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NRC, industry to review lessons from Fukushima events

The NRC will undertake a “systematic and methodical” review of the crisis at Japan’s Fukushima I nuclear power plant and lessons to be learned from it, NRC Chairman Gregory Jaczko said at a commission briefing March 21.

President Barack Obama last week ordered the agency to conduct a “comprehensive” safety review of all US nuclear power plants in light of the disaster in Japan.

Nuclear power plants in the US “have undergone exhaustive study and

have been declared safe for any number of extreme contingencies,” Obama said in remarks to the White House press corps on March 17. Still, Obama said, the US has the responsibility to learn from the crisis in Japan at Tokyo Electric Power Co.’s Fukushima site. He did not provide details on the scope of the review or take questions.

“As the immediate crisis in Japan comes to an end we will look at any information we can to gain experience from the event and see if there are

any changes we need to make to further protect public health and safety,” Jaczko said at the March 21 briefing at NRC headquarters in Rockville, Maryland.

The commission “will review the current status and identify the steps we will take to conduct that review. In the meantime we will continue to oversee and monitor plants to ensure that US reactors remain safe,” he said.

Bill Borchardt, NRC’s executive
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EU regulators propose outlines of reactor ‘stress tests’

Senior nuclear regulators from the EU, meeting this week in Helsinki for the first time since the start of the Fukushima I accident in Japan, proposed the outlines of “stress tests” expected to be conducted on all 143 nuclear power reactors in the EU over the coming year.

The Fukushima accident, which was triggered by a massive earthquake and beyond-design-basis tsunami March 11, was still ongoing as members of the

Western European Nuclear Regulators Association met March 22-23.

EU energy ministers on March 21 informally endorsed the idea of the tests and asked Wenra to define the scope, methodology and time frame. Wenra set up a task force to do that.

The two-page Wenra proposal agreed on March 23 is expected to become the basis for the tests to be applied throughout the EU, ensuring consistency in national audits, and perhaps in countries beyond

the EU’s borders.

It defines the stress tests as “a targeted reassessment of the safety margins of [nuclear power plants] in the light of the events which occurred in Fukushima.” It sets a technical scope comprising initiating events (earthquakes, flooding), consequential prolonged loss of safety functions (electrical power, ultimate heat sink), and accident management issues such as core-

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Fukushima impact on US industry unclear: analysts

Additional regulatory requirements are likely coming to the US nuclear industry in the wake of the Fukushima I nuclear accident, but the extent and cost remain unclear, lawyers and consultants said this week.

Reviews of the adequacy of procedures, equipment and regulations have been launched by the industry and NRC, and their results could determine future operating costs and even the financial viability of some units, analysts said.

“Widespread” closures of US plants due to a regulatory response is unlikely, in part because of the industry’s strong safety record, Fitch Ratings analysts said in a report March 22. But individual plants “may be susceptible in the longer run to temporary or permanent closures,” the analysts, including Philip Smyth and Glen Grabelsky, wrote.

Those plants in seismic and coastal areas such as California could be more vulnerable to regulatory restrictions, the Fitch analysts said. The increased per-

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ception that nuclear plants are risky could make it harder to secure private financing for new nuclear projects, Fitch said.

Fitch said it expects no short-term impact to the credit ratings of companies that operate nuclear units, but longer-term, the costs of safety upgrades could threaten the ratings of some companies, especially those that operate in deregulated electricity markets.

Initial reaction by government officials such as Energy Secretary Steven Chu has been "measured," a positive sign that there may be a "manageable outcome" for nuclear power generators, Fitch said.

President Barack Obama last week ordered NRC to conduct a "comprehensive" safety review of all US nuclear power plants in light of the partial meltdown at three units of the Fukushima I plant operated by Tokyo Electric Power Co. in Japan.

There was an almost immediate impact to the new nuclear project being developed by NRG Energy and Toshiba through their joint venture Nuclear Innovation North America. The two-unit expansion of the South Texas Project was identified by credit agency analysts last week as vulnerable to the events in Japan in part because Tepco had proposed investing in the project.

NINA said in a statement March 21 it would reduce spending on the project, moving forward only on efforts to seek a combined construction permit-operating license, or COL, from NRC and to obtain a loan guarantee from DOE. Previous spending had included construction work at the site and elsewhere employing more than 400 people, NRG

said last year. In August, NRG Chairman and CEO David Crane said the NINA partners were reducing spending by a third because of uncertainties surrounding loan guarantees.

New regulatory requirements or guidance are expected from NRC in the wake of Fukushima, NRG said in the statement, although it said the Advanced Boiling Water Reactor planned for the South Texas Project meets "the most rigorous safety standards" and should not require modification. "However, as we unreservedly support our government's proposed nuclear safety review, the prudent thing for us to do is to await the outcome of that review before committing more of our own or our partners' capital," Crane said in the statement.

Barclays Capital analysts Daniel Ford and Gregg Orrill wrote in a report March 22, "At this point, we view it as inevitable that the project will have to be restructured or canceled." Efforts by NRG to sell equity in the project or sign long-term power purchase agreements have been unsuccessful, leading to a reduction in the value of the project, Barclays said.

The Nuclear Energy Institute said last week the industry would conduct an immediate review of safety at US plants.

"Even before we can get lessons learned from Japan, all companies that produce electricity at nuclear power plants are verifying their capability to maintain safety even in the face of severe adverse events," NEI President and CEO Marvin Fertel said in a statement March 17.

NRC also announced short-term and long-term reviews to consider whether any regulatory action is needed in the

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wake of the Fukushima accident.

David Lewis, head of the nuclear energy practice at law firm Pillsbury Winthrop, said March 22 that answers about potential licensing delays will emerge after the short-term NRC review.

"It is too soon to tell to what extent the Japanese events may delay new plant licensing. I think that the NRC's short term review will answer that question over the next three months. However, the NRC's issuance of the renewed operating license for Vermont Yankee on [March 21] is a good indicator that the NRC does not see any need to interrupt relicensing," he said in an e-mail.

The renewal of Entergy's Vermont Yankee had been expected last week but was delayed by NRC's response to the Fukushima crisis.

Analytical exercise

The unfolding events in Japan do not allow a prediction yet on what kind of changes, if any, will be required by NRC of US plant operators, said Diane Borska, a Massachusetts-based energy analyst who has done work for nuclear utilities on responding to external events and competitive intelligence. It is unclear why diesel generators failed in the tsunami, what role, if any, the plant's containment design played in radioactive releases, and how serious problems were in the spent fuel pools, she said.

"There's no question the NRC is going to revisit and re-examine its policies, and I think the potential is there for licensees being required to take some kind of action. It may be an analytical exercise and a documentation exercise, and not a re-design exercise," she said in an interview March 22.

The public may not simply accept that rules that have developed over the past decades are enough to protect safety, as NEI and NRC have suggested, Borska said.

NRC is "almost obligated to look at the Mark I containment issue again" based on detailed information on how the containment design responded in a severe accident, Borska said.

Some consideration like seismic performance may affect few sites, she said. Other issues will be more generic and could include the behavior of the spent fuel pool cooling and structural adequacy, Borska said.

The effect on existing plants is likely to be more significant than on new projects, she said. NRC is likely to "take another look" at new reactor designs and COLs, which utilities understand, she said. The schedule might "bleed out a little bit," but there is unlikely to be a major impact to new nuclear development, she said.

Too early

It would be a mistake to draw regulatory conclusions too early in the process, said Peter Bradford, a former NRC commissioner who has been critical of nuclear power.

Bradford was a commissioner from 1977 to 1982, including during the partial meltdown of the core at Three Mile Island-2. "During Three Mile Island, so much of what we thought we knew within five days of the accident turned

out to be incorrect," he said March 18 during an event sponsored by the Friends of the Earth, an anti-nuclear organization.

At the same time, "business as usual" may not be warranted, and the expansion of nuclear power in the US may not be able to continue as the lessons of Fukushima are gleaned, he said. "As a practical matter, the chances of continuing nuclear expansion in parallel with learning the lessons is a terribly unlikely scenario. The NRC can't divert resources that it's going to have to for the lessons-learned process and still continue to review design approvals and construction and operating licenses on the original schedule," he said.

