

NUCLEONICS WEEK

Volume 57 / Number 46 / November 17, 2016

Vermont Yankee decommissioning approach could signal trend: analysts

Entergy's decision to sell its permanently shut Vermont Yankee to an industrial waste remediation and demolition company, which will assume all decommissioning responsibilities, may be a harbinger of similar arrangements for licensees that decide to shut their units, according to industry analysts.

"There is a business model where it might be cheaper to contract out to a third party rather than for the utility to do [decommissioning] itself and be the master contractor," nuclear industry consultant Ed Davis, president and CEO of the Pegasus

Group, said in a November 15 interview.

An attraction in farming out decommissioning work is that specialist firms likely can do the work at lower cost than a utility, Davis said. Such companies can do this work and make a profit, he said, because they can be more productive than a utility workforce, "using specialized equipment, [lower] labor rates and their knowhow and expertise."

"A big part of ensuring profitability and meeting schedules is estimating" project costs, he said. "Right now, the cost of

these [decommissioning] jobs are the biggest unknown."

Entergy, which shut Vermont Yankee in December 2014, announced November 8 that it will sell the station to NorthStar Services Group, an industrial waste remediation and demolition company that will decommission the unit.

The agreement specifies that NorthStar, partnering with Areva, low-level waste management company Waste Control Specialists and engineering, architecture and

[\(continued on page 7\)](#)

Japan-India agreement may not give Japan exports rapid boost, officials say

The nuclear cooperation agreement that Japan and India reached last week left aside the key issue of nuclear liability, making Japanese nuclear exporters reluctant to rush to supply reactors to that country, executives, analysts and government officials said.

The Japan-India nuclear agreement "would be helpful for us to export our equipment there [to India]," Masayoshi Hirata, executive vice president of Toshiba, said at a November 11 press conference in Tokyo. However, he said, "the liability issue is something we have to clear" before

advancing with exports to India, he added in comments on the sidelines of the event.

Japan's Prime Minister Shinzo Abe and his Indian counterpart Narendra Modi agreed to a nuclear cooperation agreement November 11 that would allow Japanese vendors to export fuel, equipment and technology to India. That country has a target of a 75% increase in its nuclear capacity to 10,080 MW by 2019 from the current 5,780 MW.

India, unlike other countries, allows lawsuits for damages against nuclear plant suppliers in case of a nuclear accident. US

and Indian officials last year announced what they described as a breakthrough in the impasse, saying an insurance fund would be established to indemnify suppliers (NW, 29 Jan '15, 1). By comparison, nuclear liability laws in most countries channel all liability to nuclear plant operators.

In May, the New India Insurance Co., a government-owned company, issued a nuclear insurance policy covering 21 reactors operated by state-run Nuclear Power Corporation of India, or NPCIL. The total

[\(continued on page 8\)](#)

Deal will give EDF control of Areva reactor unit

France's EDF said in a statement November 16 that it had signed a binding agreement with Areva SA to acquire a majority stake in the company's reactor unit which values that business at Eur2.5 billion (\$2.7 billion).

EDF will buy a newly created subsidiary of Areva NP called New NP, which excludes some ongoing company liabilities in an effort to protect the French utility, EDF said in a statement.

"The contracts for the EPR Oikiluoto-3 project [under construction in Finland] and the resources required to complete the

project, as well as certain contracts relating to components forged in Le Creusot plant, will stay within Areva NP, in Areva SA's scope," EDF said.

New NP comprises the rest of Areva NP's activities: design and manufacturing of nuclear reactors and associated equipment, manufacturing and design of nuclear fuel assemblies and services to the French nuclear fleet.

EDF said it will acquire up to 75% of New NP but that would then be reduced "to a target stake of at least 51%," depending on

INSIDE THIS ISSUE

'Significant progress' on Chinese investment in French nuclear sector: ministry	3
Vietnam canceling plan to build two nuclear plants, assembly says	3
Tepco expected to set restructuring plan by March	4
EDF UK nuclear director says AGRs safe to operate to end of scheduled lives	4
China's CGN starts construction of small floating reactor demonstration unit	6

negotiations with other potential investors. Discussions with potential investors "will start in the coming weeks," it said.

The value for 100% of New NP is set at Eur2.5 billion "excluding the potential price complements and adjustments," EDF said. The final amount to be paid for New NP could be adjusted upwards or downwards depending on the reactor unit's financial performance, EDF has previously said.

EDF did not take on any Areva debt as part of the deal, it said.

The transaction is expected to be completed during the second half of 2017, EDF said. The transaction remains subject to "favorable conclusions" from French nuclear safety authority ASN on the results of tests to demonstrate the quality of the reactor pressure vessel at the Flamanville-3 EPR under construction in France.

Areva, EDF and French nuclear safety authority ASN reported in April 2015 that high carbon content had been discovered on the top and bottom heads at EDF's Flamanville-3. High carbon content in the vessel heads can reduce fracture toughness, the ability to withstand the propagation of cracks.

In addition, EDF will only be able to finalize the purchase of the reactor unit when the quality audits in the unit's reactor equipment manufacturing subsidiaries of Le Creusot, St. Marcel and Jeumont have been completed with "satisfactory conclusions," EDF said.

Areva said in April that about 80 irregularities — later increased to 111 — had been discovered in a review of about 10,000 fabrication files from Le Creusot, an Areva NP subsidiary that manufactures forgings and castings for large nuclear components. The audit was later extended to the St. Marcel and Jeumont manufacturing sites.

The sale of the reactor unit must also be approved by the European Commission, the company said.

The EC said in a statement July 19 it had opened an in-depth investigation to verify whether Areva's restructuring plan constitutes illegal state aid.

The French state owns 87% of Areva and 84.5% of EDF.

The sale of a majority stake of Areva's reactor unit to EDF is only one of the components of Areva's restructuring plan to reduce the company's total debts of Eur7 billion, which were due, in part, to liabilities stemming from the Olkiluoto-3 EPR. The project is about nine years behind schedule and almost three times over the original Eur3.2 billion turnkey contract price.

