Who's Trying To Strangle The Pebble-Bed Reactor?

A conference of the American Society of Mechanical Engineers highlighted the benefits of nuclear power, especially the new generation of high-temperature gas-cooled reactors. Gregory Murphy reports.

The American Society of Mechanical Engineers held a conference Sept. 29-Oct. 1 in Washington, D.C., to highlight current research on high-temperature gas-cooled nuclear reactors. These are the new generation of supersafe nuclear reactors using tiny fuel particles which each carry its own containment structure.

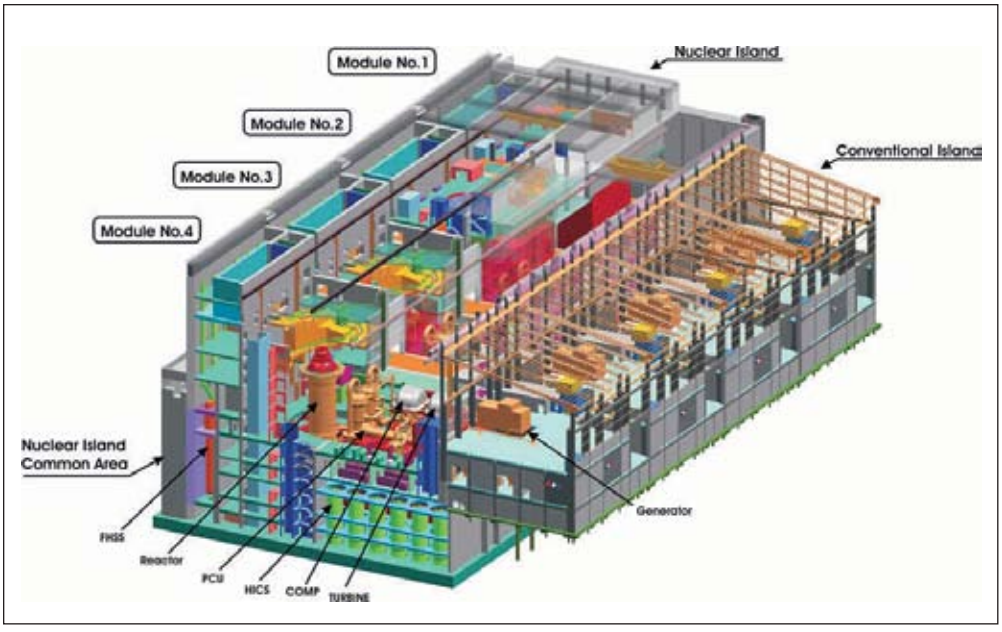
The 4th International Topical Meeting on High Temperature Reactor Technology ("HTR 2008: Beyond the Grid") focussed on the benefits of nuclear power, and in particular, the many advantages for industry and agriculture, of the high-temperature process heat that can be produced by these new-generation reactors, which include both the pebble bed design, PBMR, and the General Atomics prismatic design, GT-MHR.

This focus was driven home with real optimism by the vice chairman of General Atomics, Linden Blue, in his keynote address. Blue said that the high-temperature gas-cooled reactor's "time has come"; the new reactor will revolutionize the nuclear industry and all other industries as well. It was a welcome change from the current small and narrow thinking of the nuclear industry, which attempts to sell the nuclear renaissance as the best solution to the non-problem of global warming.

The optimism that Blue conveyed in his keynote carried over into the conference, as evidenced in the animated discussions following the conference presentations, in the hallways and the exhibit center (where nuclear companies have display booths). There has been a shift among some of the people in the nuclear industry, away from the "kicked dog" mentality of the past, to a fresh sense of hope, as was shown by the normally reserved German nuclear vendors, who were visibly cheered by the prospect that Germany might return to a pro-nuclear power stance, as in the past, which they expect to happen some time after the next election.