But Daniel Stenger, a partner in the nuclear practice at law firm Hogan Lovells based in Washington, said in an interview March 22 that NRC has separate offices for new reactors and existing reactor regulation, meaning it could continue reviews on schedule.

NRC may over the next few weeks revise its schedules for design approvals and license approvals, Bradford said.

It would take a year or longer to learn the lessons of the accident, Bradford said. "I'll bet...when we look back on this period we will see there was something that sure looks an awful lot like a moratorium in place for at least a while," he said.

Reactors using the GE Mark 1 containment design could come "under an enhanced level of scrutiny" relative to reactors with different containment designs, Bradford said. After Three Mile Island, all reactors that were, like TMI, made by Babcock & Wilcox were shut temporarily.

GE has said the Mark I containment design has been operated safely for decades and meets regulatory requirements.

The accident could cause Congress to balk at expanding DOE's loan guarantee program for nuclear power projects, said Robert Alvarez, a former DOE environmental official. "I don't necessarily believe Congress is going to have the stomach to ... expand the loan guarantee program," he said during the Friends of the Earth event March 18.

Industry, NRC aligned

Because the industry has more coordination and cooperation through organizations like the Institute of Nuclear Power Operations, some of the response to the Fukushima accident could be voluntary and industry-led, Hogan Lovell's Stenger said. Industry efforts were not as well coordinated before the Three Mile Island accident, he said.

The industry's quick initiation of an effort to begin its own review of events in Japan shows "the nuclear industry and the NRC are aligned in what needs to be done and what appropriate actions are to take," he said.

The review will allow NRC to understand what failures took place in Japan, consider them and prevent "counter-productive" responses, he said.

Fukushima's failures may have been related to specific aspects of the site, Stenger said.

Nuclear plant operators understand the need to review

the adequacy of existing procedures, equipment and rules, he said. "The sense I get is they all believe the Nuclear Regulatory Commission's actions are quite appropriate to now and that the NRC is a tough, fair regulator that bases its actions on an adequate technical basis," he said.

"They all know there are likely to be regulatory actions, but they should be responsible," he said.

—William Freebairn, *Washington*

Suspected hydrogen explosions in Japan puzzle US industry, experts

US regulators, industry experts and independent scientists are searching for explanations to the three explosions, suspected to be caused by hydrogen buildups, that damaged reactor buildings at three units at Japan's Fukushima I nuclear power plant and complicated efforts to stabilize the units in the wake of an earthquake and tsunami March 11.

Satellite photos show the blasts tore open the roofs of reactor buildings at units 1, 3 and 4. NRC's Executive Director for Operations William Borchardt told the commission in a March 21 briefing that agency staff believes "hydrogen accumulation in the upper levels of the reactor buildings" caused the explosions. At unit 2, plant operator Tokyo Electric Power Co., reported March 14 an "extraordinary sound" inside the building. The IAEA said it was likely that the sound was from a hydrogen explosion and that the containment vessel may have been damaged as a result.

How the hydrogen gathered and exploded inside the reactor buildings ranks among the top questions the US industry seeks to solve, said David Helwig, interviewed after a March 18 Nuclear Energy Institute meeting about industry response to the Japanese events. President of Helwig Consulting Services, which specializes on nuclear design and engineering, Helwig said he was asked during the meeting to list priorities for future investigations at Fukushima I, also known as Fukushima Daiichi.

When fuel rods heat up due to insufficient cooling, as happened at Fukushima I, the zirconium alloy in the fuel rods reacts with steam and produces a large amount of hydrogen. Helwig said the hydrogen at Fukushima could only have come from three places: the ventilation systems that connect primary containments to the atmosphere, the spent fuel pools above the primary containments, or "the containment was breached in some manner such that the hydrogen leaked out of the containment into the reactor building."

Containment leak

The Japan Atomic Industrial Forum, the country's nuclear power industry group, said March 15 that the containment vessel at Fukushima I-2 was suspected to be "damaged." A day before — the day of a suspected hydrogen explosion at the unit — the group said its containment was "not damaged." JAIF said March 18

unit 3's containment vessel "might not be damaged," a revision from its March 16 assessment of "damage suspected." It said the vessels at units 1, 4, 5 and 6 are "not damaged."

Helwig said, "It appears from everything we can tell that their primary containments are in fact intact" before the explosions, because pressures built up and held inside.

After Tepco lost power to cool the reactor cores, pressure started building inside the containment vessels, presumably from steam accumulation when the fuel rods started boiling water surrounding them. According to a March 12 statement by the Japanese Nuclear and Industrial Safety Agency, the country's nuclear regulator, the containment pressure at unit 1 may have increased to more than double the designed maximum level.

David Lochbaum, who taught BWR designs at the NRC's training center, said the containment vessel cannot be ruled out as a source for hydrogen leakage at Fukushima I.

It is an "unsolved riddle," said Lochbaum in a March 18 report released by the Union of Concerned Scientists, "how a significant amount of hydrogen escaped from the primary containment into the reactor building." Lochbaum is now director of the nuclear safety project at the group. He said in the report, "A little-known test performed decades ago at the Brunswick nuclear plant in North Carolina may hold the key to answering that question."

According to Lochbaum, workers at Brunswick-2, which also has the Mark I containment — a design by General Electric used at units 1, 2 and 3 at Fukushima I — performed "a structural integrity test on the reactor" in the 1970s, in order "to satisfy a requirement in the American Society of Mechanical Engineers (ASME) code for prototype containment designs."

Progress says the test is required of all containments before reactors enter service.

He said workers pumped air into the containment vessel to raise the pressure inside beyond the designed maximum of 62 pounds per square inch to 71 psi, but that the pressure stayed constant at 70 psi. "A hissing sound attracted workers to the top of the containment structure," said Lochbaum. Workers discovered that the air pushed up the metal containment head, which is bolted to the containment wall "with a rubber O-ring between the surfaces," and seeped out into the refueling cavity above the primary containment, he said.

"It is possible that the containment pressures [at Fukushima I units] rose high enough to replicate the Brunswick experience," he said.

But while containment leakage in the Brunswick test prevented the pressure inside from rising above 70 psi, Japan's NISA reported that pressure in the containment of unit 1 at Fukushima I had exceeded 120 psi a day after the reactor had lost cooling. Tepco reported that the containment vessel pressure at unit 2 had reached above 102 psi.

In a March 21 e-mail, Lochbaum said he learned of the Brunswick test through “someone intimately involved” in it.

Ryan Mosier, a spokesman for Progress Energy, which owns Brunswick, confirmed in a March 23 e-mail that the test did occur just before Brunswick-2 went into service “to verify that the structure would respond as designed under worst-case conditions.” But he added that the documentation Progress has on file about the test — which he said the company cannot share with Platts — “does not spell out in any detail the conclusions arrived at in the Lochbaum analysis.”

Mosier also said the company shared the test results with NRC and made no modifications to the containment “as a result of this test as the containment performed as expected.”

He said both units at Brunswick have reinforced concrete containments, which “is a more robust design” compared to steel containments at other Mark I reactors. In addition, Mosier said Brunswick has made changes over the years to strengthen the containments. It is unclear whether the Mark I containments at Fukushima I were made of steel or reinforced concrete and whether modifications have been made since they were built.

Ventilation system

As steam accumulated and pressure rose in the containment vessels, Tepco released some steam outside the reactor buildings at all three units. Helwig said it is possible that some steam mixed with hydrogen had escaped into the reactor building during the venting.

The original Mark I design came with a so-called standby gas treatment system, or SGTS, to vent steam under emergency situations. Such a system first scrubs most radioactive particles out of the steam through filters and then releases it through the ventilation stack to the atmosphere. Fukushima I units 1, 2 and 3 are still equipped with the SGTS system, said a Tepco official, who requested anonymity because he is not authorized to speak to the press.

The SGTS uses ductwork, which is susceptible to leaking because it is not air tight and is not designed to withstand significant pressures, to channel steam, said Helwig.