EDF Chairman and CEO Jean-Bernard Levy said in the statement that the binding agreement was "a major step forward" in the restructuring of the French nuclear industry. Areva CEO Philippe Knoche said the agreement gives Areva NP activities a "long-term vision."

Areva is expected to keep a 15% stake in New NP.

— Benjamin Leveau, London

CORRECTION

The participants in the Nuclear Power Plant and Reactor Exporters' Principles of Conduct facilitated by the Carnegie Endowment for International Peace are Areva, Atmea, GE Hitachi Nuclear Energy, Hitachi-GE Nuclear Energy, Inrap, Korea Electric Power Co., Mitsubishi Heavy Industries, Mitsubishi Nuclear Energy Systems, Rusatom Overseas, Toshiba and Westinghouse. Some of the participants were inadvertently omitted in an article in the November 10 issue of Nucleonics Week.

S&P Global Platts

NUCLEONICS WEEK

Volume 57 / Number 46 / November 17, 2016

ISSN: 0048-105X

Senior Managing Editor

William Freebairn (william.freebairn@platts.com)

Managing Editors

Steven Dolley (steven.dolley@platts.com)

Elaine Hiruo (elaine.hiruo@platts.com)

Senior Editor

Jim Ostroff (james.ostroff@platts.com)

Contact the editors:

nuclear@platts.com

European, Asian Editors

Managing Editor

Oliver Adelman (oliver.adelman@platts.com)

Editor

Benjamin Leveau (benjamin.levreau@platts.com)

Editor, Asia

Yuzo Yamaguchi (yuzo.yamaguchi@platts.com)

Editorial Director, Nuclear

Shelley Kerr

Global Editorial Director, Gas and Power

Simon Thorne

Platts President

Martin Fraenkel

Advertising

Tel: +1-720-264-6631

Manager, Advertisement Sales

Kacey Comstock

To reach Platts: E-mail: support@platts.com; North America: Tel: 800-PLATTS-8; Latin America: Tel: +54-11-4121-4810; Europe & Middle East: Tel: +44-20-7176-6111; Asia Pacific: Tel: +65-6530-6430

Nucleonics Week is published 51 times yearly by Platts, a division of S&P Global, registered office: Two Penn Plaza, 25th Floor, New York, N.Y. 10121-2298.

Officers of the Corporation: Harold McGraw III, Chairman; Doug Peterson, President and Chief Executive Officer; David Goldenberg, Acting General Counsel; Rob MacKay, Interim Chief Financial Officer; Elizabeth O'Melia, Senior Vice President, Treasury Operations.

Restrictions on Use: You may use the prices, indexes, assessments and other related information (collectively, "Data") in this publication only for your personal use or, if your company has a license from Platts and you are an "Authorized User," for your company's internal business. You may not publish, reproduce, distribute, retransmit, resell, create any derivative work from and/or otherwise provide access to Data or any portion thereof to any person (either within or outside your company including, but not limited to, via or as part of any internal electronic system or Internet site), firm or entity, other than as authorized by a separate license from Platts, including without limitation any subsidiary, parent or other entity that is affiliated with your company, it being understood that any approved use or distribution of the Data beyond the express uses authorized in this paragraph above is subject to the payment of additional fees to Platts.

Disclaimer: DATA IN THIS PUBLICATION IS BASED ON MATERIALS COLLECTED FROM ACTUAL MARKET PARTICIPANTS. PLATTS, ITS AFFILIATES AND ALL OF THEIR THIRD-PARTY LICENSORS DISCLAIM ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE AS TO THE DATA, OR THE RESULTS OBTAINED BY ITS USE OR AS TO THE PERFORMANCE THEREOF. A REFERENCE TO A PARTICULAR INVESTMENT, SECURITY, RATING OR ANY OBSERVATION CONCERNING A SECURITY OR INVESTMENT PROVIDED IN THE DATA IS NOT A

RECOMMENDATION TO BUY, SELL OR HOLD SUCH INVESTMENT OR SECURITY OR MAKE ANY OTHER INVESTMENT DECISIONS. NEITHER PLATTS, NOR ITS AFFILIATES OR THEIR THIRD-PARTY LICENSORS GUARANTEE THE ADEQUACY, ACCURACY, TIMELINESS OR COMPLETENESS OF THE DATA OR ANY COMPONENT THEREOF OR ANY COMMUNICATIONS, INCLUDING BUT NOT LIMITED TO ORAL OR WRITTEN COMMUNICATIONS (WHETHER IN ELECTRONIC OR OTHER FORMAT), WITH RESPECT THERETO.

ACCORDINGLY, ANY USER OF THE DATA SHOULD NOT RELY ON ANY RATING OR OTHER OPINION CONTAINED THEREIN IN MAKING ANY INVESTMENT OR OTHER DECISION. PLATTS, ITS AFFILIATES AND THEIR THIRD-PARTY LICENSORS SHALL NOT BE SUBJECT TO ANY DAMAGES OR LIABILITY FOR ANY ERRORS, OMISSIONS OR DELAYS IN THE DATA. THE DATA AND ALL COMPONENTS THEREOF ARE PROVIDED ON AN "AS IS" BASIS AND YOUR USE OF THE DATA IS AT YOUR OWN RISK.

Limitation of Liability: IN NO EVENT WHATSOEVER SHALL PLATTS, ITS AFFILIATES OR THEIR THIRD-PARTY LICENSORS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, TRADING LOSSES, OR LOST TIME OR GOODWILL, EVEN IF THEY HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, WHETHER IN CONTRACT, TORT, STRICT LIABILITY OR OTHERWISE.

Permission is granted for those registered with the Copyright Clearance Center (CCC) to photocopy material herein for internal reference or personal use only, provided that appropriate payment is made to the CCC, 222 Rosewood Drive, Danvers, MA 01923, phone (978) 750-8400. Reproduction in any other form, or for any other purpose, is forbidden without express permission of S&P Global. For article reprints contact: The YGS Group, phone +1-717-505-9701 x105. Text-only archives available on Dialog File 624, Data Star, Factiva, LexisNexis, and Westlaw.

