modest increases in the number of bachelor’s degrees earned over the next year or two, and this number should remain above 600 in 2017. The continued strength in graduate enrollment indicates that the number of graduate degrees awarded in the coming years is likely to remain near the levels of the past three years.

The ORISE survey also looked at citizenship, gender, and race/ethnicity data for the 2016 degree recipients. Percentages for bachelor’s, master’s, and doctoral degrees are based on the 525 bachelor’s degrees, 305 master’s degrees, and 158 doctoral degrees for which data were reported. Non-U.S. citizens accounted for 4 percent of bachelor’s degree recipients, 17 percent of master’s degree recipients, and 28 percent of doctoral degree recipients. Female recipients comprised 18 percent of the bachelor’s degrees, 15 percent of the master’s degrees, and 16 percent of the doctoral degrees. Among bachelor’s degree recipients, 20 percent of the U.S. citizens were members of minority groups. Among master’s and doctoral degree recipients, 13 percent and 16 percent, respectively, of the U.S. citizens were members of minority groups.

ORISE, a Department of Energy research and education institute, has collected and monitored data on enrollments and degrees in science- and energy-related fields of study for the DOE and other federal agencies since the mid-1970s. The report can be found on the institute’s website, at <www.orise.orau.gov>.

INTERNATIONAL

IAEA course improves regulation drafting skills

The International Atomic Energy Agency held a two-week course in July to help senior regulators and legal officers from
several European countries sharpen their ability to draft regulations. According to an IAEA press release, the IAEA School of Drafting Regulations is supported by a regional technical cooperation project that assists the harmonized and continuous improvement and development of infrastructure for radiation safety in accordance with relevant IAEA safety standards and guidance. The school provides member states with a forum to share knowledge and experience on drafting regulations, as well as guidance on all aspects of regulatory control of nuclear safety and radiation safety.

The first School of Drafting Regulations was held in 2010, and the course is now well established with “elaborate content and proven efficiency in delivering results,” according to the IAEA. The course combines learning and the exchange of experience in the drafting and revision of national regulations to incorporate best practices and IAEA and other standards and requirements and to encourage a “harmonized approach.” Experienced mentors support participants in drafting activities throughout the duration of the course, and because the schools are held mainly at IAEA headquarters in Vienna, further advice is available from IAEA technical officers.

International experts in the topic area specific to each school are invited to present on the issues facing regulators, particularly with regard to best practices, technological developments, and philosophical and political issues associated with maintaining an effective regulatory regime for nuclear and radiation safety. Because the scope of oversight of regulatory bodies in IAEA member states varies widely, some schools address the full spectrum of regulated practices, but most focus on nuclear safety or radiation safety to allow for in-depth study.

The July 2017 course focused on radiation safety. Senior regulators and legal officers from Bosnia and Herzegovina, Bulgaria, Georgia, Hungary, Lithuania, Poland, Romania, Serbia, Tajikistan, and Ukraine took part in the course, and experienced mentors from the United Kingdom, Greece, Lithuania, and Slovenia provided support and advice.

The next School of Drafting Regulations for the European region will be held November 13–24 in Vienna and will focus on the nuclear safety stream.
BUSINESS DEVELOPMENTS

GE, ARC advance SMR collaboration; other news

GE Hitachi Nuclear Energy and Advanced Reactor Concepts (ARC Nuclear) announced on August 28 that they have taken steps to advance their collaboration to develop and license the ARC-100 advanced small modular reactor. Under a development agreement signed by the companies, GE Hitachi intends to license intellectual property associated with its PRISM advanced reactor design to ARC Nuclear. GE Hitachi has also agreed to provide ARC Nuclear with access to nuclear infrastructure programs related to quality, safety culture, training, processes, procedures, and tools. In addition, GE Hitachi will make an in-kind contribution to ARC Nuclear through its agreement to provide engineering and design expertise. In March, the companies announced a collaboration agreement to progress the ARC-100 design for global power generation with initial deployment in Canada (NN, May 2017, p. 69). GE Hitachi and ARC Nuclear are pursuing a preliminary regulatory review of the reactor by the Canadian Nuclear Safety Commission through the agency’s vendor design review process. Like GE Hitachi’s PRISM reactor, the ARC-100 design is based on the EBR-II, a prototype integral sodium-cooled fast reactor.

International Isotopes Inc. announced on August 21 that it has assumed the management of RadQual following the purchase of approximately 75 percent of the member shares of RadQual by a buyers group affiliated with International Isotopes. The buyers group, which includes International Isotopes’ current chairman of the board, the former chairman of the board, and the chief executive officer, has acquired all of the member units of RadQual not already held by International Isotopes, which still retains its 25 percent ownership in RadQual. Following the purchase, the buyers group voted International Isotopes the primary managing member of RadQual. International Isotopes will be responsible for the oversight of all business activities and management of RadQual, an Idaho Falls, Idaho–based provider of SPECT imaging radioactive sealed sources for routine quality control purposes.

ICE Service Group, through its packaging division, ICE Packaging Company, announced on August 23 that it has purchased the assets of Strategic Packaging Systems, a full-service, Tennessee–based company that specializes in the design, manufacturing, and distribution of soft-sided packages and railcar liner systems for the nuclear and environmental remediation markets. The sale included an 80,000-square-foot manufacturing facility in Madisonville, Tenn., adjoining property, all manufacturing equipment, patents, and inventory. According to ICE, the acquisition gives both firms additional resources and complementary capabilities. Based in Pittsburgh, Pa., ICE provides services for the packaging, transportation, and logistical management of radioactive and hazardous materials, difficult and sensitive materials, and heavy and oversized equipment. The terms of the transaction were not disclosed.

On August 30, Golden, Colo.–based NFT announced that it has signed a licensing agreement with UltraTech International to integrate Gentoo, a corrosion-resistant, polymer-based coating, into packages and containers used in the storage and transportation of radioactive materials for the Department of Energy and the nuclear industry. According to NFT, Gentoo is a new organic, hydrophobic, corrosion- and chemical-resistant material that can be applied in a liquid form. NFT intends to incorporate Gentoo into packages and products used in the nuclear industry to increase their performance capabilities, including their ability to withstand corrosive environments.

