for Africa's Development), which is now an African Union project, there are a range of projects. We took up that idea of the corridors; in fact, we financed it. If you look at the Maputo development corridor, we did just that. We built a new highway, we are upgrading the rail line, we upgraded the telecommunications; and the Mozambican government is bringing in new operators for their port.

So you've got a whole logistical and telecommunications passage going down through to Moputo. Obviously it's easier there because you can use the strength of the South African economy. But you can do this in many African countries. So we are looking at that.

And another point I should make, of course, is that with telecommunications you also need energy. The telecommunications industry in Africa is growing very fast, led in the main by the big South African telecommunications companies, and this is mainly wireless and mobile telephone, but that needs energy to get coverage. So again, you see the complementarity between the energy and the other infrastructure.

And quite clearly also with the rail system. There are a number of projects put forward in NEPAD that we are looking at developing. I would say that the main obstacle we are having on those projects at the moment is raising finances. In South Africa we can use more sophisticated public-private partnerships; our big state companies, rail companies can enter the capital markets successfully. Elsewhere in Africa, we are probably still dependent on a higher element of grant assistance, and that is a restraining factor in Africa at the moment which we need to change.

EIR: Neo-liberal dogma says that governments should stay out of the economy. But in South Africa, the government plays a crucial role in infrastructure and economic development. How do you see this issue?

Erwin: Our view is that you must examine your economic position at any point in time. The state will always play a role, also in the United States. But what role it plays and how it does that successfully is always a question of the moment. There are no religious dogmas on these things either way.

We have a very specific set of roles that we see the state playing. For example, the state will retain ownership of the electricity company, Eskom, because that gives us a much clearer strategic shareholding. But we then designed the total electricity system in a way that brings in private capital, through independent power producers (IPPs) and other areas. So you get a genuine structural partnership between the private and the public sectors. And you can adjust the proportionality of that partnership as the economic circumstances change.

For us in South Africa now, we need a strong state involvement; but the instruments we use are not necessarily the old-style ones. Our state-owned enterprises, as we call them, Eskom, our transport companies, and so on, have to be capable of entering the capital market, raising private capital at rates that are equal to the sovereign rate. So that puts a lot of pressure on the management and the boards to manage their companies efficiently. But we do give them an economic mandate. They are not profit-maximizers. We say that you have to meet these targets with social delivery.

For South Africa, we have an exceptionally important program. Because of poverty, we have a situation where we provide a basic free allowance of water, sewage treatment, and electricity to the poorest of poor households. So you get the basic allowance which is free, in terms of electricity, that is enough to keep your lights and cooking going for the year, and it allows kids to study, with a reasonable standard of living. We can do that because we use the instruments not just to maximize profit, but to achieve certain economic objectives.

But the mix with the private sector is very strong. We work closely with the private sector; we bring them into the investment plan. So this should not be some matter of religion, it should be a matter of concrete economics.

Interview: Dieter Matzner

A Safe, Foolproof Nuclear Reactor

Dieter Matzner is General Manager of the Power Plant Division of PBMR. He was interviewed by Jonathan Tennenbaum on Jan. 30 at the London conference on the PBMR.


PBMR/G.Bennett

EIR: I think that building a fundamentally new type of reactor has not happened for 40 years.

Matzner: Yes, it's probably 40 years.

EIR: What do you think are the most interesting and challenging features that people should keep in mind about the PBMR?

Matzner: I think the most important feature by far is that the PBMR reactor design utilizes ceramic fuel, and the whole core design is made of ceramics—that is graphite materials which can withstand very high temperatures. The basic advantage of this is that the fuel is meltdown-proof. A core melt is made *impossible* essentially by the choice of materials, and therefore there is no need even for discussion about a probability of a core melt. That is the unique advantage of this high-temperature gas-cooled reactor.

Of course, there are many other advantages which this reactor has, starting with the whole idea that it has an on-line fueling system. There is only one other reactor in the world like that, Canada's CANDU reactor, a heavy water reactor [which uses natural uranium fuel].

