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Hitachi willing to discuss nuclear operations merger, president says

Hitachi's decision last week to freeze its UK nuclear power project could prompt the Japanese reactor vendor to move to begin talks about a potential merger of its nuclear operation with those of its Japanese competitors, the Hitachi president said last week.

Toshiaki Higashihara said at a January 17 press conference announcing the decision on stopping investment in its Horizon Nuclear Power subsidiary that "because we are freezing our Horizon project, we would face a shortage of human resources involved in planning, designing and building [new nuclear plants]. This is the problem we should discuss with other manufacturers." He added, "To secure human resources and technologies, we will be willing to join them for talks if there is a chance. We should have such discussions."

Higashihara expressed openness to the possibility of merger discussions for the first time during the news conference after he was asked if Hitachi would consider a merger of its nuclear operation with those of other Japanese reactor vendors.

Hitachi, Mitsubishi Heavy Industries and Toshiba are the country's reactor vendors, and there have been media reports that they could or should combine their reactor businesses as the market for large reactors has gotten smaller and competitors like Russian state nuclear company Rosatom have been more successful at exporting nuclear plants.

Hitachi last week suspended its plan to build two UK advanced boing water reactors with a total capacity of 2,700 MW at Wylfa

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Advanced technologies critical to US nuclear industry's future: DOE official

The US nuclear industry is at a "major crossroad" and it will need a "pipeline" of advanced nuclear technologies, including advanced reactors, in the 2020s in order to have a future, according to a senior US Department of Energy official.

"Time is not our friend," Edward McGinnis, DOE principal deputy assistant secretary of nuclear energy, told a Senate Appropriations subcommittee January 16. The average age of the nuclear fleet is now 38 years, McGinnis said in his written testimony. He told lawmakers that eventually the existing fleet will have to be replaced.

"Sustaining the current fleet of operating nuclear power plants is a priority for the nation because without a robust nuclear industry, we will not be able to reestablish a strong pipeline of advanced nuclear technologies and associated U.S.-based supply chains, nor maintain the fuel cycle infrastructure and workforce necessary for a vibrant civilian nuclear industry," McGinnis said in his written testimony.

The panel's Subcommittee on Energy and Water Development, chaired by Senator Lamar Alexander, a Tennessee Republican, held the hearing to review the future of nuclear power and advanced reactors in the US.

As Christina Back, a vice president of General Atomics, sees it, the US "needs to make long-term R&D decisions now." Her company is developing a helium-cooled fast small modular reactor known as Energy Multiplier Module, or EM2.

Back told lawmakers in her written testimony that it would be helpful if

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Germany needs coal generation longer: minister

Germany needs to retain half of its coal-fired power generation capacity until 2030 to offset the closure of all its nuclear reactors by 2022, economy and energy minister Peter Altmaier said January 22.

"No other country getting out of coal is also getting out of nuclear power," the minister said at an energy conference in Berlin, adding that "the ending of nuclear and the phasing out of coal should not overwhelm each other."

"That's why we have to talk about a longer timetable" for coal plant closures, he said.

The government-appointed coal commission is finalizing recommendations this week for the phase out of coal-fired power stations, which provide 35% of Germany's generating mix. The commission's final report is due February 1.

Altmaier said half of Germany's current hard coal and lignite capacity of just over 40 GW would still be operational in 2030, with any agreed phase-out timetable needing a periodic review based on criteria including security of supply and affordability.

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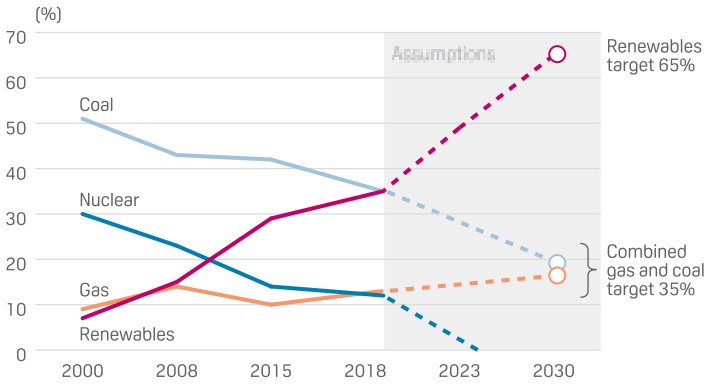

