THE *NUCLEAR NEWS* INTERVIEW

Tom Sanders: Great expectations for small modular reactors

Nuclear News checks in with Tom Sanders, associate laboratory director for Clean Energy Initiatives at the Savannah River National Laboratory, to get his take on the current status of the small modular reactor movement.

When *Nuclear News* last talked with Thomas Sanders (*NN,* July 2009, p. 85), on the occasion of his taking office as the 2009–2010 ANS president, he was manager of the Global Nuclear Futures Initiative at Sandia National Laboratories in New Mexico and an ardent believer in the importance of developing small modular reactors (SMR)—"right-sized reactors," he called them—as a way to help the United States regain a place of prominence in the global nuclear manufacturing business.

Sanders is no longer with Sandia—in late 2010, he moved some 1600 miles across the country to take the position of associate laboratory director for Clean Energy Initiatives at Savannah River National Laboratory (SRNL), near Aiken, S.C.—but he remains a dedicated supporter of SMR development.

The past few years have seen a good deal of activity on the SMR front, and it's looking as though Savannah River is the place to be for an SMR enthusiast like Sanders. Just this year, the Department of Energy, SRNL, and the Savannah River Site (SRS) entered into separate public-private partnerships with three SMR-design developers—Hyperion Power Generation Inc., NuScale Power LLC, and SMR LLC, a Holtec International subsidiary—to explore the possibility of using SRS land for the privately funded deployment of their SMRs (*NN,* Apr. 2012, p. 23). Sanders spoke with *NN* Associate Editor Michael McQueen regarding the current prospects for SMRs.

Sanders: "I see a bright future for SMR technology and the enterprise that will provide the systems."

How did you go from working in nonproliferation in New Mexico a few years ago to small modular reactors in South Carolina?

That's a good question. One of the things that concerned me most in the nonproliferation area was the fact that the United States had lost a lot of its ability to export nuclear goods and services under U.S. export licenses. That's important to nonproliferation, because it's through negotiations with other countries' export controls of nuclear technology that a lot of our goals regarding proliferation risk management are met. By that I mean that if you're not exporting anything, you're not negotiating anything, and you're not really establishing a standard for safety, security, and proliferation risk management around the world. Then we evaluated how to regain some of that capability, and small modular reactors became obvious for two reasons. One is that you could probably speed up the construction and licensing process by factory manufacturing and turn them out much more quickly than large reactors.

The Savannah River National Laboratory, the applied research and development laboratory at the DOE's Savannah River Site.

And the other is that for emerging nations, most developing countries could not absorb large nuclear systems, and smaller systems would be more acceptable to them and more affordable. They may cost a little more per megawatt, but the capital costs—the upfront costs—would be significantly less. In addition, the economy of scale you possibly get with a large plant doesn't make any sense if you can't afford it.

Did you pursue this position at SRNL, or did the DOE finally realize that SMRs might have a bright future and come to you and say, "You're a proponent of it, so why don't you do something with it?"

We were pursuing SMR technology at Sandia National Labs, from where I recently retired. We were primarily evaluating enabling technologies—licensing strategies, supercritical CO_2, power conversion systems, advanced manufacturing, those kinds of things. What the Savannah River Site offers is a place that can use SMRs and an infrastructure that needs the power and other services that you could gain from them. In other words, the Savannah River Site could be a major market initiator for SMRs. And that's critically important. In fact, the first nuclear systems, developed early in the 1950s, were achieved because the Department of Defense became the market initiator, using nuclear power for submarines and some other basic applications for the Army. And ultimately, that evolved into a commercial capability that then built hundreds of nuclear power plants around the world, based on Westinghouse, General Electric, Babcock & Wilcox, and Combustion Engineering concepts.

Today, large industrial sites like Savannah River that need power and other services, such as steam and possibly neutrons, can afford to enter into agreements for purchasing those services that would allow these small reactor vendors to acquire the capital necessary to build the first-of-a-kind system. I was recruited to help lead the SRNL effort.

How would you characterize the prospects for SMRs currently? Are they promising? Are they proceeding as you thought they would a couple of years ago when you were still at Sandia?

