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FINAL ENVIRONMENTAL SCOPING REPORT

FOR A

PROPOSED 400 MW(t) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT (PBMR DPP)

(REV 4 April 2006)

AT THE

KOEBERG POWER STATION SITE

IN THE

WESTERN CAPE

Prepared for:

Western Cape Province: Department of Environmental Affairs and Development Planning

National Department of Environmental Affairs and Tourism

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CHAPTER 1: INTRODUCTION

Eskom proposes to construct, commission, operate, maintain and decommission a Pebble Bed Modular Reactor (PBMR) Demonstration Power Plant (DPP) with a nominal thermal output of 400 MW(t) in order to assess the technological, environmental and economic viability of the technology.

1.1 BACKGROUND TO THE PROJECT

1.1.1 THE PREVIOUS EIA.

An environmental impact assessment (EIA) process for the 302 MW(t) PBMR DPP commenced in 1999. Eskom, in accordance with EIA Regulations, appointed a consortium of independent consultants to undertake an EIA. An extensive EIA process that included specialist studies was facilitated. Similarly a comprehensive public participation was facilitated through numerous interactions (focus group meetings, open days, and public meetings). This culminated in the submission of the final environmental impact report to the Department of Environmental Affairs and Tourism (DEAT) in October 2002. The evaluation of the Final environmental impact report (EIR) by DEAT and an international review panel appointed by DEAT was undertaken. From this review, the DEAT Director-General issued a positive record of decision in June 2003. Between July and August of 2003, the Minister of the Department of Environmental Affairs and Tourism received the appeals that were lodged against the record of decision.

Consequently an application was brought before the Cape High Court on behalf of Earthlife Africa (Cape Town) in September 2003. This application sought to have the record of decision issued by the DEAT DG on 25 June 2003 reviewed and set aside. The court hearing took place on 29 and 30 November 2004. The judgement was handed down on 26 January 2005. In this judgement the Cape High Court ruled in favour of the applicant and set aside the record of decision. In addition, it required the DEAT DG " …. *to* *afford the applicant and other interested parties an opportunity of addressing further written submissions to him along the lines as set out in this judgement and within such period as he may determine and to consider such submissions before making a decision anew on the second respondent's application.*"

In arriving at this judgement, the Cape High Court drew the conclusions, *inter alia*, that:

- " …. the requirements of procedural fairness were by and large recognised and observed on behalf of the department up to and including the submission by Eskom's consultants of their final EIR."
- "Subsequent thereto, however, no further submissions from interested parties were entertained or even invited by the DG ….."
- "It is clear from the evidence on record that the DG's decision was preceded by a protracted process, involving public participation on a wide scale. By and large, the process was conducted in a manner that was thorough and fair."
- "The fact that the final step, viz. the DG's decision, is to be set aside as flawed should not result in the whole process having to commence afresh."
- " ….. accordingly regard it as just and equitable, in setting aside the DG's decision, to issue directions to provide for the reconsideration by the DG of the matter after the applicant – and other interested parties – have been afforded an opportunity to address further written submissions to the DG on the final EIR as well as any other relevant considerations that may affect the decision."

The Cape High Court also emphasised that the ruling does not express any opinion as to the merits or demerits of the proposed PBMR, nor of nuclear power.

Subsequent to the Cape High Court Order, a number of meetings between DEAT and the applicant Eskom were held. This was in order to determine the process required to implement the court order. The Cape High Court judgement was studied.

Over the period from the lodging of the initial application in June 2000 to the submission of the final EIR in October 2002 the PBMR DPP design had evolved. It was considered that this would have to be taken into account when identifying a way forward that meets the requirements of due process. Both DEAT and Eskom sought legal opinion in this regard.

The legal opinion submitted to the parties indicated that the applicant, Eskom, should submit a new application for an environmental impact assessment for the evolved design. The most significant design evolutions being that of the reactor power being increased from 302 MW(t) to 400 MW(t) and the re-configuration of the turbine-generator from a vertical to a horizontal position.

1.1.2 RATIONALE FOR THE PROPOSED PROJECT

The need to expand the electricity generation capacity in South Africa is essentially based on the following documentation and policies:

- South Africa's White Paper on the energy policy – 1998;
- Integrated Energy Plan – 2003;
- National Integrated Resource Plan – 2003/2004;
- Integrated Strategic Electricity Planning – 2003.

The South African Energy Policy, published in December 1998 by the Department of Minerals and Energy (DME) identifies five key objectives, namely:

- increasing access to affordable energy services;
- improving energy sector governance;
- stimulating economic development;
- managing energy-related environmental impact;
- securing supply through diversity.

In order to meet these objectives and the developmental and socio-economic objectives in South Africa, the country needs to optimise the use of the available energy resources. Eskom is required to respond to the growing electricity demand of approximately 3% per annum. This growing demand is placing increasing pressure on Eskom's existing power generation capacity. The South African Government, through the Department of Minerals and Energy (DME), the National Electricity Regulator (NER) and Eskom are required to address how best to meet these electricity needs both in the short and long-term.

The DME performs integrated energy planning (IEP) to identify future energy demand and supply requirements. The NER performs national integrated resource planning (NIRP) to identify the future electricity demand and supply requirements. Similarly, Eskom continually assesses the projected electricity demand and supply through a process called the integrated strategic electricity plan (ISEP). From these assessment and planning processes, the most likely future electricity demand based on available resources and long-term Southern African economic scenarios are forecasted. This provides the framework for Eskom and South Africa to investigate a wide range of supply and demand-side technologies and options.

The outcome of these processes indicates that South Africa will require additional "peaking electricity generating capacity[1]" by 2007 and additional "base load electricity generating capacity[2]" by 2010.

In the longer term (2020 and beyond), the existing power stations will start to come to the end of their useful life. Replacement power stations will be required.

The current Eskom power stations have the capacity to produce 36 208 megawatt (MW) of electricity (the peak demand for electricity in the winter of 2004 being 34 195 MW, March 2005). Non-Eskom power stations in South Africa (i.e. owned by private companies and municipalities) provide approximately 2 000 MW of additional capacity. The electricity generating capacity in neighbouring countries, that is available to South Africa (mainly hydro-electric power) accounts for approximately 1200 MW of additional capacity.

Eskom thus accounts for approximately 90% of electricity supply in South Africa. Electricity generated by Eskom comprises coal-fired power stations (~92%), Koeberg nuclear power station (~6%), and hydro-power stations, including pumped storage schemes (less than ~2%) (March 2005).

In order to meet the electricity supply, the improvement of existing power stations needs to be considered. In addition, the various technology options for future power stations, fuel supply, and importation of fuels or electricity needs to be assessed.

As part of an ongoing effort to evaluate the viability of all supply-side options, a number of power generation technologies, are being evaluated. Their commercial implementation has not yet occurred in South Africa. The evaluation is to be considered in terms of technical, socio-economic and environmental aspects. The research, development and demonstration investigations include:

- gas-fired power plants;
- underground coal gasification;
- greenfield fluidised bed combustion technologies;
- renewable energy technologies (primarily wind and solar projects);
- pebble bed modular reactor (PBMR) technology;

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1 "Peaking electricity generating capacity" refers to power station technology designed specifically to generate electricity during periods of very high demand for electricity, normally on weekdays from 07:00 to 09:00 and 18:00 to 20:00.

2 "Base load electricity generating capacity" refers to power station technology designed specifically to generate electricity continuously for all hours.

- photovoltaic and biomass gasification applications as part of the government's integrated rural development programme;
- import options within the Southern African power pool (SAPP).

As older Eskom power plants reach the end of design life by about 2025, the use of all available technologies will be required in order to supply the country's growing electricity demand.

The proposed project is, therefore, in response to:

- assessments of the projected electricity demand and supply in South Africa;
- the identified need for replacement of existing power stations over and above those required to cater for growth in demand in the longer term (2020 and beyond);
- the need to evaluate a number of power generation technologies not yet implemented in South Africa on a commercial basis (as part of an ongoing effort to evaluate the viability of all supply-side options) in terms of technical, socio-economic, and environmental aspects.

1.1.3 DEMONSTRATION OF TECHNOLOGY

The preliminary results of the DME, NER and Eskom studies indicate that it is necessary to validate the assumptions and modelling of some of the supply side power generation technology options. This can only be done through demonstration or pilot plants. The research and demonstration period for new technologies may take a number of years to assess the long-term technical, operational, and socio-economic aspects. It is quite likely that the plants, once having passed their initial acceptance tests, could be phased into commercial operation.

1.1.4 TECHNICAL DESCRIPTION

The proposed PBMR DPP is pebble bed fuelled, graphite moderated and helium cooled nuclear electricity generation power station. The PBMR DPP uses a direct cycle gas turbine which converts the heat generated by nuclear fission in the reactor into electrical energy.

The technologies associated with the systems, structures, and components (SSC) used in the PBMR DPP have already been used in various applications throughout the world. One of the purposes of this project is to demonstrate the integration of these technologies tested in a full-scale module. In addition, the project is required to test the techno-economics and to influence future decisions on energy technology applications for electricity generation.

Fuel for the proposed PBMR DPP will consist of spherical pebbles (approximately 60 mm in diameter) that contain Triso coated Uranium Oxide kernels (up to 10% enriched), which are embedded in a graphite matrix.

Provision would also be made to accommodate all spent fuel produced during the design life of the plant. The site could also accommodate the spent fuel for many years beyond the design life. Other radioactive waste produced by the operations will be managed on site and be disposed of at the Vaalputs repository. This will follow statutory prescription. Spent fuel and high-level radioactive waste will be disposed of in accordance with the National Radioactive Waste Management Policy and Strategy.

The proposed PBMR DPP will be connected to the Eskom national transmission network within the Koeberg power station site. The site description is contained in Section 2.3.1 of this report.

Also proposed, is the widening of a portion of the road to the Koeberg power station from the R27 turnoff and the construction of the internal roads on the Koeberg Power Station site. This is to allow for access to the PBMR DPP site. The proposed PBMR DPP would largely make use of existing Koeberg infrastructure and services.

1.1.5 ANTICIPATED ACTIVITY TIMEFRAME

The proposed project consists of a construction/commissioning period during which constructability and the achievement of operational acceptance parameters has to be demonstrated as a precondition to taking the plant into the commercial operation for the remainder of its lifespan of 40 years.

The aspects that require demonstration initiated from fuel loading will include:

- safety systems availability / reliability (years 1 to 7);
- direct cycle power conversion unit efficiency (years 2 to 7);
- helium leakage verification (years 1 to 7);
- operational loads and states (years 1 to 2);
- reactor unit integrity (years 1 to 7);
- main power system integrity (years 1 to 7);
- generator integrity (Years 1 to 7);
- maintenance procedures on prototype (years 1 to 7);
- plant availability (years 3 to 7);
- reliability of prototype (years 1 to 7);
- plant efficiency and sustainability (years 3 to 7);

- operational and maintenance cost (years 3 to 7);
- first outage (year 3 to 6).

1.1.6 THE PREFERRED SITE: KOEBERG NUCLEAR POWER STATION SITE.

The applicant and the EIA consulting team assessed a number of sites during the Scoping Phase of the EIA for the 302 MW(t) PBMR DPP. The sites at Bantamsklip, Koeberg, Pelindaba and Thyspunt bore consideration. It was Koeberg, on the Western Cape West Coast, that emerged as the preferred site for the location of the proposed 400 MW(t) PBMR DPP.

The Koeberg Power Station site is located approximately 2 km from the Duynefontein residential area. It is 30 km north of Cape Town and 10 km south of Atlantis. The proposed PBMR DPP will be located some 400 m south east of the existing Koeberg Power Station, inside the access control one security fence. Approximately 20 hectares (200 000 m^2) of the site would be required. This land has already been disturbed. This includes the contractor's yards, temporary stockpile, as well as the terrace on which the PBMR DPP will be constructed.

1.2 CURRENT ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

1.2.1 NEW EIA APPLICATION

This application is lodged in terms of the Environmental Conservation Act 73 of 1989 and the regulations. The legal framework within which the EIA is conducted is described in Chapter 6 of this report.

The change in output of the PBMR DPP from 302 MW(t) to 400 MW(t) required a new EIA application. This includes both a scoping phase and an EIA phase (including public participation).

Baseline data sets that were generated during the previous EIA and recorded in the environmental impact report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. The public would have opportunity to comment on the assessment, results and conclusions made from these studies in the EIA phase.

The fuel manufacture and associated transportation is being considered under a separate EIA process to that of the PBMR DPP.

The application that was submitted under section 21 of the Environmental Conservation Act (Act 73 of 1989) included an application for exemption i.t.o. section 28A of the ECA. This exemption has been withdrawn and the DEAT has been formally notified of this development.

1.2.2 WHAT IS SCOPING?

The EIA regulations[3] provide for a two-tiered approach. Firstly, a scoping study is conducted, where after an Environmental Impact Report (EIR) phase may be required.

Figure 1 provides a schematic diagram of the environmental impact assessment process (EIA), of which scoping forms a part. This process forms the backbone of the approach towards this EIA. Please refer to Figure 2 for more information on scoping.

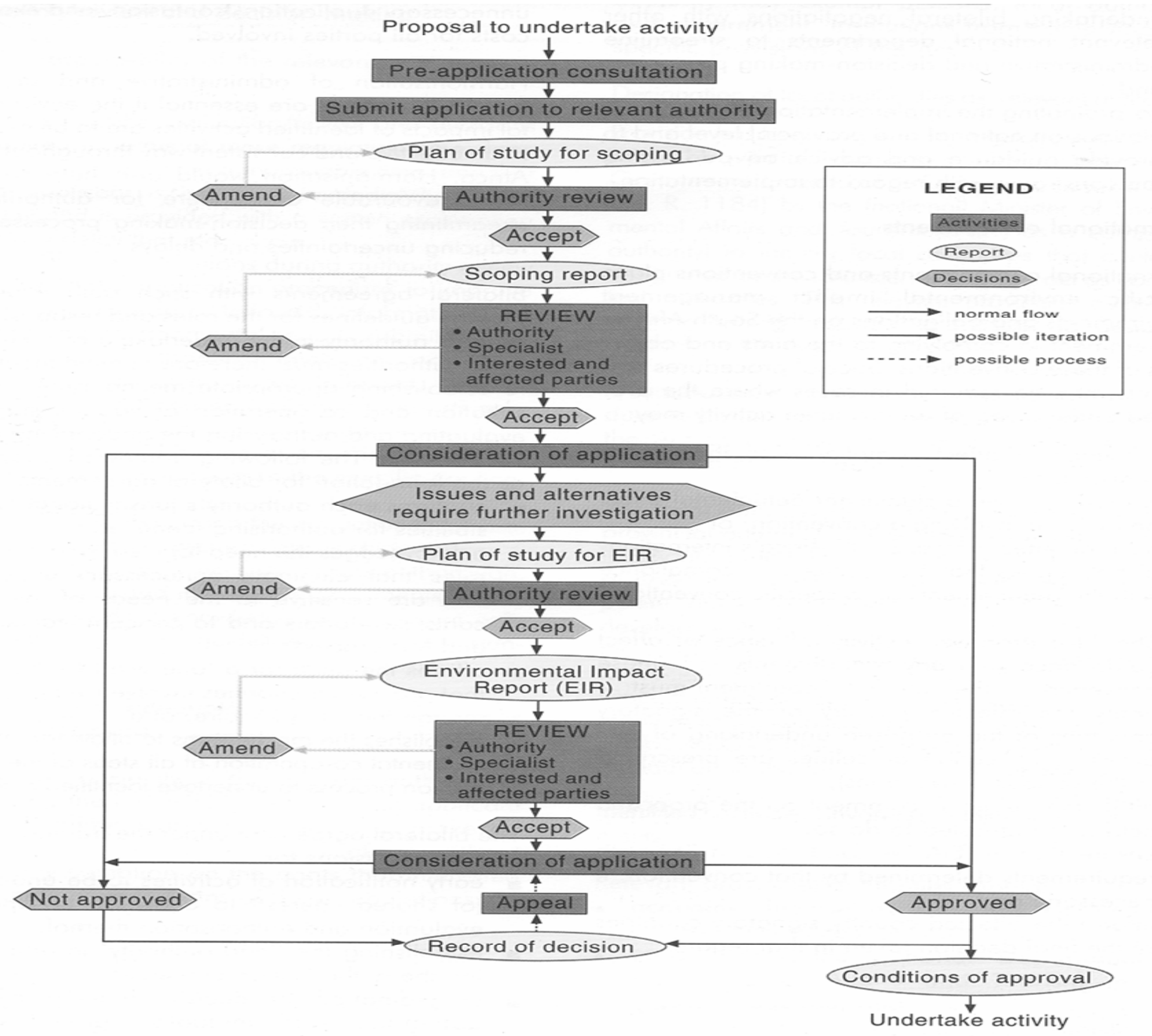


Figure 1: The Environmental Impact Assessment Process

3 An EIA is conducted under Regulation 4(6) of Government Notice R. 1883 under Section 26 of the Environment Conservation Act (Act 73 of 1989).