PBMR Safety Criticism Rebutted

Haunting the 2008 conference was the specter of the latest attack on the South African PBMR, part of a negative campaign which has been going on for the past decade. The current attack was launched by a so-called "professor of energy policy" at Britain's Greenwich University, Stephen Thomas, who travels in the circles of confessed Nazi collaborator George Soros. In July 2008, Thomas wrote a white paper titled, "Safety Issues with the South African Pebble Bed Modular Reactor: When Were the Issues Apparent?" in which he cites a July 2008 report from Dr. Rainer Moormann of Germany's Jülich Research Center. Jülich is the site of the first pebble bed test reactor on which the current design is



PBMR

The Pebble Bed Modular Reactor under development in South Africa is a fourth-generation, high-temperature meltdown-proof reactor that uses tiny particles of fission fuel, each encapsulated in its own "containment," and fashioned into spheres ("pebbles") the size of tennis balls. The helium gas carries the reactor heat to directly turn a turbine to generate electricity, without the need for a steam cycle. This simplifies the reactor design, and makes it very economical.

based.

Moormann's report, titled "A Safety Re-Evaluation of the AVR Pebble Bed Reactor Operation and Its Consequences for Future HTR Concepts," was played up by Thomas as a major work of evaluation from the famed Jülich Research Center, which built and operated the AVR (Arbeitsgemeinschaft Versuchsreaktor) pebble bed reactor. In reality, as the conference discussion made clear, the report originated from a disgruntled employee of the institution, the same Rainer Moormann, who describes himself as a "risk assessment" guy.

In a discussion with this reporter, Thomas offered arguments against the South African PBMR which were little more than thinly disguised racism of the British imperial type. Asked to explain why he opposed the pebble bed reactor, Thomas demanded: Why does South Africa believe that it could operate a high-temperature reactor, given the fact that the major nuclear powers have given up on operating them? (Doesn't Thomas know that it was a South African who did the first-ever heart transplant? Or that Japan and China are both operating demonstration HTRs?)

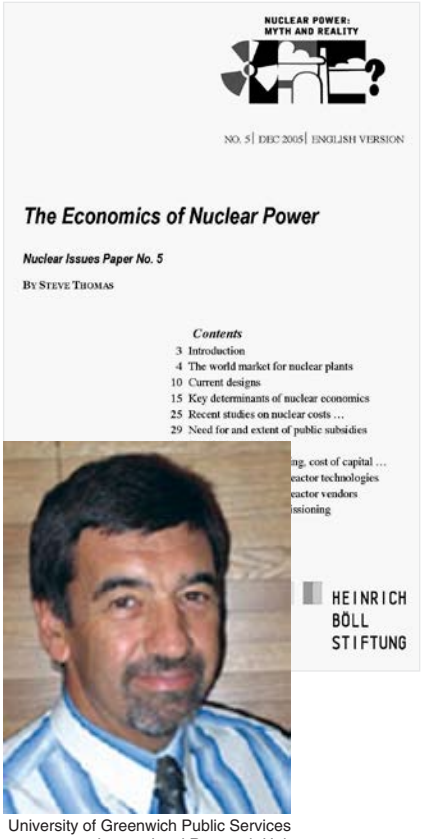
Thomas added that the pebble bed and other high-temperature reactors have not been proven to be economical. Even if they were, he said, countries around the world would not buy them from a new or novel vendor like the South African PBMR, Ltd., because countries tend to be very conservative and usually go with known vendors.

This is not the first such attack by Thomas. In 2006, he was hired by the Soros-funded Legal Resource Center in South Africa, to pen an attack on the pebble bed reactor. Thomas's report became a key element in the legal challenge against the PBMR, mounted by the Legal Resource Center against the environmental impact study which showed the PBMR safe to operate.

The legal challenge was joined by Earth Life Africa, a group set up in the 1980s as the South African version of the radical environmentalist Greenpeace, which attached itself to the anti-apartheid movement to gain support and legitimacy. Earth Life Africa runs a large anti-nuclear campaign, called "Nuclear Power Costs the Earth," which is funded by the Heinrich Böll Foundation in South Africa and the Wallace Global Fund.[1] After the presiding judge read Thomas's report, he ruled that the environmental impact study had to be redone. This has caused PBMR undue delays in building the demonstration plant that was set to begin construction in 2004.[2]

1. The Böll Foundation is Germany's premier funder of the greenies. The Wallace Global Fund is part of the Wallace Genetic Fund, set up by FDR's Vice President Henry Wallace in 1959. When first established, its mission was to further the legacy of Henry Wallace by helping to develop the world and increase the food supply. But current operations of the Wallace Fund really spit on Wallace's legacy by funding groups that attack modern agriculture and the development of nuclear power, and promote global depopulation.