A couple of years ago, I was president of ANS. As part of my tenure, one of my goals was to advance the visibility and opportunities for SMRs. I'm very pleased with the prospects for them at this point in time. The DOE has initiated a congressionally sponsored federal opportunity announcement (FOA). Proposals are being sent in by several light-water reactor vendors to partner with the government in the design and licensing of the first two designs. Sites like Savannah River and others are stepping up to the plate and saying, "We will do our part by providing a market for these first-of-a-kind systems so that they can achieve the financing necessary to get started." All that is good news. SMRs are also starting to become more and more obvious as a serious concept for the global community. There are many countries, such as Jordan and others, that are interested in the SMR concept. I see a bright future for SMR technology and the enterprise that will provide the systems.

What can the Savannah River Site offer to a company to help advance the development of the SMR design?

The Savannah River Site is basically a large nuclear site. It has virtually every part of a fuel cycle except high-level waste disposal and operating reactors. At one time, five large reactors were operated at Savannah River. It has waste management facilities. It still has significant state-of-the-art materials laboratories and industrial facilities for used fuel inventory. We have fuel on site that probably has a value of $2 billion to $3 billion and can be processed for a fuel resource for the first SMRs. We have a well-characterized site that is seismically stable and has already been certified many times for nuclear operations. We have an existing security perimeter that is 300 square miles and an existing infrastructure that supports new reactor systems, such as cooling water systems, power grid lines, and a rail and highway transportation network. The local community is used to seeing nuclear shipments around the site. We have a very supportive local community and state. We have the necessary environmental permits, and we have a very experienced, nuclear-trained workforce. Five of the largest current nuclear construction projects in the United States are on site, across the river, and down the road about 50 miles. A new mixed-oxide (MOX) fuel manufacturing facility is under construction on our site; the Vogtle plant is right across the river; and we have the Savannah River National Laboratory, which is the U.S. center of excellence for all aspects of the nuclear fuel cycle and nuclear chemical engineering technology. We have many other electrical consumers in the region and the support of several utilities.

If it's decided that SMRs will be built at Savannah River, will this be done with the full oversight of the Nuclear Regulatory Commission, or does the DOE's legal authority to operate its own reactors allow for less NRC regulation?

Continued

They will be licensed with full oversight by the NRC and will be operated by private industry on the basis of multiyear service contracts.

Does Savannah River apply for the NRC licenses or do the SMR developers apply?

The designs are certified by the NRC, and the certificates will be owned by the SMR developers.

When the Savannah River Site entered into agreements in 2010 with Hyperion Power and GE Hitachi, it was stated that the kind of SMRs that interested Savannah River most were those that consume legacy material. The more recent agreements, however, have included designers of integral pressurized water reactors, which would operate on a conventional fuel cycle. Are legacy material burnup and footprint reduction still seen as potential missions for SMRs?

Absolutely. The new MOX facility will manufacture mixed-oxide LWR fuel. All of the light-water SMR designs could accommodate the MOX fuel that will be coming out of that system. And the legacy material that is going into that MOX is all the plutonium that we are already receiving as a result of arms-control treaties. The startup fuel could also include some of the enriched uranium that we're receiving from all over the world as part of our nonproliferation "take back" agreements. The United States is bringing back high-enriched research reactor fuel forms and substituting low-enriched forms. That high-enriched fuel can be downblended in our processing factories and converted into the lower enrichment needed for LWRs.

The DOE's cost-sharing opportunity would be limited to, at most, two SMR designs. Would the Savannah River Site be limited to working only with the one or two designs backed by the DOE, or would developers of other SMR designs still have opportunities at Savannah River?

All U.S. designers will have opportunities at SRS. Our strategy was established independent of the DOE and FOA process. In fact, we had discussions with eight different SMR designers. A few intend to proceed with or without the DOE funding, and we're open to the opportunity and are willing to help. There are also several fast reactor designs being pursued that are not included in the LWR FOA. The market opportunities are becoming very apparent to virtually all designers, and several will likely proceed. The DOE can fund only a part of the design and licensing process, and some of these systems could accrue development costs in the $1-billion range. Regardless of which designs go through the licensing process first, all will learn from the process as observers of a predominantly open and transparent activity.