AE Industrial Partners (AEI), a private equity investor in aerospace, power generation, and specialty industrial companies, announced on August 28 that it has acquired Weymouth, Mass.–based BHI Energy, which provides a variety of on-site specialty maintenance, radiation protection, and staffing services to the power-generation industry. AEI, which invests in market-leading companies, said that it will work with BHI to accelerate the company’s growth in the U.S. power generation and broader infrastructure markets. BHI’s workforce includes more than 8,500 project management and technical, professional, and craft employees at more than 130 project locations. Terms of the transaction, which were closed on the day of the announcement, were not disclosed.

CONTRACTS

OneAIM wins Sellafield contract; other pacts

On August 16, Amec Foster Wheeler announced that OneAIM, its joint venture with Interserve, has won a framework contract worth up to £160 million (about $214.4 million) over four years to support reprocessing plants and facilities at the Sellafield nuclear site in Cumbria, England. The site operations contract covers engineering support services for asset care and maintenance. According to Amec Foster Wheeler, OneAIM’s participation in the life cycle of the project is designed to produce greater cost efficiencies for Sellafield Ltd., the company responsible for reprocessing, decommissioning, and nuclear waste management at the site. According to the press announcement, winning the contract reflects Amec Foster Wheeler’s strategy to extend the range of services it provides to Sellafield Ltd.

Amec Foster Wheeler also announced on August 23 that it has been awarded two framework contracts worth a combined £4 million (about $5.4 million) from the United Kingdom’s LLW Repository Ltd. to carry out environmental safety case services and waste characterization and assurance work. LLW Repository operates

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SEAMLESS STAINLESS AND HIGH NICKEL ALLOY PIPES FOR SAFETY IN NUCLEAR APPLICATIONS ACCORDING TO ASME SECT. III.

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Idaho National Laboratory: Integration of PHISICS into the Areva Reactor Design Suite for Commercial Application to High Temperature Reactors, $300,000 (with Areva NP, Lynchburg, Va.); Seismic Isolation of Major Advanced Reactor Systems for Economic Improvement and Safety Assurance, $710,000 (with Southern Company Services, Birmingham, Ala.; TerraPower, Bellevue, Wash.; and X-energy, Greenbelt, Md.).

Los Alamos National Laboratory: Development of a Micro-Reactor for Generation of Nuclear Power, $750,000 (with Westinghouse Electric Company, Cranberry Township, Pa.).

Oak Ridge National Laboratory: Polymer-Based Adsorbents for the Recovery of Uranium from Desalination Facilities, $622,000 (with 525 Solutions, Tuscaloosa, Ala.).

Sandia National Laboratories: Consolidation of Commercial Spent Nuclear Fuel into a Universal Canister for Storage, Transportation, and Disposal, $750,000 (with NAC International, Norcross, Ga.).

CRACKS IN THE SHIELD BUILDING AT DAVIS-BESSE will be repaired this fall, according to FirstEnergy Corporation spokesperson Jennifer Young. The cracks in the building’s concrete shell were first discovered in 2011 and were attributed to freezing and thawing conditions during a blizzard in 1978. In 2014, the company discovered that some of the cracks had expanded, and it has since worked to repair these deficiencies. During the week of September 11, crews began working on the areas surrounding the cracks to prepare them for new concrete. The repairs will likely take seven weeks to finish, and the 908-MWe pressurized water reactor near Oak Harbor, Ohio, will continue to operate throughout the repairs. “This work, while not routine, isn’t something new to construction projects,” Young said. “Although there are no radiological aspects to this work, the Nuclear Regulatory Commission is aware of our plans and will have inspectors on site.”

THE START OF CONSTRUCTION OF FINLAND’S HANHIKIVI-I, a 1,200-MWe AES-2006 reactor being supplied by Rosatom, Russia’s state atomic energy corporation, has been pushed back from 2018 to 2019. Fennovoima made the announcement on September 18, following a review of progress made in the processing of the construction license application.

Fennovoima applied for a construction license from the Finnish government in the summer of 2015. Among other input called for by the government in deciding to grant the license is a positive safety assessment from Finland’s Radiation and Nuclear Safety Authority (STUK). To this end, Fennovoima has been supplying STUK with documentation needed for its assessment. “Taking Finnish requirements and legislation into consideration in the design work has taken more time from the plant supplier than we originally expected,” said Toni Hemminki, chief executive officer of Fennovoima. “Since the delivery of documents during the first two years has been slower than expected, STUK has not been able to carry out its own assessment work on the scale planned.”

Hemminki also noted recent measures taken by Rosatom to speed up the flow of documents. Furthermore, he said, as Rosatom “is the most experienced nuclear power plant supplier in the world, I am confident about the end result.” Hemminki also stressed that a big advantage for Hanhikivi-I is that its reference plant, Leningrad II-1 in Sosnovy Bor, Russia, will be completed next year.

NUCLEAR WASTE PARTNERSHIP’S WIPP OPERATING CONTRACT has been extended to September 30, 2020, the Department of Energy announced on September 15. The DOE said that a modification to the contract with NWP for the management and operation of the Waste Isolation Pilot Plant near Carlsbad, N.M., exercises a newly negotiated option to extend it for three of the five years remaining on the contract, giving NWP the necessary time to continue the progress it has made in the repository’s recovery and resumption of transuranic waste shipments. Other contract modifications include cost incentives that will share savings between NWP and its workforce, increased fee award incentives for improvements to safety-related activities, and the establishment of a chief mining officer to focus on the safety of the mine. NWP was awarded the $1.3-billion WIPP contract in 2012. The three-year contract extension is worth $928 million, according to a September 19 report in the Carlsbad Current-Argus.

RECOMMENDATIONS FOR REMEDIATING HISTORIC RADIUM SITES have been approved by the Nuclear Regulatory Commission. In a September 7 staff requirements memorandum (SECY-17-0026), the commissioners approved three recommendations from the NRC staff regarding the remediation of nonmilitary, unlicensed historic radium sites in non-agreement states. The recommendations include monitoring by the NRC under a memorandum of understanding with the Environmental
Protection Agency (should an MOU become necessary) and, as appropriate, separate site-specific agreements at sites undergoing remediation through existing state and federal programs; the use of a risk-informed, graded approach to license the site, work cooperatively with site owners using a letter of forbearance, or pursue no further action; and the establishment of a new NRC fee-relief category for nonmilitary sites contaminated with radium. The recommendations are intended to define the NRC’s role in the remediation of sites contaminated by the historic use of radium, such as the former Waterbury Clock Company site in Waterbury, Conn., where radium-laden paint was used for luminescent watch dials.