NRC in the 1980s requested that all US plants with Mark I containments install hardened vents, replacing ductwork with hard pipes, according to a March 19 report on the Mark I by GE Hitachi, the company that combined the nuclear operations of GE and Hitachi.

Borchardt told NRC commissioners that all US Mark I reactors now have hardened vents, which he said would not allow hydrogen to leak during venting.

Alexander Marion, vice president of nuclear operations for NEI, said in an interview March 22 that US industry experts assume that Fukushima I reactors do not have hardened vents, “because somehow they were releasing hydrogen into the secondary containment, but we just don’t know.”

The Tepco official, who answered questions through emails, however, said the ductwork SGTS was not used at

Fukushima I for venting, “because the pressure of the containment vessel was high.” Instead, he said, the company used an alternative vent called the direct release line, which can withstand high pressure, to blow off steam and cut pressure inside the containments. “The direct vent line we used this time is hardened pipe designed for severe accident case,” he said.

Spent Fuel Pools

Helwig said the hydrogen could have also originated from the spent fuel pools sitting inside the reactor buildings “like a penthouse” above the primary containments. NRC’s Borchardt also said those pools, which are also on the same levels as the suspected locations of explosions, could have been the source of the hydrogen. “The hardened vent wouldn’t do anything to help hydrogen that came from the spent fuels pools,” he said.

The fuel rods, which stand in a rack at the bottom of the pool, with “30 feet of water on top of them” have to be “uncovered to some degree and exposed to steam” to generate hydrogen, said Helwig.

“You are talking about a matter of days without cooling for that water to heat up substantially,” he said, because the remaining heat in the spent fuel is “quite low” compared to the fuel in the reactor core. It would take even longer for the water in the pool to evaporate and expose the spent fuel rods, he said. The explosions at Fukushima happened two or three days after the reactors lost cooling. “The timeline for that doesn’t quite add up for us,” he said.

But Helwig also said it was possible that the earthquake had shaken the pools and splashed some water out.

NEI has said structural damage could cause leaks that would drain the pools quickly.

Tepco has been using helicopters and spray trucks since last week to refill water to the spent fuel pool at unit 3, which lost its reactor building roof after the explosion. The Japan Atomic Industrial Forum said March 17 that the water level in that pool was low and that some fuel may have been damaged. French nuclear authorities said last week that the water in the pool might be boiling before the refill.

Helwig said it is one of the top priorities for the US industry to find out “what in the world happened around the spent fuel pools” at Fukushima I.

The Tepco official said it will take “further investigation” to determine the exact locations and the causes for the hydrogen explosions.

NRC Chairman Gregory Jaczko said March 16 at a Senate hearing on the Fukushima I crisis that he had been told that there was no water remaining in the spent fuel pool at unit 4. A Tepco spokesman later denied that assertion. That unit, which also experienced structural damage from an explosion, was not operating at the time of the earthquake and had all fuel removed last year to the spent fuel pool.

Emergency workers have sprayed thousands of tons of water into some of the spent fuel pools at the plant since March 11 to attempt to keep the fuel covered.

—Yanmei Xie and William Freebairn, Washington

S&P expects higher expenses for operators of European reactors

Operating nuclear reactors in Europe will become more costly as tougher safety requirements are instituted in the wake of the Japanese nuclear crisis, but higher power prices should offset some of the cost, an analyst at Standard & Poor's Ratings Services said in a March 16 report.

In his analysis, Andreas Kindahl said nuclear operators with major wholesale gas businesses could also benefit from higher gas prices in cases where nuclear reactors have been shut pending special safety reviews, such as in Germany. S&P, like Platts, is owned by The McGraw-Hill Companies.

In countries such as Germany, where "nuclear opposition has always been strong, we believe [the incident] in Japan could lead to significant changes in existing nuclear fleets," Kindahl said.

In the long term, a backlash against nuclear power could lead to phase-outs, he said. That, in turn, would mean that nuclear utilities would have to develop more renewable generation more quickly than they have planned, leading to higher costs, he said.

In addition, he said that for many large European utilities, "a significant portion of earnings currently comes from low-cost nuclear production."

While events in Japan are driving concerns about nuclear power, Kindahl also noted that there is public concern in Europe about safe disposal of spent fuel.

—Ariane Sains, Stockholm

Impact of UK safety review on new reactor program unclear

A UK Health and Safety Executive spokesman said March 22 he could not say whether a safety review of UK reactors because of the Fukushima I accident would impact the regulatory reviews of the Areva EPR and Westinghouse AP1000 reactor designs, which are scheduled to be completed June 30.

Energy Secretary Chris Huhne on March 12 asked Chief Nuclear Inspector Mike Weightman to conduct the review in light of the ongoing accident.

The HSE spokesman said in an email that Weightman's review will include the EPR and AP1000 reactor designs, which have for several years now been undergoing regulatory scrutiny in the HSE's generic design assessment program.

That GDA program was due to close June 30 with the expected issuance of interim design acceptance confirmations, but the HSE spokesman said he could not say what impact Weightman's review would have on the completion of the GDA program, especially since the technical scope of that special review has not been determined.

Weightman's review "will consider if there are impli-

cations for our new nuclear build programme. It is too early to say what the impact will be on the timeframe for our work on the generic design assessment and site licensing," the spokesman said.

EDF Energy had planned to file both a planning and a site license application for a new EPR at Hinkley Point this year, after receiving an expected interim design acceptance confirmation from HSE by June 30.

The government has already said it would delay ratification of its nuclear national policy statement by Parliament pending receipt of Weightman's reports. An interim report is scheduled for completion in mid-May (NuclearFuel, 21 March, 7).

A final nuclear safety review report is due from Weightman by mid-September.

The national policy statement identifies eight sites, including Hinkley Point, as suitable for potential new nuclear construction and states that the government has determined a need for the new nuclear power plant construction.

It also represents guidance to be followed by the Infrastructure Planning Commission in reviewing applications for development consent for new nuclear power plants.

The nuclear NPS was due to be ratified by Parliament "in the spring," the Department of Energy and Climate Change had previously said.

EDF and its new construction partner Centrica have already put off a final investment decision on new reactor plans to next year, from this year.

But EDF Energy CEO Vincent de Rivaz said in a March 17 statement that the GDA process should not be put on hold while Weightman conducts his review.

"The GDA process must continue alongside the work being undertaken to finalise Dr Weightman's Interim and Final reports, as it is important that we are able, as soon as possible, to embrace the key components of these reports in relation to our new build projects," he said.

De Rivaz acknowledged some adjustment to the timetable may be necessary to "to take into account the [Weightman] report, [but] it is also equally important that establishing the framework for new nuclear should not be subject to undue delay. The events in Japan do not change the need for nuclear in Britain."

"As licensee and operator of the existing nuclear fleet in the UK, we are already examining closely reports of events [in Japan] and implementing early actions. We will work with Mike [Weightman] and his team as we do so -ahead of the publication of his reports."

In an earlier statement March 15, de Rivaz said that although there is "no reason to expect a similar scale of seismic activity in the UK compared to the severe earthquake that struck Fukushima, all EDF Energy's nuclear power stations are protected against the effects of seismic events.

"These measures cover the kind of seismic and storm surge events that could be expected in the UK and are detailed in approved safety cases which are agreed with the regulator," he said.

"In our existing stations and in any new nuclear power stations we will continue to ensure that safety is our top priority and that we meet all regulatory requirements," he said.

But it was unclear whether Weightman's review would focus only on potential earthquake and flooding vulnerabilities or whether it would also review plant vulnerabilities that could occur in a station blackout.

The HSE spokesman said he was unable to say what the scope of Weightman's post-Fukushima safety reviews would be.

Huhne has already said there is no reason to expect a similar earthquake and tsunami in the UK like the one that struck Japan.

—David Stellfox, Barcelona

EC approved Cernavoda-3, -4 despite high seismic risk

The European Commission last fall approved plans for construction of two nuclear reactors "close to a zone with high seismic risk" in Romania, according to a document released to Platts March 21.