© 2016 S&P Global Platts, a division of S&P Global. All rights reserved.

'Significant progress' on Chinese investment in French nuclear sector: ministry

"Significant progress" has been made on the conditions that could allow Chinese companies to invest in France's ongoing restructuring of its nuclear energy sector, the French Ministry of Economy said in a statement November 15.

French Minister of Economy Michel Sapin and the Ministry's Industrial Secretary of State Christophe Sirugue said in the statement that they had met November 14 with China's vice prime minister Ma Kai.

According to an article November 14 by Agence-France Presse, both governments met November 14 to sign an agreement on the conditions for China National Nuclear Corp.'s ownership of equity in Areva.

CFO Stephane Lhopiteau said at the company's headquarters in Paris November 3 that offers from investors interested in taking equity positions in Areva's newly created subsidiary, New Areva Holding, also known as NewCo, would be submitted in the coming weeks.

Sapin added that France would have to present to the European Commission all information pertinent to its plans to restructure Areva, including any foreign investments, AFP said.

AFP also said that Ma and Sirugue had visited Areva's reprocessing facility in La Hague.

CNNC signed a memorandum of understanding in November 2015 to develop ties with Areva, notably in the reprocessing of spent fuel. Areva and CNNC have also been negotiating commercial terms to build a reprocessing facility in China.

Areva said in June it was looking for strategic investors to own up to 33% of NewCo. The French state, meanwhile, would hold — either directly or indirectly — at least the remaining two thirds of NewCo's capital.

Foreign investments into Areva are part of the company's plan to reduce its total debt of Eur7 billion (\$7.5 billion) partly due to liabilities stemming from the Olikuloto-3 EPR project in Finland. That project is about nine years behind its original schedule and now has a projected cost almost three times the original Eur3.2 billion.

The creation of NewCo, whose final name has still not been decided, was announced June 15 with the objective that the new entity become independent. NewCo includes Areva's mining, conversion, enrichment services and all back-end activities, such as the company's decommissioning and reprocessing units.

Areva SA is selling a majority stake in its reactor business to EDF as part of the restructuring.

Japan's Mitsubishi Heavy Industries has said it is considering a partnership with Areva, while news reports have also linked Kazakh uranium miner Kazatomprom with interest in NewCo.

— [Benjamin Leveau, London](#)

Vietnam canceling plan to build two nuclear plants, assembly says

The Vietnamese government has proposed scrapping an ambitious plan to construct the country's first two nuclear power plants, citing falling prices of other energy sources, lower-than-expected demand for electricity and expected high construction costs.

In closed-door meetings over the past several days, Vietnam's

legislature, the National Assembly, reviewed a government proposal for the cancellation, the National Assembly said in separate statements November 11 and November 14.

The lawmakers are scheduled to vote on the proposal to cancel the Ninh Thuan I and Ninh Thuan II plants November 22, Vietnam News Agency reported last week.

"The cancellation of the Ninh Thuan I and Ninh Thuan II plants comes from the fact that nuclear power is now less competitive than other energy sources and is not urgently needed as previously forecast," Duong Quang Thanh, chairman of the state-owned Vietnam Electricity, EVN, told local media on November 9. EVN, the country's power distribution monopoly, was assigned by the government to oversee the nuclear power project.

Thanh said the prices of primary energy sources, including oil and coal, are currently much lower than at the time when the Ninh Thuan I and II were proposed.

In addition, the country's electricity demand in the coming years may not increase at the high rates previously forecast due to lower-than-expected economic growth. Vietnam's electricity consumption is now expected to grow 11% between this year and 2020, much below the range of 17-20% anticipated previously, Thanh said.

Vietnamese Deputy Prime Minister Trinh Dinh Dung told Japan's Minister of Economy, Trade and Industry Hiroshige Seko November 15 that Vietnam is considering cancelling Ninh Thuan II, Japan's trade and industry ministry said in a statement November 15.

"It is very regrettable as our country has made a significant contribution [to the project]," Seko said during his meeting with the Vietnamese deputy prime minister.

The two plants, scheduled to be located in the central coastal province of Ninh Thuan, have faced several delays since they were proposed. The government earlier this year said it planned to put the first nuclear power reactor into operation in 2028. It did not clarify at which plant that would be.

Construction of the first unit had originally been scheduled to begin in 2014, with startup projected for 2020. However, then-Prime Minister Nguyen Tan Dung said in January 2014 that construction of the first nuclear plant would be delayed to around 2020 to ensure safety standards were met.

Vietnam saw economic growth averaging 5.84% a year between 2011 and 2015, lower than the 6.5%-7% range the government had targeted.

The government has recently lowered its growth target for 2016 to between 6.3% and 6.5%, from 6.7% earlier. The economic growth target rate for 2017 has been set at 6.7%.

The cost of constructing the two nuclear power plants is another issue, Le Hong Tinh, vice chairman of the National Assembly's Committee for Science, Technology and Environment, said November 10, according to local media reports.

The two plants were estimated to have a construction cost of Dong 200 trillion (\$8.8 billion) when they were proposed in 2009. But the total capital required may be doubled to Dong 400 trillion according to current estimates, Tinh said.

The construction of the nuclear power plants will worsen the country's public debt, which is already high, according to Tinh. As of the end of 2015, Vietnam's public debt was equal to 62.2% of its gross domestic product, close to the limit of 65% set by the legislature.

Russia, Japan agreements had been signed

Vietnam signed an agreement in October 2010 with Russia's Atomstroyexport, a Rosatom subsidiary, to build the Ninh Thuan I plant, which was to have consisted of two VVER-1000 or VVER-1200 reactors with a total capacity of about 2,000 MW.

In November 2010, Vietnam signed a separate agreement with a Japanese consortium that includes Mitsubishi Heavy Industries, Toshiba and Hitachi for two 1,000-MW third-generation units at Ninh Thuan II. No specific reactor design had been specified.

— *Dao Dang Toan, Vietnam; Yuzo Yamaguchi, Tokyo*

Tepco expected to set restructuring plan by March

Japan's trade and industry ministry expects Tokyo Electric Power Co., or Tepco, to establish a restructuring plan, including a potential combination of its nuclear operations with another nuclear operator, by the end of March, a ministry official has said.

