establish a clear path forward for PBMR and high-temperature gas reactor licensing in the U.S. PBMR also hopes to work with NRC to clarify which issues identified in Exelon's pre-application work—before the company dropped out of the PBMR consortium—are still relevant to a renewed certification effort, as well as identify any new issues.

Using South Africa's Experience

The first demonstration PBMR has been launched in South Africa, Wallace said, explaining that more than 700 people already are working on the project, which will be built at Koeberg, the site of South Africa's only nuclear power plant.

Basic design of the Koeberg plant is being completed and detailed design work has started. PBMR has submitted a revised environmental impact assessment and is completing an updated safety analysis report. The company also is in the process of placing contracts with key suppliers for critical components.

Wallace detailed the firm schedule for the Koeberg plant to enable the NRC to track progress there as part of its licensing considerations. Key milestones are:

- Site access, 1st quarter 2007
- Construction excavation starts, 3rd quarter 2007
- Fuel loading, 3rd quarter 2010
- Plant turnover to client, South African utility Eskom, 3rd quarter 2011

Test Facilities

PBMR also is continuing with a comprehensive test program to provide technical and licensing support for this first-of-a-kind modular high-temperature reactor.

The ASTRA facility in Russia is validating the accuracy of control rod calculations and has constructed a mock-up of the porous central reflector.

Later this year, PBMR will begin operating the world's largest high-temperature helium test facility (HTF) in Palandaba. Wallace described HTF as the equivalent of a 12-story building. It is a non-radioactive facility the same height, and operating at the same temperatures and pressures as the PBMR vessel. It will be used to test maintenance, reliability and operability of the PBMR design, as well as for code validation.

A university-based heat transfer test facility will be used to validate thermo-hydraulic properties of the pebble bed.

A fuel test facility will be used to assure manufacturing standards for the fuel pebbles meet the same quality standards as the German prototype and a plate out test facility will be used to confirm fission product transport in helium systems. POTF also will be able to test the dynamic effect of depressurization.

Wallace and other plant officials acknowledged the PBMR is using a body of German data from its pebble-bed reactors dating back 25-30 years, validating the data, and determining where new data is needed to meet current regulatory requirements.

Constant Refueling

Rather than discrete refueling outages, the pebble bed reactor will refuel constantly on-line. Waste pebbles will be stored in below ground beneath each reactor module.

In order to volume reduce for long-term storage, PBMR is working with the EU's MINWASTE program to develop techniques to separate the coated fuel particles from the surrounding tennis-ball sized graphite spheres, and consolidate the fuel granules, Wallace said. The pea-sized fuel granules will be dissolved with organic fluid to remove remaining graphite, and then be embedded in a matrix for long-term storage.

PBMR will meet with NRC again March 15-16 to discuss safety design and analysis, plant operations, and events.

Locals Reach Into Pockets to Boost Gen-IV Reactor Initiative

By Nancy E. Roth

Deep in the heart of old Texas oil country, a path-breaking high-temperature helium-cooled reactor is going up, if all goes according to the plan of General Atomics, the University of Texas System and the University of Texas of the Permian Basin (UTPB) in Odessa. The three inked an agreement last week to produce a pre-conceptual design for a next-generation research reactor they are calling the HT3R—High-Temperature Teaching and Test Reactor. General Atomics, which has been designing high-temperature reactors for years and recently consulted on the construction of one such reactor in Japan, will manage the design effort.

One unique element of the project is the remarkable support it has received from three municipal governments in the region where it will be built. The towns of Midland and Odessa, along with the town and county of Andrews, have contributed $500,000 apiece, a total of $1.5 million that constitutes half of the $3 million initial funding needed. Andrews County will host the reactor and associated research facilities.

The agreement also names several project "collaborators," including the Arlington, Austin, Dallas and El Paso branches of the UT System, plus Thorium Power, Inc., which will take a consultative role and contribute funding to the project. The document also assigns a prominent advisory role to local leaders.

The HT3R will use the same technology that scientists at the Idaho National Laboratory are pioneering in a demonstration-sized high-temperature commercial reactor. Both reactors are based on a General Atomics design. The team expects that the research reactor will serve as a prototype of the reactor technology that will complement and support the INL project.

Benefits and Costs

Jim Wright, who directs UTPB research efforts in the project, told *FCW* that the new facilities would attract researchers from all of the involved UT branches and provide an impetus for the development of a nuclear engineering program at UTPB. The facilities will include a radiation laboratory for testing and developing new fuel cycles and fuels; a high-temperature materials-and-process laboratory for R&D on new synfuels and hydrogen; and a high-efficiency energy transfer lab for Brayton-cycle work. Wright said that once the pre-conceptual plan is done the team will seek additional funding for engineering, licensing, construction and operation of the reactor.

We're going to look [for funding] under every rock. But what we do believe is that you just can't go anymore, with a large facility like this, to the government and say, give us all the money. You've got to find many customers in the government, and I think you've got to bring [into the project] a heavy-industry presence."

—Jim Wright, Univ. of Texas of the Permian Basin

Wright said that some of those funds, perhaps as much as 25 percent, should come from "heavy industry," i.e., private-sector organizations that will benefit from the technology research. "The balance will be paid not just by the Department of Energy, but by the Department of Defense, and in fact we're sizing the reactor to meet Department of Defense needs," he told *FCW*. "We're going to look [for funding] under every rock. But what we do believe is that you just can't go anymore, with a large facility like this, to the government and say, give us all the money. You've got to find many customers in the government, and I think you've got to bring [into the project] a heavy-industry presence."