But the EC opinion, required under Article 43 of the Euratom Treaty, said that a condition of its approval was that Romania should fix the "shortcomings" in the seismic analysis on the existing site, which the EC said led to "large uncertainties in the hazard evaluation" as identified by an IAEA International Probabilistic Risk Analysis Review Team, or Ipsart, in 2004.

In the opinion, the EC said seismic hazard analyses on the existing Cernavoda-1 and -2 at the same site show that seismic damage is "the dominant contributor to nuclear power plant risk."

Cernavoda-1 and -2 are Atomic Energy of Canada Ltd.-designed Candu-6 reactors. Cernavoda-3 and -4 are to be based on unit 2, with improvements to be incorporated into the new reactors.

Neither Romanian utility Nuclearelectrica nor the Romanian nuclear regulator, the National Commission for Nuclear Activities Control, responded to a request for comment by press time.

Release of the EC opinion comes 10 days after a massive earthquake and subsequent tsunami at the Fukushima I nuclear power station resulted in an ongoing nuclear plant accident.

Last week the EC, government officials, nuclear regulators and industry executives backed the idea of voluntary safety "stress tests" for EU nuclear power plants based on common criteria, but details remain to be determined.

The EC opinion on Cernavoda-3 and -4 was released March 21 after the EC gained consent from Romania and project investors for the release of the document. The opinion was issued on November 26, 2010.

Nuclearelectrica and project officials have often cited the "positive" opinion by the EC of the project, although the opinion itself had not been published until now.

"The delay in giving access to this document made it appear [publicly] on a painful moment," said Greenpeace EU campaigner Jan Haverkamp, in reference to the Fukushima I accident.

In a March 21 email, Haverkamp said that the EC opinion is a "negative" one, "counter to earlier claims from Bucharest."

Nuclearelectrica spokeswoman Lavinia Rizea said in a March 10 email that the project was going forward despite the withdrawal of several major European utilities from the project earlier this year.

"We would like to remind you that Cernavoda Units 3 and 4 received the positive opinion from the European Commission on the basis of Euratom Treaty Art. 41," she said March 10. "The remaining investors, Enel and ArcelorMittal have expressed their confidence and determination to stay in the project," she said.

"It is high time Romania starts concentrating on alternatives" that will allow it to phase out the existing reactors and forgo building new ones, Haverkamp said.

"If Romania experiences another earthquake like it did in 1977, the last thing it needs is to have to prevent a nuclear catastrophe as well," he said.

According to the EC document, Romania experienced a 7.2-magnitude earthquake whose epicenter was about 200 kilometers (about 124 miles) from Cernavoda. That earthquake killed 1,500 people and damaged about 35,000 buildings, the EC document said.

The EC opinion also noted that the proposed AECL Candu-6 reactors are not protected against massive external impact such as the impact of a jet airliner.

But it said project investors were under no obligation to provide such protection since neither the IAEA, the Western European Nuclear Regulators Association, nor Romanian national law requires such protection.

Czech utility CEZ, Germany utility RWE, French utility GDF Suez and Spanish utility Iberdrola all withdrew from the project earlier this year.

RWE, GDF Suez and Iberdrola said in a statement in January they withdrew from the project due to "economic and market uncertainties" (NW, 27 Jan., 1).

Rizea said in the March 10 email that a new "revised investors agreement" was signed February 28 with Enel and ArcelorMittal that is valid through December 2012, "by which time the engineering, procurement and construction procedure will be finalized."

State-owned Nuclearelectrica now owns 84.65% of the project company EnergoNuclear, with Enel owning 9.15% and ArcelorMittal 6.2%, Rizea said.

"The completion of units 3 and 4 will increase the percentage of clean and safe nuclear energy in Romania, ensuring new jobs, tariff stability and independence [from] imports," she said.

—David Stellfox, Barcelona

French transparency on Fukushima said to be based on experience

As the drama of the impacts of a major earthquake and tsunami striking Japan's Fukushima nuclear power plant played out before the world's eyes this month, France stood out in the initiatives of its nuclear safety community to inform the media and the public of the events and put them in perspective.

They did it, people involved said, because France has learned by bitter experience — following the 1986 Chernobyl accident in Ukraine — what happens when the public thinks it has not been told the whole truth about a nuclear accident.

Andre-Claude Lacoste, chairman of French Nuclear Safety Authority ASN, was the first to publicly question the initial International Nuclear Event Scale rating of the accident's severity by Japanese authorities, saying it was worse than a Level 4. When more things went wrong at Fukushima, Lacoste reiterated that it was worse than the 1979 Three Mile Island accident in the US, which had been rated at Level 5. Japanese authorities since then have uprated the accident to Level 5.

ASN's technical support organization, the Institute of Radiological Protection and Nuclear Safety, IRSN, used all available data to model the predicted content and movement of the radioactive plume from Fukushima, giving authorities and the public in France and other countries a basis for judging the risk, or lack of risk, from the plant's fallout.

ASN has held daily media briefings since March 12 and made its commissioners and senior officials available for interviews. IRSN experts have repeated their analyses of the Fukushima events in front of television cameras, some of them becoming familiar faces for French TV viewers.

The ministers who oversee ASN and IRSN, Nathalie Kosciusko-Morizet (environment) and Eric Besson (industry/energy), have also promised that all lessons that France may draw from the Fukushima accident for its own reactors will be made public.

France is the country in the world most dependent on nuclear power — between 75% and 80% of its electricity comes from the atom, depending on the year. And its nuclear industry is led by industry giants like Areva, EDF, and the R&D organization CEA.

But some in the nuclear community said that is not enough to explain the drive to inform citizens about the Japanese accident.

Andre-Claude Lacoste, chairman of ASN, said in an interview March 20 that “in France, in the nuclear field we have the virtue ... of transparency,” which he called “an extremely strong and lofty idea.”

He acknowledged that having the world's second-largest nuclear reactor fleet — 58 units, after the US with 104 and more than Japan's 54 — makes France particularly sensitive to any severe accident, and even more so an accident in a

country with which France has much in common in the nuclear field.

An accident like Fukushima, he said, “is extremely disturbing for us, given the image of quality of Japan, a country that is ‘as nuclear’ as we are.”

Chernobyl legacy

But Lacoste said that the need for French authorities to proactively inform the public about the accident is a legacy of mistakes made after the Chernobyl accident and “the accusation of opacity associated with the Chernobyl situation.”

In the days following that accident, as the Chernobyl fallout approached France, the then-head of the radiation protection service, the internationally known scientist Pierre Pellerin, issued a bulletin saying that the cloud would pass over France on May 1, but adding there was no reason for protective countermeasures such as had been taken in neighboring Germany.

His judgment was translated by government ministers into a statement that suggested the cloud would not hit France. In mid-May, after independent scientists who later founded the group called Criirad detected contamination in southern France, the “Chernobyl lie,” as it has become known in France, became a national scandal that has dogged the nuclear industry and governments ever since.

The idea that “the Chernobyl cloud stopped at the border” is regularly reiterated by journalists and has resurfaced over the past two weeks.

“We had the ‘Chernobyl lie,’ that’s why” French experts are working around the clock to provide as much information as possible about the Japanese accident, said Marie-Pierre Bigot, director of communication at IRSN. “French people don’t trust the authorities” to tell them the truth. “In Norway and Sweden, they trust the authorities, but not in France,” she said in an interview March 23.

ASN and IRSN, backed by the government, are determined it won’t happen this time.

The IRSN predictions, which Bigot said were “science-based information,” indicated that the Fukushima cloud would arrive over metropolitan France on March 23, but that it was so diluted in the atmosphere that there was no risk of environmental or health consequences.

Roughly the same message was issued March 22 by Criirad, the group that had detected the Chernobyl pollution in 1986.

The effort may have paid off: interviewed in Lyon for TF1 TV March 22, two pedestrians said they weren’t worried about the Fukushima fallout because the authorities said there was no danger.

Chernobyl case dismissed?