2. For further details on this story, see Dean Andromidas, "Who's Sabotaging the PBMR?" *21st Century Science & Technology,* Spring-Summer 2006.



University of Greenwich Public Services International Research Unit

The decade-long attack by George Soros on the PBMR has been fronted by green fascist and so-called Professor of Energy Policy, Steve Thomas, of the University of Greenwich's School of Business. In July 2008, Thomas sent his recent white paper, titled, "Safety issues with the South African Pebble Bed Modular Reactor: When Were the Issues Apparent?" to anti-nuclear groups and the European and South African media.

EIRNS/Stuart Lewis

Mega-speculator George Soros funds the South African environmentalist groups to further the aims of the British in splintering the continent and cutting its population.

When Thomas was asked by this author why he objected to the South African government being the largest stakeholder in the PBMR, Ltd. project, he said that it was because "public money" was being used on a project that has not gotten off the ground, and there are other uses for that same public money, like "health care and water projects." Of course, Thomas doesn't mention that his "reports" are the reason for the delay in building the pebble bed.

Privatization and Transparency?

Thomas's office is in London, at the University of Greenwich's Public Services International Research Unit. This outfit is funded by Public Services International (PSI), a confederation of international trade unions, which includes, in the United States, the Service Employees International Union (SEIU) and the Teamsters. Yet, Public Services International is a group of rabid privatizers. According to its website, the group was active in the former Soviet bloc during the early 1990s "shock therapy" era of Jeffrey Sachs, and George Soros's Open Society Foundation.

Every year, the PSI Research Unit releases a resistance-to-privatization index, similar to the corruption index of that nation-state destroyer, Soros's Transparency International. With this background, Thomas's claim, that public money is being misspent on the pebble bed, and not on health care and water projects, which he and his group are looking to steal, is laughable.

The South African *Cape Times* newspaper picked up Thomas's white paper and promoted its deceptions. The paper's green correspondent Melanie Gosling wrote an article titled "New PBMR Will Fail U.S. Standards," which argued, entirely falsely, that the PBMR would not be certified by the U.S. Nuclear Regulatory Commission (NRC) because it does not include a secondary containment structure in its design. In fact, the self-containing design of the multi-layered fuel particles and the reactor characteristics render a secondary containment structure unnecessary for this type of reactor.

Moreover, the NRC has not been formally given the request for a design license by PBMR, and currently, the NRC is working in close cooperation with the South African nuclear regulatory group to work out what the safety regulations will be.

The argument for secondary containment was the main alarmist point in the Moormann report, and was also played up by Steve Thomas in his white paper. Sources from PBMR Ltd. whom I questioned at the conference, said that they had replied to e-mail questions from Gosling, but that none of their responses were used, even in part. Gosling's question shows that she doesn't understand the principles behind the pebble bed. Moormann, who understands the basic principles, still maintains that a gas-tight containment is needed for pebble bed reactors. How was this rebutted? This is what the PBMR spokesmen wrote:

"While containment is an appropriate concept for reactors which use water as a coolant, we believe the best concept for gas-cooled reactors such as the PBMR is to filter the helium (i.e., remove the radioactivity). The radioactivity will therefore be contained, not the coolant.... The PBMR confinement concept is by no means inferior to that of a containment structure. It is our view that confinement is the best solution for a gas-cooled reactor, both from a technical and safety point of view. Analyses have shown that confinement will reduce—rather than increase—the risk of radiation releases to the public. It is therefore a safer concept. The PBMR confinement concept allows for the release of extremely well-filtered coolant (helium)."

PBMR, Ltd. knew that the Moormann controversy could have cast a pall over the conference, and its scientists and engineers came prepared to intervene with a safety briefing, both in print and CD format. PBMR also produced a CD of their presentations countering the Moormann report, which was distributed to the conference.

What's Wrong with Moormann's Argument?

When Moormann's paper, the source for Thomas's latest attack, was issued in July of this year, there was an immediate uproar in the high-temperature reactor community working at the Jülich Research Center, including many internal e-mails attacking the report. In fact, the report is one person's opinion on the data that were accumulated from the 21 years of successful operation of the AVR reactor in Jülich, Germany.

