What's Next for Yucca Mountain?

View to the south of Yucca Mountain crest showing coring activities.

A look at what's new at the mountain, the budget, the license application, transport, the effects of fuel recycling, and more.

By Nancy J. Zacha

The one fact about Yucca Mountain that everyone in the nuclear industry wants to know right now is when the U.S. Department of Energy will submit the license application to the U.S. Nuclear Regulatory Commission for the national high-level waste/spent nuclear fuel repository. Unfortunately, that is one fact that the DOE is unable to reveal—because at this point in time, there is no schedule for the license application submission (although we know it will not be during fiscal 2006 or 2007). There is the possibility that the DOE will be able to discuss schedules later this summer. But with the license application submission date up in the air, so is the date when repository operations might actually start.

To be fair, there are reasons the DOE cannot give a definite date for a license application. For one thing, the U.S. Environmental Protection Agency has not yet released its final radiation protection standard for repository operations after 10 000 years. The agency released the draft standard in mid-2005 but has said it may not finish the standard until the end of this year. In addition, the DOE announced in late October 2005 that it was changing direction in how it plans to operate the repository at Yucca Mountain, mandating that most spent fuel will arrive at the site loaded in canisters. Bechtel SAIC, the Yucca Mountain managing contractor, is still working on the details of the new operating process.

In view of these uncertainties, the DOE is focusing on discussing those aspects of the repository that it *can* talk about: the work to reaffirm the data on moisture infiltration at the mountain in the wake of some doubts about quality assurance issues with U.S. Geological Survey (USGS) data, the containerized mode of operation, the transportation program to support the repository, and the recent selection of Sandia National Laboratories as "lead lab" for the project. Government and industry representatives at recent conferences had much to say on these topics.

Infiltration Data

In March of last year, the DOE and the USGS revealed that several e-mails written by a USGS scientist in the 1998–2000 time frame questioned the accuracy of quality assurance documents associated with computer modeling of water infiltration and climate studies. The data involved estimates of how much of the precipitation that falls on Yucca Mountain reaches down to the repository level. The USGS had validated DOE conclusions that water seepage was relatively slow, making radiation escape less likely.

With the investigation into the situation still ongoing, the DOE undertook to reverify all the infiltration data independently, said Paul Golan, principal deputy director of the DOE's Office of Civilian Radioactive Waste Management (OCRWM), which is responsible for the repository program. Golan was speaking at the NRC's Regulatory Information Conference (RIC), held in early March in Rockville, Md. The department found analogous work on infiltration from around the country and verified that the USGS work was consistent with these independent studies. In addition, Sandia reviewed all the models, and independent scientists reviewed all the findings. The result of all this study, according to Golan, is that it has been ascertained that between 0 and 10 percent of the precipitation that falls on Yucca Mountain will actually infiltrate through to the repository. Because Yucca Mountain receives only about 200 millimeters (around 7 or 8 inches) of precipitation each year, the amount reaching the repository is considered negligible.

A Safer Approach for Operations

Golan also addressed the program's new canister approach, announced last fall, which represents a new direction for the repository. Under this new approach, most of the spent nuclear fuel will arrive at the Yucca Mountain site already loaded into Transport/Aging/Disposal (TAD) canisters. This approach takes advantage of the infrastructure in the private sector today, Golan said, and will improve safety and reliability at the site. It will be included as part of the license application.

Prior to the announcement of this new approach, plans had called for shipping spent fuel assemblies in various types of canisters to the repository, where workers would empty those canisters and place the fuel in special disposal canisters. The change frees the project from having to construct several multimillion-square-foot, multimillion-dollar facilities and reduces the potential hazards caused by the oxidation of bare spent fuel during handling.

Russell Dyer, the DOE's assistant deputy director for technical and regulatory programs at OCRWM, speaking at the recent Waste Management '06 conference in Tucson, said that only about 5 to 10 percent of the spent fuel arriving at the mountain will need any handling (fuel that for various reasons cannot be placed in canisters). At the RIC, Golan clarified this statement by saying that the 5 to 10 percent was the base case number they used in their study of what kinds of facilities would be needed under the new approach.

