WNFC 2011

Conference reviews impacts of Fukushima Daiichi

World Nuclear Fuel Cycle 2011 was the first major nuclear industry conference since the accident at Japan's Fukushima Daiichi plant.

THE CROWD SEEMED somber at World Nuclear Fuel Cycle 2011, held April 5–7 in Chicago, the first nuclear meeting of major status since the accident at Japan's Fukushima Daiichi plant.

The conference—which was hosted by the Nuclear Energy Institute (NEI) and the World Nuclear Association (WNA)—focused mainly on the front end of the fuel cycle, although some comments were made about the back end and about a renewed direction for used fuel storage.

Most evident was the crowd's silence during the question-and-answer periods following the speakers' presentations. Despite prodding from session chairs, the audience members, perhaps stunned by the recent events in Japan, for the most part held back any questions they may have had for the speakers.

On the first day of the conference, attendees were greeted by about two dozen antinuclear activists who protested briefly outside the conference hotel, chanting and carrying signs. News reports indicated that this was the first antinuclear demonstration in Chicago in years, no doubt prompted by the accident in Japan, which caused immediate consternation about nuclear power around the globe.

The speakers at the meeting were aware of this negative atmosphere. "The accident at Fukushima has rocked our world in ways that Chernobyl never did, and will for many years," said Richard Myers, NEI's vice president for policy development, during the opening session of the conference. Myers, who served as the session chair, was referring to the damage done both to Tokyo Electric Power Company's Fukushima Daiichi reactors and to the nuclear industry at large as a result of the March 11 earthquake and tsunami that hit northeastern Japan.

Myers

"We must understand that we represent a technology that has, once again, frightened and confused people," Myers said, adding that the industry would be visible in its response to the accident and would take steps to prevent similar occurrences at other nuclear plants.

Following Myers on stage was John Ritch, director general of the WNA, who commented that the cause of nuclear power as the world's preeminent clean energy technology had indeed suffered a serious blow. "In regaining ground that was hard-won over years and quickly lost in days, we have our work cut out for us," he said. "As we undertake to regain public confidence, our essential tools will remain, as they have been in the past, a combination of reliable performance and public education."

Ritch

Although remarks about the effects of the accident on the industry were heard frequently throughout the conference, the prevailing view seemed to be that nuclear energy will be providing electric power around the world for a long time, despite the accident at Fukushima Daiichi.

The conference presentations focused generally on the nuclear fuel market, uranium mining projects, enrichment capacity, and fuel cycle requirements.

François-Xavier Rouxel, senior executive vice president for Areva's enrichment business unit, discussed enriching uranium for use as reactor fuel. He said that planning for, constructing, and bringing on line new enrichment plants requires a massive financial investment and many years to go from drawing board to maturity. Areva has been work-

Areva's South Unit at the Georges Besse II uranium enrichment plant in France. The first commercial production from the unit was in April. (Photo: Areva)

ing on the Georges Besse II enrichment plant in France and the Eagle Rock plant in the United States. Both facilities will use Areva's ETC centrifuge technology.

The Besse plant will replace Areva's Eurodif facility, which uses an expensive gaseous diffusion enrichment process. The Eurodif facility is in Tricastin—where the Besse plant is being built—and will be closed in 2012. The dismantling of the facility is to be carried out from 2016 to 2025, Rouxel said.

The Besse plant is being built as two units—known as the North Unit and the South Unit. Combined, they will reach a full production capacity of 7.5 million separative work units (SWU) by 2016—3.2 million SWU at the North Unit and 4.3 million SWU at the South Unit. Rouxel said that the plant's first cascade of centrifuge machines was put into operation in March 2011 and the first commercial production, from the South Unit, was in April 2011. The North Unit is expected to start production in 2012.

Regarding the Eagle Rock plant, which is being built in Idaho Falls, Idaho, Rouxel said that Areva is expecting the Nuclear Regulatory Commission to grant it a combined operating license this year, and that the plant should reach its full capacity of 3.2 million SWU by 2018. In May 2010, the Eagle Rock project received a conditional commitment from the Department of Energy for a $2-billion loan guarantee.

The Besse plant's North Unit, expected to start production in 2012. (Photo: Areva)

The Fukushima Daiichi accident, Rouxel concluded, could threaten the completion of new enrichment projects and capacity expansions around the world due to added safety regulations that would in turn increase costs. "Risks incurred by new enrichment projects appear much higher today," he said.

Daniel Einbund, vice president of New York Nuclear Corporation, used the recent spot prices of U_3O_8 to review the effects of the Fukushima Daiichi accident on the nuclear fuel market. On March 11, the day of the earthquake and tsunami, the spot price per pound of U_3O_8 was about $67. Three

Einbund

days later, the price had dropped more than 11 percent to $60/lb, and by March 16 it had bottomed out at $50/lb (a 26.19 percent drop from March 11), before it started creeping back up. The spot price hit $60/lb by March 22 and briefly went a few dollars higher than that before settling back down to $60/lb. The spot price then dropped from there, according to market reporter TradeTech LLC, hitting $55.25/lb U_3O_8 on April 22.