The ministry will review the company's current business plan, which Tepco is expected to revise within the current fiscal year, which ends March 31, Yoshifumi Murase, director-general of the electricity and gas industry department at the Ministry of Economy, Trade and Industry, said on the sidelines of a November 15 press briefing.

As part of the restructuring plan, a Tepco committee set up under the trade and industry ministry will analyze on an ongoing basis the possibility of the utility establishing a partnership with another power company for its nuclear operations. The committee will also review how its Kashiwazaki-Kariwa-6 and -7 should be operated, Kunio Ito, a professor of Hitotsubashi University and chairman of the committee, said at the same press briefing.

Ito cited committee members as saying during the November 15 meeting of the committee that the government should initiate talks about Tepco's alliance with another nuclear operator. Some members said that Kashiwazaki-Kariwa-6 and -7 should be operated by Tepco together with one or more nuclear operators because joint operation could serve to regain public support. Ito added, however, that these suggestions from committee members do not necessarily represent the committee's final conclusion.

Ito added that the committee members mostly agreed that the Kashiwazaki-Kariwa units "would be hard to restart under the current conditions." Kashiwazaki-Kariwa-6 and -7 are undergoing a safety review by the country's Nuclear Regulation Authority. The fate of the units, which have a combined capacity of 2,712 MW, could affect Tepco's restructuring, as keeping the two units offline would lead to a loss of Yen 240 billion (\$2.3 billion) per year for the utility, Tepco has said (NW, 3 Nov, 1).

The trade and industry ministry started the committee, comprising 10 members, mostly corporate executives, in October to discuss Tepco's restructuring, which is aimed at generating profits that could be used for the decommissioning of its damaged and permanently shut Fukushima I plant.

By the end of the year, the committee intends to outline a restructuring framework that would allow the utility to develop its own restructuring plan by the end of March, Murase said.

He added, however, that Tepco could not at this time name any potential partners.

"What we have to think is what should be the benefit or risk for Tepco's potential partner," Murase said. He added that the question of which company will take financial responsibility for the growing decommissioning costs for Fukushima I could be one of key issues to resolve in order for Tepco to form a nuclear alliance.

At the previous committee meeting October 25, the trade and industry ministry said a spinoff of Tepco's nuclear operation from its holding company for a potential combination with another nuclear operator was an option to consider.

The trade and industry ministry said October 25 that costs for the decommissioning work at the Fukushima I plant, where three reactors were destroyed by a severe accident, will expand to "several hundred billions of yen," or several billion dollars, a year, from the currently estimated Yen 80 billion per year.

— *Yuzo Yamaguchi, Tokyo*

EDF UK nuclear director says AGRs safe to operate to end of scheduled lives

Despite news reports of cracking issues at some of its advanced gas-cooled reactors, or AGRs, EDF Energy's director of nuclear operations in the UK said the issue will not prevent any of the reactors from running until the end of their currently scheduled operating lifetimes.

Brian Cowell, EDF Energy's director of nuclear operations, said in an email November 7 that "the graphite in our reactors is behaving exactly as experts predicted it would, underlining our confidence to operate the stations safely to 2023 and beyond."

He made his comments after the state-owned BBC reported on a series of requests it and Greenpeace had made under the UK's Freedom of Information Act, although the issue and its mitigation had also been discussed by the Office for Nuclear Regulation, or ONR. The BBC report said that there were cracks in the graphite "keyways" in which control rods are inserted to shut the 495-MW Hunterston B-2. The regulator was concerned similar cracks might exist at the two-unit Hinkley Point B plant in western England, BBC said.

Hinkley Point B-1 has a capacity of 460 MW, and Hinkley Point B-2 has a capacity of 480 MW.

The UK has 14 AGRs at eight nuclear power plants with a combined total capacity of 10,173 MW. The last of the AGRs is currently scheduled to end operations in the early 2030s.

The issue of cracks within the existing fleet of UK AGRs is not a new one.

British Energy, which was the owner of the UK AGRs prior to their sale to EDF Energy, in 2004 discovered graphite core brick cracking at one of the Hartlepool reactors (NW, 9 Dec '04, 13).

This cracking required further graphite brick inspection and eventually safety case modifications at both the Hartlepool and Heysham A plants, which are similar in design and construction. The safety case required by the then-UK nuclear regulator, the Nuclear Installations Inspectorate, increased emphasis on inspection and monitoring at the two plants.

Cowell said that "nuclear safety drives everything we do. This

means we work within very large safety margins. This applies to graphite bricks too.”

Cowell added that “the level of cracking which is considered reasonable is far below anything which would affect the reactor’s safe operation.”

An EDF Energy briefing paper on the issue of graphite cracking obtained by S&P Global Platts noted that “at the moment we have identified seven cracked bricks as a result of keyway root cracking across the two reactors at Hunterston B power station. Experts believe we can operate safely with up to 1,000 such cracks in each reactor.”

The briefing paper also noted, however, that “we set ourselves a lower limit and would shut down a reactor when it has between 300-400 cracks.”

Cracking difficult to detect

John Large, a consultant at Large Associates in London, said in an email November 7 that “the graphite moderator core [of each AGR] consists of about 2000 metric tons in total, and comprises several thousand graphite bricks.”

Large noted that “the issue is gauging the deterioration in the structural strength of the individual bricks.” He added that it was key to determine the residual strength of the reactor core overall and the impact on the core “due to irradiation ageing and radiolysis of the graphite.”

Radiolysis is the radiation-induced splitting or fracturing of molecules, which in this case could result in deterioration or cracking of the graphite bricks in the reactor core.

Large said that “it is virtually impossible to detect the keyway initiated cracking until it has reached through to and is manifest on the inner surface of the channel bore [a small circular channel through which rods are inserted into the reactor]. So, it is not possible to predict how many keyway cracks are at various stages of development at any time.”

Large has expressed skepticism about the need for nuclear power in the UK and has previously served as a consultant on nuclear issues for the anti-nuclear environmental group Greenpeace.