Scoping is the first phase of the required Environmental Impact Assessment process. During this stage the aim is to:

- identify the scope of the project in terms of the EIA requirements;
- identify possible alternatives to the project;
- gather background information regarding the location, local conditions and the environmental requirements of the proposed project;
- identify interested and affected parties (I&APs);
- provide I&APs with information regarding the proposed project;
- identify the issues, concerns and information requirements of I&APs.
- Compile a scoping report that includes the following information:
  - a brief project description;
  - a brief description of how the receiving environment may be affected;
  - a description of the environmental issues identified (this includes the issues raised by I&APs);
  - a description of all alternatives identified;
  - a description of the public participation process followed.

This report is submitted to I&APs for comment and thereafter to the relevant authority for decision-making.

Figure 2: What is a Scoping Process

This scoping phase takes cognisance of the issues and aspects raised during the scoping phase for the 302 MW(t) PBMR DPP and the specialist studies completed during the previous EIA process. These issues and aspects, where relevant, will be considered as part of the scoping for this process. They will be integrated with the issues and comments identified during the current scoping process for the 400 MW(t) PBMR DPP.

CHAPTER 2: ALTERNATIVES

In terms of the EIA regulations, it is required to demonstrate that feasible alternatives to the project have been considered and evaluated in terms of social, biophysical, economic and technical factors.

2.1 ENERGY AND TECHNOLOGY ALTERNATIVES

2.1.1 ENERGY POLICY

The White Paper on national energy policy acknowledges South Africa's need to increase its generation capacity and mix in order to become less dependent on limited sources of energy. In an attempt to pave the way to an acceptable energy mix, one of the objectives of the energy policy is to "… *pursue energy security by encouraging a diversity of both supply sources and primary energy carriers.*" According to the energy policy, the medium-term policy priorities to achieve this objective includes "*utilise(ing) integrated resource planning methodologies to evaluate future energy supply options.*" The policy lays down principles to which a particular technology/energy resource must conform to demonstrate its desirability and acceptability within a future energy mix. The Policy also acknowledges the fact that integrated resource planning approaches requires "*a great deal of data and analysis to implement and the systematic consideration of a full range of economic, environmental, social and technological factors.*"

With regard to nuclear energy generation, the policy notes that "*whilst it is unlikely that additional nuclear capacity will be required for a number of years, it would be prudent not to exclude nuclear power as a supply option. Decisions on the role of nuclear power, as with any other supply option, need to be taken within the context of an integrated resource planning process.*"

The DME has developed an integrated energy plan (IEP) and process to achieve and fulfil the current and future energy resource use objectives of the policy. The strategies are being developed in an evolutionary (bottom-up) fashion, because the projects themselves will inform and help to refine strategies and options for the national policy until, eventually, technology and policy will work in tandem.

2.1.2 THE INTEGRATED ENERGY PLAN (IEP) OF THE DEPARTMENT OF MINERALS AND ENERGY (DME).

Through the IEP the DME evaluates the availability of resources and promotes the effective and efficient use of all of the RSA's energy resources and fuels for commercial, industrial and residential purposes. In the latter case, this applies specifically for the disadvantage sectors of society. The IEP also promotes the use of appropriate technologies for the use of the fuels and energy resources and actively pursues the principles of energy conservation in all sectors of the economy.

2.1.3 THE NATIONAL INTEGRATED RESOURCE PLAN (NIRP) OF THE NATIONAL ELECTRICITY REGULATOR (NER).

The National Electricity Regulator (NER) governs the electricity industry and has established the national integrated resource plan (NIRP). This is to regulate amongst other objectives, the use of energy resources, technologies and fuels for electricity generation and supply. In summary, the NIRP determined that the coal-fired option of generating electricity would be required from 2010 for at least the next 20 years for the supply of base load. Additional energy generating facilities such as combined cycle gas turbines would be investigated, peaking options such as open cycle gas turbines (OCGTs) and pumped storage schemes would be required by 2007 and 2013 respectively. In addition to the above, the NIRP includes research and demonstration projects such as wind energy, solar energy, clean coal and nuclear (PBMR DPP). These latter technologies are all in different stages of feasibility and demonstration

2.1.4 INTEGRATED STRATEGIC ELECTRICITY PLANNING (ISEP) PROCESS.

Energy and technology alternatives are motivated in terms of Eskom's integrated strategic electricity planning (ISEP) process. This process stems from the prerogatives set by government in terms of IEP and NIRP. This process provides Eskom with strategic projections of supply-side and demand-side options to be implemented to meet long-term forecasts based on their obligation to supply electricity. ISEP provides the framework for Eskom to investigate a wide range of new supply-side and demand-side technologies with a view to optimising investments and returns. The results of the ISEP process are similar to, and consistent with the conclusions, where applicable, of the integrated energy plan of the Department of Minerals and Energy (DME) and the national integrated resource plan (NIRP) of the National Electricity Regulator (NER).

To diversify the national energy mix for the generation of electricity, a number of technologies are under investigation for further development, including the PBMR technology.

The proposed PBMR Demonstration Power Plant (PBMR DPP) would not significantly increase the generating capacity of Eskom. However, the intention is not to create generating capacity, but to evaluate the techno-economic feasibility of the PBMR technology. Similar evaluations are currently being undertaken by Eskom for various other generating technologies such as 100MW solar thermal and underground coal gasification. Once technologies are appropriately evaluated, they then form part of the base case technologies. These technologies are selected for evaluation within the framework of the

White Paper on energy, which informs the integrated energy plan, the national energy resource plan and in turn the Eskom integrated strategic energy plan. Based on the above Eskom is obliged to assess all energy sources, inclusive of nuclear energy.

2.1.5 COMPARATIVE DESCRIPTION OF TECHNOLOGY ALTERNATIVES

A description of the alternative technologies will be provided within the EIR to contextualise the PBMR DPP

2.2 THE NO-GO OPTION

The no-go option will be described in the EIR phase.

2.3 GEOGRAPHICAL / LOCATION ALTERNATIVES

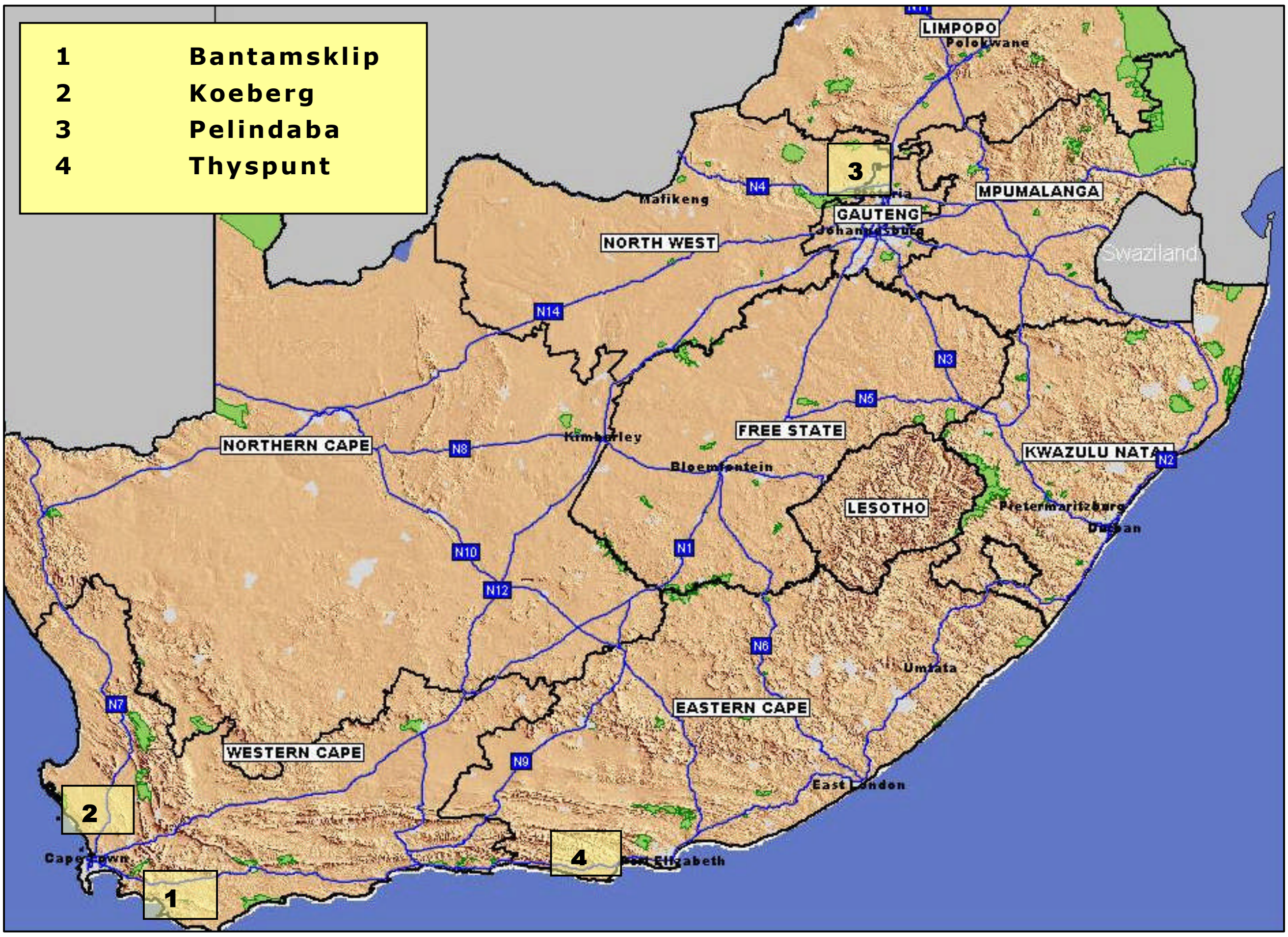
Comprehensive site alternative assessments and public participation processes were implemented during the 302 MW(t) PBMR DPP environmental assessment (PBMR EIA Consortium, 2001). The information from this previous process was evaluated and is still considered valid. This information will be used in the assessment of the site alternatives during the 400 MW(t) PBMR DPP EIA process. The re-evaluation of baseline geographic/location alternatives, to determine the desirability of each of the alternative sites for a 400 MW(t) PBMR DPP, is reported in the scoping report.

The site alternatives that will be considered and assessed are Bantamsklip, Koeberg, Pelindaba and Thyspunt Please refer to Map 1 for the location of the various sites.

Both the Thyspunt and Bantamsklip sites were previously assessed for developing a pressurised water reactor (PWR) nuclear power station, similar to the Koeberg nuclear power station.

On the basis of review of the *Draft Scoping Report for the Proposed Demonstration Module for a PBMR (March 2001 Rev* 0) by the National Department of Environmental Affairs and Tourism (DEAT), Eskom was requested to also scope Pelindaba for its feasibility as a potential alternative site for the proposed PBMR demonstration module plant.

The locational alternatives will be described in the EIR phase



Map 1: Alternative site locations

A summary of the alternative sites considered, as well as the conclusions regarding their desirability relative to the preferred Koeberg Site for the proposed PBMR demonstration module plant follows in Table 2.

2.3.1 KOEBERG (INDICATED AS 2 ON MAP 1).

Section 4.1 contains a detailed description of the Koeberg site. This information was used in the comparative assessment of the alternative sites. Please refer to Section 4.1 in this regard.

2.3.2 BANTAMSKLIP (INDICATED AS 1 ON MAP 1).

a) Location

The Bantamsklip site is located approximately 10 km south-east of Pearly Beach and *approximately* 50 km north-west of Cape Agulhas, in the southern Overberg sub-region.

b) Biophysical description

The site is underlain by Peninsula Formation quartzitic sandstone with minor green-to-grey shale bonds. Characteristic of the site is that the quartzitic sandstone often has a soft, sugary and brittle nature.

The basement is overlain by vegetated semi-consolidated dunes with alternating calcoronite and boulder beds. The semi-consolidated dunes mostly consist of light-brown, poorly sorted, calcareous sand.

The sediments of the quartzitic basement at Bantamsklip consistently dip at 25 to 30 degrees to the south-east. The mega-scale structure of the Bantamsklip site is further demonstrated by a seaward-striking outcrop, which gently submerges under the sea. A large portion of the Bantamsklip beach outcrop is eroded into a network of low-lying gullies.

The basement topography at the site is mostly below the 4 metres above mean sea level contour. The overburden thickness is essentially determined by the dunes and rises gently to 9 m in the north-east.

As a result of low permeability of the rock types, well yields were low during pump tests that were performed on the site. Water quality in the basement rocks is of better quality than in the overlying sediments.

The Bantamsklip site is at least 3 km away from a possible capable fault. Foundation conditions are suitable for the construction of a PBMR DPP.

Two vegetation communities occur on the site, namely dune asteraceous fynbos and secondary dune fynbos/acacia. The dune asteraceous fynbos community has a distinctive and high endemic dune flora. It is likely that there are 3 – 9 threatened species in this community. Although the conservation status of this community is not critical, very little of the dune asteraceous fynbos is formally conserved. The coastal margins of Bantamsklip have a *littoral fringe* community. This vegetation community is relatively stable and resilient and free of alien acacias. The coastal marginal zone is an important buffer between land and sea, and is usually an exposed area subject to wind and salt spray. Two threatened species are likely to occur in this vegetation type.

The most important vegetation type on the site is the proteoid fynbos. This vegetation type occurs on the north-eastern margin of the site, and extends north / north-east of the main road. According to an assessment of the Bantamsklip area the site may include highly localised endemic species.

Fifty-eight species of mammals can be expected to occur in the sub-region. The mammal fauna are characterised by a few prey species, such as the striped mouse (R*habdomys pumilio).* Species of conservation interest include:

- bushbuck (Tragelaphus scriptus);
- white-tailed rat (Cricetomys gambianus);
- water rat (Dasymys incomtus);
- honey badger (Mellivora capensis);
- wild cat (Felis lybica).

The sub-region is known to support 51 species of amphibians and reptiles. Only two, the Cape dwarf chameleon *(Bradypodion thamnobates*) and the Cape *chirping frog* are endemic.

One of South Africa's rarest endemic coastal breeding bird species, the African black oystercatcher (*haematopus moquini*), is found on the Bantamsklip site. These birds have been seen to breed on the site. The Damara tern (S*terna balaenarum)* is another important species likely to forage on the site. Due to the quality of the fynbos on the site some bird species endemic to the fynbos were observed on the site, i.e. Cape sugarbird (P*romerops cafer)* and the orangebreasted sunbird (*Nectarinia violacea).* The bird life on the site has conservation value and should be considered as significant.

c) Marine biophysical environment

The Peninsula Formation quartzites form a rocky coastline along the Bantamsklip site. Extensively developed joint sets have created a very ragged appearance to the outcrop. Easterly striking faults and closely spaced joints have resulted in a number of parallel gullies.

The marine floral species are made up of a variety of algal communities. The algal floral species are dominated by brown algae, such as kelp or sea bamboo, and green algae. The dense kelp beds are supported by long ridges of rock projecting seawards. Abundant limpet, winkle, alikreukel, sea urchin and abalone populations occur in the kelp beds. The abalone population at Bantamsklip is part of the viable commercially fished stock between Cape Agulhas and Cape Columbine.

Commercial and recreational line-fishing are important activities in the Bantamsklip region. Some of the most sought-after species for recreational rock and surf fishing, i.e. white steenbras (*Lithognatus lithognatus*), galjoen (*Coracinidae)* and cod (*Cephalopholis ssp*. and *Epinephelus ssp.)* are found here. The sustainability of the line fish population is highly dependent on the maintenance of the described habitat.

d) Infrastructure, demography and archaeology

The archaeological sites at Bantamsklip are chiefly shell middens of the Late Stone-age period. Shell middens are mostly covered with sand and vegetation and with organic material less well preserved. Although these sites are of archaeological importance, their research potential is not high. A fish trap constructed by the Khoi-Khoi about 2 000 years ago is located north-west of the Bantamsklip site. These fish traps should not be affected by the construction of a PBMR DPP on the site.

The Buffelsjagt campsite to the east falls within a five-kilometre radius from the centre of the Bantamsklip site. The campsite has accepted as many as 3 200 people during the High Holiday season. The 16-km radius includes both the Pearly Beach holiday population and the Buffelsjagt population, which could exceed 13 000 people.

Access to the Bantamsklip site is via the R43 beyond Gansbaai en route to Stanford. From Stanford the route follows the R43 via Gansbaai. The route is entirely on paved roads, with the R43 passing the Bantamsklip site approximately two kilometres to the north. An access road could therefore be constructed without significant environmental impact.