Global uranium needs

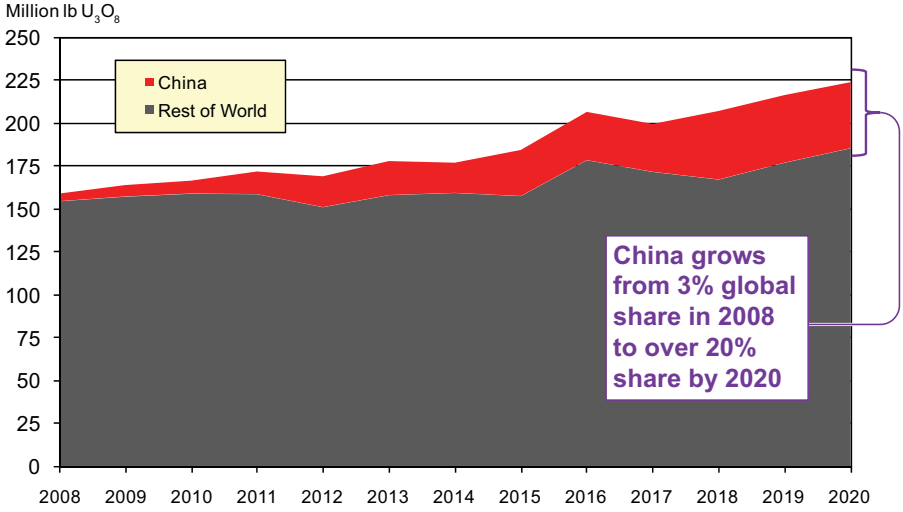
Jonathan Hinze, vice president of international operations for Ux Consulting Company LLC, opened his remarks with a perspective on Fukushima Daiichi. Because of the accident, he said, the costs for operating and building reactors will rise and will cause various reevaluations in the industry. In addition, he said, there will be a slowing down of nuclear growth around the world, but net growth in the nuclear industry remains likely. "The world still needs energy, and nuclear power will remain an option for many countries," he said. "This is not the end of nuclear power, and a renewed emphasis on safety and public education is positive."

Hinze

The initial impact of the accident on the industry could be the loss of about 16 gigawatts of nuclear power in the near term from Japan and Germany, although in time, he said, up to 10 GWe may be added back in. He noted that some additional impacts are likely, including safety checks for operating units, especially in Japan, the United States, and Europe; increased costs resulting from retrofits for operating units; additional safety checks and possible reengineering for new reactor designs and projects; and a more rapid shift to Generation III+ reactor designs.

Hinze said that Ux Consulting had done a global reactor forecast out to 2020. Before Fukushima Daiichi, the forecast predicted more than 525 GWe of nuclear electricity by 2020; after Fukushima Daiichi, the forecast dropped to just over 500 GWe.

Regarding nuclear expansion in Asia, Hinze said that China has 27 reactors (27 678 MWe net) under construction, to be completed by 2015, and about 34 additional new units (another 36 000 MWe net) will be completed by 2020. The Fukushima Daiichi event, however, has already caused delays in China's new build, Hinze said. Safety checks are being done on all existing and under-construction units, and preliminary construction and new site approvals have been suspended. In addition, he said, the new-build projects at Hunan and Sichuan are being reconsidered. Still, he added, the bottom line is that China's nuclear expansion remains on track, with 70–80 GWe expected by 2020, and despite its reductions, China's new construction still represents about 50 percent of nuclear's global net growth to 2020.



China's uranium requirements compared with the rest of the world (Graphic: Ux Consulting Co.)

Taking a look at uranium requirements for China's nuclear expansion was Milt Caplan, president of MZConsulting. In 2011, China's demand for annual first-core loads is expected to be 4400 metric tons (t). By 2020, that number could increase to 15 000 t per year, which would be 30 percent of the current global uranium production. By 2030, China's demand could be 40 000 t per year. "You're talking massive, massive numbers," Caplan said, "when today, primary global uranium production is about 50 000 t per year."

Caplan noted that India and South Korea will also have a growing demand for uranium. "India wants to achieve 20 000 MWe by 2020 and 63 000 MWe by 2032," he said. Translated into uranium, that means that India would need 4000 t by 2020 and 12 000 t by 2030.

South Korea has 21 units under construction or planned, with a goal of reaching 27 000 MWe by 2020 and 35 000 MWe by 2030. "There is no doubt they'll achieve it," Caplan said. "They've achieved their plans all the way along so far." South Korea's new construction translates into about 5400 t of uranium needed by 2020 and 7000 t by 2030.