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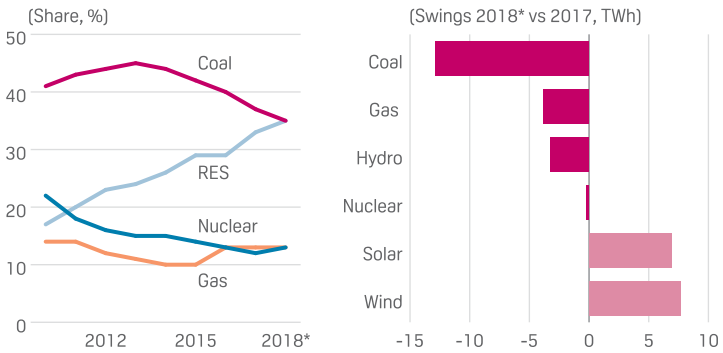
GERMAN POWER MIX CHANGES



Source: BDEW (*=preliminary)

German power prices could be 8% to 13% higher between 2022 and 2030 under an accelerated coal phaseout compared with a base scenario, analysts at broker Bernstein said in a note January 22.

Bernstein assumes 5 GW of coal closures by 2022 in the base scenario, of which 3.6 GW would be fueled by lignite. Some 2.7 GW of the oldest units are already scheduled for the lignite reserve, meaning that they would be shut but remain available if needed in case of a supply disruption.

The minister virtually excluded the possibility of additional coal closures in 2021 and 2022, as more than 4 GW of nuclear capacity is set to close each of those years.

Altmaier warned of blackout risks under various scenarios, but praised grid operators for securing grid stability to date.

The government's priority has been to accelerate grid expansion and allow further market integration by 2025.

Planning permission for a key section of the Ultranet power link, one of five north-south transmission lines in the country, was given January 21, putting it on track for a 2023 startup, the minister said.

Altmaier flagged the use of natural gas-fired peaker plants and hydrogen production from offshore wind as examples of how a future generation system might be developed as Germany moves toward a target of having renewables generate 65% of Germany's electricity production by 2030.

— *Andreas Franke, London*

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NRC delays Seabrook license renewal after concerns raised by lawmakers

NRC has put on hold issuing a renewed license and a related license amendment for NextEra Energy's Seabrook in New Hamsphire after federal lawmakers requested the public be able to air concerns over concrete degradation at the plant.

The agency had said January 11 that on or about January 22 it would issue the license amendment approving the company's proposed management of the concrete condition, known as alkali-silica reaction, or ASR. The agency also said it would issue a 20-year license renewal on or about January 30.

But in a letter to NRC administrative judges reviewing the license amendment, made public January 23, NRC said, "In response to significant public interest, the Staff plans to meet with the public before issuing both the ASR license amendment and the renewed license."

On January 16, New Hampshire senators Jeanne Shaheen and Margaret Wood Hassan, and Representative Chris Pappas, all Democrats, had written NRC Chairman Kristine Svinicki asking that the agency hold "a round of public information sessions in potentially affected communities and ensure that interested parties are allowed to present their concerns to the Commission prior to the issuance of your final actions."

Two days later, Massachusetts senators Edward Markey and Elizabeth Warren, along with Representative Seth Moulton, sent a letter to Svinicki saying the plan to approve the license amendment and renew the license "will effectively silence local stakeholders and minimize their critical role in the amendment review process." The lawmakers, all Democrats, asked that the license amendment and renewal be delayed until after an NRC Atomic Safety and Licensing Board hearing this summer on ASR at the 1,296-MW plant.

NRC spokesman Neil Sheehan said in an interview January 23 that the agency decided to hold the public meeting in response to the letter by the New Hampshire lawmakers. "We haven't firmed up a date yet, though it will probably be held at some time in the not too distant future," Sheehan said.

Sheehan also said the meeting location has not yet been determined, though it will be held "in the vicinity of Seabrook."

NextEra spokesman Peter Robbins said in a statement January 23 that since 2011 NRC "has held more than … fifteen public meetings on these topics, with the opportunity for members of the community to weigh in. We have said all along that public meetings and fact-based discussions are an important part of the NRC's process, and have always expected that public conversations would continue."