The area obtains almost all of its water from underground aquifers or runoff captured in the more mountainous areas. These water resources are insufficient during the holiday season periods. Water supply for construction and operation of a PBMR could prove to be problematic, and may require the construction of a bulk supply pipeline. Such a pipeline may be associated with significant environmental impacts.

Connection to the national transmission grid can be made at the Bacchus substation. To achieve this, transmission lines would have to be constructed across the Kleinrivierberge to Bot River, a distance of about 90 km from Bot River. It is assumed that the lines will follow the existing lines from Palmiet pumped storage scheme to the national grid, via the Bacchus Substation, a distance of about 40 km. The lines would cross over sensitive environments and therefore possibly adversely impact on these environments.

e) Socio-economic characteristics

Economic activity in the area is associated with the tourism and fishing industries. The tourism industry centres on the Buffelsjagt and Pearly Beach holiday facilities. The total number of visitors may exceed 13 000 during peak holiday season.

The Buffelsjagt community, which consists of about 20 households, has engaged in commercial fishing since the 1920s. Although the community has no legal title to the land they occupy, they retained the traditional rights to the land when it was taken over by the Department of Community Development. The community depends on the marine environment for income. Income is supplemented by picking wildflowers on neighbouring farms and occasional contact work. The community's education levels are low, emphasising the population's dependence on marine harvesting and limited ability to compete in the outside job market.

2.3.3 PELINDABA (INDICATED AS 3 ON MAP 1).

a) Location

The proposed Pelindaba site is located in the North Western Province to the west of Pretoria, and is currently owned by the South African Nuclear Energy Corporation. This is an operational site for nuclear related activities.

b) Biophysical

The Pelindaba area is underlain by rocks of the Transvaal Super Group, which display an accurate distribution around the Halfway House Granite Dome. The basal member of the Transvaal Super Group is the siliciclastic Black Reef quartzite. This is located some 15 to 20 km to the north of the Pelindaba Site. The intrusive rocks of the Bushveld Complex overlie the Transvaal Subgroup. The intrusive rocks on the Pelindaba site are represented by syenite dykes and diabase sills.

On the Pelindaba site, the Rooihoogte Formation forms the base of the Pretoria Group. It consists of a basal chert pebble meta-conglomerate (Bevets Conglomerate Member), followed by siltstones and slates containing some chert.

The aquifer beneath the Pelindaba site can be classed as a secondary aquifer with the majority of groundwater occurring within faults, fracture zones associated with diabase intrusions, and along geological contacts. This is evident from the borehole yields measured across the site.

The perennial Crocodile River, the Hartbeespoort Dam and the seasonal Moganwe stream are the only nearby bodies of surface water. Rainwater from the site drains in an easterly direction into a tributary of the Moganwe stream.

Water of the Crocodile River is used for recreation and agricultural purposes, while water of the Hartbeespoort Dam is used for recreation. Boreholes are utilised for domestic (which includes drinking purposes) and agricultural purposes. No water from the seasonal Moganwe Stream is used for recreation, domestic or agricultural purposes.

The site is situated in the summer rainfall area with thunderstorm activity and warm to hot conditions during this period. The weather conditions during winter consist of cold nights and moderate days with light wind conditions, except during the movement of cold fronts from the southwest when temperatures fall and stronger winds occur. The strongest winds tend to occur during the months of August and September.

Mean annual rainfall is 639 mm/year, based on 33 years of statistics to 2000. The predominant rainfall season is from October to April. The 1991/92 seasons recorded the lowest rainfall with 375 mm, while the highest was recorded during the 1995/96 seasons with 1196 mm.

Temperature ranges from a mean daily minimum of 25°C in July up to a mean daily maximum of 28°C in January. The average daily minimum humidity is 25% in September and the maximum 78% in April, which corresponds with the explanation for the difference between rainfall and evaporation referred to in the section on evaporation.

The prevailing wind direction ranges from the northwest through north to the east with a southerly component that can be associated with cold fronts moving from the southwest through the interior of the country during the winter. During winter most wind speeds range between 6 and 12 km/h with 17% calm conditions. In summer, the winds are a bit stronger, ranging between 12 and 19 km/h with only 7% calm conditions.

Pelindaba lies within the Savanna Biome within the veld-type that was characterized as Bankenveld. The Pelindaba site is on the transition between the grassland (veld type 34) and the Savanna biome (veld type 18). The site is probably more characteristic of Rocky Highveld Grasslands (RHG). The area of the RHG biome is 240 633 km^2; ± 65% of which is transformed, and 1.38% conserved. In the Gauteng area the vegetation is highly threatened by urbanisation, industrialisation and mining, and, to a lesser degree, agriculture.

Two rare bird species, namely the Cape vulture and the peregrine falcon *(Falcon peregrinus)* occur in the Magaliesberg area. Neither the Cape vulture nor the Peregrine falcon is known to visit the Pelindaba site.

c) Infrastructure

The public roads in the area consist of the R512 (from Johannesburg via Lanseria to Rustenburg and Brits) and the R511 (from Johannesburg via Hennopsriver to Brits). These roads bypass the site at distances of 3,6 and 6,6 km respectively.

Overhead air traffic is a function of the flying patterns in the area that depend on factors such as the proximity of airports, positioning of general flight training areas, established air traffic routes and military testing ranges.

The airports nearest to Pelindaba are Lanseria, Wonderboom, Waterkloof and Swartkops in Pretoria . Lanseria is the largest airport training facility in South Africa. There are no military testing ranges in the region.

The Johannesburg general flying area is located to the northwest of the Pelindaba site. A height of 7000 feet above sea level is enforced by the Civil Aviation Authority.

Electronic beacons for aircraft located in the close vicinity of Pelindaba include Hartbeespoort Dam, located north of the dam, as well as Meerhof.

A study commissioned by Eskom in June 2001 considered Pelindaba as an alternative site. It concluded that there are adequate fire and emergency service facilities and equipment on site (staffing levels are however low but have been recently supplemented) and a nuclear emergency plan is in place at Pelindaba.

A 5 km radius around SAFARI has been determined for the nuclear licence as the emergency planning zone (EPZ).

d) Land use and Demographics

Currently the number of personnel on site comprises 1100, employed by NECSA and 1300, employed by lessees.

The area surrounding the site comprises mostly rural and agricultural land use. To the northwest, however, a number of small towns are located around the Hartbeespoort Dam, namely Kosmos, Melodie, Schoemansville, Ifafi, Meerhof and Magaliesburg. A higher population density is also seen to the east where the western outskirts of Pretoria (Atteridgeville) lie.

A high-density population mode is developing at Diepsloot, more than 15 km to the south of the site.

The nearest hospitals, namely Kalafong and Santa Tshepong hospitals, are situated 17 km from the site. There are no old-age homes or institutions for mentally handicapped persons situated within the 5 km EPZ of Pelindaba.

According to the Gauteng spatial development framework, agriculture is a significant component of the economy, but it has experienced negative growth.

According to the site description report compiled by NECSA Risk Management division dated December 2001, there are 151 smallholdings and 16 farms within the EPZ area, which are used for residential purposes only. Two smallholdings and four farms are utilized for livestock farming, seventeen smallholdings and two farms for growing crops or flowers and fifteen smallholdings for unspecified uses.

According to the Gauteng spatial development framework, the natural environment in the Western Gauteng Services Council, particularly in the north, could support substantial tourism. The areas of southern Crocodile River, Magaliesburg and Magalies Mountain Range have been included as important resources.

The Hartbeespoort Dam area, is an important recreation and tourism node. The Cradle of Humankind world heritage site forms an integral part of this area. The node has a market area drawing mainly from Gauteng.

2.3.4 THYSPUNT (INDICATED AS 4 ON MAP 1).

a) Location

Thyspunt was selected as one of the potential sites for a nuclear power station during the nuclear siting investigation programme (NSIP) conducted in the Eastern Cape between 1984 and 1987.

During the NSIP two sub-regions were evaluated in the Eastern Cape, namely:

- east of Port Elizabeth – between the Sundays River mouth and Cape Padrone;
- west of Port Elizabeth – between Cape St. Francis and the Groot River mouth.

The area east of Port Elizabeth was eliminated from further consideration due to unsuitable geology, unfavourable demographics and high environmental sensitivity.

Towards the west of Port Elizabeth, unfavourable topography eliminated the area between the Tsitsikamma River mouth and Groot River mouth. The coast from Cape St. Francis to Tsitsikamma River mouth was therefore the only remaining possibility. Subsequently, based on the findings of preliminary sensitivity and suitability studies, Thyspunt was identified as the most suitable site on the East Cape coast for developing a future pressurised water reactor (PWR) Power Station.

b) Biophysical description

The vegetation cover is undisturbed along the coastline of the site, with only a small area of exposed sands and pioneer species at the eastern end. The large mammal population of the site is typical of this part of the coast and the species recorded are not among those considered to be at risk, i.e. endangered or rare. Dassies *(Procavia capensis)* and water mongoose *(Atilax paludinosis)* are restricted to the seaward margins of the site. Bushbuck *(Tragelaphus scriptus)* are the most commonly sighted large mammals. Fauna and flora on this site is not considered to be of high conservation significance.

During the NSIP extensive core drilling was carried out to evaluate the structural geology and bedrock conditions. The Thyspunt site straddles the contact between the steep south-dipping quartzitic Kouga Formation and the quartz-feldspardic Tchando Formation. Both these formations are part of the Cape Supergroup.

Foundation conditions are good. A large portion of the site lies below the 20 m contour, and is covered by vegetated hummocked sand dunes. Bedrock elevation rises gently inland and is on average 4 m to 6 m above sea level. There is no major faulting below the site. The relief is low and the sand dunes are fairly well cemented, rendering the chances of soil liquefaction by heavy rain or a seismic event low. However, the Klippepunt Fault, 5 km to the south of the site, must be regarded as seismically active, until proven otherwise.

c) Marine biophysical environment

This consists of a long narrow bay, extending from a small beach in the west, through a shallow, extensive boulder bay to the open sea in the east. The northern shore of the bay consists of stable rocks, which become progressively more exposed from west to east, resulting in a corresponding increase in the width of the biotic zones. The southern boundary of the long bay comprises a ridge of stable rocks typical of exposed sites. The lower side of this ridge is protected from wave action and consequently supports much smaller macro-algal populations.

The intertidal zone consists of a uniform area of very jagged rocks, forming a narrow intertidal zone of about 50 m wide. Barnacles are prolific. *Pomatoleios kraussi* and *P. granuloris* encrust the lower pool edges. *P. oculus* and *P. longirosta* appear to be less numerous than *P. granuloris*, probably due to lack of habitat.

The sub-tidal area consists predominantly of large rocky outcrops, between 3 to 4 m high. At a depth of 18 m, the ridges are 6 to 10 m wide, separated by sand-filled gullies. Between the 15 m and 5 m depth contours, the rocky ridges appear as vertical plates, parallel to the shore. The amount of sand present at the shallower depths is negligible.

The benthic macro-algae are dominated by two genera of erect corallines (kelp), i.e. *Arthrocordia spp*. and *Amphiroa spp*. Plants are an average of 10 m high at all depths of the sub tidal zone. The percentage cover is fairly equal at all depths of the sub tidal zone. The percentage cover of macro-fauna increases with depth. The sub tidal habitat is highly suitable for a large variety of fish and marine fauna.

Fish fauna observed at the site consist of the following species:

- blacktail (Diplodus sargus);
- zebra fish (Diplodus cervinus);
- fransmadam (Boopsoidea inornata);
- janbruin (Gymnocrotaphus curvidens);
- white musselcracker (*Sparodon duranensis*);

- striped catshark species.

Although none of the above fish are threatened or rare, the population is healthy and sustainable and should therefore be considered to be of significance.

d) Infrastructure, land use, demography, history and archaeology

The Thyspunt site is situated in an area where socio-economic development has been limited almost exclusively to recreation and agriculture activities. Access to the site is from both the west and east via a low-order gravel track. The N2 national road runs in an east-west direction, approximately 20 km to the north. The remoteness of the site increases its potential for tourism development. Furthermore, remoteness and absence of suitable access roads would require the construction of extensive new roads, with the associated environmental impact.

Oyster Bay is the nearest settlement, and consists mainly of holiday houses. Sea Vista and Humansdorp are 11 km to the north-east and 19 km to the north respectively. Several farms exist west and north-west of the site. Demographic requirements in terms of nuclear licence requirements can be complied with.

No shipwrecks occur at the site. However, the wreck of the Cromatyshire (1901) is known to be in Thysbaai, approximately one kilometre west of the site. Two series of fish traps with archaeological significance occur at the site. These would be severely affected by the construction of a cooling water intake bay.

e) Socio-economic aspects

The principal farming activities in the area consists predominately of sheep and dairy farming. Wheat is also cultivated in this region. The construction of a PBMR should not have any significant impact on the economic activities in the immediate vicinity of the site.

2.3.5 AN ASSESSMENT OF THE ALTERNATIVE SITES TO DETERMINE THE DESIRABILITY FOR A PBMR DPP.

The desirability of the alternative sites compared to the preferred site is given in Table 1.

The KNPS site, and the three alternative sites, Pelindaba, Thyspunt and Bantamsklip, were evaluated against a set of technical site criteria. They were similarly evaluated against specific environmental sensitivities associated with each site. The purpose of the assessment was to determine whether any of the alternative sites were more suitable than the KNPS site for a PBMR DPP.

This assessment focused on the possible construction of a **PBMR DPP.** This furthermore has no relevance on the construction of further PBMR units, PWR Power Stations or any other future proposed development at any of the sites assessed.

Environmental sensitivities of each site and the results of the site assessment are indicated in Table 1. These sensitivities were obtained from the site evaluations and existing documents reviewed and evaluated as part of this assessment.

Table 1: Results of the Assessment of Alternative Sites

PBMR DPP Site Criteria		KNPS Site	Bantamsklip Site	Thyspunt Site	Pelindaba Site
1.	**Supporting infrastructure**				
1.1.	Still water bay housing the cooling water inlet	Existing infrastructure	Non-existent, undeveloped site	Non-existent, undeveloped site	Inland site. Cooling water would most likely be obtained from the Hartebeespoortdam Alternatively, dry cooling may be used at significant additional expense
1.2.	Cooling water outlet system	Existing infrastructure	Non-existent, undeveloped site	Non-existent, undeveloped site	Will require some further modification at additional expense
1.3.	Access roads designed to handle Nicolas horse and trailer. Width 8.0 m, radius and curves 30 m minimum	Existing infrastructure. Upgrading of some roads and construction of a 132 kV power line on the Koeberg site required	Non-existent, undeveloped site Approximately 2 km of new road to be developed	Non-existent, undeveloped site. Approximately 20 km of new road to be developed	Will require upgrading of some off-site feeder roads
1.4.	Storm water systems – clean, dirty	Existing infrastructure, minor modifications required	Non-existent, undeveloped site	Non-existent, undeveloped site	Will require upgrading of existing infrastructure

PBMR DPP Site Criteria		KNPS Site	Bantamsklip Site	Thyspunt Site	Pelindaba Site
1.5.	Sewage system	Existing infrastructure	Non-existent, undeveloped site	Non-existent, undeveloped site	Will require addition
1.6.	Security fences/access control	Existing infrastructure	Non-existent, undeveloped site.	Non-existent, undeveloped site	Will require addition.
1.7.	Potable water supply	Existing infrastructure	Non-existent, undeveloped site.	Non-existent, undeveloped site	Will require addition
1.8.	High voltage yard and buildings	Existing infrastructure	Non-existent, undeveloped site.	Non-existent, undeveloped site	Will need modification and addition
1.9.	Connection to the national electricity transmission and distribution grid	Existing infrastructure	Non-existent, undeveloped site	Non-existent, undeveloped site	Will need addition
2	**SITE SENSITIVITIES**				
2.1.	Biophysical	No fauna and flora related sensitivities since this is going to be on a brownfields area	Possible occurrence of threatened flora species of the dune fynbos Occurrence of highly localised endemic flora of	Virgin biological environment	No Fauna and flora related sensitivities since this is going to be on a brownfields area

PBMR DPP Site Criteria		KNPS Site	Bantamsklip Site	Thyspunt Site	Pelindaba Site
		Geological faults within 5 km of the site	the proteoid fynbos Occurrence of bird life with conservation value At least three km. away from a possible capable fault	Anticipated seismically active Klippepunt fault 5 km south of the site	
2.2.	Marine biophysical	No sensitivities	Viable commercially fished abalone stock Sustainable line fish population	Healthy/ sustainable fish population in the area	Not applicable to this site
2.3.	Land use	No sensitivities	In addition to onsite infrastructure development the construction of 40 km of transmission line would be required	Environmental impacts associated with the construction of 20 km access road. Transmission line, and onsite infrastructure	Onsite infrastructure. Rapidly expanding residential areas in proximity of the site
2.4.	Demography for PBMR requirements	Sensitive, Melkbosstrand, van Riebeeckstrand urban	Sensitive, Buffelsjagt campsite within 5 km	Limited sensitivities, holiday developments 11 km from	Sensitive. Rapidly expanding residential areas in proximity of the site –

PBMR DPP Site Criteria		KNPS Site	Bantamsklip Site	Thyspunt Site	Pelindaba Site
		areas within 5 km		the site	Hartebeespoortdam and Atteridgeville
2.5.	History/Archaeology	No sensitivities	No sensitivities on the terrace	Archaeological significant fish traps on the site	Archaeological resources in the surrounding environment, none on site itself
2.6.	Socio-economic	No sensitivities	Buffelsjagt fishing community is sensitive to social and environmental changes, especially as this community is dependent on the marine resources of the area	No sensitivities	No sensitivities

a) Discussion of the assessment

- The parameters used to assess the desirability of the alternative and preferred sites did not change significantly since the 302 MW(t) EIA, and were therefore reused in this assessment.
- Ambient environmental conditions at all four sites included in this assessment comply with the requirements for developing a PBMR DPP. However, due to the availability of a large source of cooling water adjacent to the sites, the three coastal sites are more desirable than the Pelindaba site.
- Existing supporting infrastructure at the KNPS site contains all the elements to sustain a PBMR DPP. The Bantamsklip and Thyspunt sites are undeveloped, and would require the construction of not only the PBMR DPP, but also the supporting infrastructure. Both sites are remote from the national transmission grid and would therefore require the construction of a high-voltage power line from the site to the national grid connection point. Although the Pelindaba site is a developed site, the supporting infrastructure specifically required for the PBMR DPP was either dismantled, or does not exist on the site. An access road network is absent for the Thyspunt and Bantamsklip sites and would require development of new roads (for extra heavy loads) and upgrading of existing roads for approximately 20 km. and 2 km. respectively.
- Cooling water intake and outlet infrastructure would have to be developed at Pelindaba, Thyspunt and Bantamsklip. The coastal sites will require extensive civil construction in the tidal zone and marine environments. In the case of Pelindaba cooling water will be drawn from the Hartebeespoortdam, which would require extensive civil construction at the dam intake, as well as along the route of the pipeline to the Pelindaba site. This infrastructure already exists at the KNPS site and would only require extension of the pipe system to accommodate the PBMR DPP.
- The environmental sensitivities indicated in Table 1 at the undeveloped Bantamsklip and Thyspunt sites, and partially developed Pelindaba site, suggest that for the purposes of a PBMR DPP these sites are less desirable than the Koeberg site.