Coincidentally, last week AFP reported that the chief prosecutor of the Paris Court of Appeals would ask the court to dismiss the long-running case brought by Criirad and a thyroid patients’ association, AFMT, to identify those responsible for the “Chernobyl lie.” The court is to hear the

arguments March 31.

The judge who has been investigating the case since July 2001, Marie-Odile Bertella-Geffroy, has been suspended pending the decision of the appeals court, AFP said March 18.

So far, charges have been brought only against Pellerin. The scientist, who is 87, has refused all comment throughout the case, as has his lawyer.

Bertella-Geffroy rejected an initial request for dismissal of the case.

The plaintiffs have sought to prove that their illnesses were due to irradiation by the Chernobyl cloud caused by failure of authorities to prescribe countermeasures such as prohibiting consumption of milk and fresh vegetables.

The anti-nuclear association Sortir du Nucleaire called the request for dismissal of the case and the judge "an indecent provocation."

—Ann MacLachlan, Paris

Uranium industry coming back, but recovery incomplete

The stock prices of several uranium mining companies, as well as spot U prices, were climbing back March 22 from a fall due to early impacts related to the ongoing problems at the Fukushima I nuclear power plant in Japan, but recovery was still not complete.

Share prices for Cameco, Paladin Energy and Uranium One dropped dramatically in heavy trading the week of March 14 amid nonstop news coverage of the Fukushima I crisis following a March 11 earthquake and tsunami.

Cameco, the world's second-largest uranium producer (after Kazakhstan's Kazatomprom), saw its stock drop to C\$27.73/share on March 17, a six-month low, from C\$36.51 on March 10. But its share price continued to inch up, closing at C\$31.53 on March 22, unchanged from the previous day.

Australia-based Paladin's stock fell from A\$4.83 on March 10 to as low as A\$3.26 on March 15 before inching up to A\$3.65 on March 22.

Vancouver-based Uranium One's stock closed at C\$3.46 on the Toronto Stock Exchange on March 17 (down from C\$5.96 on March 11), but climbed back to C\$4.48 on March 21 before dipping 2.23% to close at C\$4.38 on March 22.

Uranium miners' stock prices were jolted not just by the Fukushima I accident itself but by the accompanying reactions — China's decision to pull back from approvals of new reactors, and the subsequent news (later reversed) that Uranium One majority owner Atomredmetzoloto would not complete a deal to buy Australia-based Mantra Resources Ltd.

China, seen as the engine of nuclear construction for decades to come, announced that approval for new reactors would be suspended until it conducts a review of safety standards at existing units, state-owned Xinhua News Agency

reported March 16.

According to the World Nuclear Association, mainland China has 13 nuclear power reactors in operation, more than 25 under construction, and more about to start construction soon.

Additional reactors are planned, to give more than a tenfold increase in nuclear capacity to at least 80 GW by 2020, 200 GW by 2030, and 400 GW by 2050.

A day after China's decision, Uranium One announced that Russia state-owned ARMZ's A\$1.2-billion deal to buy Mantra could not go forward under the existing agreement because events in Japan had altered the conditions of the deal. But on March 21, Uranium One announced that ARMZ and Mantra had revised the terms of the agreement and that the deal would go through.

U3O8 market price

The spot uranium market was roiled by problems at Fukushima I and then by China's announcement that it would suspend approval of new projects.

The spot price was about US\$67.75 prior to the Fukushima events. The price dropped to US\$60/lb March 11, and hit a low of US\$50 before recovering to around US\$60 by March 21, according to the daily price published by TradeTech.

Early this week, analysts expected the price to climb past US\$60 again, but were not in agreement on how quickly the turnaround would occur. At \$60/lb or higher, there will be fewer buyers, at least until it is clear that the situation at Fukushima I has been stabilized, analysts said. The price hit a three-year high of US\$73/lb in February.

Uranium prices also slumped after accidents at Three Mile Island-2 in the US in 1979 and at Chernobyl in Ukraine in 1986, but there were other reasons for the decline. The TMI-2 accident might have hastened some nuclear plant cancellations, but many were going to happen anyway. Surplus supplies of U3O8 and the lifting of restrictions on sales of non-US uranium also led to a fall in prices.

After Chernobyl — but not necessarily as a result of the accident — came an influx of Soviet uranium to the Western market through the Nuclear Exchange Corp., or Nuexco, which in 1968 became the first organization to publish uranium prices and which is the predecessor of TradeTech.

This was followed by the breakup of the Soviet Union into competing uranium countries, notably Uzbekistan and Kazakhstan, and the world's first nonproliferation agreement with a commercial basis. This so-called 'megatons-to-megawatts' deal, signed by the US and Russia in 1993, spans 20 years and sets out to convert 500 mt of high enriched uranium from dismantled Russian nuclear warheads into low enriched uranium suitable for US commercial reactors.

Shutdowns, construction, plans

The reactors impacted by the earthquake and tsunami — the three operating units at Tokyo Electric Power Co.'s Fukushima I and four at Fukushima II that automatically shut down, three at Tohoku Electric Power's Onagawa and

one at Japan Atomic Power's Tokai-2 — represent 9,702 MW, or about 20%, of Japan's total nuclear generating capacity of 49,112 MW. Units 4, 5 and 6 (totaling 2,668 MW) at Fukushima I were already shut for periodic inspection before the March 11 events.

Also, three of Tepco's Kashiwazaki-Kariwa units — totaling 3,300 MW — are still shut after a July 16, 2007 earthquake.

Japan has two reactors under construction and plans for additional nuclear units.

Hitachi-GE Nuclear Energy is building a third nuclear unit — a 1,373-MW Advanced Boiling Water Reactor — for Chugoku Electric Power at the Shimane site, with the unit targeted to begin operation in March 2012, according to the World Nuclear Association. Construction began in December 2005.

Hitachi-GE, owned 80.01% by Hitachi and 19.99% by GE, is also building a 1,383-MW ABWR for J-Power (formerly the Electric Power Development Corp.) as Ohma-1, with operation targeted for November 2014. Construction began in May 2010.

Japan's plans call for construction to begin on 12 units between 2012 and 2018 and start operation between 2017 and 2022, according to WNA. Tepco plans to build four of the units, including two at the Fukushima II site, with construction scheduled to begin in April 2012.

Optimistic outlook

Industry executives and an analyst predicted that the Fukushima I accident would have a limited long-term impact on global uranium demand.

A senior official at a uranium mining company said March 14 that the loss of the 11 reactors impacted by the earthquake will result in a short-term decrease in Japanese demand and might result in "a small amount" — perhaps 3 million pounds of U3O8 — being made available to the spot market over the next 12-18 months. That depends on whether any other reactors are taken offline and "how the Japanese handle their current deliveries," he said.

Damien Hackett, the global head of mining research at Canaccord Genuity, said in a March 18 interview that the uranium industry will soon bounce back. Canaccord Genuity is the global capital markets division of Canaccord Financial.

"In the longer term — six to 12 months from now — these events will likely be seen to have made absolutely no difference to demand for uranium for power generation," he said. "The reason is that the big growth markets are China and India, which in no way can change their dependence on uranium. Alternative sources for the energy requirements of those two countries with their current growth plans are simply not viable."

"There will be appropriate reviews of safety measures at nuclear power plants, and reviews of those in the planning stage, but I believe that in a month or two, nuclear build programs will resume," he said.

"In a few months from now, everyone will be saying,

'You know what? Fukushima was a 40-year-old plant and still it didn't explode.'"

Coal is not an alternative to uranium in terms of world power demand, he said.

"Global supply of coal is not limitless and even if power production proves 100% 'clean coal', which it can't, the mining of the coal is not," he said.

Hackett said the greater "risk" to uranium prices is not weaker demand, but increasing supply.

The US DOE's Energy Information Administration is forecasting a balanced market before 2020, although Hackett said he doubted "they have got Chinese demand for energy correct."

"Everyone has underestimated Chinese energy demand over the past 10 years, possibly by as much as 25%," he said.

Fletcher Newton, executive vice president of strategic affairs at Uranium One, said in a March 18 interview that media coverage of events in Japan had spooked the market.