The EDF briefing note said that “the internal stresses in the graphite bricks [of the AGRs] change over time and as a result we expect cracking to occur in some of the bricks as they age.”

The note added that “this is a well-known phenomenon which was fully considered as part of the stations’ design and is factored into safety limits approved by the independent regulator, the Office for Nuclear Regulation (ONR).”

Jo deBank, a spokeswoman for the ONR, said in an email November 10 that graphite cracking “is a potential issue across all AGRs.”

Asked what solutions might be available for the problem, she said that “it is not the safety regulator’s remit to find solutions, but to ensure that the safety cases made by the operator are justified.”

ONR said on its website that “the graphite core of the AGRs cannot be replaced and ageing mechanisms such as weight loss and cracking can change the mass, dimensions and material properties within the core. As such, they pose unique challenges to the operator and to us as the regulator.”

The keyway cracking “is considered to be the likely phenomenon that will ultimately limit the lifetime of most of the AGRs,” ONR said.

ONR added on its website that “EDF takes a ‘multi legged’ approach to managing potential graphite issues. These include: predictions of component and core condition; assessing the tolerance of the core safety functions to any predicted damage; assessing the consequences of core damage for safety function; and monitoring core condition during plant operation.”

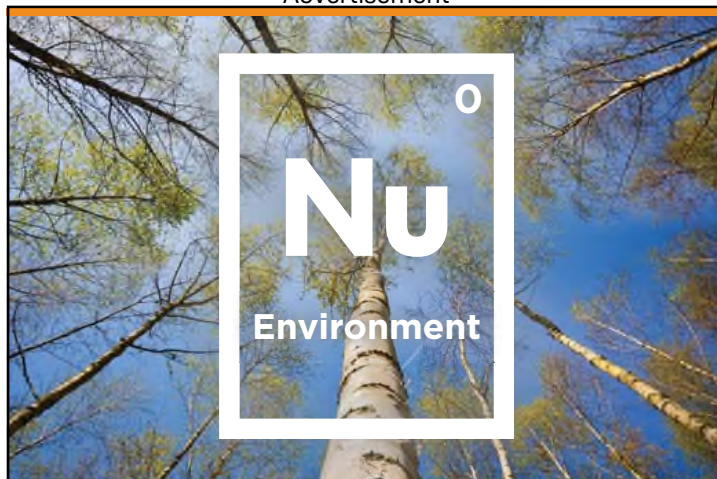
ONR said “[i]t is not believed that the onset of keyway root cracking within this small population of high shrinkage bricks will materially affect core integrity.”

‘Hard to know’ if additional cracking will occur

Stephen Thomas, an energy professor at London’s University of Greenwich, noted in a November 7 email that it was “hard to know” whether this level of cracking was to be expected in this stage of the life cycle of the AGRs because “there are seven AGRs with four significantly different designs.”

Hinkley Point B-1 and B-2 and the 495-MW Hunterston B-1 and -2 have one design, while Hartlepool-1 and -2 and Heysham A-1 and A-2 are a second type of design. The 625-MW Dungeness B-1 and -2 are a third type of design, while the 677-MW Heysham B-1 and B-2 and the 657-MW Torness-1 and the 662-MW Torness-2 represent a fourth type of AGR.

Advertisement



New nuclear plants are necessary to lessen dependence on fossil fuels, meet the needs of developed and expanding economies, and reduce CO₂ emitted into our environment. NuScale Power has developed a clean, reliable, carbon-free Small Modular Reactor technology. It has the smallest environmental footprint of the technologies available today generating electricity. It will play a significant role in meeting demand in the U.S. and internationally as part of a diverse energy portfolio. Environment: The Element of Nu.™



**NUSCALE
POWER™**

nuscalepower.com



© 2016 NuScale Power, LLC. All Rights Reserved.

Thomas said that the “the most likely ones [to also have the keyway cracking issue] are Heysham 2 and Torness. These were ordered in 1979 and were based on the Hinkley/Hunterston design, not least because this design was the only one that was actually in operation then.”

Cowell in his November 7 email said: “It is accepted by our regulators and materials experts that cracks will occur in some of the bricks and that the core will lose some of its mass as part of the normal ageing process.”

Large noted that “extra mitigation measures against core failure” have been introduced. These measures include “articulated control rods that provide greater flexibility to enable the control rod (virtually a chain) to negotiate a misaligned core,” according to Large.

UK AGR ELECTRICITY PRODUCTION 2010-16

Year	Total UK AGR Generation (MWh)
2010	51,584,558
2011	59,678,209
2012	64,660,041
2013	64,132,526
2015	64,145,953
2016	56,776,458*

Source: S&P Global Platts

*2016 data through end of October 2016 only

A separate issue with an unexpected level of boiler tube cracking at Hinkley Point B and Hunterston B was reported as far back as 2006 (NW, 31 Aug. '06, 6). This led the UK's nuclear regulator to impose a capacity limit of 70% on both reactors in 2007.

Problems with potential cracking in the boiler spines of four different UK AGRs were first identified in August 2014, when the 670-MW Heysham A-1 and A-2 and the 650-MW Hartlepool-1 and -2 were shut following the discovery of a crack in one of the boilers in Heysham A-1 (NW, 29 Oct '15, 1). The boiler of an AGR is used to remove heat from the reactor and to generate steam.

The original crack in boiler spine weld 12.3 in Heysham A-1 reactor was found during a routine inspection of the unit during August 2014. After the discovery, the four units were taken offline, but Heysham A-2 and Hartlepool-1 and -2 subsequently returned to service at 75% to 80% of capacity in November 2014 (NW, 27 Nov '14, 8). Heysham A-1 did not return to service until January 2015.

The units subsequently resumed operating at full output.

— *Oliver Adelman, London*

China's CGN starts construction of small floating reactor demonstration unit

China General Nuclear Corp., or CGN, announced November 4 that it has signed a purchase agreement with Dongfang Electric, a nuclear equipment manufacturing company, to supply the reactor pressure vessel for a demonstration unit of a small ship-borne reactor called ACPR50S.