Natalie Hildt Treat, executive director of the non-profit C-10 Research and Education Foundation, said in a statement January 23 that the group "is pleased that the NRC will slow down the process and meet with the public. We would like to think that with eleven more years on the plant's current operating license, they can afford to wait a few more months for the hearing." C-10 is based in Newburyport, Massachusetts, near Seabrook.

NRC issued Seabrook's initial 40-year operating license in March 1990. NextEra submitted an application in May 2010 to renew the license, which expires in March 2030, for an additional 20 years. But concrete borings withdrawn from structures at Seabrook in 2010 confirmed degradation of some concrete due to ASR, prolonging the review of the license renewal application.

Seabrook is the only US nuclear power plant where ASR has been identified. NRC staff has said that ASR, which occurs in the presence of water, creates a gel that can cause "micro-cracks" in concrete.

NRC staff concluded last year during the review of the license amendment request, which specified an aging management program for ASR, that NextEra had an adequate plan for managing the issue.

NRC commissioners in April affirmed a challenge by C-10 to the license amendment request. While the licensing board is to hold a hearing on that request in the summer, a hearing date has yet to be set. NRC officials have said the license amendment and renewal could be issued before the hearing because the agency completed a review finding that no significant hazards were involved in the issuance.

In January 22 letters to the New Hampshire and Massachusetts lawmakers that were made public January 23, NRC said the five-member NRC commission will not become involved in the issuing of the license amendment at this time, as it would hear any appeal that might come following a licensing board decision.

"We're not trying to shut the plant down," C-10 founding board member Christopher Nord said in the group's statement. "We are about monitoring the safety of Seabrook. We have been working on this issue nonstop since 2010."

The Seabrook license renewal is the only initial license renewal application under review by NRC, which to date has renewed 93 operating licenses for power reactors.

— *Michael McAuliffe, Washington*

UK minister blames falling cost of renewables for Horizon suspension

- **Investors favor power plants with lower cost, quicker construction**
- **Government reviewing alternative financing models**

The UK's energy minister, Greg Clark, in comments to the country's Parliament January 17, blamed the falling cost of renewable power generation in comparison to that of nuclear power for the suspension of Hitachi's investment in two new nuclear plant projects in the UK.

"The economics of the energy market have changed significantly in recent years. The cost of renewable technologies such as offshore wind has fallen dramatically, to the point where they now require very little public subsidy and will soon require none," Clark told Parliament.

He added that, "Whilst this is good news for consumers as we strive to reduce carbon emissions at the lowest cost, this positive trend has not been true when it comes to new nuclear. Across the world, a combination of factors including tighter safety regulations have seen the cost of most new nuclear projects increase, as the cost of alternatives has fallen and the cost of construction has risen."

Clark said that this has made the "challenge of attracting private finance" into new nuclear construction projects "more difficult than ever, with investors favoring other technologies that are less capital-

intensive upfront, quicker to build, and less exposed to cost overruns."

After failing to find partners to share the risk, Hitachi put its plan to build two nuclear plants in the UK on hold, and will also cut jobs at its UK subsidiary Horizon Nuclear Power and also consider a sale of Horizon, Hitachi President Toshiaki Higashihara said at a Tokyo press conference January 17.

Hitachi added in a January 17 statement that it could also restart the project if it reached a satisfactory funding agreement with the UK government and potential investment partners.

"We will not spend any more money on" Horizon, Higashihara said at the press conference. The company had spent the equivalent of $2.78 billion on the effort so far. Higashihara also said that Hitachi will "minimize" its UK nuclear business "We will also consider a sale of it if needed," he added.

The decision raises questions about the UK government's ambitious plan to build up to 16 GW of new nuclear capacity by 2030. That program had featured three developers seeking to build at least six plants, but Hitachi's decision leaves EDF Energy and its partners the only ones actively planning to build nuclear plants in the country.

Toshiba's UK subsidiary NuGeneration Ltd. folded late last year and its planned Moorside plant was abandoned after Toshiba also failed to attract investors to the project.

EDF and China General Nuclear, or CGN, have started work on the 3,200-MW Hinkley Point C plant in western England, where the first unit is expected to generate power during 2025.

Paul Dorfman, an energy researcher at University College London, said in an email January 21 that Hitachi's decision meant that there were few reactor vendors left for the UK government to work with other than state nuclear power companies in China and Russia subject to "command and control" economies.

Dorfman noted that the UK government would likely find it politically difficult to work with Russia on new nuclear construction due to political tensions between the UK and Russian governments, and that this effectively only left technology vendors from China and France.