In offering assistance to SMR developers, would the site give priority to companies that have U.S. majority ownership?

I don't think I'm the one who is sufficiently knowledgeable to answer that question, but I can give you my opinion. One of my goals as ANS president was to help reestablish a U.S. capability for exporting nuclear goods and services. Does that mean we wouldn't include a foreign owner? My preference would be that foreign developers would manufacture their systems in the United States and export those systems under U.S. laws. My goal is to rebuild extensive manufacturing capabilities here in the United States.

Recently, both Generation mPower and Holtec announced higher peak power levels for their SMRs, and Westinghouse's SMR would be rated even higher. Are companies moving away from the earlier concept of several very small modules linked to a single structure and control room? And if so, is this because of NRC concerns over that concept?

You would have to ask the NRC the second part of that question. I don't see any reason for concern over the smaller systems. B&W's mPower, NuScale, Holtec, and Westinghouse are all also focused on the domestic market, and they're evaluating the market in terms of the power they can generate and still be small enough to accrue the advantages of being small. The NuScale design, for example, is a modular concept, but it can grow to several hundred megawatts in size.

I do believe that the smaller systems are quite appropriate, because there are some very small markets that need a 50-megawatt range. The developing world, specifically, is where those small markets are that will find reactors of 100 MW or less more accessible. One of the larger potentials in the U.S. domestic market is the replacement of old coal plants that are in the 200- to 300-MW range. That's another incentive for building something that you can plug right into a grid infrastructure that's already set up for that capacity.

Four new power reactors are under construction not far from SRS at the Vogtle and Summer sites. If these reactors all enter service, will the Savannah River Site need its own generating capacity?

The utilities are investing in these large systems based on their current market. Savannah River has always generated its own electricity. We had a coal plant that we took out of service a while back and replaced with a biomass plant. What we're using in excess of that is coming from our local utility. The opportunity to develop more power and, of course, to provide an incentive for SMR development is what's driving us in this particular case. The MOX plant coming on line is going to require more power. We're not competing with our local utilities, because those utilities are going to be probable operators for these systems. They're going to be selling the power. Anything in excess they'll just sell outside and, quite frankly, economic development in large-scale manufacturing that consumes power doesn't happen unless the power is there. We're not competing with the utilities, because the utilities are our sponsors. Those utilities operate a lot of coal plants that they'll need to shut down, and they may have other at-risk systems. All of this together gives them a lot more flexibility in their current capacity. By the way, South Carolina has seven operating nuclear power plants.

Would SMRs at Savannah River be used for the testing of fuel from the MOX fuel fabrication facility?

They could ultimately be used for several testing scenarios. Several large reactors operated by the Tennessee Valley Authority and others are also capable of using MOX fuel.

There was talk in the past that the Department of Defense would be interested in SMRs to provide energy independence for some of its sites. Does that talk still hold true?

DOD is required to reduce greenhouse gas emissions by up to 20 percent within a short period of time, and also to secure power sources, depending on the particular mission. We're currently in discussions with several military installations up and down the Carolina corridor, and their interest is twofold: satisfying a clean energy mandate and having access to a secure source of electricity.

Regarding U.S. nuclear manufacturing capability, have companies stepped up to say they want to be part of SMR parts and components development?

Absolutely. We've seen a real interest by a number of companies that want to be part of these projects. We recently participated in a very large SMR conference in Columbia, S.C., and we had a topical meeting at the last ANS conference that drew quite a crowd, including a lot of the parts and components industry that currently exists in the United States and now performs quality nuclear work for the Navy. Most of those components are still manufactured in this country. So yes, there is a lot of interest. We are regaining our N Stamp–qualified capabilities because the MOX plant requires all of those standards to be met. The MOX plant is going to be licensed by the NRC, and as part of that, a lot of supplier capability has been developed in the United States that will also be applied to these small reactors. NN