Moormann's report is based on the 40-year-old design of the AVR. The main concerns he raises are the release of the radioactive isotopes strontium-90 and cesium-137 into the primary coolant loop. Moormann claims that this was caused by the unusually high temperatures at which the AVR core operated. Based on this assumption of these unusually high temperatures, Moormann states that the ability to produce high-temperature process heat, which is a main advantage of the pebble bed, should not have been demonstrated.

Nukem Technologies

Sample fuel pebbles for the PBMR. Each fuel sphere contains about 15,000 fission fuel kernels. About 450,000 of these pebbles will be loaded into each reactor vessel.

Moormann's report is *not* anti-nuclear, as Thomas and the greens in the media have presented it. His report contains some conclusions that are worth looking at in designing future high-temperature reactors. But his main conclusion, that the pebble bed reactor needs an airtight containment, is just pure alarmism, and shows a real failure in his interpretation of the lessons learned at the AVR.

It is to their credit that the organizers of the HTR 2008 conference invited Moormann to present his paper there in person, and face his peers. This was the first time, in fact, that this author has seen a real discussion on a controversial paper like Moormann's, at such a conference. Most often, the author, if invited, gives his presentation and leaves. To his credit, Moormann took several questions after his presentation, and stayed around to discuss his paper with attendees and answer some tough questions about his conclusions.

It is a good sign that the nuclear industry is now showing that it is not afraid to confront controversial or negative reports on nuclear power—something it has failed to do for the past 30 years.

As part of the general discussion of the Moormann report, there were several other presentations on the data from the experimental AVR. Most showed that the majority of the strontium-90 releases took place in the early years of the reactor operation. As noted in a presentation by Karl Verfondern et al. from the Jülich Center, titled, "Fuel and Fission Products in the Jülich AVR Pebble Bed Reactor," the early fuel was of poor quality and used highly enriched uranium, which was the source of the release of strontium.

Arbeitsgemeinschaft Versuchsreaktor GmbH

Cutaway view of the AVR experimental high-temperature reactor at Jülich, Germany. This was the first HTR to use a pebble bed core, and it operated successfully for more than 20 years, from 1966 to 1988. The AVR demonstrated the high-temperature capability and its safety features, including a safe shutdown with total loss of coolant and no control rods.

In his presentation, Verfondern showed that as higher-quality fuel was introduced into the core of the AVR in the mid-1970s, the release of strontium and cesium decreased. Most of the strontium activity monitored came from the earlier fuel, as could be demonstrated from the 30-year half-life for strontium-90.

The most effective rebuttal of Moormann's report came from the scientists and engineers who work with the PBMR. They judoed Moormann's report by using the same AVR data set which he used to show that their "Dust and Activity Migration and Distribution (DAMD) model," demonstrated (as did most of the other studies) that it was the poor quality of fuel in the beginning of operations of the AVR which was largely responsible for the problem. They also showed that certain core design problems, since recognized, created voids and bypasses in the coolant flows around the pebbles.

It is important to recall that the Jülich AVR was a first-of-a-kind reactor; it was the first pebble bed reactor ever built, and operated for 21 years with only minor incidents. In those 21 years of operation, the AVR generated a very valuable data base, and there were many engineering lessons learned, which have already had their impact on future design specifications.

One recent development is that, with the use of high-temperature fiber optics, it may be possible to monitor the core temperatures of pebble bed reactors. Because of its moving fuel—with pebbles introduced at the top, flowing through, and reintroduced at the top again—it is difficult to precisely monitor the internal temperatures. But that may be solved with the application of engineering principles and some human creativity, the real answer to any design problem.

AVR: A Pebble Bed Success Story

Now let's look at what a success story the AVR and its sister pebble bed reactor, the THTR, really were.

In 1959, the agreement on the construction of a pebble bed reactor was signed by BBC/Krupp and Ar-

beitsgemeinschaft Versuchsreaktor GmbH (AVR Experimental Reactor Group). The AVR, a 15-megawatt-electric demonstration reactor was the first high-temperature reactor to use a pebble bed core, as developed by scientist Rudolf Schulten, the director of the Jülich Nuclear Research Center.