Dorfman also said that the UK new nuclear construction program was facing serious problems, with only a very limited chance of any new reactor being commissioned after Hinkley Point C.

Bradwell B is a planned two-reactor plant located around 30 miles east of London, adjacent to an existing closed Magnox plant, Bradwell A. Bradwell B is 66.5% owned by CGN and 33.5% owned by EDF Energy.

The plant would use Chinese UK HPR reactor technology. The UK HPR, also known as the Hualong One, is currently going through the UK nuclear regulator's generic design assessment reactor approval process.

Sizewell C, which is 80% owned by EDF Energy and 20% owned by CGN, is a planned 3,200-MW, two-unit nuclear plant in the county of Suffolk in eastern England which would also use the EPR design.

Jim Crawford, the project director for Sizewell C, said in an interview January 15 in Bridgewater, England, on the sidelines of a public consultation for the planned plant, that he expected the construction of Sizewell C to take up to 10 years, following a final investment decision on whether to proceed with the plant in late 2021 or early 2022.

Gillian Capewell, a spokeswoman for the UK's Department of Business, Energy and Industrial Strategy, or BEIS, said in an email January 17 that the UK government is "committed to the nuclear sector, giving the go ahead to the first new nuclear power station in a generation at Hinkley Point C, [and] investing £200 million through our recent sector deal, which includes millions for advanced nuclear technologies."

She added that the government was also "reviewing alternative funding models for future nuclear projects and will update on these findings in summer 2019."

Regulated asset base model

The regulated asset base, or RAB, funding model for new nuclear construction has been widely discussed in the UK as a way to potentially fund further new nuclear construction in the UK, but Hitachi has said that this model needs further time to be develop for use in the UK new nuclear construction market.

The RAB funding model is milestone-based, meaning funds are incrementally released by investors in a particular project over a period of time after different phases of the project are completed. Examples of such milestones include completion of a phase of construction or a regulatory approval such as issuance of a site license for a power plant.

An independent regulator — likely the Office of Gas and Electricity Markets, or Ofgem — would decide when milestones had been reached, and when funds could be released by investors and charges added to ratepayer bills.

— *Oliver Adelman, London*

Legislation will revise NRC fee structure, advanced reactor licensing

Legislation passed by Congress in December and signed by President Donald Trump January 14 will revise NRC's process for setting licensee fees and require further preparation by the agency for the licensing of non-light water advanced reactors.

S. 512, the Nuclear Energy Innovation and Modernization Act, was introduced in March 2017. It passed Congress by voice votes in the US Senate December 20 and in the US House of Representatives the next day.

Asked about plans to implement the requirements of S. 512, NRC spokesman Scott Burnell said in an email January 23 that "the agency continues to analyze the provisions of the new law," without elaborating.

Among other requirements, S. 512 will cap the annual fee charged to licensees of operating power reactors to the annual fee charged power reactor licensees in fiscal year 2015, adjusted for inflation. The commission can waive that cap for one year if it submits to the Senate a written determination that imposing the cap "may compromise the safety and security mission" of NRC, according to the legislation.

Also, the Nuclear Energy Institute said in a statement January 16, S. 512 "alters the NRC's current fee structure, replacing it with a system under which licensees are responsible for paying for activities directly attributable to the industry. This will ensure fee collection is

more equitable, transparent and predictable."

Operators were charged a licensee fee of about $4.8 million by NRC for each power reactor operating in fiscal year 2015. That fee was about $4.3 million per power reactor in fiscal 2018, the most recent year for which the agency has issued a fee rule.

The legislation also states that NRC will be required to develop and implement within nine months "strategies for establishing stages in the licensing process for commercial advanced nuclear reactors and developing procedures and processes for using a licensing project plan." NRC will also be required to provide for "optional use of a conceptual design assessment," which the bill defined as "an early stage review" that "assesses preliminary design information for consistency with applicable regulatory requirements."

Advanced reactor developers have called for more opportunities for pre-application engagement with NRC staff on their designs, saying such engagement would make licensing reviews more cost-effective and efficient.

Within two years, NRC is required by S. 512 to "develop and implement, where appropriate, strategies for the increased use of risk-informed, performance-based licensing evaluation techniques and guidance for commercial advanced nuclear reactors," including for "applicable policy issues identified during the course of review by the Commission of a commercial advanced nuclear reactor licensing application."

