James Conca: On WIPP and other things nuclear

A science center in New Mexico that monitors radiation in the environment within a 100-mile radius of the WIPP repository has found no detrimental effects from WIPP's operation.

James Conca is the director of the Carlsbad Environmental Monitoring and Research Center (CEMRC), a division of the College of Engineering at New Mexico State University. The center is housed in a 26 000 ft^2 structure that includes environmental and general radiochemistry laboratories, a special plutonium-uranium lab, an *in vivo* bioassay facility, mobile labs, computing operations, and offices and classrooms. A wide range of environmental and radiochemistry work is performed at the facility, including characterization, monitoring, and feasibility studies in support of performance assessment, radiological and environmental training and education, subsurface flow and transport experiments, research related to nuclear energy, and investigation into homeland security issues, particularly those dealing with radiation dispersal devices.

Conca: "WIPP is merely the best repository for anything that exists, including nuclear waste."

CEMRC, located in Carlsbad, N.M., constantly monitors the environment around the Department of Energy's Waste Isolation Pilot Plant, the world's only operating deep underground geologic nuclear repository. At WIPP, defense-related transuranic radioactive waste is placed in rooms excavated 2150 feet underground in a 2000-ft-thick salt formation that has been stable for more than 200 million years. Because the salt is somewhat plastic, it flows to seal any cracks that develop.

WIPP began operating in March 1999, and operations are expected to continue beyond 2020, with active monitoring continuing for another 100 years. The site is managed by Washington TRU Solutions (WTS), with Los Alamos National Laboratory (LANL) and Sandia National Laboratories (SNL) providing technical assistance.

In addition to environmental monitoring, CEMRC provides support to WIPP, LANL, SNL, and WTS through site monitoring, *in vivo* bioassay, and laboratory support.

Conca took an indirect path to becoming the director of CEMRC. He began his career as a planetary scientist and was doing post-doctoral work for the National Aeronautics and Space Administration and the National Science Foundation when, in January 1986, the fateful *Challenger* accident occurred. His job with NASA was eliminated, and he started working at the DOE's Pacific Northwest National Laboratory (PNNL), in Richland, Wash., in waste management because, as he explains, "My thesis dealt with work on chemical alterations of different rock types such as basalt and tuff."

While at PNNL, Conca and another scientist, Judith Wright, who eventually became his wife, developed a characterization method for rock and soil that quickly measures permeability, aqueous diffusion, and other transport properties. The DOE convinced the two scientists to start a spin-off company to sell the service, as well as the instruments they had developed. That company, owned by Wright, is still in existence today.

From Richland, Conca moved on to LANL, in New

Mexico, to work on projects for the DOE's proposed Yucca Mountain spent fuel and high-level waste repository program in Nevada. When a project manager moved from LANL to Carlsbad in 2000 to work on the WIPP repository program, Conca and about 40 other scientists followed. CEMRC had been monitoring WIPP since 1993 (which was before the repository opened), and Conca explored the possibility of LANL's using some of CEMRC's radiochemistry facilities. When the director's position there opened up in 2004, he applied for the job and got it.