**AUSTRALIA ACCEDED TO THE GIF FRAMEWORK AGREEMENT**

After depositing its instrument of accession on September 14, the Generation IV International Forum is a cooperative international endeavor whose members carry out research and development to establish the feasibility and performance capabilities of next-generation nuclear energy systems. Australia had signed the GIF charter in June 2016, and its accession to the Framework Agreement was marked by a ceremony at the Paris-based Organization for Economic Cooperation and Development. The OECD Nuclear Energy Agency provides the technical secretariat for GIF.

Although an important uranium producer, Australia is the only member country without a nuclear power program. Being part of GIF will enable Australia to take part in R&D projects, including those developing advanced materials with applications in extreme industrial environments, an area in which Australia has world-class capabilities, said Adrian Paterson, chief executive officer of the Australian Nuclear Science and Technology Organisation (ANSTO). Paterson also sees this as an opportunity to strengthen Australia’s role on the global stage, allowing it to share its expertise in nuclear research and technology and further its nonproliferation and nuclear safety objectives.

As the 14th member of GIF, Australia joins Argentina, Brazil, Canada, China, Euretom, France, Japan, Russia, South Africa, South Korea, Switzerland, the United Kingdom, and the United States.

**THE NRC HAS APPROVED AN NEI CYBERSECURITY GUIDE**

Following revisions made to the document at the agency's request, NEI 13-10, Cyber Security Control Assessments, Revision 6, was submitted by the Nuclear Energy Institute to the Nuclear Regulatory Commission in August for its review and endorsement after the agency had identified issues with Revision 5 (NN, Sept. 2017, p. 28), which was submitted in February. In a September 7 letter, the NRC informed NEI that the agency staff had completed its review of the latest revision and concluded that Revision 6 is acceptable for use by licensees to address the security controls provided in their cybersecurity plans. The goal of NEI 13-10, according to the executive summary, “is to minimize the burden on licensees of complying with their NRC-approved cybersecurity plan, while continuing to ensure that the adequate protection criteria of 10 CFR 73.54 [Protection of digital computer and communication systems and networks] are met.”

NEI 13-10 can be accessed from the NRC’s ADAMS document retrieval system at <www.nrc.gov>, with a search for accession number MLI7234A615.

**THE NRC HAS PROPOSED A $14,000 FINE AGAINST A HAWAII FIRM—**

Engineering & Inspections Hawaii—for violations related to the security requirements of 10 CFR Part 37, Physical protection of Category 1 and Category 2 quantities of radioactive material. According to the Nuclear Regulatory Commission’s September 12 inspection report, the violations were identified during a routine inspection conducted in January of this year at a temporary job site in Guam. (Details surrounding security-related violations are not typically made available to the public.) The decision to propose the fine was due in part to a similar violation by the company identified at a temporary job site in Hawaii last year, the NRC said.

**THE FERC CHAIRMAN WAS NONCOMMITTAL ABOUT NUCLEAR**

In testimony before a House Energy and Commerce subcommittee on September 14, after stating the previous month that nuclear (and coal) plants must be properly compensated for the value they provide to the electric grid (NN, Sept. 2017, p. 21), “In terms of strategies or a path forward, the [Federal Energy Regulatory Commission] is fuel neutral,” said FERC chairman Neil Chatterjee, “and will look to ensure as the grid undergoes this transformation, we make sure we evaluate the attributes of fuel sources to see what values they provide and, if there is a demonstrated need for reliability, whether those things can be compensated.”

President Trump’s latest FERC picks, Kevin McIntyre (designated to become the commission chairman) and Richard Glick (NN, Aug. 2017, p. 27), were unanimously approved by the Senate Energy and Natural Resources Committee on September 19. At this writing, a confirmation vote before the full Senate had not been scheduled.
# Index to Advertisers

## Nuclear News

October 2017

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the United Kingdom–based infrastructure company Balfour Beatty announced on August 21 that it has been appointed by EDF Energy as the preferred bidder for the tunneling and marine works package for the Hinkley Point C nuclear power station project in Somerset, England. According to the company, the four-year package will include the construction of three marine tunnels—both onshore and offshore—totaling more than 9.5 kilometers in length and 7 meters in diameter to form part of the reactor’s required cooling system. This is the second major package Balfour Beatty will deliver at Hinkley Point C, following its appointment in 2015, along with joint venture partner NG Bailey, to the plant’s electrical works package, which is worth £460 million (about $616 million). The value of the tunneling and marine works package was not disclosed.

On August 21, L3 MAPPS announced that under a contract with Swiss industrial technology company ABB, it will update the simulator that the company provided in 2006 for DTE Electric’s Fermi-2 nuclear power unit in Newport, Mich. Work under the contract calls for the modification of the 120-kV switchyard portion of the simulator, in conjunction with associated changes to the actual switchyard equipment and ABB’s Symphony Plus process control system that controls it. L3 MAPPS will update the simulator’s process models and provide a hardware interface consisting of a compact input/output system and power supplies that will allow the Fermi plant simulation to communicate with a replica of the ABB distributed control system hardware and software for the switchyard. The interface and simulation will aid in factory acceptance testing by DTE Electric at ABB’s facility in Wickliffe, Ohio. Work under the contract, the value of which was not disclosed, is expected to be completed by the end of 2017.

On August 23, Westinghouse Electric Company announced that it has signed a nuclear fuel contract extension with PSEG Nuclear to continue providing fuel assemblies for both units at the Salem nuclear power plant in New Jersey. Under the terms of the contract, Westinghouse will deliver its 17 × 17 Robust Fuel Assemblies, known as RFA-2. The RFA-2 fuel assemblies for the two pressurized water reactors will continue to be manufactured at Westinghouse’s Columbia Fuel Fabrication Facility in Columbia, S.C. Westinghouse has been the single-source fuel provider for the Salem plant since its start of operations more than 40 years ago. The value of the contract extension was not disclosed.