The Congressional Budget Office's June 20, 2017 cost estimate for S. 512 said that implementation of its requirements would cost $386 million from 2018 through 2022, "assuming appropriation [by Congress] of the necessary amounts."

Industry sees positive step

Maria Korsnick, president and CEO of NEI, said in the group's statement January 16 that adoption of the legislation "is a significant, positive step toward reform of NRC's fee collection process." The legislation "will benefit all operating reactors and future licensees."

Korsnick said that S. 512 "also reaffirms Congress's support for nuclear innovation by working to establish an efficient and stable regulatory structure that is prepared to license the advanced reactors of the future."

Marilyn Kray, president-elect of the American Nuclear Society, said in an ANS statement January 4 that "by reforming outdated laws, NRC will now be able to invest more freely in advanced nuclear R&D and licensing activities. This in turn will accelerate deployment of cutting-edge American nuclear systems and better prepare the next generation of nuclear engineers and technologists."

— *Steven Dolley, Washington*

LNG, grid resilience are priorities for FERC's Chatterjee, he says

- **McNamee will recuse himself from DOE coal, nuclear proposal**
- **Chatterjee confident urgency in filling vacant seat understood**

Advancing LNG projects and completing a grid resilience review are among Federal Energy Regulatory Commission priorities, Chairman Neil Chatterjee told reporters January 17 after the agency's first open meeting of the year.

Development of an updated transmission incentives policy, consideration of the 1999 pipeline certificate policy, work on cybersecurity issues and an effort to revise the Public Utility Regulatory Policies Act are also areas in which Chatterjee said he hoped the agency will make progress during 2019.

Chatterjee said he would prefer to have a full complement of five commissioners before making major policy decisions. "But that is outside of our control here, so we're going to continue to plow ahead on these myriad initiatives and let the nomination and confirmation process play out on its own," he said.

With the death of Commissioner Kevin McIntyre January 2, FERC is down to four members: Republicans Chatterjee and Bernard McNamee and Democrats Cheryl LaFleur and Richard Glick. The current roster raises the possibility of 2-2 deadlocks along party lines, adding to uncertainty about the fate of more contentious issues.

Resilience recusal

Actions tied to FERC's grid resilience review could be complicated by the current makeup of the commission, with McNamee facing calls for him to recuse himself from those matters. While he was a lawyer at the US Department of Energy, McNamee helped craft DOE's notice of proposed rulemaking, or NOPR, to stem retirements of coal-fired and nuclear power plants.

A recent letter to Senate Democrats from McNamee contained a memo from the agency ethics officer indicating McNamee would not participate in any FERC reconsideration of the DOE proposal, which FERC rejected early last year. However ethics guidance leaves him free to vote on future resilience issues as long as they do not "closely resemble" the DOE NOPR, the memo, dated January 2, said. When FERC rejected the DOE proposal, it said it would conduct a review of grid resilience in an effort to develop a policy of its own.

"I am confident [McNamee] will make the clear and correct ethical decision, but it's ultimately his decision to make," Chatterjee said of McNamee's role in the resilience review. Given the amount of work that still needs to be done in that proceeding, he added that it would be "premature" to assess the similarities of any ultimate resilience policy to the DOE NOPR at this point.

Shutdown woes

How quickly a fifth commissioner could be vetted, nominated and confirmed is potentially complicated by the ongoing partial federal government shutdown.

But Chatterjee suggested there was some awareness of the urgency to fill the open seat.

"For better or for worse," he said, FERC's "profile has been raised considerably because of the significance of the issues that are before us, and I think there is a keen understanding at the White House, within the administration and in the US Senate of the importance of having FERC with a full complement of five commissioners," Chatterjee said.

"I've had numerous conversations with people that understand that filling this vacancy quickly is important," he added.

A nearly month-long shutdown has shuttered agencies whose spending bills have been stalled as part of a dispute between President Donald Trump and Democratic lawmakers over border security.

FERC, however, is "funded and working and … going full steam ahead," Chatterjee said, as the agency's appropriation was included in an energy spending bill that was signed by the president in September. "Right now, we're doing our work," he added.

As the shutdown continues, it could impact the role of other agencies that participate in the FERC permitting process, including LNG projects. FERC in 2018 signed a memorandum of understanding with the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration to better coordinate and streamline their reviews.

