

## PEBBLE BED MODULAR REACTOR DEMONSTRATION PLANT IS FUNDED BUT NOT CONSTRUCTED

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In February 2010, Finance Minister Pravin Gordhan announced that the South African government would stop funding the development of a demonstration power plant for the Pebble Bed Modular Reactor (Pty) Ltd (PBMR). The Department of Public Enterprises has transferred R6 billion to the PBMR company over the past three years for 'the funding of operations and building of a demonstration power plant', according to Vuyo Tlale, the department's Acting Chief Director for Energy. But no plant has been built and the PBMR board chairman, Alistair Ruiters, has declined to elaborate on how this money was spent.

Ruiters was prepared to say only that R8.8bn of government funds had been spent since 1999 in developing 'highly skilled human resources', computer systems and 'enterprise architecture' (Figure 1). His office supplied a breakdown presented to the parliamentary Portfolio Committee on Public Enterprises in March, which accounts for R2.7bn for the demonstration power plant ([http://www.pmg.org.za/files/docs/100323PBMR-edit\\_0.pdf](http://www.pmg.org.za/files/docs/100323PBMR-edit_0.pdf)). A helium test facility and fuel development laboratories were commissioned at the Pelindaba site (owned by the Nuclear Energy Corporation of South Africa) and a heat transfer test facility was built at North-West University, at a cumulative cost of R370 million. But these had all been completed by the beginning of 2007 – before the R6bn was allocated.

The transfers were allocated in three successive years, starting in 2007/8, through the department's parliamentary vote and in accordance with the standard provisions for a medium term expenditure framework, which allows for government financial planning over three-year cycles. But the department appears to have made these transfers despite no evidence of progress between the years. The allocation should have been reviewed annually pending satisfactory progress, according to Shadow Minister of Public Enterprises, Manie van Dyk.

The R6bn was approved by parliament on two conditions: (1) by February 2010, the PBMR needed to attract additional private investment – other than the US energy corporation Westinghouse (which holds only 4% of its shares), the Industrial Development Corporation (IDC), Eskom and government; and (2) the PBMR needed to find an international customer to which they would provide plants once the technology was proven. These conditions were not met and, on this basis, government has now provisionally withdrawn its support, although it has commissioned a review of possible options for the PBMR, due in August. According to the department, the goal of the review team is to ensure South Africa retains nuclear expertise, currently residing within the PBMR company, for developing a possible future nuclear power generation programme.

As a result of the government's withdrawal of funding, PBMR started large-scale restructuring in March, announcing that 600 of its 800 core employees would be retrenched; company CEO, Jaco Kriek, resigned in February. 'We're in a crisis mode at the moment and we're looking for other people to bring money into the programme', said the IDC's head of public-private partnerships, Lindi Toyi.

The PBMR was based on a prototype abandoned by Germany in 1989, but aggressively pursued by the South African government after they purchased the patent. When the programme was announced in 1998, South Africans were told the demonstration plant would be completed in 2004 and it would cost R2bn. In the event of the technology being successfully developed, Eskom, which originally established the PBMR company, had agreed to buy 24 units for South African consumption and it was hoped that global sales would follow.

The PBMR itself is a small, high-temperature reactor using helium gas as a coolant medium to extract heat (Figure 2). Its designers believe it can be built relatively quickly, and that its small, modular design is easily replicable. Using gas rather than water to cool the fuel (the failure of which led to the Chernobyl 'meltdown') the enriched uranium is contained in ceramic, billiard ball-sized 'pebbles' which use graphite, an integral part of the fuel, as a moderator. The technology is claimed to be both intrinsically safe and more thermally efficient than that of a conventional pressurised water reactor used in conventional nuclear power stations such as Koeberg.