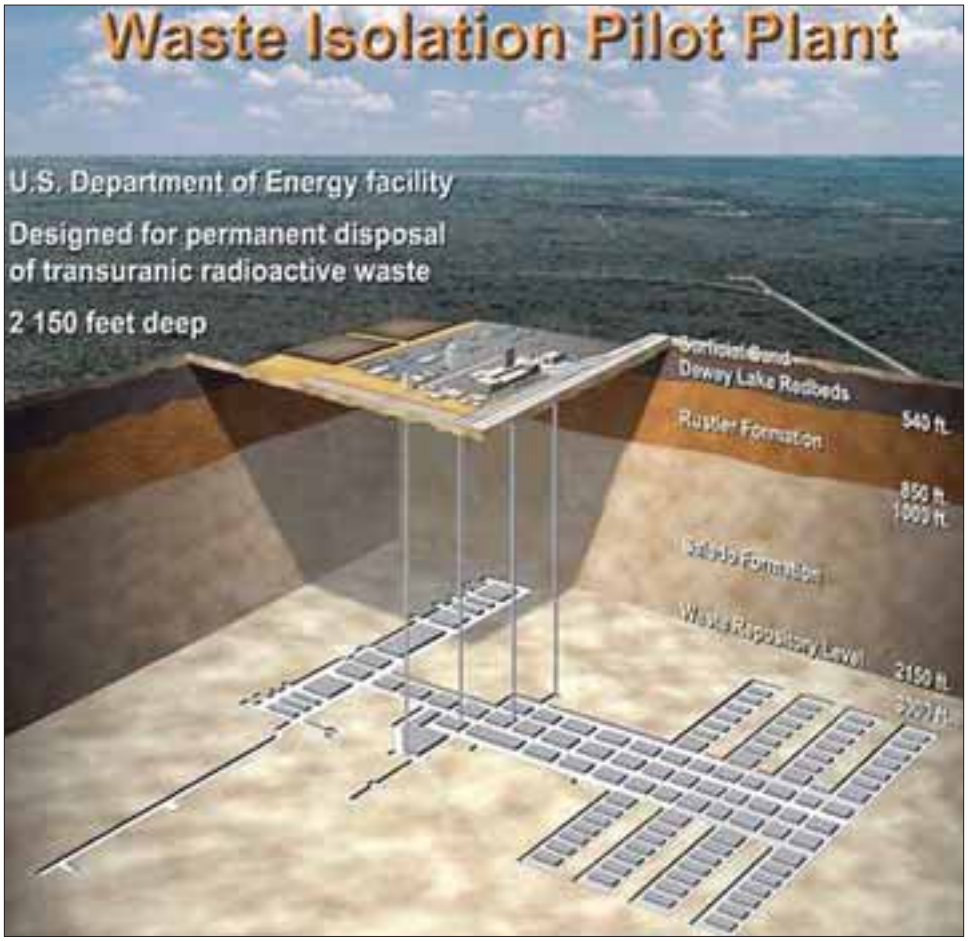
Recently, Conca and Wright collaborated to write a book, *The GeoPolitics of Energy: Achieving a Just and Sustainable Energy Distribution by 2040,* which is available on Amazon.com (*NN,* Jan. 2008, p. 9). The objective of the book is to raise awareness of the global issues surrounding energy availability and cost, the environmental effects of CO_2 emissions, and the politics that drive energy production and consumption. A key conclusion of the book is the necessity for nuclear power to increase several-fold worldwide in order to have any chance of addressing the looming global environmental and economic crises.

In this interview, Conca talked with Rick Michal, *NN* senior editor, about the book and his views on the WIPP and Yucca Mountain projects.

How did you get the idea to write a book?

Before I even arrived at WIPP, I thought that no one outside the DOE really knew anything about the repository. That's where the idea for the book came from. It started with tours of WIPP for schoolteachers that my wife, Judith, and I were leading. As part of each tour, we gave a lecture on nuclear technology, and the feedback was very positive. So we put together some lectures on energy in general, comparing nuclear with other alternative energy sources. I even gave a lecture at a petroleum geologists' meeting last year in Los Angeles. There were about 100 oil men sitting in front of me, saying, "Yeah, we need more nuclear."

When the facts are presented well, there is no doubt that the world needs nuclear power. Nuclear gets a bad rap primarily because of its association with weapons. When I talk with people, even educated ones, I realize that most of them have no idea that nuclear fuel cannot go off like a nuclear bomb. With serious information gaps like that, we realized that we needed to write a book to address energy-related issues.



The Waste Isolation Pilot Plant, the only operating deep geologic nuclear waste repository

The book also has a sociopolitical bent to it.

That's right. No one else has talked about how intertwined science and sociopolitical issues are—and I think this is unique to our book. One example: In order to basically solve war, poverty, and terrorism, the world needs to provide about 3000 kilowatt-hours per person each year to all humans. Can this be done? It certainly will be difficult and will involve a concerted global political effort unlike anything seen before.