2.3.6 CONCLUSION.

The application made by Eskom is for the construction and operation of a PBMR DPP at the Koeberg nuclear power station site. The desirability of the selected site is therefore determined by the availability of existing infrastructure and services (hence least construction of new infrastructure), and therefore least disturbance of the receiving environment.

Although all the assessed sites may be suitable for the siting of commercial nuclear power stations the assessment results as discussed above, indicate that the KNPS is a more suitable site for developing a PBMR DPP than the Pelindaba, Bantamsklip or Thyspunt site. The establishment of the already existing infrastructure at the Koeberg site on the alternative sites will increase the environmental impact of the PBMR DPP and therefore the alternative sites are less desirable than the Koeberg NPS site for the construction of a PBMR DPP.

An assessment of the alternative sites, including the no – go option will be included in the EIR.

CHAPTER 3: DESCRIPTION OF THE PROPOSED ACTIVITY

3.1 INTERNATIONAL STATUS OF NUCLEAR ENERGY

The year 2004 marked the 50th anniversary of civilian nuclear power generation. Growing energy needs around the world, rising fossil fuel prices, environmental constraints, and nuclear power performance records are leading to nuclear being considered increasingly as an energy option. The IAEA now projects 423-592 DW(e) nuclear power installed world wide by 2030, compared to the 366 GW(e) installed by the end of 2004. Nuclear power has grown at the same pace as overall global electricity generation for the past 18 years, and held steady its generating share of 16% of total global generating capacity.

Globally the policy of governments on nuclear is changing. There are 55 new reactors planned or under construction in China, Russia, India, Japan, and South Korea. The Swedish and German governments have halted their shutdown programs. France has placed an order for a new nuclear power station, while Finland has already started construction of a new power plant.

3.2 OVERVIEW OF THE PROPOSED PBMR DPP.

The PBMR module consists of a pebble bed fuelled, graphite-moderated, helium-cooled reactor in which the gas is heated by the nuclear fission process. A direct cycle power conversion unit converts the heat into electrical energy by means of a turbine-driven generator.

The PBMR reactor core is based on the high-temperature gas-cooled reactor technology developed in Germany. This technology makes use of spherical fuel elements, referred to as pebbles, which are in size and physical characteristics similar to the fuel which was developed for the German High-temperature Reactor (HTR) programmes.

Provision would also be made to accommodate all spent fuel produced during the design life of the plant. Low and medium level radioactive waste would be processed on site in accordance with regulatory requirements.

3.2.1 THE DEMONSTRATION

Although the key components of the PBMR technology have been tested and proven at different times and places, the integrated PBMR DPP is a "First-of-a-kind engineering" project. In this regard, Eskom wishes to demonstrate the techno-economic feasibility of the integrated system.

The two important aspects of the demonstration program are the testing of the functional integrity and the commercial performance.

a) Demonstration of the functional integrity.

The demonstration of the functional integrity will test the operability, safety and the maintainability of the integrated plant system. Eskom is interested in the total plant availability, age management, online maintenance for critical equipment, and the ease of achieving the 6-yearly maintenance intervals between the general overhauls.

The operational modes and states including consistent and predictable base load operation, load following, transient management, equipment protection and load rejection will be demonstrated. Overall cycle efficiency, including that of the direct cycle power conversion unit (PCU) and fuel handling system will be demonstrated.

The ability to retain helium within the pressure boundary and the performance, under different conditions, of key mechanical components such as the graphite structures, reactor pressure vessel, valves, heat exchangers, turbine, compressors, seals, gearbox and generator will be demonstrated.

The dynamics of the reactor core will be monitored to ensure consistent and predictable operation under different operational regimes.

b) Demonstration of the commercial performance.

The demonstration of the key commercial performance parameters of the PBMR DPP such as construction costs, plant availability and efficiency, operational and maintenance costs and mid-life upgrade requirements will be demonstrated during various stages of the project.

3.3 BUILDING INFRASTRUCTURE

3.3.1 BUILDINGS

The PBMR Demonstration Power Plant (DPP) consists of a number of buildings, including:

An integrated Reactor Building and Generator Building: The nuclear reactor and associated components are housed in the reactor building. The reactor building structure is constructed of reinforced concrete. The reactor building foundation comprises an approximately 3 m thick raft, founded on bedrock approximately 26 m below surface level. The surface level around the reactor building at the proposed site is at elevation of approximately +13.5 m above mean sea level.

The generator and associated electrical and auxiliary power plant are located in a generator building, located adjacent to the northern gable of the reactor building. The generator house comprises a conventional framed structure, constructed of conventional reinforced concrete to 3 m above the generator floor, located approximately +10 m above surface. Above this level a structural steel support system, covered with aluminium sheeting, is proposed.

A Services Building: The services building houses the main control room and the waste handling and storage system and also provides the controlled access to the reactor building.

An Ancillary Building: The ancillary building is located to the east of the reactor building and north of the services building and houses the medium and low voltage switchgear, the diesel generators, and other systems associated with the operation of the PBMR DPP. Underground tunnels interconnect the reactor building with the services and ancillary buildings.

A Cooling Water Plant Building: Sea water is used for cooling the helium gas that cycles between the reactor and the turbine. A cooling water plant Building is located to the west of the generator building and houses the cooling water pumps and heat exchangers. Piping between the cooling water plant building and the reactor building is routed via an underground tunnel.

An Administration Office Building: An administration office building on the south west corner of the terrace will house the PBMR DPP staff. The services building, ancillary building, administration building and cooling water plant building are likely to be constructed using conventional beam column frames supporting reinforced concrete floors and structural steel, clad roofs.

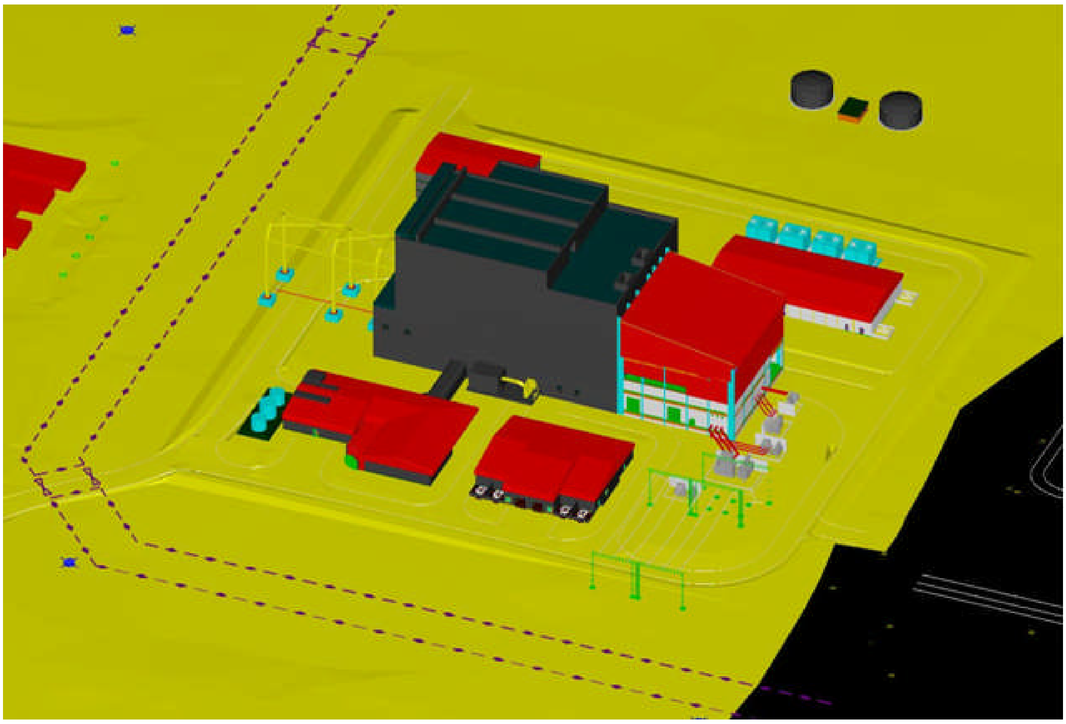


Figure 3: Site Layout Drawing

3.3.2 USING OF EXISTING KOEBERG INFRASTRUCTURE

The proposed PBMR DPP would to a large extent make use of existing Koeberg infrastructure and services. These include:

- Potable water supply - Raw water for the intermediate cooling system and domestic use in the station.
- Cooling water from the sea - Marine cooling water intake basin and outflow structures.
- Low and intermediate level radioactive waste management and storage structures and systems for the processing of such waste that will be disposed of at Vaalputs.
- Transmission network including substations.
- Sewage treatment facilities.
- Certain roads.
- Security.

3.3.3 OTHER INFRASTRUCTURE

A 132 kV transmission line, including transmission pylons, will be operated between the proposed PBMR DPP and the Koeberg substation, via the Duyne substation, all on the Koeberg power station site. This transmission line would link the proposed PBMR DPP to the national transmission network.

A widening of a portion of the road to the Koeberg power station from the R27 turnoff, and the construction of the internal roads on the Koeberg power station site for access to the PBMR DPP site are also proposed.

3.3.4 DESCRIPTION OF THE PROPOSED PBMR DPP.

The PBMR DPP consists of a single reactor/turbo-generator module incorporating all the support and auxiliary systems required for operation and maintenance

The design parameters that may be relevant to the assessment of possible environmental impacts are listed in Table 2:

Table 2: Approximate Plant Parameters

Design Parameters	Value(s)			Comment
Plant				
Location	On Koeberg site			
PBMR building size L x W x H				
Nuclear Island	Approximately 74 m x 37 m x 65 m, (65m high of which 40 m are above ground)			
Conventional Island (L x W)	Approximately 40 m x 40 m			
Building footprint	Approximately 40 000 m^2			
Emergency planning zone	None, falls inside Koeberg zone			
Exclusion area boundary	< 400 m for other sites			
Construction				
Reactor Building	Robust protective enclosure with controllable radionuclide retention function			
Safe Shutdown Earthquake	0.3 g PGA horizontal			
Main vessels – size, mass				
	ID top & bottom (m)	Overall height (m)	Total mass (t)	
Reactor vessel	6.2	30.4	1 016	
Power				
Total Thermal power (Pn)	Nominal 400 MW(t)			
Maximum Continuous Rating (MCR)	Nominal 175 MW(e)			

Design Parameters	Value(s)	Comment
Power conversion	Single-shaft Brayton cycle with helium as coolant	Shaft is horizontal
Generator placement	In conventional island	
Core		
Core shape	Annular cylinder around near-solid central graphite reflector	
Fuel		
Fuel type	TRISO coated UO_2 particle	
Fuel enrichment • start up core • normal operation	 4.9% to 5.9% 9.6%	
Fuel configuration	Coated particles in 60 mm diameter graphite spheres	
Uranium content per sphere	9 g U per sphere	
Fuel spheres (steady state)	Approx. 450 000 at 60 mm dia	
Primary circuit – MPS Pressure Boundary (MPS-PB)		
Maximum operating pressure at 100% MCR	9.0 MPa	
Design leak rate of MPS	0.1%/day of MPS inventory	
Secondary circuit – closed loop cooling		
Coolant	Demineralized water	Closed circuit
Tertiary circuit – Main Heat Sink System (MHSS)		
Coolant	Sea water	
Nominal flow rate	4 000 kg/s	

Design Parameters	Value(s)	Comment
Inlet temperature	< 25^0C	Shares Koeberg Cooling Water (CW) inlet wells
Heat exchange capacity	> 230 MW	
Outlet temperature	< 45^0 C	
Maximum temperature rise in outlet channel	< 1.5^0 C	Shares Koeberg outlet channel.
Potable water		
Storage capacity	2 270 m^3	Fire protection system reservoirs.
Consumption	200 m^3 to 250 m^3/month	Used by demineralization plant, sanitary waste
Staff		
During construction	Estimated maximum 800	
Normal operation	Estimated 105	
During outage	Estimated 250	
Operation and maintenance		
Plant operating lifetime	40 years	
Availability target	95%	
General overhauls	30 to 50 days scheduled per 6 years	

3.4 DESCRIPTION OF THE PBMR DPP FUEL.

3.4.1 NOMINAL CHARACTERISTICS

Fuel for the proposed PBMR DPP would consist of spherical pebbles (approximately 60 mm in diameter) that contain Triso coated Uranium Oxide kernels (up to 10% enriched), which are embedded in a pure graphite matrix.

Nominal characteristics for a PBMR fuel sphere are shown in Table 3.

Table 3: Nominal Characteristics for PBMR Fuel Sphere

Characteristic	Unit	Nominal Value
Fuel Sphere:		
Geometry	-	Spherical
Fuel sphere diameter	Mm	60
Fuel region diameter	Mm	50
Fuel-free region thickness	Mm	5
Uranium enrichment	% U-235	9.6 (equilibrium core)

The spherical PBMR fuel pebble is cold pressed from matrix graphite, which is a mixture of natural graphite, electrographite, and a phenolic resin that acts as binder. It consists of an inner region that contains fuel in the form of spherical coated particles embedded in the matrix graphite. A shell of matrix graphite that does not contain any fuel surrounds the inner region.

3.4.2 COATED PARTICLES.

A coated particle consists of a spherical uranium dioxide kernel surrounded by four concentric coating layers. The first layer surrounding the kernel is a porous pyrocarbon layer, known as the buffer layer. An inner high-density pyrocarbon layer, a silicon carbide layer, and an outer high-density pyrocarbon layer follows this layer. The layers are deposited sequentially by dissociation of gaseous chemical compounds in a continuous process in a fluidized bed.

Figure 4 indicates the design of the PBMR fuel sphere.