The signing of the agreement marks “a new phase” in the development of the small floating offshore nuclear unit, CGN said in the statement.

Rui Min, a deputy chief engineer with CGN Research Institute and

the chief designer of the small reactor, said that the design of the ACPR50S reactor is based on the traditional pressurized water reactor and mature nuclear and maritime engineering technologies.

The design will adopt the highest safety standards to meet the demand of maritime customers, he said. “The ACPR50S project is expected to offer safe, stable and reliable offshore energy, while it is environmentally safe,” he said.

The ACPR50S, which is similar in design to the ACPR100 small land-based reactor, is “a comprehensive nuclear energy supply system used in marine” settings, Rui said in the statement. It will be aimed at offshore power needs, he said.

The ACPR50S is a ship-mounted reactor designed to provide power, heat and fresh water in offshore environments including oilfield exploration in the Bohai Sea and deep-water oil and gas development in the South China Sea, CGN says on its website. They could also be used in island communities not linked to the national power grid, it said.

Unlike reactors on land, where the pouring of first concrete marks the start of construction, for marine units the signing of the reactor vessel purchase agreement represents the beginning of construction, CGN said in the statement.

The ACPR50S reactor construction was approved by China's National Development and Reform Commission in December 2015 as part of the country's energy innovation project.

The ACPR50S is a floating small reactor design developed by CGN. The reactor has a thermal capacity of 200 MW, CGN said in the statement. The preliminary design work is expected to be completed soon, CGN said.

CGN announced January 15 that it had signed a strategic cooperation framework agreement with China National Offshore Oil Corp., or CNOOC, on the joint development of marine small reactors, in particular the ACPR50S (NW, 28 Jan, 3).

CGN is currently conducting preliminary design of the ACPR50S reactor, and expects to bring the first unit into operation by 2020, CGN said in a statement January 12.

CGN is also developing the ACPR100 small reactor to be used on land. The 450-MW thermal reactor would be complementary to CGN's current large units and be used to provide power for remote mountainous communities or large industrial parks, it said in the statement.

Rival ship-borne reactor in development

Separately, on January 14, China National Nuclear Corp., or CNNC, said it plans to begin construction of its first demonstration floating nuclear reactor at the end of 2016 and start commercial operation of the unit in 2019. The NDRC also issued approval recently for CNNC's floating plant, the ACP100S small reactor, as part of the country's latest five-year plan, which runs from 2016 through 2020, CNNC said in the statement.

The ACP100S small reactor is a marine version of the ACP100 small modular reactor design, for use on offshore facilities or coastal areas. CNNC said its subsidiary, the Nuclear Power Institute of China, has completed an initial design of and key technological work on the unit.

— *Hua Wen, Beijing*

EDF works council wins ruling to extend Fessenheim shutdown consultation

FO energie et mines, an EDF labor union, said in a statement November 15 that EDF's works council had won a ruling allowing the employee consultation period on a Fessenheim shutdown to be extended for a period of two months or until January 10.

The works council — made up of 20 employees representing EDF's three labor unions CGT, FO and CFO-CGC — had lodged a complaint September 14 in a French court, the Tribunal de Grande Instance, to get access to more information on the agreement between the government and EDF regarding the closure of the plant.

The November 11 ruling means EDF will have to provide the council with detailed information on the cost of closure and its financing, notably the financing related to the social ramifications to the closure of a plant where 1,100 people work.

EDF and the government agreed in late August to a Eur400 million (\$429 million) payment to EDF for the closure of Fessenheim, with a variable component to be paid later based on future wholesale prices and future generation of the company's 900-MW series of reactors.

A decree by the government to close the twin-unit Fessenheim plant had been expected this year after EDF had agreed with the Ministry of Energy on the compensation structure.

"Contrary to what [Minister of Energy Segolene Royal] had promised ... the decree repealing the authorization to operate the power plant will not be taken before the end of the year," FO said in the statement.

The two-unit Fessenheim nuclear power plant is expected to shut permanently when the Flamanville-3 EPR, now under construction, comes online during the fourth quarter of 2018. EDF needs to retire 1,650 MW of nuclear capacity when Flamanville-3 starts commercial operation to meet the cap on capacity that was set as part of France's 2015 energy law, which also aims to reduce the share of nuclear energy in power production to 50%.

FO said EDF's board of directors will only be able to vote on the plant's closure once the council has issued its opinion.

FO said that Royal wanted the decree to be finalized in 2016 "to prevent Fessenheim from becoming an electoral issue."

In the run-up to the 2012 presidential election, François Hollande had pledged to shut Fessenheim by 2016.

France's next presidential elections are set for April-May. Most recent national polls show President François Hollande, or any other centre-left candidate, losing to any centre-right candidate from Les Républicains, formerly known as UMP.

Bordeaux Mayor Alain Juppé is the favorite to become the official Les Républicains candidate, with former president and Les Républicains party leader Nicolas Sarkozy behind him in the polls.

"The absurd objective of reducing nuclear in electricity production to 50% will be removed," according to Juppé's energy proposals listed on the candidate's official website, adding the Fessenheim nuclear plant closure would be "cancelled," if he is elected.

Marine Le Pen, the conservative candidate of the Front National, leads some polls in first round voting. She favors maintaining nuclear power until a future phase-out is feasible, according to energy proposals listed on the Front National's official website.

— *Benjamin Leveau, London*

BRIEFLY

China-UK nuclear research center opens, CNNC says

Chinese vice premier Ma Kai and Lucy Neville-Rolfe, minister of state in the UK's Department for Business, Energy and Intellectual Property, on November 9 opened a new Sino-UK Nuclear Research and Innovation Center, China National Nuclear Corp., or CNNC, said in a statement November 10.

The inauguration of the research center marks a new chapter in Sino-UK collaboration on nuclear energy and will allow more cooperation in fields of scientific research, technology, and across the whole nuclear industry supply chain, CNNC said.

Located in Manchester, the center aims to drive Sino-UK cooperation in nuclear technologies as well as build a platform for research and studies between the two countries, it said.