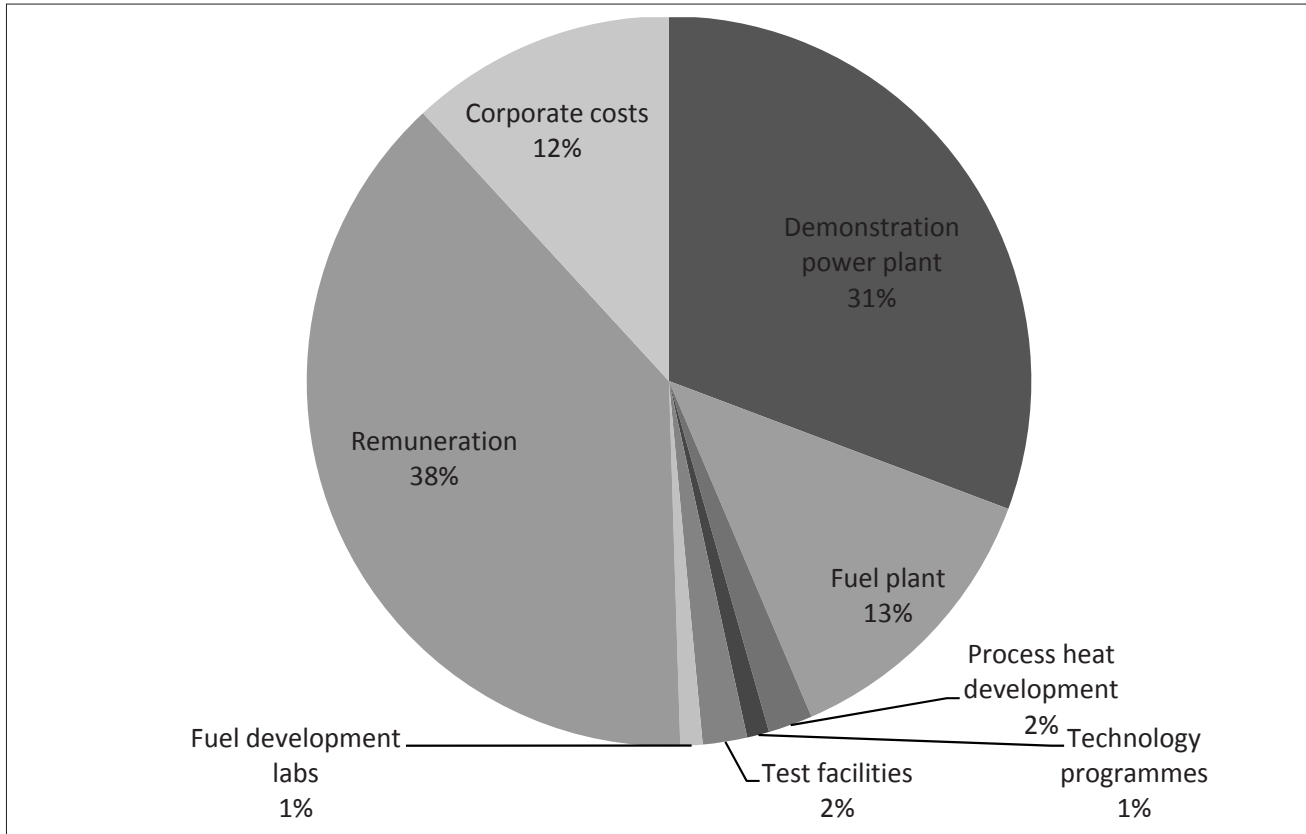
But critics have long argued that the PBMR would never be economically feasible. These include University of Greenwich energy policy expert Steve Thomas and Thomas Auf der Heyde, now Deputy Director General at the Department of Science and Technology.

The PBMR's German predecessor – THTR-300 (a 300MW thorium high-temperature nuclear reactor) – was abandoned in 1989, less than two years after it was launched commercially and following a series of technical problems, safety concerns and a dearth of private or public funding. According to Thomas:

*Clearly there were technical problems, in the five years from going critical to being closed, it generated next to no electricity and had numerous problems. There were also financial problems. It was uneconomic and the utilities were baulking at paying the extra costs. Nuclear was also very unpopular after Chernobyl.*

Regis Matzie, the former Senior Vice-President of Westinghouse, who still represents the company on the PBMR board, said it was unfair to compare South Africa's effort to Germany's. 'You have to appreciate the political environment at the time. Chernobyl had just happened, and the German public and government had become very anti-nuclear.'