Medical isotopes company SHINE Medical Technologies announced on September 6 that it has chosen Baker Concrete Construction as the prime contractor for the construction of its molybdenum-99 production facility in Janesville, Wis. According to SHINE, Baker has a good work culture and understands nuclear quality requirements, having previously worked with URENCO on the construction of its uranium enrichment facility in southeastern New Mexico. SHINE received a construction permit from the Nuclear Regulatory Commission in 2016 and broke ground on its new facility in August (NN, Sept. 2017, p. 40). The company intends to produce Mo-99, which decays into the medical diagnostic imaging agent technetium-99m, at the facility using low-enriched uranium. The value of the contract was not disclosed.

Various relay issues, software errors discovered

On August 17, Energy Northwest reported that two GE Nuclear relays (HMA124A2) supplied by GE Hitachi Nuclear Energy and intended for use at the Columbia nuclear power plant had back plates that were mounted upside down, causing the terminals not to match the standard configuration. Although the internal wiring to the physical stud locations was correct, the numbering scheme embossed on the back plate did not match the correct configuration. According to Energy Northwest, this could result in the internal coil of the energizing circuit being wired to the incorrect portion of the control circuitry, which would not energize when required and could result in the failure of a safety function. While the deviation presents a substantial safety hazard as defined in 10 CFR 21.3, the company said that there was no actual risk to plant safety since the issue was recognized and resolved prior to the installation of the relays. Energy Northwest said that no additional defects were identified in the remaining HMA124A2 relays and that GE Hitachi has been notified of the condition.

Nebraska Public Power District (NPPD) notified the Nuclear Regulatory Commission on August 28 that it has completed a 10 CFR 21 evaluation of a defect identified in an Allen-Bradley relay (model No. 700DC-P220Z2) delivered to the
Cooper nuclear power plant by NuTherm International. According to NPPD, an independent laboratory determined that a relay that failed after 133 hours of service contained a wound wire fault that apparently was caused by a manufacturing flaw. The relay failure, which was first reported to the NRC on April 26, 2016, as a loss of safety function, was characterized as “component infant mortality” and NPPD has determined that the deviation presents a substantial safety hazard, as the relay model was approved for use in safety-related applications.

NuTherm reported on August 30 that after reviewing all procurements of the 700DC-series relays, it found that a total of 49 potentially flawed units were shipped to NPPD (Cooper) and Indiana Michigan Power Company (Cook). NuTherm notified the affected customers of the condition, but the company said that it does not have sufficient information to determine whether the issue creates a substantial safety hazard or would have created a technical specification safety limit violation. NuTherm said that it is taking no further actions at this time as the company has no current orders for the relays and has no units in stock.

On August 24, the Georgia Department of Natural Resources (DNR) reported an error with Elekta’s Oncentra Brachy software, version 4.5.2, which is used for the planning of medical brachytherapy treatments. According to the DNR, a patient mistreatment involving the software occurred on August 8 due to an inconsistent step size when treating the ring source path. Three other facilities previously identified this issue during quality assurance testing (no patients were involved) and Elekta is working on a bug fix and field notification, the DNR said. Applications using the software have been stopped until a new version is available.

Elekta also reported on August 25 that a user in France notified the company on July 13 that they discovered the same issue with the Oncentra Brachy software during a QA audit. Elekta said that it has determined that an issue exists in versions 4.5, 4.5.1, and 4.5.2 of the software, which will be resolved in the next issued version.

Fisher Controls International reported on August 28 that an erroneous rotary seating torque calculation is contained in its FlowScanner 6.6 (build 6.6.000.29) and 6.6 SP1 (build 6.6.000.67) software. According to Fisher Controls, while updating an older FlowScanner software version to 6.6 SP1, a customer performed additional software acceptance validation and discovered a discrepancy between the two software versions when calculating seating torque values for rotary valve assemblies with a lever arm linkage type. An equation in the software that was incorrectly written in the software code was found to be the cause for the discrepancy.

Fisher Controls said that the equation has been corrected and installation CDs will be ready for distribution to affected customers by December 1, 2017. The company also has initiated a corrective action request to prevent the issue from recurring. Supplied customers include FPL Group (Seabrook), NextEra Energy (Arnold, Point Beach), Dominion (Millstone), and Omaha Public Power District (Fort Calhoun), as well as Southern Company and Exelon PowerLabs.

On September 11, Curtiss-Wright Flow Control Company issued a revised report concerning a potential defect in Grayboot socket contacts that was first reported on May 15 (NN, July 2017, p. 76). According to the company, test results, which included cycle aging, functional testing, and pullout force, confirmed that the affected socket contacts will continue to perform their intended safety function throughout their qualified life. Based on the findings, Curtiss-Wright is recommending no further actions for the notified utilities. Any potentially affected socket contacts, either in inventory or installed, are acceptable for use in their intended safety-related application, the company said.

NN

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2017/2018
Wall Maps of Commercial Nuclear Power Plants

Updated Nuclear News wall maps show the location of each commercial power reactor that is operative, under construction, or ordered as of February 28, 2017, for the U.S. map, and as of March 31, 2017, for the non-U.S. maps. Tabular information includes each reactor’s generating capacity (in Net MWe), design type, date of commercial operation (actual or expected), and reactor supplier.

Green stars on the United States map indicate the locations of six reactor projects for which licenses have been issued; two of those are under construction. Red stars indicate two sites where applications for combined construction and operating licenses have been submitted to the Nuclear Regulatory Commission, and are being actively pursued. Blue stars indicate two sites where license applications have been suspended. For each of the 10 projects, boxed information provides the plant name, the city and state of the site, the reactor model (if known), and the owner.

Also, updated versions of the two worldwide maps are now available: Europe and Russia, and The Americas, Africa, and Asia (which includes Canada, Mexico, South America, Africa, and Asia).

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- Individual Maps: $40.00 per map
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- 2-Map Worldwide Combo #2: $72.00

Europe and Russia map & The Americas,* Africa, and Asia map

*The Americas include Canada, Mexico, and South America, but not the United States.

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Actual map dimensions: 39.25” X 26.75”. Map data valid as of 2/28/17 (U.S.) and 3/31/17 (non-U.S.). Note that U.S. nuclear power plants are shown on the U.S. map only, not on either of the worldwide maps.
Standards approved, comments requested

The following standards have been approved:


This standard provides safety guidance for conducting subcritical neutron multiplication measurements where physical protection of personnel against the consequences of a criticality accident is not provided. The objectives of in situ measurements are either to confirm an adequate safety margin or to improve an estimate of such a margin.