All of the Western industrialized countries are "energy fat" and will dislike having to increase conservation and efficiencies. In the United States, for example, we're at 16 000 kWh per person per year, while Pakistan and India are at 500 kWh per person per year. If the United States, Canada, Japan, and the other industrialized nations get back to about 6000 kWh per year per person, which is close to where England is now, it would save a few trillion kWh per year overall. For the roughly 9 billion people that will be alive in 2040, however, raising 7 billion of them up to a reasonable standard of living—which is 3000 kWh per person per year—will require about 21 trillion kWh per year.

Adopting conservation measures and increasing energy efficiencies in the developed world could bring the 1 billion people now above 8000 kWh per person per year down to 6000 kWh per person per year, or about 6 trillion kWh per year total. If the remaining 1 billion stay at about 3000 kWh

per person per year, then the total power consumption would be leveled at 30 trillion kWh per year, a little lower than what most projections predict based on simple demographics.

This is a lot of energy—twice what the world uses now, three times the amount that fossil fuel produces today—and most of it will come from fossil fuel unless we are very proactive and innovative. These larger issues are what need to be understood. Unfortunately, most Americans seem to put too much stock in technology as a fix for all problems and think things such as a better solar cell will solve everything.

It's an interesting paradox because, as your book mentions, by 2040 we would need 1700 nuclear power plants around the world, but there is a certain segment of society that would fight that idea.

They would, and they are the ones who think they are helping the planet. They have to realize that there is almost nothing we can do to keep CO_2 levels from getting out of hand. We'll never reverse it, and we'll be lucky if we cap it where it is now. The fact is that CO_2 levels are going to increase, and if we're smart we can keep the increase to a minimum. By 2040, we're going to have to produce 10 trillion kWh per year each from renewables and from nuclear just to keep fossil fuel use and CO_2 levels from rising, but even the American Council on Renewable Energy doubts that we can get 4 trillion out of renewables that fast. If we don't get to 10 trillion each from renewables and nuclear, however, then fossil fuel use is going to more than double. If that happens, then CO_2 levels will exceed 800 parts-per-million in the atmosphere, something all climate modelers feel is disastrous. There is no way around it unless we accept upfront that nuclear can produce the needed energy without producing CO_2. Otherwise, we're stuck.

WIPP's history is a testament to its safety. Waste has been shipped here for nine years, and 250 000 drum-equivalents of nuclear waste have been placed in the ground without incident.

Could you talk about CEMRC's relationship with WIPP?

The funding for CEMRC comes from a DOE grant, and we act as the independent environmental monitor of WIPP. We monitor air, water, soil, and people. CEMRC has some of the best radiological monitoring capabilities in the world. Using our whole-body counter, we can statistically see, for example, if someone is an extreme sports person from the increased potassium-40 in their muscles, or a smoker, because of the increased uranium and cesium-137 from tobacco that get deposited in the lungs from smoking. We monitor everything in the environment within a 100-mile radius of WIPP, and have been doing so from before WIPP opened, up to the present day, nine years after WIPP's opening. And, of course, there is no detrimental effect from WIPP. We can't even see that WIPP exists. That's important to show the public, because a lot of the people living around here and elsewhere in New Mexico thought they were going to become radioactive from WIPP.

WIPP is not perfect, but it does have the best safety record of any endeavor in the history of the world.

Let's talk about WIPP and Yucca Mountain.

Having worked on both projects for many years, I think I have a unique perspective. The issue is that they are both incredibly political, and Yucca Mountain specifically is bound up with the whole business of recycling. If the United States and the world don't recycle nuclear fuel, after 300 years or so nuclear fuel will run out. But if we do recycle, fuel will be available for thousands of years, and nuclear waste itself will be less of a problem. Even plutonium can be burned in fast reactors instead of being disposed of. What would be left would be cesium, strontium, and other products, which could be stored for 200 to 300 years until they are no longer a radiation hazard and then disposed of, or used in other ways such as for the irradiation of food and medical supplies.