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Source: Pebble Bed Modular Reactor Company

**FIGURE 1**  
Breakdown of Pebble Bed Modular Reactor's total expenditure (R8.8 billion) as of 31 December 2009

Thomas and Auf der Heyde argued in 2002 (S Afr J Sci. 98:36) that, as the development of similar plants had failed in developed countries, South Africa was unlikely to succeed. 'Against a background of failed attempts in Germany, the US and Britain to commercialise HTR technology, Eskom, a newcomer to nuclear plant design, may have difficulties in succeeding', they wrote. Even the department itself has stated, in 2006, that while the technology was deemed feasible, 'the economic feasibility is questionable for a start-up venture, if no cognisance is taken of the socio- and macroeconomic benefits' (<http://www.treasury.gov.za/documents/national%20budget/2006/ene/Vote%209%20Public%20Enterprises.pdf>).

One of the first major setbacks for PBMR was the withdrawal of its initial private investor, Exelon, in 2002. Explaining this, US nuclear engineer, Rod Adams, a vocal PBMR commentator and supporter since the project's inception, said Exelon's strategic shift was rooted in a change in the company's leadership and a shift in focus from to being 'an electricity supplier, not a technology developer'.

In 2003, Eskom made a similar shift and has made no financial contribution since, according to Steve Lennon, its Managing Director for Corporate Services. While it remains a shareholder, 'it's no longer part of our business model to develop new technologies', he said.

Australian Nuclear Science and Technology Organisation CEO, Adi Paterson – previously a Deputy Director General at the Department of Science and Technology and a PBMR board member from May 2007 to December 2008 – said he believed the programme 'should have had a more conservative design baseline'. For example, the Chinese (who are also pursuing PBMR) have chosen a lower temperature reactor and a more conventional steam cycle. As Paterson stated:

*With the benefit of hindsight the Chinese approach seems more conservative and achievable. I do believe that the SA design could have been achieved but that would have required a committed client and funding for the lifecycle of the project.*

According to Matzie, the company had set itself a 'way over-optimistic' timeline in announcing that the demo plant would be online by 2004:

*This was an unrealistic schedule for a new technology in a country that had never developed and licensed a nuclear plant from the start. The technology wasn't ready; the regulator [National Energy Regulator of SA] wasn't ready, and PBMR was still in the process of building a company.*

Early last year, PBMR announced it was changing its focus and was seeking an industrial company, rather than an electricity utility, as its launch client, in which case the PBMR would process heat in addition to creating electricity. This means that, rather than designing and building a 400MW high-temperature, gas-cooled reactor with a closed-cycle Brayton conversion system for electricity generation, it is now working on a more conventional 200MW, gas-cooled, modular, indirect-cycle pebble bed reactor.