"Unfortunately, news reporters who are interested in holding their viewers' attention broadcast what sound like facts but aren't," he said. "Instead, we hear about doomsday scenarios. This is great for ratings and broadcast market share. No one wants to get up and get a cold beer when they can watch end of the world on TV."

Newton said he had received calls from people in Denver, where he has an office, "asking me where they can buy potassium iodide tablets."

Uranium One's share price has probably suffered more than a lot of other uranium producers because of its deliberate exposure of its contracts to the uranium spot market, Newton said. "Since the spot price of uranium has dropped, our deliveries that are coming up will be at this lower price, but \$50/lb is still a very healthy margin for us," he said.

Nevertheless, the uranium mining industry needs higher prices to support higher production costs, he said.

Deposits are increasingly remote, labor costs are higher and the price of petroleum is rising, he said.

Capital costs are significantly higher for conventional mining than they are for in situ recovery mining, which is more common in Kazakhstan than elsewhere, Newton said.

Paladin's deposit in Malawi and Mantra's Mkuju River project in Tanzania are good examples of the "new sort of project uranium mining companies are going to need to meet future demand," he said.

But these regions, like "most places" outside Kazakhstan, require conventional mining methods, he said.—*Claire-Louise Isted, London; Michael Knapik and Tom Harrison, Washington*

Tepco says tsunami exceeded Fukushima design basis

Tokyo Electric Power Co. said March 22 that the tsunami that hit its Fukushima I nuclear power plant March 11 was more than twice as high as the wave its facilities were

designed to withstand.

The magnitude of the earthquake that triggered the tsunami — 9.0 on the Richter scale — was also greater than the company had expected, Tepco officials said in Tokyo, according to NHK television.

But Tepco said in a separate information notice that according to preliminary calculations, the ground acceleration that occurred at key locations at the Fukushima I and II sites March 11 was well within the plants' design bases, with the exception of one value measured at Fukushima I-3, and pending acquisition of data still missing from units 1 and 2.

Tepco discovered by checking the walls of Fukushima I (also known as Fukushima Daiichi) and the nearby Fukushima II (also known as Fukushima Daini) March 21 that the tsunami had reached higher than 14 meters (about 46 feet) above sea level, the company said in statements March 22 and 23. Fukushima I and II had been designed to withstand tsunamis of 5.7 meters and 5.2 meters, respectively.

Kazuhito Takeda, manager of Tepco's London office, said March 22 in an interview that the nuclear power plants' design was not based on earthquake magnitude, but rather on the ground acceleration that an earthquake was assumed to generate at different points of the sites.

In a "tentative assessment" of the impact of the March 11 earthquake and following events on the Fukushima facilities, distributed March 18, Tepco said the loss of cooling function to the entire Fukushima I site was believed to be caused not by the earthquake vibration but by the "unprecedented massive Tsunami."

Japanese authorities had revised guidelines for seismic resistance design just before the July 2007 earthquake off the coast of Niigata prefecture, and required utilities to check their designs using the new guidelines.

The July 16, 2007 earthquake was found to have caused ground acceleration and vibration greater than Tepco had included in the design basis of its Kashiwazaki-Kariwa site, leading to lengthy shutdowns at that site pending re-evaluations and backfits.

The Nuclear and Industrial Safety Agency also required all Japanese utilities to take the observations from the Niigata earthquake into account in their updated analyses.

Takeda said that the analysis had been done for Kashiwazaki-Kariwa and the plant structures were strengthened to withstand ground acceleration of 1,000 gal, almost double the original design value.

A measure of gravitational acceleration, one gal equals one centimeter per second per second.

The reassessment of vibration calculations had also been done for Fukushima I and II, he said, and "we had planned to take countermeasures in future" before the earthquake and tsunami struck the sites this month.

But Takeda said that "according to the new calculations, the current design [of Fukushima I and II] has sufficient strength against the vibration" now assumed for the design-basis earthquake.

The reassessment had been done for major components related to three main vital functions: shutdown, cooling and

containment, Tepco said in the March 18 assessment.

The company said in a fact sheet that "in fact, the plants' conditions were good and well-controlled even after the earthquake vibration hit the plants until the Tsunami hit subsequently."

Takeda said the guidelines for the earthquake resistance reassessments were drawn up by the Nuclear Safety Commission on the basis of expert opinion. The Nuclear Safety Commission is an independent and autonomous five-member panel appointed by the prime minister with Diet consent and is housed in the prime minister's Cabinet office. The NSC is tasked with developing the basic philosophy of safety regulations, notably on seismic safety. It has authority over the regulatory authorities that are part of ministries, notably NISA, and operators on behalf of the prime minister and is the latter's adviser in the event of nuclear emergencies.

Vulnerable

Last week, the world nuclear community was trying to figure out how safety officials in a country so prone to earthquakes could have authorized a plant design that proved so vulnerable.

The Niigata earthquake, whose epicenter was about 16 kilometers from the Kashiwazaki-Kariwa site, measured 6.6 on the Richter scale. The nuclear plant had no essential damage, and no radiation leaked from the seven BWR units or their spent fuel pools.

One European nuclear engineer said that Tepco, or Japanese authorities, should have taken into account the biggest of the huge earthquakes — up to magnitude 9.5 on the Richter scale — that have struck the so-called Pacific Ring of Fire, the world's seismically most active region. The ring is on the edge of the Pacific Ocean basin where three continental plates slowly grind against one another, building up enormous seismic pressure. Tokyo — and the Fukushima area northeast of the capital — are in one of the most dangerous areas of the ring, close to a major fault.

A French nuclear safety official said that taking the maximum historical earthquake for such a large region is not the approach used to determine the design basis of a nuclear power plant. He said that the maximum earthquake risk for a given nuclear plant site is determined for that specific location, not taking the biggest earthquake in a big region like the Pacific. If every plant had to be designed against the maximum threat worldwide, even if it is unrealistic at a given site, the cost could be prohibitive, the official said.

—Ann MacLachlan, Paris

MOX fuel in damaged reactor not seen hindering response work

The presence of mixed-oxide, or MOX, fuel in unit 3 at Tokyo Electric Power Co.'s damaged Fukushima I station does not present an additional challenge to recovery efforts,

an industry official and an analyst said March 17.

Unit 3 is the only reactor at the six-unit Fukushima I station that contains MOX fuel, which contains plutonium as well as uranium. That fuel was loaded into the reactor in September, according to Edwin Lyman, a senior scientist in the Global Security Program at the Union of Concerned Scientists, and Anthony Pietrangelo, senior vice president and chief nuclear officer with the Nuclear Energy Institute. Units 1, 2 and 3 sustained core damage after a tsunami disabled offsite power and diesel generators used to pump water to cool the reactors.

Edwin Lyman, a senior scientist in the Global Security Program with the Union of Concerned Scientists, raised concerns about MOX fuel in unit 3, stating during a March 14 press briefing that the fuel “can increase the consequences” of the accident because the fuel rods are a blend of fissile plutonium and uranium. But Lyman said he “wouldn’t consider [the MOX] to be a significant additional risk.”

Plutonium is very dangerous to humans if they inhale it or its decay products, such as Americium, should these be dispersed into the atmosphere by an explosion that releases MOX and other material from the reactor core, Sharon Squassoni, director and senior fellow at Proliferation Prevention Program with the Center for Strategic and International Studies, said in a March 17 interview.

Tom Clements, Southeastern Nuclear Campaign Coordinator with Friends of the Earth, said in a March 17 interview that the MOX fuel loaded into unit 3’s core comprises 5% of the fuel load and wouldn’t substantially increase radiation levels at the site, even if the core melted, so long as the fuel remained in the reactor vessel.

Clements said, “The big concern would be if there is an explosion that destroyed the reactor vessel, which would spew out plutonium.”

Anthony Pietrangelo, senior vice president and chief nuclear officer with the Nuclear Energy Institute, said during a March 17 briefing that “the presence of plutonium in the fuel [at unit 3] is not going to complicate the recovery actions” with respect to any of the Fukushima reactors.