CNNC's UK branch and the UK's National Nuclear Laboratory each own a 50% share of the research center. They will jointly pay for the center's research and development expenses and plan to invest Yuan 422 million (\$65.1 million) over a five-year period, according to CNNC.

The research center aims to organize research project proposals on nuclear technologies; choose the research departments to manage research projects and to conduct consulting services for nuclear technology research, CNNC said.

A series of events has already been held at the center, it said.

— *Hua Wen, Beijing*

Decommissioning [... from page 1](#)

consulting firm Burns & McDonnell, will decontaminate and dismantle Vermont Yankee by 2021. NorthStar will restore the site to a greenfield condition by 2030, except for maintaining the independent spent fuel storage installation, or Isfsi, Entergy said in a November 8 statement.

"It makes sense to have a specialized company that's an expert on decommissioning do the job," Dale Klein, a former NRC chairman and a professor of mechanical engineering at the University of Texas-Austin, said in an interview the same day.

"A utility's expertise is in safely and securely operating a nuclear plant. It can build up the expertise needed to do decommissioning, but that's different than for operating a plant," Klein said.

NorthStar will decommission the Isfsi and restore its concrete storage pad site to greenfield condition after DOE "fulfills its statutory and contractual obligations to remove all spent nuclear fuel" from operating and decommissioned reactor sites, the statement said.

The agreement is expected to close in "late 2018," by which time Entergy has pledged to move all spent fuel from the reactor building pool into dry cask storage on the site, two years ahead of the current schedule, the statement said. It added the agreement is subject to NRC approval of the unit's license transfer to NorthStar and the Vermont Public Service Board's, or PSB's, approval of "proposed site restoration standards."

Entergy did not disclose the sale price for Vermont Yankee, noting in the statement that the company "will receive nominal cash consideration." It added the "transaction is expected to result in a loss at closing."

Entergy did not provide estimates for the costs NorthStar is expected to incur in decommissioning Vermont Yankee.

The agreement calls for Entergy to transfer to NorthStar the unit's "decommissioning trust fund and its obligations for spent fuel management and decommissioning," the statement said. This fund totaled \$574.9 million as of September 30, plant spokesman Martin Cohn said in a November 8 email.

The minimum amount of money required to decommission Vermont Yankee is \$740.5 million, Entergy said in a report filed March 30 with NRC. However, this total assumes the unit would be decommissioned using the Safstor approach, which permits this work to be conducted over 60 years.

The Entergy statement said, "A contractually agreed minimum level of funding" at the time of the completion of the sale in late 2018 would be required. It did not disclose that minimum amount, but said if the fund produces annual returns of 5.5% between now and the end of 2018, and other assumptions are met, no additional payment from Entergy would be required. For every 1 percentage point of returns below 5.5%, a contribution of \$10 million to \$12 million would be required, it said.

The Entergy decision marks the third time that a power reactor licensee has not conducted decommissioning itself.

Exelon in 2010 signed a contract with EnergySolutions, a nuclear waste management company that specializes in decommissioning reactors, for it to decommission two Westinghouse PWRs, Zion-1 and -2 in Illinois. The units began commercial operation in 1973 and were permanently shut in 1997 and 1996, respectively. The total estimated cost to decommission the site is "just under" \$1 billion, EnergySolutions spokesman Mark Walker said in an interview July 13, 2015. Exelon retains the operating license.

Ken Robuck, president of EnergySolutions, said in a March 29 statement that "more than 98% of all the radioactive source term of the Zion plant has now been removed from the plant and safely disposed of or placed into dry storage on site, a major accomplishment for this project."

Dairyland Power Cooperative and EnergySolutions said in a statement November 3, 2015 that they have an agreement for the decommissioning of Dairyland's La Crosse BWR in Wisconsin. The 50-MW La Crosse plant was built in 1967 as part of an Atomic Energy Commission project. It was permanently shut in 1987 and placed in Safstor.

Under the agreement, Dairyland's possession-only license would be transferred to the EnergySolutions company LaCrosseSolutions, which will complete decommissioning the site, except for the spent nuclear fuel storage facility. NRC issued an order approving the license transfer in May.

Dairyland retains ownership of the site and the spent nuclear fuel.

Davis said the use of industrial remediation specialist contractors to conduct decommissioning, or the outright sale of shut units to such companies, likely "will be a trend" going forward, noting there could be more unit retirements in coming years and "obviously when you get past 2030 there will be more."

NRC, in an October 28 memorandum on lessons learned from decommissioning units, said it has received letters from licensees

indicating their intention to shut seven units through 2019, although one unit, Entergy's FitzPatrick, is slated to be sold to Exelon.

Companies such as NorthStar and EnergySolutions "have many years of experience in estimating, developing productive workforce practices, processes and have all the needed equipment," Davis said, adding, "Most of the [decommissioning] work is dismantlement, it's basic civil construction and a tear down" job.

Klein said that an industrial remediation company can operate cost effectively since it has a trained workforce and, unlike a utility, does not have large upfront costs to train workers.

Eugene Grecheck, a longtime Dominion Resources executive who now is principal of Grecheck Consulting, said in a November 15 interview that Entergy's decision to sell Vermont Yankee to NorthStar "makes sense" because the utility does not "have a particular expertise and if it is not going to do this work in the future why accept the risks?"

Grecheck, who worked as a Dominion vice president overseeing nuclear services and nuclear engineering and led Dominion's new plant development activities, said avoidance of potential regulatory and financial risks by outsourcing decommissioning activities is an important factor for licensees that are planning to shut units.

Remediation companies can make profits by taking over this work, he said, "through good practices and cost control." In addition, Grecheck said in tapping a unit's decommissioning trust fund, such companies can "charge for administrative and management costs, for costs incurred in planning the project and doing the activities that are required."

At Vermont Yankee, however, NorthStar cannot count on taking all the funds left in the trust fund after all decommissioning work has been completed, NRC Region I spokesman Neil Sheehan said in a November 15 interview.

As part of the 2002 agreement under which Entergy bought Vermont Yankee from Vermont Yankee Nuclear Power Corp. and the Vermont utility's owner Green Mountain Power Corp., any remaining decommissioning trust funds "do not revert to the owner" of the site, he said.