WIPP is merely the best repository for anything that exists, including nuclear waste. The repository consists of bedded salt, more massive than almost any other salt deposit in the world. From a geologic standpoint, the area is tectonically quiet, there are no fractures or folds in its structure, and there would be nothing of consequence that could happen there for 200 million years. DNA has even been sequenced recently from organic material found in fluid inclusions of 230-million-year-old seawater in the salt. No other site has ever been demonstrated to be more stable than WIPP.

What makes WIPP so stable?

It's the creeping salt. When waste is put into WIPP, the salt creep-closes slowly, embedding it in a system that has almost zero permeability or diffusivity over millions of years. The salt creep-closes several inches per year, depending upon the shape of the opening. In 15 years, the rooms with the waste packages are closed. In 1000 years, they are completely sealed back to the properties of the undisturbed salt.

WIPP is perfect for any waste as long as the goal is to get rid of it for good. As long as we do not recycle, however, any repository for spent fuel has to have a retrievability option, and that locks us into a hard-rock repository for spent fuel. To address our energy future, recycling must occur, and the law has to be changed so that the United States can recycle. The recycled waste could then go into WIPP, as it is quite similar to the remote-handled waste presently going into WIPP. Right now there is an arbitrary designation that WIPP can accept only defense-related waste. There needs to be a large political change going forward, hand-in-hand with the adoption of nuclear power as a major energy source for the future.

Yucca Mountain is a hard-rock repository rather than one based in salt. What are Yucca Mountain's problems when compared with WIPP?

Yucca Mountain is dependent on its engineered barriers. A storage canister for waste has to be built to last a long time, and it requires the additional performance of engineered backfill and other materials that must perform inside Yucca Mountain for 10 000 years or more. It's doable, but it's difficult to convince anyone that an engineered system is going to be built to last that long. WIPP, on the other hand, doesn't depend on any engineered barriers. We just put the waste inside and leave it alone.

Why has WIPP been operating efficiently and quietly for nine years now, and yet no one

seems to be saying positive things about it?

I think that's because WIPP has worked so well, and no one wants to mess with success. If WIPP is given a high profile, there's more pressure to keep things near perfect. Any misstep can be viewed negatively. For example, if someone at a nuclear facility falls off a ladder, some would view it as a nuclear accident. On the other hand, WIPP's success should be used to inform the public that nuclear is safe and economically feasible, and that it is there when the public finally realizes that nuclear energy must play a more prominent role in saving this planet.

Why haven't opponents been railing against WIPP and the waste shipments?

They aren't now, but they had been. For the first shipment to WIPP in 1999, people were lining the streets. They were going to lie down in front of the truck to keep the radioactive material from entering the site. But WIPP's history is a testament to its safety. Waste has been shipped here for nine years, and 250 000 drum-equivalents of nuclear waste have been placed in the ground without incident. Still, one or two opponents always come to the various public meetings. It's to the point where they're waiting for us to mess up. WIPP is not perfect, but it does have the best safety record of any endeavor in the history of the world. It's hard to argue with that.

What do you think the future holds for Yucca Mountain?

It's important to understand that the DOE is proceeding with Yucca Mountain because it is legally obligated to do so. The Nuclear Waste Policy Act of 1977 mandates a permanent repository. If the United States changes the law to say that we're going to recycle, there would be no need for a retrievable waste repository in hard rock. The idea that we're going to dispose of spent fuel in a once-through fuel cycle must change.

Would Yucca Mountain then be used as a cooling center for spent fuel?

Yes. Yucca Mountain could be useful in many ways if the United States is going to embrace nuclear as one-third of its energy source. The politics have to change so that we look to the long term, and policy has to include recycling and repositories such as WIPP and facilities like Yucca Mountain.

It will be interesting in the next few years because the political landscape will likely change.

That's what is so strange. Both parties are quite misinformed on nuclear. I hope the next administration will be willing to do its homework and take the hard look that is needed on all energy fronts. NN