DOT is one of the departments hit by the shutdown, and FERC Office of Energy Projects Director Terry Turpin said in an interview January 17 that PHMSA appears to be facing furloughs.

Under the MOU, PHMSA is making preliminary determinations about whether proposed projects meet the agency's safety standards related to the siting of LNG facilities.

Turpin said PHMSA has already sent along a handful of determinations, and another batch was expected in February.

Offices within the US Department of Interior that participate in FERC project reviews are also affected.

'Hopeful' on LNG

The commission has already experienced delays in natural gas infrastructure reviews, with approval of an LNG terminal and a pipeline project pulled from the agency's December meeting agenda and yet to be scheduled for a vote. While most projects have advanced, LaFleur and Glick over the last year have expressed dismay with a change in FERC's consideration of greenhouse gas emissions. FERC previously had performed an estimate of the indirect emissions impact of natural gas projects, but under Republican leadership determined such information was speculative in many cases and curtailed the practice.

Pressed on the fate of LNG projects until a fifth commissioner is seated, Chatterjee said he was "hopeful" the commission was close to moving forward on applications.

While he declined to comment on a timetable for LNG project approvals, he said: "I've been very vocal about my desire to see … applications considered in a timely fashion, and I think the team has done a tremendous job in the past year of putting us in a position to move forward with some of these applications."

Asked whether compromise on climate analyses and other issues now splitting the commission could be reached, Chatterjee said there was agreement among his colleagues that orders approving projects must be able to withstand legal scrutiny. "The most disruptive thing would be if a court were to later intervene and potentially stay a project," he added.

"I want to ensure that … our orders and approvals are legally durable, and that takes time. So we just want to make sure we get it right," Chatterjee said.

— *Jasmin Melvin, Washington*

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Newydd at Anglesey in Wales. MHI has experienced delays in plans to build the Sinop nuclear plant in Turkey with partner Framatome. Toshiba announced in February 2017 that it will withdraw from construction of nuclear plants overseas following delays and cost overruns in two plant expansion projects in the US managed by then-subsidiary Westinghouse.

The failure by the Japanese reactor vendors to export their nuclear technologies will confine their focus to support of domestic restarts and decommissioning work, giving their engineers little chance of building new reactors over the next decade, the three vendors have said.

Under its energy policy, the Japanese government calls for nuclear power to generate about a fifth of the country's electricity by the 2030 fiscal year, relying on reactor restarts and lifespan extensions at the existing units without construction of new plants.

Hitachi may be most motivated to merge

Among the three reactor vendors, "Hitachi should be most interested in a potential nuclear merger because no BWRs have restarted in Japan," weighing on Hitachi's prospects, a Japanese nuclear industry official said in an interview January 21. He spoke on the condition of anonymity as he is not authorized to speak to the media. Hitachi has focused on the design and construction of BWRs.

Of the 34 operable reactors in Japan, nine pressurized water reactors have restarted following the 2011 Fukusima I accident. Those operable units exclude five that the utilities have decided or taken initial steps to decommission. The restarts took place after the units met safety requirements set by the country's Nuclear Regulation Authority, a requirement of operation since the 2011 Fukushima I nuclear accident.

Some academics expect that Hitachi, Mitsubishi Heavy industries and Toshiba will seek to combine their nuclear operations in some way as their efforts to export reactors have stumbled.

"In the future, a three-way merger will be a necessity because the nuclear business is becoming increasingly risky and tough to make profits in," Noriko Endo, project professor of the graduate school of media and governance at Keio University, said in an interview January 21.

"They [the three vendors] could need to work together on a project basis at least, as a full merger could be no easy task for them," she added.

Endo is a member of a committee of the trade and industry ministry which has been convened to discuss the future of Japan's nuclear power policy.

Takeko Kikkawa, a professor at the graduate school of innovation studies at Tokyo University of Science, said in a January 21 interview that "chances are substantially high" that the three vendors will consolidate their nuclear businesses into one entity because they are losing money in nuclear operations.

A Toshiba executive said in an interview December 19 that a potential merger among the three vendors may be "unavoidable" because each of them has experienced setbacks in efforts to build

new plants at home and overseas. He spoke on the condition of anonymity as he is not authorized to speak to the media.