This standard specifies and provides requirements for the reference measurements of reactor geometry, reactivity, and operation parameters in light-water power reactors. The measurement data are used in the verification of reactor physics computational methods used for nuclear core designs and analyses. The standard identifies the types of parameters, a brief description of test conditions and experimental data required for such reference measurements, problems and concerns that may affect the accuracy or interpretation of the data, and criteria to be used in documenting the results of reference measurements.


This standard sets forth the design, construction, and performance requirements for a solid radioactive waste processing system for light-water–cooled reactor plants. For the purposes of this standard, the solid radioactive waste processing system begins at the interface with the liquid radioactive waste processing system boundary and at the inlets to the spent resin, filter sludge, evaporator concentrate, and phase separator tanks. In addition, this standard pertains to dry active waste, mixed waste, and other solid radioactive waste forms that are generated as part of the operation and maintenance of light-water–cooled reactor plants. The system includes facilities for temporary on-site storage of packaged waste but terminates at the point of loading the filled drums and other containers on a vehicle for shipping off-site to a licensed disposal site or transfer to interim on-site storage facilities.


This standard establishes time response design criteria for safety-related operator actions to be used in the design of light-water reactor nuclear power plants. The standard specifies time requirements that are to be met to receive credit in the safety analysis for operator actions that initiate or control safety-related functions.

Comments requested

Comments were requested on the following standards by October 2, 2017:


This standard is applicable to operations with fissionable materials in which inadvertent criticality could occur, leading to an excessive radiation dose to personnel. This standard is not applicable to nuclear reactors or critical experiments.


This standard provides guidance for the use of borosilicate-glass Raschig rings as a neutron absorber for criticality control in ring-packed vessels containing solutions of U-235, Pu-239, or U-233. The chemical and physical environment, properties of the rings and packed vessels, maintenance inspection procedures, and operating guidelines are specified.

Volunteer support needed

The following standards projects are in need of volunteer support. Interested individuals should contact <standards@ans.org> for more information.

- ANSI-2.34, Characterization and Probabilistic Analysis of Volcanic Hazards (new standard).


This standard is not applicable to nuclear reactors or critical experiments.
Standards & Documentation

including blanket zones, control elements and core internals, pressure vessel, and the thermal and biological shielding.

All published and draft standards can be ordered from ANS through standards manager Pat Schroeder (<pschroeder@ans.org>) or customer service representative Sue Cook (<scook@ans.org>). Comments on draft standards can be sent to Schroeder at ANS, with a copy of the comments sent to the Board of Standards Review at the American National Standards Institute.

NRC

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Draft, for comment


Withdrawn


NUREGs

Issued


Regulatory Issue Summaries

Issued


Information Notices

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IN 2017-05, Potential Binding of Schneider Electric/Square-D Masterpact NT and NW 480-VAC Circuit Breaker Anti-Pump Feature (ML17100B278). Issued September 1.

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Keith Polson has been appointed senior vice president and chief nuclear officer of DTE Energy, effective October 2. He succeeds Paul Fessler, who has retired after 41 years with the company. Polson most recently was vice president of nuclear generation for DTE Energy. Prior to joining the company in January 2016, he was the site vice president at the Tennessee Valley Authority’s Browns Ferry nuclear plant.

Steve Miltenberger, ANS member since 2010, has been promoted to chief of staff for Greg Piefer, chief executive officer of SHINE Medical Technologies. Miltenberger has over 30 years of nuclear industry experience in engineering, construction, and operations. His role at SHINE is to move the project plan for SHINE’s Janesville, Wis., facility through construction and into commercial operation. The facility will produce molybdenum-99 and other medical isotopes.

FirstEnergy Nuclear Operating Company (FENOC) has announced a number of leadership changes. Richard Bologna has been promoted to vice president of the Beaver Valley nuclear power plant in Shippingport, Pa., and John Grabnar has been named general plant manager at Beaver Valley, the position most recently held by Bologna. Brian Boles has been promoted to vice president of nuclear support for FENOC’s nuclear fleet, and Mark Bezilla has been promoted to vice president of the Davis-Besse nuclear power plant in Oak Harbor, Ohio, the position most recently held by Boles. Terry Brown has been named vice president of fleet oversight, the position most recently held by Bezilla, and Doug Huey has been promoted to director of performance improvement.

Charles McMillan has announced his intention to step down as director of Los Alamos National Laboratory at the end of the year after six years in the position. McMillan said that he would work closely with his successor when named by the board of Los Alamos National Security LLC, which operates the lab, to ensure a smooth transition.

Scott Head, ANS member since April 2017, has joined Certrec as business development director in its Office of Licensing and Compliance. Head recently retired from STP Nuclear Operating Company, where he was responsible for all safety and environmental activities performed to support obtaining and maintaining the combined operating licenses for South Texas Project-3 and -4.

Continued
Lonnie Carter is retiring as president and chief executive officer of Santee Cooper following a 35-year career with the state-owned South Carolina utility. Carter joined Santee Cooper in 1982 and became president and CEO in 2004. He will remain in the position while the utility’s board searches for a replacement and will participate in any legislative hearings regarding Santee Cooper’s abandonment of the Summer nuclear expansion project (NN, Sept. 2017, p. 14).

Richard Hawryluk has replaced Terry Brog as interim director of the Princeton Plasma Physics Laboratory (PPPL). Hawryluk joined PPPL in 1974 and most recently was head of the NSTX-U Recovery Project at the laboratory. Brog, who has returned to his position as deputy director of operations, served as interim director since September 2016, following the resignation of Stewart Prager as director. Princeton University has dropped the requirement that candidates for the position must qualify for tenure at the university and has formed a new search committee.

David K. Owens has been elected to Xcel Energy’s board of directors. Owens recently retired from the Edison Electric Institute (EEI) after 36 years of service. He had served as an executive vice president of EEI, guiding the association on issues affecting the future structure of the electric industry and the new rules in evolving competitive markets.

Horizon Nuclear Power, the U.K. subsidiary of Hitachi Ltd., has announced the appointments of Rabih Hafez as project-planning unit director and James Jones as general counsel and company secretary. Hafez, who has over 34 years of international experience in the nuclear industry, most recently was senior project manager for the Mochovce nuclear power plant in Slovakia. Jones, who has 25 years of industry experience, was principal counsel for Horizon prior to his new appointment.