The team is already at work on the project, said Wright, and by August will have all the technical work on the pre-conceptual design completed. He emphasized that the pre-conceptual design will include a business plan laying out financing for the construction and operation of the facilities, and an academic plan describing how the university will use the facilities to jump-start its incipient physics and engineering departments. The engineering, licensing and construction should be completed by the end of 2012, he added.

A Nuclear-Friendly Corner of Texas

West Texas once bustled with engineers and scientists who had moved in for the high-paying industry jobs during the first oil-boom era. But of late oil companies have been shipping their staff out, as the industry has centralized and the most accessible oil reserves have waned. Civic leaders in the area had for some time sought to reverse that trend, and so when David Watts, president of UTPB approached them with a proposal to build a state-of-the-art nuclear facility that would draw energy and technical researchers back to the area, they were immediately receptive.

Watts, a sociologist by training, had seen that the needs of the region dovetailed with the needs of his university, the smallest branch of the University of Texas System. The reactor and accompanying facilities would create a significant research opportunity that could not only grow the university but expand the regional economy as well.

"These communities think this is of benefit to the area," Watts told *FCW*.

As Watts built community support, Wright connected with Michael Campbell, a senior vice president at General Atomics. Wright said GA officials were initially skeptical of the project, partly because of the obstacles to building a reactor in the U.S., and partly because of UTPB's lack of background in nuclear engineering. But after visiting the university and meeting some of the community-based backers of the project, they decided to sign on.

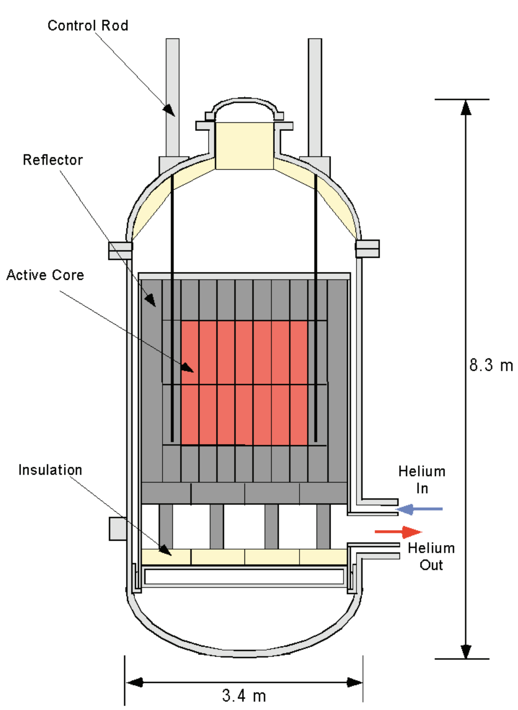
"The people in Texas…at UTPB and the UT System, and the people in Andrews, Midland and Odessa, have been … very proactive," Campbell told *FCW*. "They understand what it is to live in an energy area."

General Atomics Modular Helium Reactor

The proposed HT3R is one within a class of modular helium reactors that General Atomics developed decades ago, but never managed to bring to fruition in the U.S. because of the vicissitudes of the nuclear industry. Yet the helium-cooled high-temperature reactor technology has attracted interest elsewhere in the world because of its many advantages, including:

- High-temperature capability: Because the reactor can produce process-heat temperatures of 950 degrees and higher, it provides a highly efficient conversion mechanism for many forms of energy, including electricity, hydrogen and synfuel generation;
- Passive safety: Safety-related core-decay heat moves out by natural conduction, radiation and convection, a process that inherently shuts down the reactor in the event of an error or control system failure. The reactor also runs on fuel particles coated in a tough ceramic shell that retains fission products under all operational conditions, even in the most severe accident conditions.

General Atomics University Research – Modular Helium Reactor



Source: General Atomics

- Economically competitive design: The high-energy conversion efficiency plus the elimination of active safety systems results in a simpler design that costs less to build;
- Fuel-cycle adaptability: The high-temperature reactor can run on several kinds of fuels, including low-enriched uranium, highly-enriched uranium, mixed uranium/thorium, weapons-grade plutonium, and the high temperature allows for a high burn-up in a once-through cycle.

A General Atomics white paper on the modular helium reactor offered a description of a new-generation research reactor design that will be the blueprint for the UTPB reactor. The UR-MHR (University Research Modular Helium Reactor) is a small-scale modular helium reactor system that fits in a pressure vessel measuring about 8.3 meters high by 3.4 meters diameter.

General Atomics designed the reactor to "serve as a cornerstone of MHR technology educational programs at colleges and universities and as a facility for research," the paper said, adding that the reactor could be designed, licensed and constructed at low budget in a relatively short time. China built and commissioned one in about five years, for example.

"One of the things this country has to do if we believe there will be an expansion of nuclear [is] to have people trained in modern systems," Campbell told *FCW*. "That was one of [GA's] motivations. … This is part of the strategy of getting gas-cooled reactors, or any Gen-III+ or Gen-IV reactors, into the mix."

"I don't want to have any illusions about how difficult this challenge will be to get this [technology] going in the U.S."

—Michael Campbell, senior vice president, General Atomics

But given the technology's star-crossed history, GA officials are still cautious in speculating about the prospects for the helium-cooled reactor in the U.S.

Asked if he thought the Texas reactor would bring GA a long-awaited chance to make a go of the technology, Campbell told *FCW*, "We sure hope so. It's going to be a very long, difficult, challenging road to make this become real. We think the reactor has enough advantages and meritorious opportunities along with that, but … I don't want to have any illusions about how difficult this challenge will be to get this [technology] going in the U.S."