Dyer also noted that by 2055, if all currently operating reactors renew their operating licenses, the accumulation of spent fuel will total 130 000 metric tons.

Lead Lab Selection

On January 18, 2006, OCRWM announced that it was designating Sandia National Laboratories as its lead laboratory to integrate repository science work for the Yucca Mountain project. That work had previously been overseen by Bechtel SAIC. According to the DOE, "Designating Sandia as the lead laboratory will provide OCRWM with strong, centralized leadership for its science program and will increase technical credibility with the scientific community, as well as the project's regulators and stakeholders. As OCRWM's lead laboratory, Sandia will provide management and integration services for all Yucca Mountain scientific programs necessary. These services will support OCRWM's license application and its defense in the [NRC's] review process, including the allocation of funding and the assignment of technical tasks to selected supporting organizations such as other national laboratories, subcontractors, federal agencies, universities, and expert panels."

According to Paul Golan, Sandia was chosen in large part because of its "unique experience in managing scientific investigations in support of a federal licensed geologic disposal facility, having served in that role as the scientific advisor to the Waste Isolation Pilot Plant in Carlsbad, N.M."

The transition of responsibility in this area from Bechtel to Sandia will be completed this year, Golan said at the RIC.

Transport

Gary Lanthrum, director of the DOE's Office of National Transportation, also speaking at the RIC, highlighted several 2005 developments in the DOE Transportation program, including the decision announced in July to use dedicated trains for the transport of spent fuel once the repository is operational. Dedicated trains can bring efficiencies in the transportation effort, Lanthrum said. Railroads, like the airlines, use a hub system of routing, and at various hubs, cars are unhitched and rehitched, depending on their destinations, and some cars may sit at the hub for several hours or up to a day. A dedicated train, on the other hand, is sent directly to its destination, and cars do not have to remain at a hub to be switched to another train. Using dedicated trains thus saves time, and saving time in transit means the program may need fewer

Deep Background on a Deep Repository

The authorization for a U.S. deep geological repository for spent fuel and high-level waste came with the Nuclear Waste Policy Act of 1982 (NWPA), which authorized the U.S. Department of Energy to begin a search for a suitable site west of the Mississippi River for such a repository. In the following years, the DOE selected three sites for characterization, but Congress later cut the characterization list down to one, Yucca Mountain, in Nevada. The state of Nevada has been adamantly opposed to the repository ever since and has tried to thwart characterization and other scientific work at the site through any means they could think of.

The NWPA also authorized a second repository, to be located east of the Mississippi River. The DOE has begun studies on this second repository and must report to Congress between January 2007 and January 2010 on whether this facility will be needed. The framework of the NWPA to have at least two repositories, located in different parts of the country, was aimed at fairness and equity. Any state could end up being the site of a repository, so no state could feel it was unfairly selected.

The legal capacity of the repository is 70 000 metric tons uranium, divided between defense waste (7000 MT) and commercial spent fuel (63 000 MT). The actual physical capacity of the mountain is around 125 000 MT, according to some DOE experts. Other DOE personnel note that if additional portions of the mountain are characterized, the physical capacity could go much higher. However, Congress would have to change the law to allow for any disposal at the repository beyond the original 70 000-MT number.

A Yucca Mountain project scientist tests for water movement in rock inside Yucca Mountain.

transport casks, because the casks will spend less time on the trains, Lanthrum explained.

In another development in the transport program, in December the U.S. Department of the Interior signed a Public Land Order granting a land withdrawal along the Caliente corridor in Nevada. This land withdrawal gives the DOE a 10-year period to study the Caliente corridor, during which time the land cannot be sold for mining or mineral interests. Grazing rights, on the other hand, are not affected by the land withdrawal. (An earlier, two-year segregation of public lands along the corridor that had been granted in December 2003 was set to expire on December 29, 2005.) Lanthrum said once the studies are completed, the DOE will release the lands it does not plan to use and will apply for a right of way for the rest.