Construction began in 1961, and the AVR went critical in 1966. A year later, the AVR was supplying electricity to the grid. The AVR was originally designed to breed uranium-233 from thorium-232. Thorium-232 is about 400 times as abundant in the Earth's crust as the fissionable uranium-235, and an effective thorium breeder reactor would be considered valuable technology. However, the fuel design of the AVR contained the fuel so well that the transmuted fuels were uneconomical to extract at the time. As a result, the AVR became a test-bed for different formulations of reactor fuel with different coatings. During the 21 years that the AVR operated successfully, 18 different types of pebble fuel were tested. Until the AVR was shut down in 1988, new types of fuel pebbles were loaded into the core.

The AVR tested the pebble bed's main safety features. In one test, during the 1980s, the AVR reactor was brought to full power and the coolant flow was stopped, to demonstrate a loss-of-coolant accident. It was found that one of the main design safety features, the negative coefficient of reactivity (as the reactor fuel gets hotter, it becomes less reactive), responded beautifully as planned. With all coolant lost, the reactor temperature increased, but the reactor shut itself down.

After the operating success of the AVR, another, larger HTR was constructed in 1983, the Thorium High-Temperature Reactor, THTR-300. Like the AVR, the THTR had a pebble bed design core. The core contained about 670,000 spherical fuel balls, each 6 centimeters in diameter. This reactor was unique, in that the pressure vessel that housed the pebble bed was formed of pre-stressed concrete—the first time this material had been used instead of a steel pressure vessel.

The THTR operated successfully for five years, with only a minor water ingress accident, where water from a burst tube in the steam generator leaked into the reactor core. Nevertheless, both the AVR and the THTR were shut down in 1988, because of the anti-nuclear hysteria that surrounded the aftermath of the Chernobyl reactor accident in April of 1986.

The Beauty of Modular HTRs

High-temperature reactors are the keystone to development because they are modular, and can be built in remote areas like rural areas in India or small city areas in Africa. These reactors can provide electricity and at the same time, provide high-temperature process heat for water desalination where needed, or for producing hydrogen. The fact that these reactors are modular, means that they could be built on the sites of industrial companies: for example, petrochemical plants, to provide high-temperature process heat to make better plastics. This would be a great benefit to industry, which right now burns large amounts of natural gas just to produce the needed process heat. (See "The Nuclear Power Revolution: Modular High-Temperature Reactors Can Change the World," *EIR* Nov. 21, 2008).

All of the possible uses of the pebble bed or the General Atomics prismatic block HTRs are limited only by man's imagination!

References

R. Bäumer, "AVR: Experimental High-temperature Reactor: 21 Years of Successful Operation for a Future Energy," VDI-Gesellschaft Energietechnik, Vereins Deutscher Ingenieure, 1990.

K. Verfondern and H. Nabielek, "Fuel and Fission Products in the Jülich AVR Pebble-Bed Reactor," Institute of Energy Research, Safety Research and Reactor Technology Forschungszentrum Jülich, Jülich, Germany, presentation HTR2008-58337, 2008.

K. Verfondern and H. Nabielek, "Fission Product Release from HTGR Fuel Under Core Heatup Accident Conditions," Institute of Energy Research, Safety Research and Reactor Technology Forschungszentrum Jülich, Jülich, Germany, presentation HTR2008-58160, 2008.

B. Boer, J.L. Kloosterman, D. Lathouwers, T.H.J.J. van der Hagen, H. van Dam, "Optimization of a Radially Cooled Pebble Bed Reactor," Delft University of Technology, the Netherlands, presentation HTR2008-58117, 2008.

R. Moormann, "A Safety Re-Evaluation of the AVR Pebble Bed Reactor Operation and its Consequences for Future HTR Concepts," Forschungszentrum Jülich Zentralbibliothek, Verlag http://juwel.fz-juelich.de:8080/dspace/handle/ 2128/3136, 2008.

C. Stoker, L. Stassen , F. Reitsma, H. vd Merwe, "PBMR Radionuclide Source Term Analysis Validation Based on AVR Operating Experience," PBMR Ltd, Centurion, South Africa, and D. Olivier, Independent Nuclear Consultants, Grahamstown, South Africa, presentation HTR2008-58338, 2008.

Steve Thomas, "Safety Issues with the South African Pebble Bed Modular Reactor: When Were the Issues Apparent?, A Briefing Paper," London: University of Greenwich, PSIRU, July, 2008.