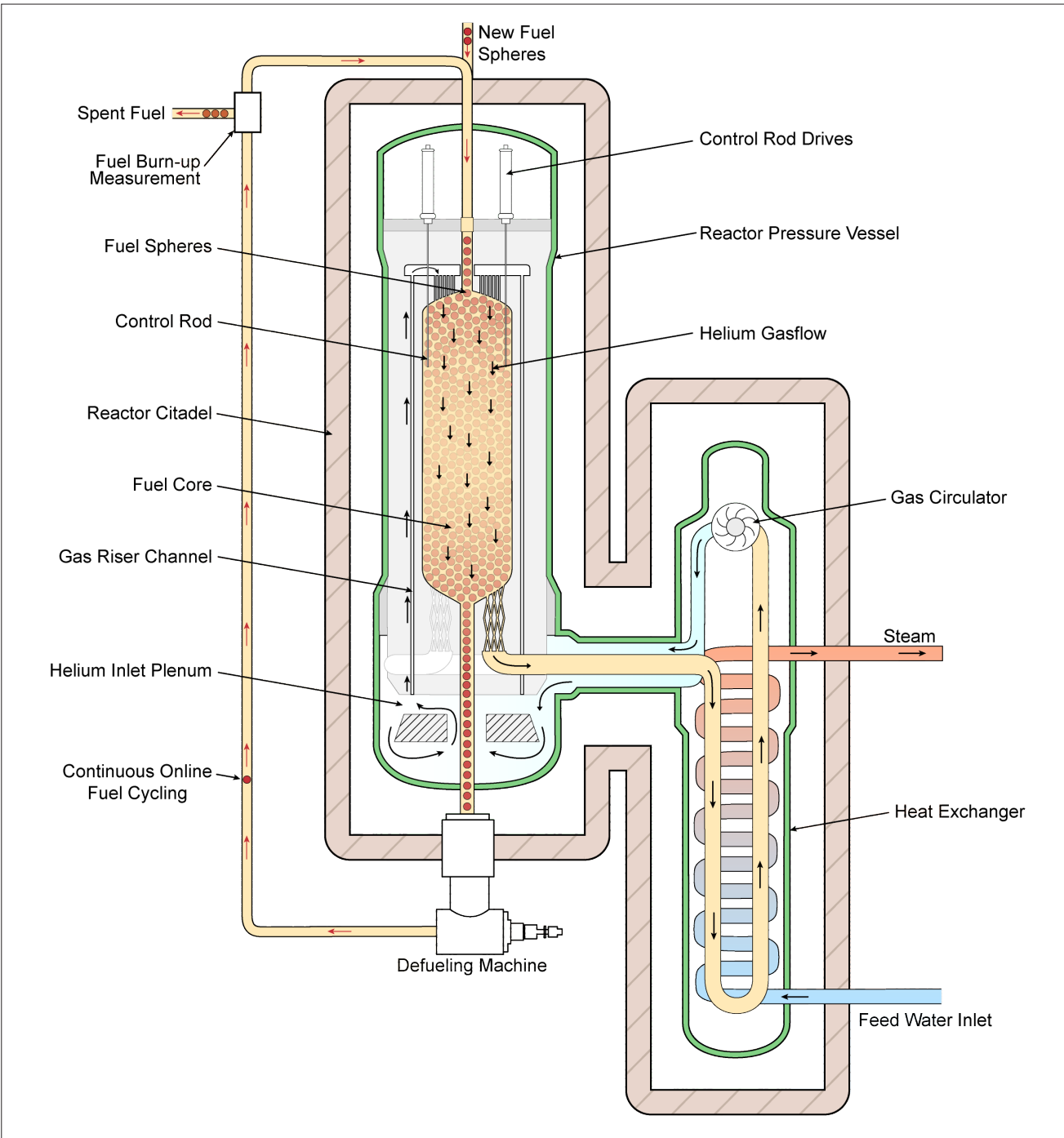
According to Lennon, this new direction has compromised Eskom's position as a potential customer:

*The status of the project has changed so much over the years. Now that it's going in as heat processing technology, rather than only electricity, indicates that it is moving away from being a commercial power generator.*

Lennon added that, although Eskom had signed a letter of intent to buy 24 plants once the technology was ready, the project timeline had extended so far that PBMR units might only be ready for sale in 2030. 'This is right on the edge of our current planning parameters, so it becomes an academic discussion whether or not we are going to buy units.'

But Paterson and Matzie both defended government's spending on the programme – despite PBMR's failure to attract additional private investors or stick to its timeline. 'SA government funding was essentially to capture the technology from Germany', said Paterson, who went on to state:

*Nevertheless even with all this access there was still a requirement for hundreds of thousands of engineering hours to get a design that*



Source: Pebble Bed Modular Reactor Company

**FIGURE 2**  
Pebble bed modular reactor demonstration plant reactor

*would meet modern safety and performance requirements – this is inherently expensive.*

Matzie argued that the government’s commitment to the project had to be seen in the context of the previous political administration:

*Around about 2000, we had a clear customer in Eskom and strong support from [former president] Thabo Mbeki and [former minister] Alec Erwin, who had a vision that this could place SA on the map and allow them to build capacity here.*

Despite failed efforts to pursue similar technology in Germany, ‘South Africans have had an attitude of innovation, developed over the apartheid years – a confidence that they could develop technology like this and take it to the market’, he said.

Also, despite having failed to build a demonstration plant, for which the allocated R2.7bn remains unaccounted, Tiale is adamant the project has been worthwhile:

*There is no uncertainty about the soundness of the technology. However, alternative funding mechanisms are being sought for this programme as government no longer has pockets deep enough to fund it on the scale and length of time required.*

PBMR’s 2009/10 annual report is due to be tabled in parliament in October 2010. ‘It will have to answer some difficult questions’, says Van Dyk, ‘in particular what happened to these funds between March 2007 and February 2010’.