James Van Dam has been named acting associate director for the Office of Fusion Energy Science (FES) in the Department of Energy’s Office of Science. Replacing Van Dam as acting division director for the FES Research Division is John Mandrekas, who most recently held the position of program manager for the FES theory and simulation program.

Collins Juma has been appointed chief executive officer of the Kenya Nuclear Electricity Board (KNEB). In January 2016, Juma was appointed acting CEO of KNEB, the statutory body mandated to fast-track the development of nuclear power in Kenya.

To Andreas Enqvist, ANS member since 2014, who has received the Institute of Nuclear Materials Management (INMM) Early Career Award, which recognizes INMM members 35 years of age or younger who have made “a singular outstanding achievement or a series of notable achievements in an area of nuclear materials management relevant to the institute and its technical divisions,” according to an INMM press release. Enqvist is an assistant professor in the University of Florida’s Nuclear Engineering Program.

Continued on page 107
CALL FOR PAPERS
Future of Nuclear in the Shifting Energy Landscape: Safety, Sustainability, and Flexibility

CONFERENCE CHAIRS:

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Dr. Krishna P. Singh, Holtec International

Technical Program Chair
Martin Sattison, Idaho National Laboratory

Assistant Technical Program Chair
Nicholas Brown, Pennsylvania State University

SUMMARY DEADLINE: JANUARY 12, 2018

OCTOBER
SUBMISSION OF SUMMARIES: October 1, 2017-January 12, 2018

FEBRUARY
SUBMISSION OF DESCRIPTION AND PANELISTS/SPEAKERS FOR PREVIEW PROGRAM: February 16, 2018

AUTHOR NOTIFICATION OF ACCEPTANCE: February 23, 2018

MARCH
REVISED SUMMARIES DUE: March 16, 2018

APRIL
ANY ADDITIONAL DESCRIPTIONS AND PANELISTS/SPEAKERS FOR OFFICIAL PROGRAM: April 17, 2018

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1. Introduction: State the purpose of the work.
2. Description of the actual work: Must be NEW and SIGNIFICANT.
3. Results: Discuss their significance.
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### 2018 ANNUAL MEETING: SESSION TITLES BY DIVISION

**1. ACCELERATOR APPLICATIONS (AAD)**
- 1a. Accelerator Applications: General

**2. AEROSPACE NUCLEAR SCIENCE AND TECHNOLOGY (ANSTD)**
- 2a. Aerospace Nuclear Science and Technology: General

**3. BIOLOGY AND MEDICINE (BMD)**
- 3a. Biology and Medicine: General

**4. DECOMMISSIONING AND ENVIRONMENTAL SCIENCES (DESD)**
- 4a. DESD Security Optimization and Cost Savings in the 21st Century (P)
- 4b. Evolving and Contrasting Environmental Aspects—DESD for U.S. West and East Coast States (e.g. Ca and VT)
- 4c. Current Ongoing/Mature NPP Commercial DESD Owner, DOC and Licensee Perspectives
- 4d. Decommissioning and Environmental Sciences: New and Improved Tools, Techniques and Methods for the 21st Century

**5. EDUCATION, TRAINING, AND WORKFORCE DEVELOPMENT (ETWDD)**
- 5a. Education, Training and Workforce Development: General
- 5b. Training, Human Performance and Workforce Development
- 5c. Focus on Communications—I: Communicating with Policy Makers (P)
- 5d. Focus on Communications—II: Meet the Media (P)
- 5e. Innovations in New Reactor Designs (e.g., SMRs)
- 5f. Best of ANS Student Conference
- 5g. Research by the U.S. DOE NEUP Sponsored Students—I
- 5h. Research by the U.S. DOE NEUP Sponsored Students—II
- 5i. Workforce Needs for the Small Modular Reactor (SMR) World
- 5j. Hybrid Programs versus New Programs in Nuclear Engineering (P)
- 5k. Lessons from Young Nuclear Engineering College Programs (P)

**6. FUEL CYCLE AND WASTE MANAGEMENT (FCWMD)**
- 6a. Technical Grand Challenges—Closing the Nuclear Fuel Cycle
- 6b. Fuel Cycle and Waste Management: General
- 6c. The Waste Isolation Pilot Plant
- 6d. Modeling Spent Fuel Repository Performance
- 6e. Advances in Aqueous Separations Technologies
- 6f. Molten Salt Systems for FHRs and MSRs: Chemistry and Mass Transport
- 6g. Advanced Closed Fuel Cycles—The Economic Challenge (P)
- 6h. Status on Repository Concepts Internationally (P)
- 6i. Disposal of High-Level Radioactive Waste: What is the Strategy? (P)
- 6j. Updates on Environmental Monitoring Programs of Nuclear Sites
- 6k. Recycle and Reuse of Used Nuclear Fuel Resources
- 6l. University Research in Fuel Cycle and Waste Management

**7. FUSION ENERGY (FED)**
- 7a. Fusion Energy—Technology and Applications

**8. HUMAN FACTORS, INSTRUMENTATION, AND CONTROLS (HFICD)**
- 8a. Advanced Control Methods
- 8b. On-line Monitoring/Prognostic and Health Management for Nuclear Power Plants
- 8c. Advanced Reactor Instrumentation
- 8d. Nuclear Plant Design and Control for the Electric Grid of the Future
- 8e. Human Factors, Instrumentation and Controls: General

**9. ISOTOPES AND RADIATION (IRD)**
- 9a. Isotopes and Radiation: General
- 9b. Applications of DOE-NE Infrastructure Support for University Research Reactors
- 9c. Innovations in Radiation Detectors: New Designs, Improvements and Applications

**10. MATERIALS SCIENCE AND TECHNOLOGY (MSTD)**
- Sponsoring embedded topical meeting—Nuclear Fuels and Structural Materials (NFSM)

**11. MATHEMATICS AND COMPUTATION (MCD)**
- 11a. Current Issues in Computational Methods—Roundtable (P)
- 11b. Transport Methods
- 11c. Computational Methods
- 11d. Mathematical Modeling
- 11e. Uncertainty Quantification and Sensitivity Analysis
- 11f. Optimization Techniques in Nuclear Systems Design