This on-line fueling system has some very unique advantages. First and foremost, you can design the reactor with a very low excess reactivity, which means that in case of an accident, you are essentially safeguarded by the design from a reactivity event [runaway chain reaction].

On-line fueling of course enables you to have much longer operational cycles between maintenance outages—planned shutdowns. In our case, the aim is to achieve an outage cycle of 30 days every six years, instead of the conventional 18-24 months' fueling and refueling cycles of light water reactors. In theory, this should give you an availability capability of about 97.5%, if, of course, all the mechanical equipment performs satisfactorily. But in principle, it's possible to achieve this very high availability. That, for the nuclear power generation industry, is very important.

The other thing is that because outage cycles are not determined by the fueling cycles, you have much greater flexibility to schedule maintenance outages. So, when there are, say, outages of other power-generating equipment, you are in a much better position to plan when the reactor must come offline for maintenance.

The other very important advantage of this pebble-bed reactor is that the pebble itself, the fuel form, lends itself perfectly for heat transfer, because the heat transfer around the sphere is optimal. It has a high surface area and stress distributions in the fuel are optimal because of its symmetrical fuel arrangement. That in itself is very unique. You are not restricted in any sense in the design.

The other interesting fact about this reactor is that it is very proliferation-resistant. It is very efficient in burning plutonium, and in fact you would never deploy this technology for the purpose of breeding weapons-grade material.

EIR: Do you mean that any plutonium that is generated in the reactor is burned up right away?

Matzner: Yes, it is burned up right away, and there is very little plutonium left. To get enough plutonium from this reactor for a bomb would require something like 100,000 fuel elements to be diverted, which is unthinkable in a process inspected by an international authority like the International Atomic Energy Agency. Therefore, we see this as a very strong feature of this technology.

Furthermore, the technology lends itself very well to handling multiple fuel cycles. In South Africa we utilize UO_2, uranium dioxide, but it is very thinkable that different fuel cycles could be introduced into the same reactor without changing its design. First and foremost, in Germany the thorium-uranium fuel cycle was demonstrated very successfully. If you wish to do so, you could burn plutonium in this reactor, and even mixed oxide (MOX) fuels would be possible. All these different fuel cycles could be introduced into this reactor without actually needing to make any reactor design changes.

EIR: Are there any other unusual features of the PBMR?

Matzner: Another unique feature of this reactor technology is that it is unrivaled in terms of its high-temperature process heat application. In other words, this is the only carbon-dioxide-free high-temperature heat source available to mankind at this point in time. There is just no other way around this.

This reactor also has a very high burn-up rate of the fuel. The achievable burn-up at the present enrichment of 9.6%, is about 92,000 megawatt-days a ton of heavy metal. This leads to a significant reduction in high-level waste, and of course promotes the economics of the reactor from a fuel-efficiency point of view.

We have opted to couple this reactor technology with a gas-turbine cycle, which is unique, and that enables us to utilize the high-temperature capability of the reactor with a subsequent increase in efficiency. Normal reactor technologies coupled to the steam cycles give you on the order of 25-36% thermal cycle efficiencies, but we are on the order of 42%, which is a significant increase.

So in principle therefore, the specific safety features of a meltdown-proof core, the on-line fueling capability, the high efficiency capability, the process-heat applicability, the proliferation-resistance of this reactor technology, make it a very unique system design, and therefore it can be truly labelled as a so-called Generation IV reactor.

EIR: How does the design complexity of the PBMR compare to that of the traditional light water reactor? Conventional light water reactors have extremely complex safety systems.

Matzner: We have done a comparison to an AP1000 [Westinghouse] reactor, which is regarded as the Generation III-plus reactor and which relies much more on passive safety features than the traditional Generation II reactors. The PBMR essentially has about half the systems which the AP1000 reactor has, in order to support the whole power-generation process. I haven't got the exact figures to tell you now, but this study has been done and it is amazing how few systems the PBMR really utilizes.