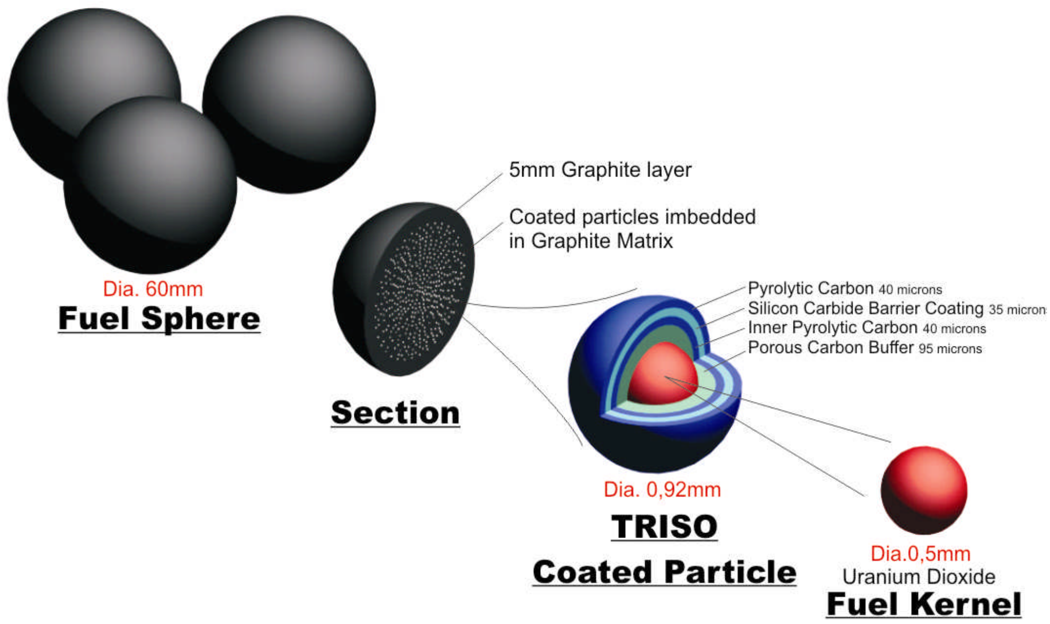


Figure 4: PBMR Fuel Sphere Design

3.4.3 FUEL SPHERE

The coated particles are embedded in a graphite fuel sphere. The function of the matrix graphite is to contain and protect the coated particles in a fuel sphere from mechanical damage and to provide a heat conduction path between the coated particles and the reactor coolant. The carbon in the matrix also acts as the moderator for neutrons in the PBMR core.

3.5 SAFETY FEATURES OF THE PBMR DPP.

In all existing power reactors, safety objectives and regulatory limits are achieved by means of active custom-engineered safety systems. In contrast, the PBMR is designed to rely on passive safety features and systems to meet required safety objectives and regulatory limits. All safety claims made by the PBMR design will be proved during the nuclear regulatory approval process, as required by the National Nuclear Regulatory Act.

CHAPTER 4: DESCRIPTION OF AFFECTED ENVIRONMENT

4.1 DESCRIPTION OF THE ENVIRONMENT SURROUNDING THE KOEBERG SITE

4.1.1 LOCATION

The proposed Koeberg site for the establishment of the PBMR DPP is located within the Eskom Controlled Area of the Koeberg Nuclear Power Station (KNPS) on the farm Duynefontein (Farm No 34) on the Western Cape West Coast. The site is located approximately 2 km from the Duynefontein residential area, 30 km north of Cape Town and 10 km south of Atlantis, within the Cape Metropolitan Council jurisdiction. The proposed PBMR DPP is proposed to be located some 400 m southeast of the existing Koeberg power station, inside the access control 1 security fence of the Koeberg power station site (please refer to Figure 5). Once constructed, the proposed PBMR DPP would require approximately 9 hectares of the KNPS site (approximately 125 Ha).

The KNPS site is located within a proclaimed nature reserve of 3 000 ha. The site and surrounding nature reserve are managed according to a formal integrated environmental management system (IEMS).

Map 2: Locality map indicating Koeberg Nuclear Power Station

Photo: Courtesy of Bjorn Rudner

Figure 5: Approximate location of the proposed PBMR DPP on the site

4.2 BIOPHYSICAL DESCRIPTION

4.2.1 GEOMORPHOLOGY

The KNPS site lies within the coastal plain of the Western Cape, which is mainly covered by Tertiary and Recent deposits. Ancient dunes stabilised by vegetation and recent unconsolidated dunes occupy large areas. This "Sandveld" rises gently towards the east and south-east to an elevation of between 100 m and 200 m some 20 km east of Koeberg.

The Western Cape coastal plane is drained by two river systems, the Grootberg River to the north of the Darling Range, and the Diep River draining the area between the Darling Range and Tierberg. Both are mature, incised river systems that meander across 1 km to 6 km wide floodplains within 20 km of the site. Several short perennial annual streams flow directly to the Atlantic. Of these, the Sout River north of Melkbosstrand is the most prominent. Most of the other small rivers disappear into the flat areas near the sea or cannot maintain open river channels across the coastal dunes.

The Tygerberg Formation of the Malmesbury Group and the cape granite that intrudes the Malmesbury rocks comprise most of the bedrock on which the younger Quaternary sediments were deposited.

The Malmesbury Group consists predominantly of a marine sedimentary assembly with a large lithological variation, which has been deformed by two tectonic events. The first phase of folding took place along the almost horizontal north-west striking fold axes. This was followed by the main fold event, which formed tight isoclinal folds with north-west to south-east trending fold axes.

The underlying Tygerberg Formation on the site consists of greywackes, mudstones and intermittent shale bends. These rocks are overlain by unconsolidated sands of Tertiary to Recent periods. The time gap between the folded Malmesbury and the Tertiary formation exceeds 500 million years.

During 2000, Andersen Geological Consulting reproduced and imaged previous aeromagnetic surveys of the Duynefontein area. Advances in the science of signal processing allow geologists to enhance existing aeromagnetic data, thus enabling a more comprehensive structural and geological interpretation. The structural interpretation of the magnetic images indicates the presence of two faults striking west/south-west to east/north-east, cross-cutting the coastline between 3,5 and 4,5 km south of the KNPS site. A third fault, striking approximately east-west cuts the coastline five kilometres to the north of the KNPS site.

All of these faults were found to be stable and conforming to suitability criteria for the siting and operation of nuclear facilities

4.2.2 VEGETATION AND SITE MANAGEMENT AT THE KNPS

Vegetation on the KNPS site is kept cropped. Alien vegetation is removed from the KNPS site and surrounding reserve area and a continuous monitoring programme is in place to prevent re-infestation. Rehabilitation of disturbed sites is done according to a formal programme. Success rate of rehabilitation is high, as is evident from the absence of aliens and growth of indigenous Sandveld Fynbos species.

Herbicides and pesticides are occasionally used on the site. These chemicals are used in a controlled manner according to the following set of criteria:

- annual or calendar spraying is prohibited. Spraying is done in response to infestation levels only;
- stock-keeping practices are in place for these chemicals;

- application of chemicals is authorised for each use incident by a senior conservation officer;
- occupational health and safety standards are adhered to in the use of chemicals.

Nesting sites of African Black Oystercatchers *(Haematopus moquini)* occur in the area of the cooling water intake basin of the KNPS. The occurrence of nesting sites indicates that current management strategies at the KNPS site is limiting the environmental impact on the bird life within acceptable levels.

4.3 MARINE BIOPHYSICAL ENVIRONMENT

The coastline in the area of the KNPS comprises a high percentage of fine to medium quartz sand particles, shells and organic material. The coastline is completely exposed and subjected to vigorous pounding by the Atlantic ocean and has an extensive surf zone due to the shallow seabed gradient. The average sea temperature in the region is 13°C with the minimum below 10°C and the maximum approaching 20°C.

At full operation, KNPS extracts 80 cubic meters (m^3) of water per second from the ocean. The proposed PBMR DPP would require an additional 2,5 m^3 of water per second to be extracted from the ocean. This water is chlorinated to 1 part per million (ppm) before reaching the condensers, where the water temperature increases to an average of about 10°C above ambient.

This water, warmed and chlorinated, is then returned into relatively shallow seawater via the outfall structure, causing the water to be jetted in a south-westerly direction at a speed of between 2 and 3 m/s at the outlet of the outfall structure. As the warm water is more buoyant, a warm water plume is formed.

An important physical property of water is its ability to dissolve gases, thereby making possible the existence of macro-fauna and micro-fauna. The solubility of gases is an inverse function of temperature and time. Increasing the water temperature for a longer period would decrease the capability of the water to retain dissolved oxygen. In addition, micro and macro-organism metabolic rates would increase due to an increase in temperature. Increased metabolism would speed up organism development, so that more dissolved oxygen would be needed to survive. Changes in temperature can also affect the life cycles of various organisms, as the mating and spawning of some are triggered by certain water temperature regimes. The overall effect of increased thermal pollution may therefore be a reduction in the number and species of marine fauna in the area.

In the Koeberg area the surf-zone temperature standard deviation is in the order of 0,46°C, and with the PBMR DPP in operation it would be negligible. The Zoology Department of the University of Cape Town has monitored the marine environment surrounding the KNPS site since the 1980s. To date no detrimental effect on the marine life around Koeberg due to the warm water plume of the power station has been found. In addition, no settlement by opportunistic warm water species or reduction in the species diversity index has been found.

4.4 INFRASTRUCTURE

The site has a fully developed infrastructure, with sufficient capacity to accommodate the proposed PBMR DPP.

Infrastructure and services available on the site include the following:

- seawater, utilised as cooling water. There will be an intake basin and water treatment facility;
- cooling water outfall facility;
- raw and potable water supply;
- maintenance workshops and expertise in the maintenance of nuclear plant;
- security and emergency facilities and services with expertise relating to nuclear plant;
- existing connection to the national transmission grid;
- waste handling and storage facilities and services to process solid and liquid waste, as well as non-nuclear, low-level and intermediate waste;
- suitable access roads;
- a comprehensive environmental monitoring system (EMS) supported by a detailed historic database useful for interpreting trends and/or acute changes.

4.5 DEMOGRAPHY AND LAND USE

4.5.1 LAND USE

Koeberg Nuclear Power Station, and the proposed PBMR site is located on the boundary between Duynefontein (Cape Farm No. 34) and Kleine Springfontein (Cape Farm No. 33). Duynefontein measures 1 257 ha, stretching 4,4 km along the coast and 3,5 km inland. Kleine Springfontein, which also belongs to Eskom, measures 1 590 ha, stretching 3,6 km along the coast and 3,75 km inland.

To the south of the above properties a residential area known as Duynefontein is located. The Melkbosstrand and Van Riebeeckstrand urban areas further along the coast dominate the land use within a 5 km radius. Wheat and dairy farms are found within the north-eastern to east-south-eastern sectors bordering the Eskom properties. The farms Duynefontein and Kleine Springfontein were proclaimed as the Koeberg private nature reserve in 1991.

The Atlantis industrial and residential areas form the most significant urban development to the north of Koeberg Power Station and are situated approximately 10 km to the northeast of the Koeberg site. The residential town of Atlantis has an estimated population of approximately 50 000 people. The economic growth of the industrial area is relatively stagnant. The area between Atlantis and the coastline has been identified for inclusion in the proposed West Coast biosphere reserve.

There are no major fishing activities within a 15 nautical mile (27 km) radius from the proposed PBMR site. The closest commercial activity in the Atlantic ocean is at Robben Island, approximately 15 km south-southwest of the Koeberg site.

The land-use pattern within a 20 km radius of the Koeberg Nuclear Power Station (KNPS) can be classified in the following categories: cultivated land; uncultivated land; residential development; industrial development; dune areas; vlei areas and river valleys. The Melkbosstrand urban strip, which lies along the coast, is the dominant land-use within a 5 km radius of Koeberg. The area to the immediate east of KNPS is largely uncultivated as it consists of sandy soil of low agricultural value. The northern area consists of Standveld Coastal Shrublands. Poorly vegetated sands occur in the dune areas along the coast and further inland to the NNW of KNPS.

The soil quality generally improves outwards towards the 20 km radius and this is reflected in the intensity and quality of the agricultural output. The farming is typically Swartland with wheat and fodder crop cultivation dominating agricultural activities. Dairy farming is also popular. Poultry farming occurs mainly in the NE sector, particularly in the area of smallholdings east of Atlantis.

The industrial and residential towns of Atlantis form the most significant urban development to the north of KNPS. There is metropolitan growth in the area north of Milnerton (SSE and SE of KNPS). The area immediately north of Table view is exhibiting rapid growth. Residential development in this area is still beyond the 10 km radius from KNPS.

Scattered industries in the form of brickfields and waste sites also occur in the SE and SSE sectors. Extensions of industrial areas south of the Diep River characterize the SE sector around the 20 km radius.

Please refer to Figure 6 for a map of the Cape Town area.

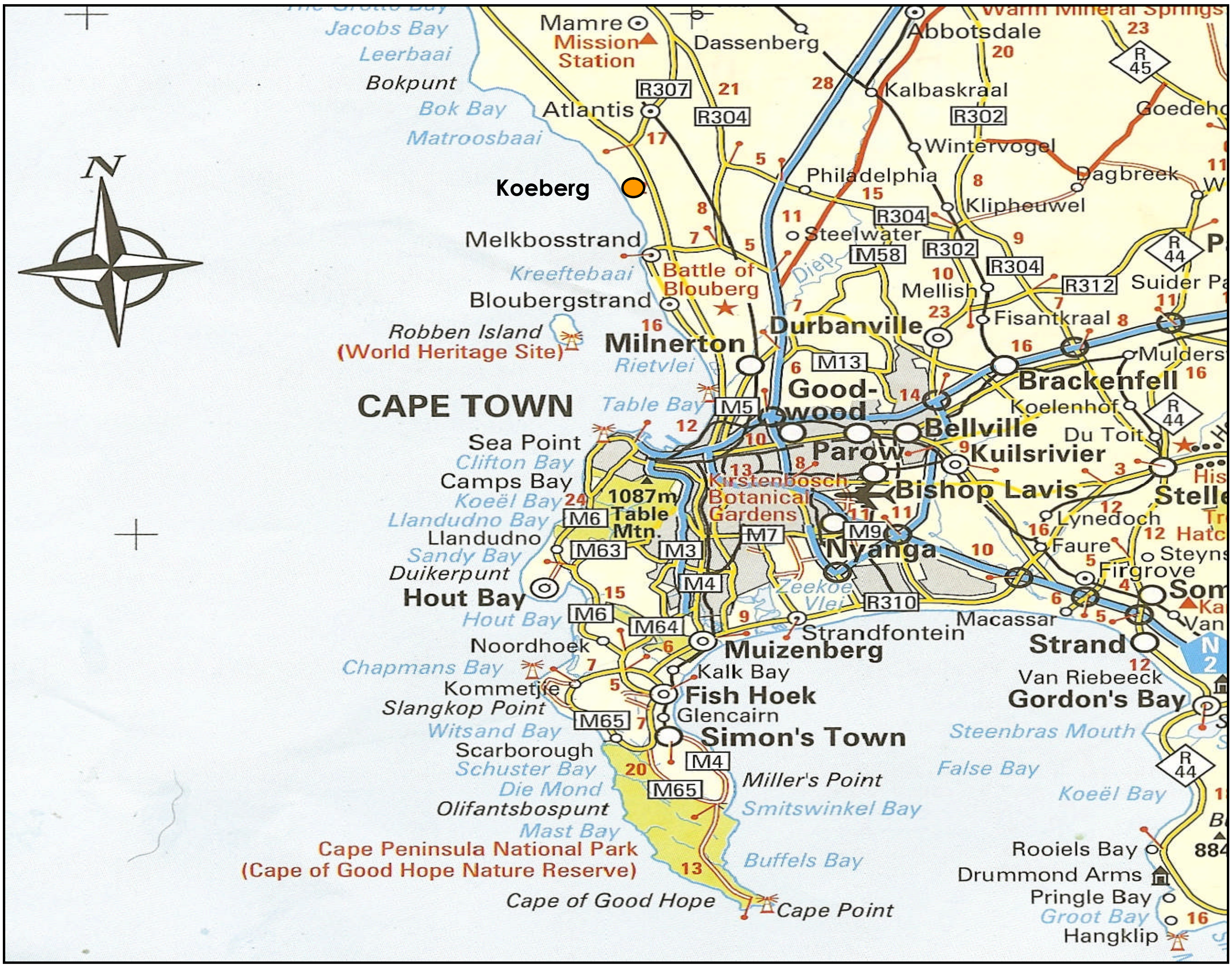


Figure 6: The Cape Town Area

4.6 SOCIO-DEMOGRAPHIC PROFILE

In Cape Town, according to the 2001 census figures the coloureds form the largest group of population with 48%. The black community contributing 31% to the total population. Whites and Indian/Asians follow with 18.7% and 1.4%.

Ward 2 accounts for 1.5% of the of city's population. With an area of 555 sq km, it has a population density of 70 persons per kilometre. The major population group in the area is comprised of the coloureds which accounts for 68% while whites and Africans constitute 21% and 12% respectively.

4.6.1 AGE AND GENDER DISTRIBUTION

The median age of the population varies amongst population groups. The second highest number of population in the WC is composed of people between the age groups of 20–

24. The male population constituting 50.1% and the female population comprises of 49.8% of the total population.

Almost 36% of the population of ward 2 is between the ages of 15-34 years. This can be indicative of a large potential work force residing in this area. The population under the age of 14 is at 28% which may point to a need of education and training in the future. The male population accounts to 48% in comparison female population come to a total of 51%.