French nuclear safety officials, queried repeatedly during press briefings last week about the risks of MOX fuel at Fukushima, said that there was plutonium in spent fuel even at the units that had loaded no fresh MOX fuel, and that the increased plutonium content of the MOX fuel — about 7% versus 1% in uranium fuel — would not make a significant difference in doses off the site from the accident. There are 26 EDF reactors loaded with MOX fuel, the highest use of the fuel in the world.

Lyman said he has “serious concerns” about the US program, “which would use MOX cores of up to 40%.”

No US power reactors use MOX fuel. The Fissile Material Disposition Program run by DOE’s National Nuclear Security Administration plans to convert about 34 metric tons of surplus weapons plutonium into MOX

fuel for use in reactors.

NNSA contracted with Shaw Areva MOX Services to build a MOX Fuel Fabrication Facility at DOE’s Savannah River Site in South Carolina. The facility is on track to begin production in 2016, Anne Harrington, NNSA deputy administrator for defense nuclear nonproliferation, said during a February 14 briefing on the NNSA’s proposed fiscal 2012 budget.

The Tennessee Valley Authority has signed a letter of intent with Areva to consider the use of MOX in some of its nuclear units, Areva said in a statement February 18. TVA and Areva will negotiate use of MOX to be produced at the Savannah River Site.

Areva said it has a non-exclusive preliminary agreement to market MOX fuel from the facility.

TVA has not decided whether to use the fuel in any of its reactors, spokesman Terry Johnson said February 18. The federal utility is preparing a supplemental environmental impact statement on the use of MOX fuel at its Browns Ferry and Sequoyah nuclear plants, he said.

Pacific Northwest National Laboratory and Energy Northwest’s Columbia plant have been evaluating the use of MOX fuel at Columbia, spokesmen for both facilities said February 3.

Greg Koller, a spokesman for the laboratory, said in a March 15 e-mail, “We don’t anticipate the events in Japan will have an impact on the study.”

“Our project with Global Nuclear Fuels-American and Energy Northwest to determine the safety, licensing, safeguards, disposal, and transportation issues associated with the use of MOX fuel in a BWR was recently launched and is scheduled to last about 18 months. We don’t anticipate the events in Japan will have an impact on the study.”

NRC would have to issue a license amendment for Energy Northwest to use MOX fuel in Columbia, NRC spokesman David McIntyre said February 3.

—Jim Ostroff, Washington

Older German units shut for review, hold placed on lifetime extension

Germany’s government has shut seven pre-1980 power reactors for a safety review and ordered a three-month moratorium on formally allowing extending reactor lifetimes.

At a webcast press conference March 14, German Chancellor Angela Merkel said that a special commission is being set up to review the safety of Germany’s 17 nuclear units, especially their ability to withstand natural disasters such as earthquakes and floods following the accident at Fukushima.

Vice Chancellor and Foreign Minister Guido Westerwelle said at the press conference that there needs to be “a new risk analysis.”

The moves put the future of German’s reactors and of

lifetime extension into question.

Merkel said in a speech to the Bundestag March 17 that the German government will not move to reverse nuclear plant lifetime extension as the opposition wants, because it would mean relying on imports now. But she also said that nuclear power in Germany needs to be phased out. In her speech, she said a phase-out should be “measured,” with units being shut as renewable energy comes online.

But speaking in the state of Baden-Wuerttemberg March 16, where EnBW operates reactors and where voters will go to the polls in a state election March 27, Merkel said that if a phase-out can be completed before 2022, “all the better.” All reactors were to be shut by 2022 under an agreement between the nuclear utilities and the government of former German Chancellor Gerhard Schroeder.

The Bundestag, the lower house of parliament, approved lifetime extension for German reactors in October as the government wanted. Units were set to be allowed to operate for eight or 14 years each past 2022.

The Merkel government’s push for lifetime extension sparked bitter debate in Germany and several lawsuits have been filed in an effort to stop it.

The moratorium comes as Merkel’s Christian Democratic Union is facing tough election campaigns in five federal states beginning with Baden-Wuerttemberg and running through mid-May, with nuclear power and life extension being key issues. The moratorium means lifetime extension will be on hold during those elections.

Sigmar Gabriel, head of the Social Democratic Party and a former environment minister responsible for nuclear energy in Merkel’s previous government, questioned her motives for the moratorium.

“One has to ask why Merkel decided six months ago to extend the lifetimes of Germany’s oldest nuclear power stations by 12 years, without addressing the safety questions that she is suddenly seeing,” he told German media on March 14.

In interview with *Der Spiegel* published online March 22, E.On chief executive Johannes Teysen said that shutting seven reactors could lead to power outages.

“It may now become extremely difficult to keep the electricity grid stable,” Teysen said. He added that E.On has informed the economics ministry of the potential problem and that it will be difficult to redistribute power through the grid to make up for nuclear reactors that are offline in the southern part of the country.

Teyssen said that if the German parliament should reinstitute a nuclear phase-out, “we cannot and will not refuse to cooperate. However, I assume that it will not come to that.”

In a March 16 statement, however, Teysen acknowledged that given the situation in Japan, “it is not possible to go back to business as usual.”

He said that while E.On supports the moratorium and the safety review, despite the potential grid problems, “the issue of safety is not confined by national borders, certainly

not in a densely populated region like Europe. There is little benefit in having one state in Europe exit the peaceful use of nuclear energy only to then import nuclear energy from a neighboring state. This will not solve the safety problem so much as put it ‘out of sight, out of mind.’ “

Because lifetime extension was approved by the Bundestag, technically the government cannot impose a moratorium. But Merkel has said the moratorium is in the “overwhelming public interest,” and that a legal framework for it is being worked out.

The units which have been ordered offline are Neckarwestheim-1, Philippsburg-1, Biblis A and B Isar-I, and Unterweser. In addition, the 805-MW Brunsbuettel must remain down, the government said. Brunsbuettel has been shut since June 2007 for extended repairs. Also, the 1,402-MW Kruemmel was shut in June 2007, returned to service for about two weeks before scrambling July 4, 2009 and has remained shut since.

Merkel has not said what will be used for replacement generation. Nuclear power generates about 23% of Germany’s electricity.

On March 17, EnBW management said Neckarwestheim-1 and Philippsburg-1 had been taken offline.

In a statement, March 15, EnBW Chief Executive Hans-Peter Villis said he understands the concerns in Germany following the Japanese accidents.

But he added that “a discussion, reduced only to the question ‘continued operation of nuclear power, yes or no’ is short-sighted.”

“Nuclear power has been consciously developed over decades in Germany, so that one must also discuss the implications and consequences of the shutdown of nuclear power plants.”

The same day, E.On said it was preparing to shut the 840-MW Isar-1, but said that the unit meets all German safety standards. The company said Unterweser was taken offline March 18.

RWE management also said in a March 19 statement that it had taken the 1,225-MW Biblis-A offline the day before. The 1,300-MW Biblis-B has been down since February 25 for maintenance.

“In view of the catastrophe in Fukushima, it is right to examine whether the events in Japan can provide us with concrete information as to how we can further increase our already high safety levels,” RWE management said.

But it added that “RWE would like to emphasize that its nuclear power stations work at maximum safety levels and that, from a safety perspective, the company sees no necessity to call the lifetime extension into general question.”

RWE management also said it will discuss the financial and legal aspects of the moratorium and plant shutdown with the government.

In a statement March 12, the industry lobbying group German Atomic Forum said that “German nuclear power plants are designed in such a way that, even in severe earthquakes, the safety objectives will be upheld.”

—Ariane Sains, *Gothenburg and Stockholm*

Lessons ... from page 1

director for operations, said at the briefing that the agency staff will conduct at least two reviews, the first of which will be completed in the next three months.

The short-term review, Borchardt said, "will evaluate all of the currently available information from the Japanese event, and look at it to evaluate our 104 operating reactors' ability to protect against natural disasters, to evaluate the response to station blackouts, severe accidents and spent fuel accident progression, look at radiological consequence analysis, and also look at severe accident management issues regarding equipment."