For 2006, Lanthrum said, the transport program plans to focus on completing the draft Nevada Rail Alignment Environmental Impact Statement (which it also hopes to issue in 2006), on developing options for accelerating transportation schedules, on continuing its work with state and Tribal regional groups, and on updating the OCRWM section of the *Radioactive Material Transportation Practices Manual.*

Meanwhile, the DOE is developing performance-based technical specifications for its TAD canisters and will be looking to make a decision to either procure a fleet of locomotives or to utilize locomotives supplied by the railroads. DOE modeling of railcar suspension systems with heavy loads has found that existing railcars can meet its performance standards. Requests for proposals for the conceptual design of the prototype cask, buffer, and escort railcars are pending, Lanthrum said.

Lanthrum noted in passing that as far as future transport schedules and routes go, optimum (that is, the most efficient) schedules and routes may not be possible to implement, because the scheduling and routing will be driven not by efficiency, but by the contracts that the DOE has with individual utilities.

National Academies Transport Study

In February 2006, the National Academies released a prepublication report on a study done to assess the risks of spent fuel and high-level radioactive waste transport in the United States. The report, prepared by a study committee of 16 experts, concluded that there were "no fundamental technical barriers to the safe transport of spent fuel and high-level waste in the United States."

However, the report continued, there are a number of social and institutional challenges to the successful initial implementation of large-quantity shipping programs. In addition, the committee was concerned about "malevolent acts" against such shipments and recommended an independent examination of transportation security before any large-quantity shipping campaign begins. Because of security clearance issues, the committee was not able to get adequate information to address the security situation.

In other sections of the report, the committee offers the following endorsements:

- Strongly endorses the use of dedicated trains for spent fuel/HLW shipments.
- Endorses full-scale cask testing as part of an integrated testing program. (In other words, "keep doing what you're doing," according to Kevin Crowley, director of the Nuclear and Radiation Studies Board of the National Academies, speaking at the RIC.) Full-scale testing to destruction, a demand of some Yucca Mountain opponents, is not required in a testing program, Crowley said.
- Endorses current regulations, which are described as "adequate to ensure package containment effectiveness."

The report issued some strong advice on improving spent fuel/HLW transportation. It stated that the DOE should negotiate with utilities to ship older fuel first to either a repository or an interim storage center, and if the negotiations prove unsuccessful, Congress should consider legislative remedies. Shipping older fuel first reduces exposures to transport workers, Crowley said. The report also suggested that the DOE initiate a pilot program involving relatively short, "logistically simple" movements of older fuel from shutdown reactors.

Finally, the report suggested that the energy secretary and Congress examine the following options for changing the organizational structure of the DOE's transport program to increase its chances for success:

- Create a quasi-independent DOE office reporting to upper-level management.
- Create a quasi-government corporation.
- Create a fully private organization operated by the commercial nuclear industry.

The prepublication version of the report can be read online at http://fermat.nap.edu/catalog/11538.html. The final version of the report is expected to be issued this June.

The Budget

Money has always been a problem for the repository program, which was supposed to be paid for by the Nuclear Waste Fund, which gets its money from a 1 mill/kilowatt-hour surcharge on nuclear-generated electricity. But Congress has been using the fund for other things for more than 20 years and now thinks of the money as its own, to do with as it pleases. Trying to get the fund to be used only for Yucca Mountain could prove very difficult.

For 2007, the repository program has requested a total of $544.5 million. Of this, $355.4 million would be for Yucca Mountain, $67.6 million would be for the Transportation program, and $121 million would cover Program Management and Integration/Program Direction. Money for the Integrated Spent Fuel Recycling project would come from the DOE's Nuclear Energy program, not the repository program. (In the fiscal 2006 allocation, the $495 million budgeted for the repository program included $49.5 million for the Spent Fuel Recycling project, leaving only around $450 million for the repository.)

The budget request allocates $156.4 million from the Nuclear Waste Fund and $388.1 million from the Defense Nuclear Waste Disposal program.

OCRWM is experimenting with new robotic technologies. Here, a robot, equipped with four video cameras and tank-like wheels, ascends a rock pile on the Yucca Mountain crest.