4.6.2 RELIGION

The majority of the population (79%) attests to the Christian faith. There are 2 mosques in the area, both in Atlantis.

4.6.3 HOUSING

In 1995, the City of Cape Town had the largest core of formal housing in South Africa (75.1% as opposed to 64.9% in SA). The housing backlog has steadily increased with the estimated backlog for 1998 at 150 000 houses and for 2000 at 240 000 houses.

About 13% of the house holds in ward 2 are in informal settlements. The average size of the houses is just over 4 rooms.

4.6.4 EDUCATION

Educational progress in the Western Cape is good with the proportion of adults in the WC with no formal education substantially lower than the national level. The number of pupils per teacher is smallest in the WC with literacy levels significantly higher compared to the national figure. The CMA has a similar educational attainment to the WC.

4.6.5 EMPLOYMENT RATE

According to the Census 2001 figures, the unemployment rate for ward 2 is 23%. Approximately 28% labour is employed in elementary occupations while 11% is employed in the craft and trade related occupations. Professionals account for 7% of the labour force. In ward 2, 54% of the house holds earn less than R3, 200/- per month.

4.6.6 OCCUPATIONAL CATEGORIES

The main economic sectors in the Western Cape are community, social and personal services followed by manufacturing (21% of the total in SA).

The population percentage of elementary (unskilled) labourers is 16%. Seventy nine percent of these are involved in sales and service while 18% are labourers in construction, manufacturing and transport. The main economic sectors in the City of Cape Town municipality are the same as in the WC as a whole. Of those employed in community, social and personal services, 32% are employed in the health sector; 29% in public administration and defence sectors and 25% in education.

4.6.7 INCOME

The cultural groups have different profiles. Black and coloured communities have a low income; high unemployment and low levels of education and skills. The white communities have middle to high income, little unemployment and relatively high levels of education. White-collar workers have to travel outside the area for employment.

4.6.8 AGRICULTURE

As a result of the limited potential of the soil, there is no agricultural production of significance within the 5 km. radius of KNPS. The 5 - 7.5 km band reflects the first intensive agricultural use between the NE and SSE sectors. Cultivated land is dominant in this area with wheat, fodder crops and dairy farming the main agricultural products. There is much chicken farming activity in the NE sector.

The most fertile land is in the 10 - 16 km. band. Well-established wheat farms and accompanying high production of fodder crops characterizes the ENE and ESE sectors. Some of the farmers also have a well-established dairy component.

The smallholdings of Klein Dassenberg characterize the NE sector. This area shows more specialized farming activities that include: bee-farming; vegetables; chicken and egg production; stud-farming and dairy farming. The only significant vegetable production (mainly potatoes) occurs in this sector.

As a result of urban development and proximity to the sea, there is a decrease in agriculture towards the south. Most of the land north of Table View is owned in large tracts by property development companies and is destined for future urban development.

4.6.9 ECONOMIC ACTIVITY

The city of Cape Town contributes 11% to South Africa's GDP and 75% to the Western Cape's economy. Its economy has on average grown faster than the national economy by almost 1% between 1991 and 2000.

The performance of the economic sectors measured by percentage contribution to real gross geographic product for Cape Town is as follows. The manufacturing sector makes the largest contribution at 25% followed by trade (23%); finance (19%); services (17%); transport (9%); construction (4%) and other (3%).

4.6.10 TRANSPORT

Within the 35 km. zone around KNPS the major roads include: the West Coast Road (R27); N7; Otto du Plessis Drive and Blaauwberg Drive (M14); The Mamre-Darling Road (R304); the

Melkbosstrand Road (M19); the Brakfontein road and the Dassenberg Road. Other significant roads with regard to KNPS are: the Klein Dassenberg Road; Philadelphia Road and Old Malmesbury Road. Other significant roads in Blaauwberg include: Bosmansdam Road (M8); Omuramba Drive/ Ratanga Road; Koeberg Road (M); Race Course Road and Parklands Main Road.

a) Rail

There are two north-south railway lines within the 35 km. zone. These are the line to Namaqualand, which runs past Kalbaskraal and Malmesbury (approximately 24 km east of the KNPS site) and the Atlantis goods line (which runs approximately 6 km. east of the KNPS site, connecting with the suburban line system at Champed Station).

b) Airports and air routes

The information regarding the military installations at Interplant is restricted. Aeronautic Properties cc owns a private and unregistered airfield situated on portion 6 of the farm Brakkefontein no. 32 approximately 4.5 km. NE of KNPS. It is located 2 km. east of the West Coast Road. The airfield is currently used for light aircraft pilot training. The airfield is located within the Cape Town general flying zone and flying to and from the airfield is outside the Koeberg restricted zone.

There are numerous airfields or emergency landing strips without facilities on farms within 50 km. of the KNPS site. These are mainly unregistered facilities for private use.

Cape Town International Airport is the main centre for air traffic control in the area and the KNPS falls within its control area.

4.6.11 SERVICES

In terms of service provision, the Western Cape compares favourably to the rest of the country. Rapid growth in the City of Cape Town Municipality, particularly in the informal settlement sector, continues to place immense pressure on the service delivery functions of local authorities. Service providers are seen as capable of ensuring reasonable service to most communities with technically skilled, committed and experienced management and a work force that is relatively well trained.

4.6.12 INDUSTRIAL INSTALLATIONS AND OTHER URBAN INFRASTRUCTURE

There are a large number and range of comparatively smaller industrial areas in the CMA. Many have a relatively low occupancy level. Over the past ten years there has been a distinct shift of the industrial growth momentum from the older areas close to the inner city to the north-west (Montagu Gardens) and north-east (Parow, Bellville South and Brackenfell). There has also been expansion to a lesser degree in the Ottery and Retreat areas of the southern metropolitan area. There has been little momentum in the Mitchell's Plain, Phillippi and Blackheath areas.

a) Atlantis Industrial Areas (10 km NNE)

The Atlantis industrial area consists of 964 ha of developable land of which 606 ha is currently undeveloped. Atlantis Diesel Engines and Foundries represented the largest concern in the area but has recently shut down its diesel engine manufacturing component. Other activities in the area include textiles, paper and packaging, engineering services and chinaware.

b) Doornbach Industrial Area (18 km SSE)

The planned Doornbach industrial area comprises 38 ha of developable land within the 55 ha site. It is located next to Potsdam road opposite Du Noon with the Atlantis railway line forming its southern boundary.

c) Mamre

A small site of 3.6 ha is reserved for light industrial purposes. The site consists of 51 even, which are undeveloped at this stage.

d) Scattered industries

The main source of building material in the CMA is 3 active quarries in the northwest Tygerberg region. South of Dassenberg road are sand mining activities, which are managed by Atlantis Foundries. Kilos lime works is located along the coastal stretch between Melkbosstrand and Bloomberg. Clay brick enterprises run their brick works at Vissershoek (13.5 km SE). This is also the site for the Cape Town city councils evaporation depot and the Wastetech Treatment works. Other brickworks are dispersed through the area north of the Tygerberg hills and at Fisantekraal, Durbanville.

4.6.13 ENERGY GENERATION

a) Standby power-generating installations

The City of Cape Town no longer runs any standby generators in the area however, several private companies in Atlantis and Montague Gardens industrial areas run their own standby generators that vary in capacity from 100 kVA to 400 kVA. There is also an open cycle gas turbine (OCGT) plant under construction in the Atlantis Area and an operating OCGT in Acacia.

b) Coal burning installations and other

There are several coal burning installations in the Atlantis Industrial area and one each at Vissershoek, Montague gardens and Melkbosstrand.

4.6.14 TELECOMMUNICATION

Telkom has microwave towers at Atlantis (M-1) and Melkbosstrand (M-2). There are no radio and television transmitters connected to the Telkom infrastructure within 16 km of KNPS. Telkom's South Atlantic Submarine Cable is located at Melkbosstrand 6 km to the south of KNPS. The Melkbosstrand station has to be permanently manned and falls under the jurisdiction of Telkom. Sentech (Pty) Ltd controls all radio and television transmitters in the region (none of which are within the specified 6 km radius of KNPS).

4.6.15 CAPE WEST COAST BIOSPHERE RESERVE

The southern core of this biosphere reserve is located to the north west of Atlantis and includes a coastal core. The northern area covers the Saldanha sector. The buffer zone includes a few areas that have conservation status: Koeberg Private Nature Reserve; Blouberg Private Nature Reserve and Rietvlei Wetland Reserve. The southern core covers 13 805 ha and is a conglomeration of publicly owned state farms without any formal conservation status.

4.6.16 NATIONAL MONUMENTS

Several national monuments are named in the Blaauwberg Spatial development framework: 3rd draft, 2001. These include: the Old Municipal Hall; the wooden bridge over the lagoon at Milnerton; Klein Zoar in Milnerton; Ons Huisie in Bloubergstrand and the mission station and water mill in Mamre.

CHAPTER 5: ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

5.1 ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

In terms of the EIA regulations (published in Government Notice R1182, R1183 and R1184 of 1997) in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), there are a number of listed activities that could potentially have substantial detrimental effects on the environment and which are required to be subjected to an environmental impact assessment (EIA) process. The environmental scoping study for the proposed 400 MW(t) PBMR DPP has been undertaken in accordance with the EIA Regulations, Section 21 of the Environment Conservation Act, 1989, as well as the National Environmental Management Act (NEMA; No 107 of 1998).

In terms of Government Notice R1182 (Schedule 1), the proposed 400 MW(t) PBMR DPP includes activities that fall within the ambit of the following listed activities:

Activity 1. The construction, erection or upgrading of:

- (a) facilities for commercial generation with an output of at least 10 megawatts and infrastructure for bulk supply;
- (b) nuclear reactors and facilities for the production, enrichment, processing, reprocessing, storage or disposal of nuclear fuels and wastes;
- (c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation:
    - (ii) manufacturing, storage, handling, treatment or processing facilities for any such substance;
- (d) roads, railways, airfields and associated structures;

Activity 2. The change of land use from:

- (c) agricultural or zoned undetermined use or an equivalent zoning to any other land use;

Activity 9. Scheduled processes listed in the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965):

29. *Power generation processes:* That is to say, processes in which:

- (c) any fuel burning appliance is used that is not controlled in terms of Part III of this Act, excluding appliances in private dwellings.[4]

[4] This activity is related to the D-generator, which is used as an auxiliary source and for a short term only. It is not related to the primary generation of electricity.

The environmental studies are being undertaken through:

Phase 1: Environmental Scoping Study.

Phase 2: Environmental Impact Assessment.

The environmental scoping process undertaken for the proposed project is described below.

5.2 APPLICATION FOR AUTHORISATION

An application form and checklist was submitted to the Western Cape Province, Department of Environmental Affairs and Development Planning (WC DEA&DP) in terms of Section 21, 22, 26 and 28A of the Environment Conservation Act, (Act No. 73 of 1989). The section 28A exemption application has since been withdrawn

This application included information concerning the applicant, the proposed project as well as the independent project consultants. A declaration of independence from the consultants was included in the application.

A plan of study for scoping was submitted to the Department of Environment Affairs and Tourism. Provisional approval for this plan of study was received on 8 November 2005.

The Department of Environmental Affairs and Development Planning (DEA&DP) reference is E12/2/1-AC4-ESKOM FARM DUYNEFONTEIN NR 34, CAPE TOWN.

5.3 AUTHORITY CONSULTATION

5.3.1 CONSULTATION WITH DECISION-MAKING AUTHORITIES

The national Department of Environmental Affairs and Tourism (National DEAT) is the lead authority of the project. National DEAT, as well as the Western Cape Department of Environmental Affairs and Development Planning as commenting authorities, were consulted from the outset of the study, and will be engaged throughout the project process.

Authority consultation included, *inter alia*, the following activities:

- pre-application meetings and consultation with national DEAT and the relevant provincial environmental authorities;
- submission of an application for authorisation in terms of Section 21 of the Environment Conservation Act (No 73 of 1989);
- submission of a plan of study for scoping;
- receipt of acceptance of the plan of study for scoping;
- on-going consultation throughout the process.

5.3.2 CONSULTATION WITH OTHER RELEVANT AUTHORITIES

Consultation with non-DEAT authorities were undertaken through telephonic and written correspondence and meetings in order to provide background information to the proposed project. The other authorities consulted include:

- South African Heritage Resources Agency (SAHRA);
- Department of Trade and Industry;
- National Department of Minerals and Energy (DME);
- National Electricity Regulator;
- National Nuclear Regulator.

5.4 SCREENING OF ENVIRONMENTAL ISSUES/CONCERNS

The environmental scoping study provides a description of how the environment may be affected by the development of the proposed project. Potential environmental impacts associated with the construction and operation during the demonstration phase of the 400 MW(t) PBMR DPP have been identified through desktop studies, the use of existing information and studies (PBMR EIA Consortium, 2001), review of public debate in the press and on the internet, and the public participation process. Information sourced during the "302 MW(t) PBMR EIA" was considered where relevant and appropriate.

The issues and comments raised during the public participation process have been noted, incorporated into an issues register and documented within this scoping report. This includes issues raised during meetings, in writing, or during interviews and discussions. I&APs will be afforded an opportunity to review the scoping report to verify the accuracy and completeness of the issues raised by them.

All issues identified through the public participation process and issues-based scoping have been subject to a screening process, which served as the mechanism to determine the scope of those aspects that are considered significant and which are required to be assessed during the environmental impact assessment phase.

In order to evaluate issues and assign an order of priority, it was necessary to identify the following characteristics of each potential issue/impact:

- the *nature,* which includes a description of what causes the effect, what will be affected, and how will it be affected; and
- the *extent*, wherein it is indicated whether the impact will be limited to the immediate areas or site of the development activity (local), limited to the immediate surroundings, sub-regional, regional, and/or national.

During the screening process the following key factors have been considered:

- the anticipated environmental impacts of the proposed 400 MW(t) PBMR DPP during the demonstration phase;
- the legal, policy, and planning context of the proposed PBMR DPP;
- the nature of the proposed PBMR DPP;
- the characteristics of the receiving environment;
- the environmental expectations of the affected population, both on a local/regional and national level. This relates to clearly defined expectations that may be in direct conflict with the proposed activity. Where such expectations were identified during the scoping phase it was noted. Where such expectations are deemed to be significant they may progress to the EIA phase.

This screening process will, therefore, inform the subject and terms of reference of specialist studies to be performed, the terms of reference for the environmental impact report and will form the basis of the specialist assessment during the EIA phase.

5.5 ASSUMPTIONS AND GAPS OF THE STUDY

5.5.1. The assumptions on which this study are based include.

- Appropriate studies and datasets undertaken during the '302 MW(t) PBMR EIA' (2001), will, after validation and reassessment be, used in this EIA process.
- All information provided by Eskom and its agents to Mawatsan (Environmental consultant team) is deemed correct
- Representatives are acting on behalf of the parties which they represent.
- This report and its investigation are project specific for a demonstration plant and consequently the environmental team did not evaluate any other energy or technology alternatives. The other demonstration technologies and their status will be discussed.
- Radiological Issues, their evaluation and assessments, will be done by the NNR and dealt with within the co-operative governance agreement between the DEAT and the NNR.
- The high level design for the 400 MW(t) is finalised.

5.6 OVERVIEW OF THE PUBLIC PARTICIPATION PROCESS UNDERTAKEN WITHIN THE SCOPING PROCESS

A comprehensive public participation process was implemented during the scoping phase of the project. The focus was on informing I&APs of the proposed development and of the significant differences between the 302 MW(t) and 400 MW(t) PBMR DPPs.

Issues raised during the public participation process for the 302 MW(t) PBMR DPP, have been collated and incorporated into the scoping phase of the current process.

5.6.1 COMPONENTS OF THE PUBLIC PARTICIPATION PROCESS

The public participation process consisted of the following activities:

- **advertisements** in national, regional and local news papers;
- ***notification*** of I&APs regarding the EIA process, consultation activities, and availability of reports and decisions by the authorities using a variety of mechanisms;
- ***interviews*** with a variety of I&APs in respect of the PBMR demonstration plant;
- ***focus group meetings*** with relevant sectoral groups (groups of role-players with similar interests, such as the business sector, tourism, agriculture, local government, etc.);
- ***public meetings*** which were widely advertised. These provided I&APs with project information, an opportunity to record concerns, issues and suggestions, as well as to identify other I&APs.

5.6.2 OBJECTIVES OF THE PUBLIC PARTICIPATION PROCESS

The objectives of the public participation process were to:

- inform the public of the environmental impacts associated with the proposed 400 MW(t) PBMR DPP;
- confirm previously identified and identify new interested and affected parties (I&APs) and key stakeholder groupings;
- disseminate information to I&APs;
- solicit and register I&AP inputs on issues/concerns, alternatives and mitigation measures. These inputs were evaluated during the scoping phase and relevant issues put forward for further investigation in the EIA phase;
- provide feedback to I&APs on the manner in which their views have been taken into account in decision making;
- inform I&APs of the results of the study (i.e. scoping report) and obtain their final comments.