Borchardt said he expected that the 90-day review will include "development of some recommendations for generic communications ... to make sure that the industry has a broad understanding of the events and the issues, as best we understand them." The NRC staff will also "evaluate whether or not some regulatory action, perhaps in the framework of an order, would be required, in order to require the licensees to take some actions that they have not already done."

The review is expected to include "a quick look 30-day report to the commission ... just to get a quick snapshot of the regulatory response and the condition of the US fleet based on whatever information we have available," Borchardt said. The result of that review will be made public, he said.

Borchardt said he could not say when the longer review would begin or how long it would take to complete. He said the staff "will evaluate all the technical and policy issues to identify additional research, or generic communications, changes to our Reactor Oversight Program, potential new rulemakings, [and] adjustments to the regulatory framework that should be

conducted by the NRC."

The longer review is expected to have "substantial stakeholder involvement, and the outcomes are likely to be along the lines of generic letters, bulletins, and potential rulemakings," he said.

Borchardt said in response to a question from Commissioner Kristine Svinicki that he is "quite confident" that the agency's "regulatory focus" is appropriate, given what is now known about the crisis in Japan. "We've looked at the design basis for the US reactors. We continue with the inspection program, and we have a high degree of confidence that ... there's an adequate basis to assure adequate protection" at the nation's power reactors, he said.

NRC is preparing a temporary instruction to plant inspectors intended to confirm the readiness of plants to deal with both design-basis and "beyond-design basis" accidents, Borchardt said. This instruction will tell inspectors to verify that plants have the capability to mitigate the effects of severe accidents, including a total loss of electric power, he said. The results of the inspections stemming from the temporary instruction will help NRC decide if additional regulatory actions need to be taken, Borchardt said.

Edwin Lyman, senior scientist in the global security program at the Union of Concerned Scientists, said during a March 20 telephone press briefing that a "primary question" the agency should be asking is how the disaster at the Fukushima I plant "will impact the scope of NRC activities, many of which are based on risk and the presumption that this type of accident is a 1-in-100,000-a-year accident, whether or not the design basis for all their decision-making needs to be reviewed or not."

Industry review

Marvin Fertel, president and CEO of the Nuclear Energy Institute, said in a statement March 17 that "a review of our nuclear plants is an appropriate step after an event of this scale." He said the US nuclear industry "will incorporate lessons learned from this accident at American nuclear energy facilities. The commitment, along with the strict regulation of the industry by the [NRC], has made US reactors the safest in the world.

"Even before we can get lessons learned from Japan, all companies that produce electricity at nuclear power plants are verifying their capability to maintain safety even in the face of severe adverse events," Fertel said.

Anthony Pietrangelo, Nuclear Energy Institute senior vice president and chief nuclear officer, told members of the Senate Environment and Public Works Committee March 16 that chief nuclear officers of US nuclear utilities have agreed to verify the "capability to mitigate severe adverse events" at their reactors, "including loss of major safety systems."

NEI said in a March 16 statement the industry agreed to "verify each company's capability to mitigate conditions that result from severe adverse events, including

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the loss of significant operational and safety systems due to natural events, fires, aircraft impact and explosions. Specific actions include testing and inspecting equipment required to mitigate these events and verifying that qualifications of operators and support staff required to implement them are current."

Operators will "verify that the capability to mitigate a total loss of electric power to a nuclear power plant is proper and functional. This will require inspections verifying that all required materials are adequate and properly staged and that procedures are implemented," NEI said.

—Steven Dolley and Yanmei Xie, *Washington*

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melt accidents and hydrogen accumulation and "degraded conditions in the spent fuel storage including consequential effects such as the loss of shielding of radiation."

But at a press conference after the Wenra meeting, Wenra leaders said the process would be a long one, taking perhaps up to a year, even if they recognized the political urgency of launching the tests as soon as possible.

The Wenra document proposes that once the scope and methodology of the tests are agreed on at the EU level, licensees would be given six months to do the required reassessments and report to national regulators, which would review the submissions. Regulators would publish reports on the reviews within three months. Results would be discussed at a public seminar to which other experts would be invited, the document stipulates.

The chairman of French nuclear safety authority, Andre-Claude Lacoste, said that on March 25, EU heads of state and government (the EU Council) "will probably approve the idea of the stress tests," will ask their national nuclear safety authorities to conduct such tests in countries with nuclear power plants, and "will ask neighboring countries to do the same thing."

He and Wenra Chairman Jukka Laaksonen said they expected Russia, Switzerland and Ukraine to apply the same kind of tests to their nuclear facilities.

They said that although the stress tests are nominally voluntary, Wenra members had committed to apply them in their countries, so no EU reactor operator would be exempted.

Wenra comprises the heads of nuclear regulatory bodies in 16 EU states with nuclear power plants, plus Switzerland. Created about 11 years ago, it is an informal association, in contrast to the more recent European Nuclear Safety Regulators Group, Ensreg, which is an EU institution representing all 27 member states. Observers from eight non-member countries attend Wenra meetings.

Laaksonen said Wenra's task force will discuss the draft proposal with industry and with EU institutions "to make sure our response is what they expect from us." Ensreg will meet May 12 to consider it, and the proposal "will be fur-

ther discussed at the European level," Wenra said.

That timing indicates that the EU Council might approve the test proposal in June.

Individual EU countries will not wait to launch their own stress tests. Lacoste said France's process, called "national audits," will be launched March 24 when Prime Minister Francois Fillon visits ASN's emergency response center and hands Lacoste a formal mandate to start the tests on French facilities.

But he said that to ensure consistency with the European tests, "I will obviously use the European [proposal]."

Revision of EU directive?

On March 21, EU energy commissioner Guenther Oettinger said the European Commission hoped to have results of the stress tests by late 2011. With those results in hand, he said, the EC could review EU nuclear safety rules as early as next year. Then, "the EC can propose an early revision of EU nuclear legislation and perhaps recommend measures to increase nuclear safety," he told a press conference after an emergency meeting of EU energy ministers in Brussels.

"We certainly have to speed up" the nuclear safety review foreseen for 2014 in the EU's 2009 nuclear safety directive, Oettinger said. EU governments have to incorporate the 2009 directive into national law by July 22.

Wenra this week stopped short of calling for changes in EU nuclear safety requirements. The EU has made a commitment to work towards high safety standards worldwide based on the EU approach, but that wasn't part of Wenra's statement on the Fukushima accident and its lessons.

The need to upgrade safety at some operating nuclear units is evident, one European regulator said, because "we aren't going to turn off all the reactors in the world."

Last week, Germany's government shut seven pre-1980 power reactors for a safety review and suspended for three months measures authorizing reactor life extension.

Laaksonen said that "so far, according to the information

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received from Japan, it seems we have not overlooked something. It seems that there is no need to call for immediate measures to close the [European] plants.

But the review of the Fukushima accident, he said, “may give us new ideas on how to make further improvements” to nuclear plant safety.

No haste

At the Brussels press conference, Hungary’s national development minister Tamas Fellegi, representing the Hungarian EU Presidency, said the stress test results “will give us a new foundation to base energy policy on.” But he added ministers were keen to avoid “any over-hasty decisions or actions” until it was clear what exactly had happened in Japan.

Fellegi said member states would apply the stress tests in their own interest, to win public trust. He said the process should be transparent to allay concerns that some governments would not be as rigorous as others in applying the tests.

Oettinger said all EU countries, even those without nuclear power, must agree on the test criteria, so that their concerns are taken into account.

‘Gloss over’?

The Green political group in the European Parliament warned March 21 that the stress tests could be “little more than a tool to gloss over more fundamental decisions on nuclear power,” as expressed by German Green Member of the European Parliament Rebecca Harms.

“Stress tests of nuclear reactors could be an important step on the road to a phase-out of nuclear power but only if they are based on robust criteria and, crucially, carried out by independent experts,” she added.

Luxembourg Green MEP Claude Turmes said the EU energy roadmap for 2050, due to be presented soon by the EC, should factor in a nuclear phase-out.

—Ann MacLachlan, Paris; Siobhan Hall, Brussels