Legislative Impacts

In the end, the future of Yucca Mountain as a waste repository may not depend on work being done at the

A scientist conducts a hydrology experiment in niche #3 of the Exploratory Studies Facility (the underground laboratory inside Yucca Mountain).

Aerial view of the crest of Yucca Mountain.

mountain, but rather on work being done elsewhere, including Capitol Hill and the White House.

The Reid/Hatch Bill

Last December, Nevada Sens. Harry Reid (D) and John Ensign (R) introduced legislation (S.2099) mandating that spent nuclear fuel be stored onsite where it is produced and requiring the federal government to take responsibility for possession, stewardship, maintenance, and monitoring. It would require commercial nuclear utilities to transfer spent fuel from pools into dry storage casks within six years after enactment or six years after it is released from the core, whichever comes first. The DOE would have to take title to all spent fuel currently in onsite dry cask storage within 30 days of enactment. Expenditures from the Nuclear Waste Fund would be used to compensate the utilities for expenses associated with transferring, storing, and securing the waste. Under this legislation, the need for a nuclear waste repository would be eliminated, according to Reid and Ensign. The law is needed, according to bill cosponsor Sen. Robert Bennett (R-Utah), because varying state laws make onsite dry storage difficult or impossible for some plants.

The bill makes no direct mention of the Yucca Mountain repository; Reid, however, in his press release describing the bill, noted that "conclusive evidence has shown that the Yucca Mountain project is fraught with safety, scientific, and budgetary problems, making it a near certainty that the site will never be approved for use."

In addition to Bennett, Sen. Orrin Hatch (R-Utah) is also cosponsoring the legislation. Utah is facing the possibility of interim spent fuel storage in the state, in the wake of the NRC's granting a license to Private Fuel Storage LLC to operate an away-from-reactor dry fuel storage facility. Companion legislation was introduced in the House of Representatives by the Nevada and Utah delegations.

Congress is expected to debate the bill later this year. The nuclear industry, which terms the legislation the "back to square one" bill, is actively opposed.

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The DOE-Domenici Bill

Through the DOE, the administration is proposing legislation that would lift the 70 000 MT storage limit on the Yucca Mountain repository. Other features of the legislation would dedicate the money in the Nuclear Waste Fund to the repository project, and would allow federal officials to preempt state and local transportation regulations in their spent fuel and waste shipment program. At press time, the bill was to be introduced in the Senate by Energy Committee Chair Pete Domenici (R-N.M.). Domenici has stated that because the DOE bill does not include provisions for an interim storage facility where spent fuel could be stored until the repository is operating, he may introduce his own bill covering that aspect.

In the short legislative session this year (due to the November elections), the bill faces a fight from Sen. Reid, who has already declared it dead on arrival.

Advanced Fuel Cycles

The movement to advanced fuel cycles, particularly as is expected to be outlined in President Bush's Global Nuclear Energy Partnership (GNEP), could change the role that Yucca Mountain plays in the future.

GNEP has four main goals:

- Reduce America's dependence on foreign sources of fossil fuels and encourage economic growth.
- Recycle nuclear fuel using new proliferation-resistant technologies to recover more energy and reduce waste.
- Encourage prosperity, growth, and clean development around the world.
- Utilize the latest technologies to reduce the risk of nuclear proliferation worldwide.

The GNEP strategy includes building a new generation of nuclear power plants in the United States, developing and deploying new nuclear recycling technologies, working to effectively manage and eventually store spent nuclear fuel in the U.S., and designing advance burner reactors that would produce energy from recycled nuclear fuel.

Under GNEP, commercial spent fuel would be recycled so that transuranic elements would be consumed, not disposed of as waste. Residual waste fission products would be reconfigured for disposal at a single geologic repository. GNEP would provide three improvements to spent fuel disposal at a repository: significantly reduce the volume of waste, enhance thermal management by reducing the waste form heat load, and reduce the amount of long-lived radionuclides requiring disposal. According to the DOE, with recycling and spent fuel management, the planned geologic repository at Yucca Mountain has the technical capability to accommodate all the U.S. commercial spent fuel that has been or will be generated by U.S. nuclear power plants over their lifetimes, deferring the need for additional nuclear waste repositories until the next century. ■

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