5.6.3 IDENTIFYING STAKEHOLDERS

From the outset, the I&AP database built on the database developed for the previous PBMR DPP public participation process. Contact details were verified and updated. In addition, a networking process was used to identify and register additional I&APs. In registering I&APs, due care was taken to ensure that the scope of the project was well defined and that the consultation mechanisms and procedures clear. Currently, there are 2407 I&APs on a database.

Mawatsan endeavoured to ensure that individuals/organisations from a 'vertical' (institutional) as well as a 'horizontal' (geographical) point of view are identified. Geographically, those I&APs (e.g. residents, community groupings and businesses) located in and immediately around the sites had to be included into the process. A 'vertical' approach was used to identify those institutions or individuals that might be affected by, or could make a contribution to the project, but who are not necessarily in its direct sphere of impact.

Participants that attended any of the public events or meetings or requested specific information, were also entered on the I&AP database. The I&AP database will be continuously updated throughout the EIA process.

5.6.4 INFORMING STAKEHOLDERS ABOUT THE PROJECT AND SCOPING PROCESS

The following methods were employed to notify I&APs of the proposed project and of how they could meaningfully participate:

- **Newspaper advertisements** were employed to notify I&APs of the proposed project and of how they could meaningfully participate:

  Advertisements notifying the public of the EIA process and inviting them to the various public meetings were placed in a number of national, regional and local newspapers. Refer to Table 4 for a list of the newspapers and the publication dates.

Table 4: Newspaper Advertisements

Newspaper	Date published
Star	1/11/2005
Rapport	30//10/2005
Sunday Times	6/11/2005
Table Talk	3/11/2005
Argus	1/11/2005
Tygerberger Coast	1/11/2005
Swartland/Weskus Herald	3/11/2005
Burger	1/11/2005
City Vision	3/11/2005
Natal Mercury	1/11/2005

Illanga	3/11/2005
Bristspos	4/11/2005
Kormorant	2/11/2005
Beeld	1/11/2005

Depending upon the newspaper, advertisements were placed in English and Afrikaans. Refer to Section 8.1 for copies of the advertisements.

- **On site notice:** Notices were placed on the Koeberg site.
- Existing **community forums** were also utilised to inform the local residents of the proposed activity and how to register as an I&AP.
- **Atlantis radio** was also utilised to invite people to the public meetings.
- **Notices** were sent to all I&APS on the database, to the local municipality, to community organisations and the relevant government authorities. In this regard some 600 e-mails were sent and more than 800 letters posted.
- A **Background Information Document** (BID) was compiled, which contained information about the proposed project and the scoping phase. The BID also contained a form to facilitate registration as an I&AP. Copies of the BID were sent to registered I&APs and were also available the various meetings. Please refer to Section 8.2 for a copy of the BID and Section 8.3 for the registration form.
- A **project website** was developed (refer www.pbmr-eia.co.za) and I&APs advised of the address. This website contains relevant project documentation, links to appropriate documentation as well as an opportunity to make comments and register as I&APs.

5.6.5 DISSEMINATION OF INFORMATION

The mechanisms that were employed to notify I&APs about the proposed project and the scoping process (i.e. the newspaper advertisements, posters, written notices, and the BID) were also used to communicate information about the proposed project and the scoping process. In particular, these contained information regarding:

- details of the scoping process and the environmental evaluations that were to be conducted as part of this process;
- details of the public participation process (the dates and venues of public meetings, etc.);
- the role of I&APs, and the steps to be followed to register as an I&AP;
- the name and contact details of the public participation facilitator;

- how and when decisions were to be made, and by whom.

5.6.6 MEDIUM OF COMMUNICATION

The medium of communication was primarily in English. Printed information is primarily available in English.

5.6.7 CONSULTATION MECHANISMS

a) Focus group meetings

Focus group meetings were utilised as a tool for issue-based consultation in order to assimilate issues and concerns raised by I&AP groupings. I&APs with similar characteristics and objectives (e.g. businesses) were consulted together in focus groups. The objective was to inform and educate, with the emphasis on making technical information as tangible as possible.

Focus group meetings were held with the following organisations:

- Afrikaanse Handels Instituut;
- Wildlife and Environment Society of Southern Africa (WESSA);
- CHAMSA;
- Pelindaba Working Group.
- Vaalputs community forum.

Minutes of all focus group meetings were recorded, and these were distributed to the attendants of the particular focus group meeting. Please refer to Section 8.4 for the minutes of the focus groups.

b) Public meetings

A series of public meetings were held. Formal invitations to the public meetings were forwarded to the registered I&APs on the database. An open invitation was also placed in national, regional and local newspapers.

The public meetings served to provide information on the proposed project and the scoping process, and to identify issues and viewpoints. Public meetings were held as follows:

- Cape Town: 9 November 2005 - Milnerton Sports Club, at 18:30;
- Atlantis: 10 November 2005 - Hartebeeskraal Multi Purpose Community Centre at 18:30;
- Midrand: 15 November 2005 - Eskom Convention Centre at 18:30;
- Durban: 17 November 2005 - Durban Exhibition Centre at 18:30.

Formal minutes were compiled for the meetings. Please refer to Section 8.5 for the minutes of the various public meetings.

A second series of public meetings will be held during the public review period for the environmental impact report. In this second round of meetings, the findings, conclusions, and recommendations of the EIR will be presented and the accuracy and appropriateness thereof motivated.

5.6.8 IDENTIFICATION OF ISSUES AND CONCERNS

The following mechanisms have been employed to identify and capture issues and concerns raised by I&APs:

- **Comment sheets.** The BID included a loose reply sheet that I&APs could use to raise initial issues of concern, make suggestions and comment on the proposed public participation process. These comments were incorporated into the issues and response register.
- **Public Meetings and Focus Group Meetings.** During such events, attendants were afforded the opportunity to formally comment on site by filling in a comment sheet. These comments were incorporated into the issues and response register.
- **Written feedback.** I&APs also indicated issues and concerns through the use of the comment sheets, by telephone, e-mails, in writing, etc. All of these comments were incorporated into the issues and response register.

5.6.9 RECORDING AND ANALYSIS OF ISSUES AND CONCERNS

All issues and concerns raised by I&APs were recorded in an issues and response register, which was continually updated. This register described issues raised by I&APs and provided a response. The issues and response register has been incorporated into this scoping report.

The public participation process includes the provision of feedback to I&APs on the manner in which their views have been taken into account in decision making. Two key documents provide such feedback:

- An i**ssues and response register** in which issues raised by stakeholders during the public participation process have been recorded and response provided.
- A d**raft scoping report**, which outlines the issues that will be investigated by specialists during the EIA phase.

A full set of reports have been placed in a number of public places in and around the study area as well as on the project web site for public review. The draft environmental scoping report will be made available for public review at the following public locations:

ATLANTIS (AVONDALE) LIBRARY Grosvenor Street	**CAPE TOWN (Central Library)** City Hall (Darling Street)	**MELKBOSSTRAND LIBRARY** Merchant Walk (**Duynefontein**)
ATTERIDGEVILLE LIBRARY Mohlaba Street	**DURBAN LIBRARY (2)** City Hall, Smith Street	**MILNERTON LIBRARY (2)** Pienaar Road
BLAAUWBERGSTRAND LIBRARY Andrew Foster Street	**HARTBEESPOORT LIBRARY** Marais Street	**PRETORIA (Mawatsan)** 280 Brooks Street, Brooklyn
JHB (Northcliff) LIBRARY Fir Drive	**TABLE VIEW LIBRARY** Birkenhead Road	**BRITS LIBRARY** City Hall (Van Velden Street)
KOEBERG POWER STATION Visitor's Centre (R27)	**www.pbmr-eia.co.za**	

Stakeholders formally requesting copies of the report were supplied with an electronic or CD version of the scoping report. Forty one copies of the CD were distributed to a number of I&APs.

A 30-day period (26 January 2006 to 27 February 2006) had been allowed for the public to review the draft report and submit written comments on the contents of the reports. Registered I&APS were notified of the report through e-mail, facsimile or post.

Formal submissions were received from:

- Die Afrikaanse Handelsinstituut.
- City of Cape Town.
- RCH Garbett, CT Garbett, Wat Props Pty, Karee Trust, Itumaleng Farm cc, Professional Aviation Services (Pty) Ltd.
- The Legal Resources Centre – on behalf of Earthlife Africa.
- The Wildlife and Environmental Society of South Africa.

In addition, a number of I&APs sent notifications requesting us to formally note the objection to or support of the proposed PBMR DPP. These are attached as Appendix 13.

Once comments were received, the report was updated and the final scoping report forwarded to the authorities for their consideration. Copies of the final scoping report will be made available in the same public places and website for perusal by the public. Comments received from I&APs after the submission of the final scoping report to the authorities must be addressed to the decision maker (DEAT) and copies submitted to DEA&DP and the consultant.

5.6.10 ADDRESSING CONCERNS ABOUT THE PUBLIC PARTICIPATION PROCESS

The same principle regarding revision of the scoping process will also apply to revisions of the public participation process. Any concerns received from I&APs regarding the process of scoping and public participation will be evaluated and appropriate measures will be put in place after consultation with the relevant authorities if necessary. The relevant I&APs will be provided with a response to their concerns. The response will also be circulated to the relevant authorities.

CHAPTER 6: LEGAL FRAMEWORK

6.1 INTERDEPARTMENTAL COLLABORATION

At the outset of the EIA, the Department of Environmental Affairs and Tourism (DEAT) as the lead authority on environmental matters, and the National Nuclear Regulator (NNR) agreed to work in close collaboration regarding the assessment of nuclear related matters associated with the project. As a result, the scoping report reflects numerous issues relating to nuclear safety that were raised by interested and affected parties (I&APs). Such issues will be dealt with in terms of the National Nuclear Regulator Act (Act No. 47 of 1999). The National Nuclear Regulator (NNR) nuclear installation licence process is detailed below.

The National Nuclear Regulator Act (Act No. 47 of 1999) authorises the NNR to:

Provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety and regulatory practices.

These safety standard and regulatory practices typically include risk criteria addressing risk to public and workers, radiation dose limits due to normal operation, fundamental safety principles including as-low-as-reasonably-achievable (ALARA) and defence-in-depth, general safety principles related to international standards and requirements for emergency planning.

Subject to the NNR board's approval, the Chief Executive Officer (CEO) may:

- refuse an application for a nuclear installation licence and must provide the applicant with the reasons for the refusal in writing; or
- grant an application for a nuclear installation licence, subject to such conditions.

In order to give practical impetus to the process described above a cooperative governance agreement was entered into between the DEAT and the NNR. The process described in this agreement will be followed to address radiological and nuclear safety related issues during this EIA.

6.2 STATUTORY FRAMEWORK

Beside the normal decision-making structures for an EIA, several other acts, regulations and treaties apply to this particular proposed study. These include, *inter alia*:

6.2.1 ACTS

- The Constitution of South Africa (Act 108 of 1996);
- National Environmental Management Act (Act 107 of 1998);

- National Heritage Resources Act (Act 25 of 1999);
- National Roads Traffic Act (Act 93 of 1996);
- National Water Act (Act 36 of 1998);
- Occupational Health and Safety Act (Act 85 of 1993);
- Physical Planning Act (Act 125 of 1991);
- Promotion of Access to Information Act (Act 2 of 2000);
- The Atmospheric Pollution Prevention Act (Act 45 of 1965);
- The Electricity Act (Act 41 of 1987);
- The Environmental Conservation Act (Act 73 of 1989);
- The Hazardous Substances Act (Act 15 of 1973);
- The National Nuclear Regulator Act (Act 47 of 1999);
- The Nuclear Act (Act 46 of 1999);
- The Seashore Act (Act 21 of 1935);
- Dumping at Sea Control Act, 1980;
- Air Quality Act, 2004 (in force 11/09/05);
- Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993);
- Disaster Management Act (Act 57 of 2002);
- National Building Regulations and Building Standards Act (Act 103 of 1977);
- National Key Points Act (Act 102 of 1980).

6.2.2 PROVINCIAL/LOCAL LEGISLATION

- Land Use Planning Ordinance (Ordinance 15 of 1985);
- Local By-laws.

6.2.3 REGULATIONS

The EIA Regulations, Regulation R1182, 1183 and 1184 as published in the Government Gazette of 5 September 1997.

6.2.4 TREATIES

- National Nuclear Non-Proliferation Treaty enacted by the Nuclear Energy Act.
- The Basel Convention on Transboundary Waste Transport.

6.3 NUCLEAR LICENCE PROCESS

In addition to the EIA process, the project proponent also needs nuclear installation licences for the proposed nuclear activities.

These licences must be obtained from the National Nuclear Regulator (NNR) and are required under the National Nuclear Regulator Act (Act 47 of 1999). The act states that no person may site, construct, operate, decontaminate or decommission a nuclear installation, except under the authority of a nuclear installation licence. Section 21 of the Act makes provision for persons wishing to engage in any of these activities to apply to the (CEO) of the NNR for such a licence. It is important to note that different requirements exist for the nuclear installation licence and the EIA process.

As is the case with the EIA process, the licence process is a sequential (staged) process. Unlike the EIA process, the licence process is ongoing (i.e. throughout the life cycle of the project – planning, construction, commissioning, operation / maintenance and decommissioning).

The involvement of the public in the licence process is at the discretion of the CEO of the NNR. In terms of the Act, the CEO of the NNR is obliged to direct the applicant for a nuclear installation licence to serve a copy of the application upon:

- every municipality affected by the application;
- such other body or person as the CEO determines;
- publish a copy of the application in the Government Gazette and two newspapers circulating in the area of every such municipality.

Any person(s) who may be directly affected by the granting of a nuclear installation licence pursuant to an application, may make representation to the NNR Board on matters relating to radiological health, safety and environmental issues connected to the application, within 30 days of the date of publication in the *Government Gazette*.

For nuclear installations and the transport of nuclear material(s), the licence process entails the setting down of standards expressed in terms of:

- the quality of engineering and operation required;
- the limitation of radiation exposure to people.

The prime considerations during a good nuclear safety design are the principles of "ALARA" (As low as reasonable achievable) and "defence-in depth".

With regard to good nuclear safety design practice, of prime consideration are the principles of defence-in-depth and of ensuring that risks and radiation doses to members of the public and workers will be maintained as low as reasonably achievable (ALARA) below the stipulated radiation dose limits.

The principle of "defence-in-depth" requires that there should be multiple layers (structures, components, systems, procedures or a combination thereof) with overlapping safety provisions. Accident prevention and accident mitigation are natural consequences of the defence-in-depth principle.

Besides the normal decision-making structures for an EIA, several other approvals apply to this particular proposed study. These steps in the approval process include:

- DEAT must approve the EIA in co-operative agreement with the relevant provincial environmental authorities.
- The NNR must approve the nuclear safety aspects of the design, construction and operation/maintenance of the plant(s) (electricity generation and fuel manufacture) as well as the transportation of nuclear materials.
- Thereafter, Cabinet must consider all of the information in the documents that result from the above studies, and approve the construction of a demonstration module PBMR to demonstrate the techno-economic feasibility of the technology.
- After cabinet approval of this project, various permits must be applied for and issued for land-use, emission releases, effluent disposal, conventional waste disposal and water use.

6.4 ESKOM'S INTEGRATED STRATEGIC ELECTRICITY PROGRAMME (ISEP)

Eskom also has responsibilities in respect of the White Paper on National Energy Policy. Eskom uses a programme called the Integrated Strategic Electricity Programme (ISEP) to guide their planning process.

As stated previously, the ISEP concerns supply-side and demand-side options. The PBMR is an option for the supply-side.

ISEP is the way in which Eskom assesses by how much the demand for electricity is likely to grow, and how best to meet and manage that demand. Long-term economic forecasts are made and provide the framework to investigate and implement a wide range of new supply-side and demand-side technologies.

As part of the ongoing effort to evaluate the viability of all the supply-side options, a number of power generation technologies, which have not yet been implemented in South Africa on a commercial basis, are being evaluated in terms of technical, socio-economic and environmental aspects.

6.5 AUTHORISATIONS AND PERMITS TO BE OBTAINED

Table 5 summarises the permits that may be required for the proposed project, their legal basis and the authorities that would be required to issue them.