Of course it is true that because of the very low energy-densities in the reactor, there are very large reactor structures, for a relatively small power output. That in itself means that there are few components, but these components are very large, and are essentially of the same size as a large light-water reactor.

EIR: So, you save on the safety systems, but pay more for the components. And do you have confidence that in the overall cost, the PBMR will be competitive with the conventional light water reactor or even with coal generation?

Matzner: Of course, you have to compare like with like. We cannot compete with a large coal-fired station located directly at the coal field. We have very cheap coal. So we must compare ourselves with power-generation options on the coastline, which is far away from our coal fields. There we can say that we are definitely competitive with combined-cycle base-load gas. There is no question about it—in fact, we are cheaper than that.

But I would expect that our technology is more expensive than the large light-water reactors. That is because the new generation of light water reactors, going up to 1,600 megawatts, are very large machines, and they have achieved economy-of-scale benefits by their larger size.

We have a definite disadvantage because of the small size, but it is for that reason that we picture ourselves not in the areas where large-scale power requirements are, but rather in the areas where you have 600 megawatts and less for power requirements. There are many countries, specifically in the developing world and most notably in Africa, which need only 200 or 400 or 600 megawatts of power for the country's grid. They would never be able to afford to buy a large 1,600-MW light water reactor.

Even South Africa, with its distribution grid, it would not be considered viable to have one large machine put onto the coast line, for the simple reason that if that machine goes offline for maintenance, or whatever, then you have no power. So you still have to install the spinning reserves in the transmission grid in order to be able to compensate for the loss of such a machine.

And benefits of size, in terms of power-generation, also bring financing risks. Because the financing risks of such a large power station are substantial, the utilization risk that it would not be utilized from day one, and the disruption factor of not being able to feed an area where a large machine goes off-line—these extract a premium in the price.

EIR: How big a market do you envision developing countries to be for the PBMR, and where would the staffing come from?

Matzner: The most important challenge with respect to the deployment of this technology in Third World countries, at the moment, is that most of these countries do not have the nuclear regulatory frameworks and regimes. And, therefore, we would have to find a way to be able to deploy these systems in these countries. I believe it is quite likely that in Africa, specifically sub-Saharan Africa, one could probably find a way where the South African licensing regimes, also with Eskom which is a major regional utility, would provide the operational support, within the regulatory framework from South Africa, under which these reactors could be licensed in these countries.

What is certainly true is, that we see it as one of the operational benefits that the costs of power generation, are less from a staffing point of view. We expect to have less staff on a station like this, because it is a simple station. Also because it is such a foregiving technology. In other words, this is probably one of the big advantages: If anything goes wrong, you have days, not minutes, before something happens. Even in the worst case, with this technology you will not have a catastrophic accident. You might lose your investment, but you will certainly not have a core melt. This is, of course, totally different from the other reactor technologies.

So from that perspective, I don't want to say that you can get away with unskilled and untrained personnel, but the severity of an accident, is much less, even if the plant doesn't have the most highly trained persons there. So this is exactly the technology of the future that can be deployed in the developing countries, where there is a shortage of skills and where the large power requirements are just not there.

EIR: In terms of the plant construction, what are the requirements for the nuclear-quality components?

Matzner: About 40% of the cost of the plant is in good-quality industrial equipment, like that you would find in any country, on the electrical side and chemical auxiliaries, civil structures, and so on. Of course, the reactor itself and the turbo machinery are high-quality components, and those always have to be imported or manufactured in factories which can make them according very stringent quality control. That's already a requirement in order to have not only safe operation but reliable operation. And that is the intent of any utility.

Interview: Dr. Regis Matzie

How the U.S. Plans To Use the PBMR

Dr. Regis Matzie is Senior Vice President and Chief Technical Officer, Westinghouse Electric Company. He was interviewed by Jonathan Tennenbaum on Jan. 30 at the London conference on the PBMR.

EIR: How do you see the situation with PBMR applications in the U.S.A.?

Matzie: We have started the early phases of licensing in the Nuclear Regulatory Commission (NRC) of the pebble-bed reactor, the so-called pre-application review. Pre-application