**12. NUCLEAR CRITICALITY SAFETY (NCSD)**
- 12a. ANS-8 Standards Forum (P)
- 12b. Data, Analysis and Operations in Nuclear Criticality Safety
- 12c. Criticality Accident Alarm System: Issues and Testing
- 12d. ENDF/B-VIII.0: Evaluation and Validation
- 12e. ANS 8.10 Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement, Uses and Purpose (P)
- 12f. Sharing of Good Industry Practices and/or Lessons Learned in Nuclear Criticality Safety (P)

**13. NUCLEAR INSTALLATIONS SAFETY (NISD)**
- 13a. Licensing of Medical Isotope Production Facility
- 13b. Emergent Topics in Consensus Standards
- 13c. Current Topics in Probabilistic Risk Analysis
- 13d. Nuclear Installations Safety: General
- 13e. Developments for Strengthening Global Nuclear Governance
- 13f. Nuclear Safety R&D at the NRC and NNSA
- 13g. Effects of Long-Term Operation on Electrical Cable Aging, Condition Monitoring, and Performance
- 13h. Safety Aspects of Accident Tolerant Fuels (P)

**14. NUCLEAR NONPROLIFERATION POLICY (NNPD)**
- 14a. Advancing Global Nuclear Energy and Strengthening National Security (P)
- 14b. Nuclear Nonproliferation Policy: General

**15. OPERATIONS AND POWER (OPD)**
- 15a. Advanced Gen-IV Reactors
- 15b. Energy Storage
- 15d. Hybrid Energy Systems
- 15e. Energy Mix—Fossil, Gas, Hydro, Wind, Solar and Nuclear (P)

**16. RADIATION PROTECTION AND SHIELDING (RPSD)**
- 16a. Radiation Protection and Shielding—General
- 16b. Computational Tools for Radiation Protection and Shielding
- 16c. Radiation Protection and Shielding—Roundtable (P)
- 16d. Defense Nuclear Nonproliferation Research and Development University Consortia Work Applied to Radiation Shielding

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**Call For Papers**
2018 ANNUAL MEETING: TECHNICAL DIVISIONS

ACCELERATOR APPLICATIONS (AAD)
Peter Hosemann, peterh@berkeley.edu

AEROSPACE NUCLEAR SCIENCE AND TECHNOLOGY (ANSTD)
Robert O’Brian, robert.obrien@inl.gov

BIOLOGY AND MEDICINE (BMD)
Robert G. Downing, downing@nist.gov

EDUCATION, TRAINING, AND WORKFORCE DEVELOPMENT (ETWDD)
Lisa Marshall, lisa.marshall@ncsu.edu

DECOMMISSIONING AND ENVIRONMENTAL SCIENCES (DESD)
Scott Zinkham, scott.zinkham@rezources.com

FUEL CYCLE AND WASTE MANAGEMENT (FCWMD)
Jared A. Johnson, johnsonja@ornl.gov

FUSION ENERGY (FED)
Arnold Lumsdaine, lumsdainea@ornl.gov

HUMAN FACTORS, INSTRUMENTATION, AND CONTROLS (HFICD)
Jamie Coble Baalis, jcoble1@utk.edu

ISOTOPES AND RADIATION (IRD)
Kenan Unlu, K-unlu@psu.edu

MATERIALS SCIENCE AND TECHNOLOGY (MSTD)
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MATHEMATICS AND COMPUTATION (MCD)
Jeff Densmore, jeffery.densmore@unrpp.gov

NUCLEAR CRITICALITY SAFETY (NCSD)
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NUCLEAR INSTALLATIONS SAFETY (NISD)
Reed Labarge, labargnr@westinghouse.com

NUCLEAR NONPROLIFERATION POLICY (NNPD)
Kelsey Amundson, kamundson5@gmail.com

OPERATIONS AND POWER (OPD)
Piyush Sabbarwall, piyush.sabbarwall@inl.gov

RADIATION PROTECTION AND SHIELDING (RPSD)
Dominic Napolitano, dnapolitano@enercon.com
Irina Popova, irinapolova@ornl.gov

REACTOR PHYSICS (RPD)
Cristian Rabiti, Cristian.rabiti@inl.gov

ROBOTICS AND REMOTE SYSTEMS (RRSD)
Mitch W. Pryor, mpryor@utexas.edu

THERMAL HYDRAULICS (THD)
Elia Merzari, pcchair@thd-ans.org

YOUNG MEMBERS GROUP (YMG)
Alyse Scurlock, alyse.scurlock@duke-energy.com
Nicolas Stauff, nstauff@anl.gov

2018 ANNUAL MEETING: SESSION TITLES BY DIVISION CONTINUED

17. REACTOR PHYSICS (RPD)
17a. Reactor Physics: General
17b. Reactor Analysis Methods
17c. The Nuclear Energy Advance Modeling and Simulation (NEAMS) Workbench
17d. Advances in Fast Reactor Design and Concepts

18. ROBOTICS AND REMOTE SYSTEMS (RRSD)

19. THERMAL HYDRAULICS (THD)
19a. Experimental Thermal Hydraulics
19b. Computational Thermal Hydraulics
19c. General Thermal Hydraulics
19d. Two-Phase and Heat Transfer Fundamentals
19e. Multiscale Thermal Hydraulics Simulation and Validation
19f. Computational Fluid Dynamics Codes for Nuclear Thermal Hydraulics Applications (P)
19g. High-Resolution Multi-Phase Simulations
19h. Thermal Hydraulic Analysis in Support of Severe Accident Management
19i. Natural Circulation and Reliability of Natural Circulation Phenomena and Associates Systems
19j. Molten Salt Thermal Hydraulics and Mass Transport

(P) = Panel Call For Papers
CALL FOR PAPERS
Nuclear Fuels and Structural Materials for the Next Generation Nuclear Reactors (NFSM 2018)

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Kurt A. Terrani, Oak Ridge National Laboratory

Technical Program Chairs
Giovanni Pastore, Idaho National Laboratory
Kevin G. Field, Oak Ridge National Laboratory

OCTOBER
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AUTHOR NOTIFICATION: February 23, 2018
REVISED SUMMARIES DUE: March 16, 2018

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ABOUT THE MEETING
NFSM 2018 will bring together international experts working on development and deployment of next generation fuels and structural materials for current and advanced fission reactors. Experts from national laboratories, industry, and academia are invited to attend and discuss their current research, development directions and latest findings. The meeting will cover a wide spectrum of experimental and modeling research related to fuels and core structural materials across various reactor platforms and throughout the fuel cycle.