Mitsubishi Heavy Industries has "no intention" at present of joining Hitachi and Toshiba because MHI produces PWRs, not the BWRs with which the other companies are associated, Daisaku Ishii, a company spokesman, said in an interview January 22.

Power industry welcomes merger

The Japanese electricity industry would welcome the merger of the reactor vendors, some officials said. Satoshi Katsuno, president of Chubu Electric Power Co., and Tomoaki Kobayakawa, president of Tokyo Electric Power Co., told reporters separately January 18 that they expect such a merger would help reduce costs for reactor equipment and components due to the economies of scale.

"Are we getting cost-competitive supply [of components] from the vendors at present?" Kobayakawa asked, and then answered himself, saying "No."

Hiroshige Seko, the minister of trade and industry, said at a January 18 press conference in Tokyo that the merger is "a matter for private companies." Seko added, however, that Japan's policy of exporting nuclear technologies will remain unchanged as there are many countries seeking to use nuclear power.

Kikkawa said that the trade and industry ministry might be eager to encourage a combination of the three vendors as part of a strategy to match the global expansion by Chinese and Russian nuclear power companies.

— *Yuzo Yamaguchi, Tokyo*

Advanced ...from page 1

appropriators funded "a small number of new technology advanced reactor concepts, each in the range of $10-$30 million a year for 4-5 years."

She added, "This level would allow further development of these concepts to determine whether they can fulfill their promise. Any recipients would have to pay their required cost share. Funding would continue, or terminate, depending on their progress."

"We're falling behind the rest of the world in a field we pioneered," Thomas Zacharia, director of DOE's Oak Ridge National Laboratory in Tennessee, told the subcommittee. "The US nuclear industry is searching for ways to modernize," he said in his testimony. "Today's [power reactor] fleet will be gone in 35 years," he said.

Alexander noted in his opening statement that in order to expand nuclear power in the US, two problems must be solved. First, the nuclear waste stalemate must be resolved, he said. Alexander added that he supports funding a restart of NRC's review of the DOE license application for a high-level waste repository proposed for Yucca Mountain, Nevada and for private sector consolidated interim storage facilities for utility spent fuel.

"I expect President Trump will continue to request funding" for those projects, he said.

"Second, we must address the high cost to build a new nuclear plant," he added. "I believe advanced reactors will give us a chance to do that."

"The cost of constructing two reactors in the US is $25 billion," Alexander said in an apparent reference to the two Vogtle reactors, which have a combined capacity of about 2,300 MW, under construction in Georgia. "By comparison, the cost of constructing two natural gas plants that would produce the same amount of electricity is less than $2 billion," he said.

In her opening statement, Senator Dianne Feinstein of California, the ranking Democrat on the subcommittee, also cited the waste issue and high upfront cost of new reactors as being among the US industry's three "major weaknesses." She also said there are "significant risks to the general public in the event of a critical accident," adding, "We must address these weaknesses."

Feinstein said, "New nuclear technology must overcome challenges of the existing fleet if they're going to be a viable solution. That means lower upfront costs, less nuclear waste and increased accident tolerance."

First advanced reactor a microreactor?

Advanced reactors with passive safety systems, such as SMRs and Westinghouse's AP100 and GE Hitachi's ESBWR large reactor designs, would rely on such natural forces as gravity, pressure differences or natural heat convection to perform safety functions without an active power source, according to information on the International Atomic Energy Agency website.

In addition, SMRs — that is, reactors smaller than 300 MW — have components that can be manufactured, while the reactor itself is factory built and designed to be assembled at the site. The cost of an SMR plant would be about $1.6 billion, Back said.

To date NRC has only received one application for certification of a small modular reactor design, NuScale's SMR. That light water reactor, or LWR, design features a 60-MW module that can be fabricated in a factory; NuScale has said a power plant could be comprised of as many as 12 modules.

McGinnis said he believes the first non-LWR design to seek NRC certification will be a microreactor, without disclosing the name of the vendor or of the design. "In my view, it could happen within 12 months from now," he said.

According to information on DOE's website, microreactors would be designed to produce 1 MW to 20 MW of thermal energy that could be used directly as heat or converted to electricity. It also said microreactors would be fabricated in a factory; would be transportable; would require fewer components, maintenance and operators; and would be capable of generating power within a week of arriving at a site.

— *Elaine Hiruo, Washington*