Total demand from China, India, and South Korea by 2030 will be 69 000 tU/yr, almost 40 percent more than the global primary production in 2009, Caplan said.

To provide for its reactors, China has been aggressive in securing uranium for long-term needs. In 2010, it purchased 17 136 tU to bolster its strategic reserve, and last November it signed a purchase agreement with Canada's Cameco Corporation for uranium supply to 2025. In addition, China has invested in uranium mines in Africa, Australia, and Mongolia and has started production from a Chinese-owned mine in Africa. India and Korea have also made investments, but not to the extent that China has. "The uranium market will fundamentally change as the large users move from the West to Asia," Caplan concluded.

MOX fuel use in the U.S.

Back in the United States, the Tennessee Valley Authority is investigating the use of mixed-oxide (MOX) fuel, derived from dismantled U.S. nuclear weapons, for some of its reactors. Mick Mastilovic, TVA's manager of nuclear fuel, said that the MOX fuel that would be used in Sequoyah's pressurized water reactors and Browns Ferry's boiling water reactors would amount to no more than 50 percent of the fuel assemblies in any reactor core.

Mastilovic

MOX fuel is a mixture of plutonium and uranium. The MOX derived from weapons has a higher concentration of Pu-239 and fewer impurities than commercial MOX, according to Mastilovic. The MOX fuel would come to TVA through the Department of Energy, which is building the MOX Fuel Fabrication Facility (MFFF) at the Savannah River Site in South Carolina (see page 60 for an update on the MFFF).

TVA has extensive experience with DOE programs, Mastilovic noted. The DOE's Blended Low-Enriched Uranium project, which converts weapons-program uranium into usable reactor fuel, has provided fuel

to Browns Ferry since 2005, he said.

MOX fuel was first used in a thermal reactor in 1963, Mastilovic explained. The commercial use of MOX fuel started in the 1980s, and significant operating experience has been acquired in Belgium, Switzerland, Germany, and France. About 40 reactors around the world are licensed to use MOX, he said, although only 30 or so are actually using it. Generally, he added, MOX fuel makes up about one-third of the reactor core.

In the United States, Mastilovic said, MOX fuel was used in testing programs in the 1970s and 1980s. More than 280 MOX fuel rods were successfully used at the Quad Cities, Big Rock Point, San Onofre, and Ginna nuclear plants, confirming that MOX performance is comparable to uranium fuel, he said. Most recently, he added, Duke Power Company participated in a test program for MOX derived from nuclear weapons.

Mastilovic said that a decision by TVA about whether to use weapons-derived MOX fuel would come in 2012, but even then the delivery of the first fuel assemblies would not occur until 2018, because the MFFF must first be completed and put into operation.

Managing used fuel

Steven Kraft, senior director of special projects at NEI, addressed the back end of the fuel cycle. With the proposed Yucca Mountain repository no longer an option for the disposal of used nuclear fuel in the United States, a plausible and durable policy and plan to manage it responsibly is needed, he said. He added that an integrated management plan would encompass the interim storage of used fuel at reactor sites and at centralized locations, the recycling of materials, disposal options, and the creation of a federal corporation to manage the fuel cycle.

Kraft

The used fuel inventory in the United States as of January 2011 was about 65 200 tU, according to Kraft, and each year, 2000–2400 tU is added to it. Dry cask storage through 2010 was at 16 100 tU, with more than 1400 casks loaded and 54 operating independent spent fuel storage installations (ISFSI) in service. By 2020, the estimate is that 26 200 tU of used fuel will be in dry storage, with 2600 casks loaded at 75 ISFSIs.

Kraft also discussed the NRC's Waste Confidence Rule, which was published in the *Federal Register* on December 23, 2010. The rule determines that used fuel can be safely stored for up to 60 years beyond the licensed life of a reactor (including renewals), for a total of 120 years. The rule also notes that a geologic repository will be available "when necessary."

With Yucca Mountain taken off the table as a disposal site, industry interest has returned to the idea of centralized storage sites, one on each side of the Mississippi River, Kraft said. One community in the east has volunteered as a site, but no site has come forward west of the river.

During the Q&A session that followed his presentation, Kraft said that the industry is prepared for roadblocks on the path toward centralized storage. He referenced the ordeal that the company Private Fuel Storage LLC went through a decade ago when it tried to open an ISFSI in Utah on the Skull Valley Reservation. The ISFSI was welcomed by the majority of the Skull Valley Band of Goshute Indians, and it was licensed by the NRC. The U.S Bureau of Indian Affairs and the U.S. Bureau of Land Management, however, refused to give the ISFSI permission to operate. In addition, some of Utah's government officials, local advocacy groups, and a few Goshute Native Americans were against the project to bring used fuel to the state. Kraft also said that lawsuits are likely to be filed against the industry if it moves forward with centralized used fuel storage.—*Rick Michal* NN