The state of Vermont, in an August 2015 lawsuit that sought, unsuccessfully, to limit Entergy's withdrawals from the decommissioning trust fund, said the 2002 agreement stipulated Green Mountain Power "and through it their Vermont ratepayers, have a 55% interest in all monies that remain in the trust fund following completion of decommissioning," plaintiffs said in the lawsuit.

— *Jim Ostroff, Washington*

Japan-India [... from page 1](#)

premium is about Rupee 1 billion (\$14.4 million) for liability coverage of Rupee 15 billion, according to an NPCIL official who spoke on condition of anonymity because the person was not authorized to speak to the media.

This will cover liability from third party claims by the public in case of any nuclear accident at the reactors covered under the policy, the source said.

In addition, there is a policy offered by New India Insurance to

nuclear suppliers, providing them protection from the "right to recourse" against suppliers in the Indian liability law. That coverage was launched in August. This right to recourse policy works in conjunction with the nuclear operator's liability policy issued to NPCIL, according to an August 13 statement by state-run General Insurance Corp. of India.

However, Charudatta Palekar, director of energy, utilities and mining at consulting company PricewaterhouseCoopers India, said in an interview November 15 that suppliers still have some concerns regarding liability, especially equipment manufacturers from Japan and the US as they consist of private companies and not state-owned suppliers, Palekar said.

Japan ministry may hold liability talks

"We understand that the nuclear agreement would not work without settling the liability issue," an official at the Ministry of Economy, Trade and Industry said in an interview November 16. "We as the government will continue to discuss this issue with them [the Indian government]." He declined to provide further information such as when and how the trade and industry ministry will lead the bilateral liability talks. The official spoke on condition of anonymity because of the sensitivity of the issue.

"The liability is a very critical issue for an actual business but the Japanese government could not be involved in this issue immediately," a government official involved in Japan's nuclear policy said in an interview November 14. The official declined to be named as he is not authorized to speak to the press.

"Even if India creates an insurance fund [for damage compensation], that could only cover several tens of billions of yen

[several hundred million dollars] for a plant supplier," the official added. "That could make Japanese manufacturers reluctant to rush into the [Indian] market because there is a possibility that they could be facing compensation of several hundred billions of yen in a case of an accident," he added.

The official also noted that Toshiba and its Westinghouse subsidiary might move to sign a commercial contract to supply reactors to India without settling the nuclear liability issue, as Westinghouse "bets itself on a nuclear business, while GE might not be so quick to take action" due to remaining concerns about the liability issue.

Westinghouse wants to tap into the Indian market. In addition to its plan to build six AP1000s at a site in the Indian state of Andhra Pradesh, the US-based vendor is looking at the construction of another six reactors at a site in the state of Gujarat, Danny Roderick, president and CEO of Toshiba's energy systems and solutions business, said in an interview July 8.

GE Hitachi Nuclear Energy has said it has concerns about an Indian nuclear liability law under which nuclear plant suppliers could be sued for damages in the event of a nuclear accident, but remains interested in building ESBWRs in the country.

A Hitachi official said in an interview November 14 that he "sees this nuclear agreement as welcoming, but it won't simply accelerate Japanese exports because concerns remain about the liability issue." He declined to be named as he is not authorized to speak to the press.

Mitsubishi Heavy Industries "will have to keep watching the issue of compensation of nuclear damages despite the fact that India is a huge market where the construction of many plants is planned," a company spokesman said in an interview November 14.

— *Yuzo Yamaguchi, Tokyo; Sapna Dogra, New Delhi*

13th Annual

Nuclear Energy Conference

February 9-10, 2017 | Renaissance Washington, DC Downtown Hotel | Washington, DC



Benefit from the insights of industry leaders:

- **Sheldon Whitehouse**, Senator, **U.S. Senate**
- **Christopher Mudrick**, SVP Northeast Operations, **Exelon Corporation**
- **Bill Mohl**, President, **Entergy Wholesale Commodities**
- **David I. Fein**, VP, State Government Affairs East, **Exelon Corporation**
- **Rajnish Barua**, Executive Director, **National Regulatory Research Institute**
- **Christine Csizmadia**, Director, State Outreach, **Nuclear Energy Institute**
- **Michael Ferguson**, Credit Analyst, **S&P Ratings**
- **Dean Keller**, Sr. Managing Director, **Guggenheim Securities**
- **John E. Kelly**, Deputy Assistant Secretary, **U.S. Department of Energy**
- **Rita Baranwal**, Director, GAIN Initiative, **Idaho National Laboratory**
- **Jennifer Uhle**, Director, Office of New Reactors, **U.S. Nuclear Regulatory Commission**
- **Simon Irish**, Chief Executive Officer, **Terrestrial Energy**
- **Kirk Sorensen**, Chief Technology Officer, **Flibe Energy, Inc.**
- **Kevin Lee**, Sr. Regulatory Policy Officer, **Canadian Nuclear Safety Commission**
- **Christian Carrier**, Director, **Canadian Nuclear Safety Commission**
- **Pablo Chama**, Site VP, **Laguna Verde Nuclear Power - Mexico**
- **Jane Nakano**, Sr. Fellow, **Center for Strategic and International Studies**
- **Curtis Moore**, VP, Marketing and Corporate Development, **Energy Fuels**
- **Jim Ostroff**, Sr. Editor, Nuclear Publications, **S&P Global Platts**
- **Maria Lovely Umayam**, Research Analyst, **The Stimson Center**

Learn more:

Find further details, including a complete agenda, at:
www.nuclearenergyconference.com

For questions about the program or to request a brochure, contact:

Ron Berg
Conference Manager
Tel. +1 857-383-5739
ron.berg@spglobal.com

Supported by:



S&P Global
Platts

NUCLEONICS WEEK

S&P Global
Platts

NUCLEAR FUEL

S&P Global
Platts

INSIDE NRC

**Register
Now**

www.nuclearenergyconference.com
registration@platts.com
800-752-8878 (toll free)
+1 212-904-3070 (outside USA & Canada)