NFSM 2018 features a single oral track with talks focused on summaries and directions of ongoing large-scale research programs and upcoming initiatives. Only a limited number of submissions will be scheduled for oral presentations. The majority of technical presentations at NFSM 2018 will be held in a poster session to facilitate detailed discussions. Student attendance is highly encouraged and awards will be provided to the two best student posters. At least one author is required to register and attend the meeting.

Experimental and modeling research activities within the following areas are particularly encouraged for submission to NFSM 2018:

- Fabrication and Characteristics of Advanced Fuel Forms
- Cladding Development for Fast and Thermal Reactors
- Metallic and Ceramic Core Structural Component Development
- Environmental Effects on Core Constituents in Fast and Thermal Reactors
- Irradiation and PIE of Fuel and Core Structural Materials
- In-Pile Behavior of Core Constituents
- Fuel Performance Modeling and Analysis
- Lifetime Management and Sustainability for LWRs
- Used Fuel Management, Storage, and Reprocessing
- Fuel and Core Materials Impact on Reactor Safety
- Accident Tolerant Fuels

Summaries submitted to NFSM 2018 will be reviewed and published electronically to be available at the meeting.
Continued from page 102

his “many years of dedication to advancing the prospects for fusion power” and “decades of outstanding career contributions as a scientist and leader of fusion power plant studies that have provided perspective on the requirements for future commercial fusion electrical power plants,” according to an FPA press release. Najmabadi is a professor of electrical and computer engineering and director of the Center for Energy Research at the University of California at San Diego.

To Harold Williamson, ANS member since 1957, who has received the Distinguished Examination Service Award from the National Council of Examiners for Engineering and Surveying (NCEES), a nonprofit organization committed to advancing licensure for engineers and surveyors in order to safeguard the health, safety, and welfare of the U.S. public. Williamson was recognized for his dedicated service to NCEES and the engineering profession. He is a principal engineer for HEW Enterprises in Richland, Wash., and serves on the Principles and Practice of Engineering (PE) Nuclear Exam Development Committee.

Obituaries

Hans Toffer, 81, ANS Fellow and member since 1972; earned a bachelor’s degree in physics from Muhlenberg College in 1959, a master’s degree in physics from Iowa State University in 1962, and a doctorate in nuclear engineering from the University of Washington in 1974; began his career in 1963 with General Electric Company at the Hanford Site as an engineer; joined UNC Nuclear Industries in Richland, Wash., in 1974 as manager of the Reactor and Applied Physics Subsection of the Advanced Engineering and Technology Department; retired from Fluor Federal Services after 48 years in the nuclear industry; died September 4.
We never had it so good

Last month I told you about the TV Veggie Tales pirates who don’t do anything. (As a retired guy, I feel a certain kinship with them.) The song they sing about the things they don’t do ends with “and I’ve never been to Boston in the fall.”

I’ve got one up on them there, as I used to live in greater Boston and spent four glorious falls there. In fact, I’m going back to visit next week, as the high school class I would have been in if I’d stayed there is holding its 65th reunion.

Sixty-five years. The clichéd statement I’m supposed to make here is “Gee, it feels like yesterday.” And it did, until it was brought into perspective by an event I recently attended at my favorite high school where I live now.

That high school had an open house to celebrate the beautiful new addition that was built to accommodate its rapidly growing student population. There are 40 new classrooms, including a second art room, larger band and orchestra facilities, larger and fancier technology (formerly “shop”) space, and greatly enhanced science labs. More about those in a minute.

First let me tell you about the high school I attended 65 years ago.

It was the middle of the 20th century. World War II had recently ended. The school didn’t have TV. Television that you could watch at home was only three years old. We had one local channel, showing either professional wrestling or the Test Pattern, which was important because often your picture would go crazy and you’d have to adjust your rabbit-ears antenna or give the set a good whack.

In school, the only visual aids were photos or graphs your teacher would hold up or pass around. Teachers wrote copiously on the dark green chalkboard with white chalk, and we were expected to copy it all down in our notebooks with pencil or pen. The boards were erased with felt erasers, and chalk dust was everywhere. Once in a while we’d be shown a movie from a big reel of 16mm film threaded into a clunky, noisy projector that was prone to frequent failure. Usually there was one kid in the class who knew how to make it work.

To make copies of handouts and tests and things, the teachers used a spirit duplicator, commonly called a Ditto machine, which could make up to a hundred copies in purple ink from Ditto mats. The fluid that made this work was addictively fragrant and would give you a high if you stood nearby during the process. The other option was the mimeograph, which was messier and more complicated but could make up to a thousand copies.

For writing on paper, pencils and fountain pens were standard. Ballpoint pens had just been invented and didn’t work very well. They would skip, or deposit blobs of ink on your work or in your pocket.

For arithmetic and such, engineers and scientists used slide rules. In school or at home, calculations were done by hand on paper with a pencil. The only computers were huge machines at places like MIT or the Pentagon. Pocket calculators were but a dream.

When you were absent from school, you needed to have a friend bring you your assignments so that you wouldn’t get behind.

Textbooks were actual books made of actual paper. At my school, you borrowed them for the course and returned them at the end. Many of them were quite heavy, which led to spine injury.

Nowadays, in the school I just visited, each student is loaned an HP Revolve computer (a laptop that functions as a tablet, I’m told). And with that, the student can access all kinds of magical stuff. For example:

■ Most textbooks are online now. You can read the text from your laptop, or even your cell phone. No more lugging the book itself home. However, some students still like the hard copy book, and teachers have some available.

■ The school belongs to something called Google Classroom, which allows teachers to post their notes and assignments and interact with students, and students with each other, online. Students Face-Time with each other to consult or work in groups.

■ For visual aids, teachers can easily show videos on their classroom screens, and PowerPoint slides of photos, graphs, art, notices, and so forth. There’s lots of room for creativity and humor here.

■ And for making copies, what I consider one of the greatest inventions of the 20th century: the electrostatic copier, also known as the Xerox machine. Teachers can use them, and in the updated school, these, as well as phone/laptop charging stations, are abundant and available for students to use simply by typing in their student ID number.

How did we survive back in the mid-20th century without all this neat stuff? We didn’t know any better, that’s how.

—Bill Minkler
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