Table 5: Permits potentially required for the proposed project

LEGAL BASIS	DEPARTMENT	NATURE OF PERMIT
Environment Conservation Act, 73/1989 (sect 21,22,26 and Sept 1997 regulations)	Dept of Environmental Affairs and Tourism	Environmental Impact Authorisation
National Environmental Management Act, 107 of 1998 (sect 24)	Dept of Environmental Affairs and Tourism	Environmental Impact Authorisation: New EIA regulations
National Water Act, 36 of 1998	Dept. of Water Affairs and Forestry (DWAF), regional office Cape Town	Permission to carry out “water use” – widely defined
Atmospheric Pollution Prevention Act 45 of 1965	Dept of Environmental Affairs and Tourism	Noxious & Offensive gas permit: Scheduled process under Annexure APPA
National Environmental Management: Air Quality Act, 39 of 2004	Dept of Environmental Affairs and Tourism	Act promulgated regulations not formulated
Nuclear Regulator Act 47/1999 (Sect 20(1))	National Nuclear Regulator	Nuclear installation licence: Authorisation for sitting, constructing, operating, decontaminating or decommissioning a nuclear installation
Nuclear Energy Act 46/1999 (Sect 46)	Department of Minerals and Energy	Dealing with nuclear waste – permit requirement
Nuclear Energy Act 46/1999 (Sect 34)	Department of Minerals and Energy	Identified Authorizations by the Minister
Land Use Planning Ordinance 15/1985	Western Cape Provincial Dept of Environment & Development Planning	Rezoning i.t.o. 14.4(a) Full Rezoning process

In addition to the legislation mentioned in Table 5, the Department of Minerals and Energy has established a national policy on the management of radioactive waste, including spent fuel.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

This section of the environmental scoping report provides a summary of the potential positive and negative environmental (biophysical and social) impacts associated with the proposed PBMR DPP. A number of issues for consideration were identified through the EIA processes for both the 302 MW(t) PBMR DPP (undertaken in 2001 and 2002) and the 400 MW(t) PBMR DPP (current process). From the evaluation of these issues, recommendations are made regarding further detailed studies that are required to be undertaken in the environmental impact assessment (EIA) phase.

7.1 SUMMARY OF ISSUES IDENTIFIED

a) Technical issues:

- climate (meteorological) characteristics;
- construction issues;
- emergency preparedness and planning;
- fuel integrity and spent fuel storage;
- geotectonics;
- groundwater characteristics;
- Infrastructure e.g. roads, harbours, telecommunication;marine (oceanographic) characteristics;
- nuclear safety standards, practices and procedures;
- population distribution (demographics);
- safety and security issues;
- technology alternatives.

b) Biophysical issues:

- archaeological/palaeontological characteristics;
- marine fauna and flora;
- sensory assessment(s);
- terrestrial fauna and flora;
- waste impacts, i.e. gaseous, liquid and solid (types, volumes/quantities and management).

c) Social issues:

- employment creation;
- institutional capacity impacts;
- legal impacts including financial provisions;
- potential impact on health;
- public consultation and EIA process issues;safety and security impacts;
- social impact.

d) Economic aspects:

- economics of the technology;financial provisions;impact on spatial planning and land use;
- impact on supply-side management;
- impact on tourism;
- life cycle costing;regional benefits,

7.2 EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

Identified issues can be divided into three major groups, i.e.

- issues that are significant but fall outside of the scope of the EIA for the PBMR DPP;
- issues with a non-radiological dimension;
- issues with a radiological dimension.

Identified issues will be assessed quantitatively and qualitatively based on the level of available data.

a) Issues which are significant, but fall outside of the scope of the EIA for the PBMR DPP.

These issues where identified during the scoping phase and are noted in this report for the record. Notice should be taken of these issues by either the applicant, or PBMR Limited, or the relevant authorities as appropriate. These issues are summarised as follows:

Table 6: Significant issues falling outside the scope of the EIA for the PBMR DPP

1. The financial viability of PBMR as an electricity generating option for South Africa.
2. Alternative energy sources. However, a description of the different technologies pursued by Eskom, will be included into the EIR to contextualise the PBMR technology.

3. Opposition to the expansion of the nuclear legacy in South Africa.
4. Environmental impact of uranium mining.
5. Absence of approved procedures/regulations to deal with spent nuclear fuel.
6. Use of public funds to develop a nuclear technology.
7. The sincerity of the participation approach in the compilation of the National Radio-Active Waste Policy.
8. Historical impacts on the health of radiological workers at Koeberg NPS and Pelindaba.
9. Absence of an international market for future PBMR technology.

b) Environmental aspects with no radiological dimension

The issues have been summarised into a number of generic aspects. These generic issues associated with the various life cycle phases of the proposed development are provided in Table 7. Each issue was assessed in terms of the nature and extent of the issue, while considering the following key factors, i.e.

- the anticipated environmental impacts of the proposed 400 MW(t) PBMR DPP;
- the legal, policy and planning context of the proposed PBMR DPP;
- the nature of the proposed PBMR DPP;
- the characteristics of the receiving environment;
- the environmental expectations of the affected population, both on a local/regional and national level;

A summary of the screening assessment, as well as the recommendation on the future detailed assessment of each issue is given in Table 8.

Table 7: Issues (With out any radiological dimension) associated with the proposed PBMR DPP at Koeberg.

Project Life Cycle/ Activity.	Issues	Nature of Impact	Extent of Impact	Recommendations
Construction Phase				
Earthworks for: **Foundations** Services trenches Construction of building Site linkage roads Security fences Switch yard & transmission lines Workshops/offices. Material storage yard Construction activities Rehabilitation works				

	Geomorphology and tectonics.	Disruption of natural topography. The receiving environment has a gentle elevation which could be sensitive to large disruptions. Refer to section 4.2 of this report. Erosion potential. Malmesbury Group of marine sedimentary assembly could be receptive to erosion. Refer to page section 4.2 of this report Two structural fault lines 3.5 and 4.5 km south of the KNPS Site – proven to be non capable. Refer to section 4.2 of this report..	Local. Local. Regional.	Potential impact should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impact.
	Archaeology sites.	Impact on sites of archaeological/heritage significance	Local/regional/national (depending on significance of site).	Potential impacts should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Surface and groundwater	Potential contamination from construction related spillages during construction. Please refer to Section 4.2 of this report Disposal of seepage water in excavation(s)	Local/regional.	Potential impact should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Dust generation.	Dust during the excavation phase.	Local.	Potential impact (before and after mitigation) should be assessed during the EIA Phase.

	Noise.	Noise related to construction equipment	Local	Potential impact (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impact.
	Visual impacts.	Aesthetic quality of the area during construction. The receiving environment has a gentle elevation which could be sensitive to large disruptions. Refer to Section 4.2 of this report	Local.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Impact on social environment.	Influx of temporary workers. Receiving population could be sensitive to major changes, refer to section 4.6. of this report Job creation	Regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Waste management	Construction Waste, including: Concrete, Resin, Glass, Metal, Paint, Wood, Plastic, Paper, Sewage, Lubricants, Bitumen, Domestic waste, Excavation spoil	Local	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts. An appropriate waste management strategy should be developed and implemented through the EMP.

Transport of: **Materials** **Heavy loads** **Contractor labour** Import of Equipment (Cape Town Harbour) Local/International purchases of equipment Material Housing of construction Employment and contracting				
	Increased traffic volumes with associated risk.	Extra heavy loads will slow traffic flow (this will be limited, since only 3 or 4 loads will be transported). Safety risks to road users. The traffic volume on the N4 at the KNPS is approximately 7000 vehicles per day. An increase in volumes may have a negative impact. See section 4.6 of this report.	Regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Economic impacts.	Stimulation of local, regional and national economy. Commercial advantage for private sector transporters. International purchases results in the outflow of capital. Increased local spending.	Local/regional/national/ international.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise/optimise impacts.

	Social impacts.	Job/skills creation from the labour to the technical/ professional level. Pressure on municipal/ provincial/ national service capacity, e.g. schools medical, telecoms etc. Receiving population could be sensitive to major changes, refer to section 4.6. of this report.	Local/regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise/optimise impacts.
		<u>Commissioning and Demonstration</u>		
Commissioning of the plant by means of pressurised nitrogen without nuclear fuel.				
	Heated water outflow.	Creates a buoyant warm water plume in the near shore marine environment. Cooling water is extracted from the ocean at a rate of 2,5 m^3 per second, chlorinated to 1 ppm, and returned to the ocean with an increased temperature of 10 degrees Celsius. This may impact on the receiving marine environment as described in section 4.3 of this report.	Limited impact on marine fauna and flora.	300 MW(t) data were evaluated during the scoping phase and it was assessed to still be applicable and valid. See Annexure 3.5. Based on the assumption of 2.5m^3 effluent release of cooling water, no reassessment is recommended.
	Air emissions.	Nitrogen release during the cold commissioning.	Local.	Potential impacts should be assessed during the EIA Phase.

	Waste management: non reactive	Non-radioactive waste - Office. - Domestic. - Sewage.	Local and regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts
Operations of the plant after loading and activation of the nuclear fuel				
	Storage of fuel.	Health and safety issues.	Local.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Waste Management.	Generation of non-radio-active waste (as above plans replaced equipment.)	Local/regional	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts. An appropriate waste management strategy should be developed and implemented through the EMP.
	Heated water outflow.	Creates a buoyant warm water plume and a near shore marine environment.	Limited impact on marine fauna and flora.	No further study required as concluded by the studies conducted by the University of Cape Town.

	Air emissions.	Emissions of noble gasses. Helium emissions during the operation of the station – anticipated quantities are expected to be less than 10 kg per day. Green house gas emissions.	Local.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise/optimise impacts.
	Air emissions.	Helium during the operation of the station – anticipated quantities are expected to be less than 10 kg per day. Residential areas towards the south (Duynefontein, Klein Springfontein), see section 4.5 of this report.	Local.	Potential impacts should be assessed during the EIA Phase.
	Noise.	The gas turbine air intake facility will cause the highest level of residual noise. Residential areas towards the south (Duynefontein, Klein Springfontein), see section 4.5 of this report.	Local.	Potential impacts should be assessed during the EIA Phase. The design of the PBMR DPP should incorporate measures to reduce the internal build up of noise and minimise its transmission outside.
	Groundwater.	Potential contamination – Atlantis Aquifer to the Northwest of the site identified as an important groundwater resource in the area.	Local/regional.	300 MW(t) EIA data was evaluated during the scoping phase and found to still be applicable and valid. See Annexure 3.5. No further assessment is recommended..

	Social impacts.	Safety and security issues. Health issues, risk assessment and monitoring. Job creation. Impacts on spatial planning and surrounding land use. Receiving population could be sensitive to major changes, refer to section 4.6. of this report.	Local/regional.	300 MW(t) EIA data was evaluated during the scoping phase and mostly found to still be applicable and valid. See Annexure 3.5. Selective reassessment recommended.
	Operational accident(s)/failure(s).	- Non-radiological. - Radiological.	Local. Regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts. NNR process to assess issues and to inform the EIA process.
	Economic impact.	Rate of financial provisions for dismantling and rehabilitation. Cost of emergency planning as a result of the proposed PBMR DPP to CCT and other local authorities. See section 4.6. of this report.	National.	Potential impacts should be assessed during the EIA Phase. Recommendations should be made regarding appropriate measures.
Decommissioning of the plant.	Social impacts.	Redeployment of operational staff. Receiving population could be sensitive to major changes, refer to section 4.6. of this report. Influx of decommission personnel.	Local.	Addressed in selective social Impact Assessment.

				Issues to be considered by the Department of Mineral and Energy and included in the National Waste Policy. Issues to be assessed by the NNR process, and to inform the EIA process. Issues to be considered by the Department of Mineral and Energy and included in the National Waste Policy.
Dismantling of the plant, disposal of plant material and the high level waste stored in the plant.	Economic impacts.	Expenditure and support for the dismantling and rehabilitation.	Local/regional/national.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.
	Social impacts.	Institutional capacity/ professional skills to manage the operations.	Local/regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts.

	Waste management.	Non-radiological. *Pending the degree of dismantling the volumes of waste may vary but will include:* Concrete, Plastic, Glass, Steel. Radiological waste *Pending the level of radioactivity, such material or equipment will go to low or high level disposal/storage areas with further decontamination as may be required* [a].	Local/regional.	Potential impacts (before and after mitigation) should be assessed during the EIA Phase. Recommendations should be made regarding appropriate mitigation measures required to minimise impacts. An appropriate waste management strategy should be developed and implemented through the EMP. Issues to be assessed by the NNR process, and to inform the EIA process [a].

c) Issues with a radiological dimension

Issues with a radiological dimension will be addressed in the EIA process in terms of the NNR/DEAT Cooperative Governance Agreement (Refer to Chapter 6). In terms of the mentioned cooperative governance agreement these issues where classified into one of four classes. The above classification, response required from the EIA consultant, NNR responsibility, and DEAT responsibility of each issue is indicated in Table 8.

Table 8. Classification of radiological related issues in terms of the Cooperative Governance Agreement between the NNR and the DEAT.

Issue Category.	Consultant responsibility.	NNR responsibility.	DEAT Responsibility.
Category 1: Radiological/radiation issues of a generic nature and not necessary directly related to the project.	**The draft and final EIR should contain answers to these issues.**	**On request of DEAT the NNR will review the information in the EIR and communicate their opinion to DEAT.**	**DEAT to consider the EIR information and the NRR in the process of issuing a ROD.**
	How will the current EIA address nuclear safety issues, since the High Court Ruling directed that the DG for Environmental Affairs cannot abdicate his responsibility in this regard to the DG of DME? In the previous EIA health and epidemiological studies were of a desktop nature. This EIA will need more information.		
Category 2: Radiological/radiation issues directly related to the proposed project.	**The Scoping report to indicate how, when, and where these issues will be addressed in the documentation submitted by the applicant to the NNR as part of the licence process.**	**NNR to review to licence documentation to ensure that these issues are addressed by the applicant. Depending on the time frame and synergies between the EIA and Licence process, the NNR will provide DEAT with an evaluation report on these issues.**	**DEAT to review the NNR evaluation report in the process of issuing a ROD. Where the NNR evaluation report is not available during the DEAT review of the final EIR, DEAT will refer these issues to NNR as a condition of the ROD.**

Issue Category.	Consultant responsibility.	NNR responsibility.	DEAT Responsibility.
	Occurrence of credible events: • Graphite fires • Fuel failure • Uncontrolled air ingress • Sabotage • Aircraft incidents Walk away safety, is this true? How long does the sent fuel remain hazardous? Where will spent fuel be stored and what is the ultimate destination and full life cycle associated cost? Are nuclear standards, practices and procedures sufficiently demonstrated and maintained at KNPS? What distance is the evacuation boundary of the PBMR? What are the probabilities and consequences of a catastrophic event affecting the PBMR and/or the impact of a catastrophic event at Koeberg on the PBMR. What will happen if there is an (accidental) radioactive release from the PBMR and what contingencies are in place for Koeberg? There are allegations that Koeberg is not so safe and that the emergency plans are not sufficient. Generation of radio-active waste, including used fuel pebbles, resins, carbon spheres,		

Issue Category.	Consultant responsibility.	NNR responsibility.	DEAT Responsibility.
	filters, control spheres, clothing, contaminated equipment, transportation of waste Continued management of radio-active wastes. Radioactive gases and liquids. Continued management of radio-active wastes. Radioactive solids. Possible long-term disposal at the Vaalputs facility. Storage/management of long-term high level waste. Decontamination of irradiated materials/equipment. Impact of lack of secondary containment on safety and economics of plant.		
Category 3: **Issues directly related to the proposed project with a radiological/radiation and non-radiological/radiation dimension.**	**The Scoping report to indicate how, when, and where these issues will be addressed in the documentation submitted by the applicant to the NNR as part of the licence process.** **The non-radiological dimension of the issues must be addressed in the EIA documentation submitted to the public and DEAT.**	**NNR and DEAT will consult with one another about the requirements related to the necessary studies, as well as their evaluation.**	**NNR and DEAT will consult with one another about the requirements related to the necessary studies, as well as their evaluation.** **DEAT to review the NNR evaluation report in the process of issuing a ROD. Where the NNR evaluation report is not available during the DEAT review of the final EIR, DEAT will refer these issues to NNR as a**

Issue Category.	Consultant responsibility.	NNR responsibility.	DEAT Responsibility.
			condition of the ROD.
	No issues in this category at this stage.		
Category 4: **Issues related to the NNR process e.g. safety standards etc.**	**EIA Consultant to identify these issues, communicate them to the NNR for response. The response of the NNR will be included in the final EIR.**	**NNR to compile responses that will be included in the EIR, and other relevant EIA documentation.**	**DEAT to consider responses by the NNR that are included in the EIR. Decisions related to these issues will communicated by the DEAT to the NNR after issuing of an ROD.**
	Safety case submitted to NNR for the previous design is not on international standard and will not be approved in another part of the world.		

7.3 EPIDEMIOLOGICAL STUDIES OF POPULATIONS LIVING AROUND NUCLEAR FACILITIES

Some I&APs indicated the need for real time epidemiological studies as a precondition/requirement for the EIA study. The EIA study will not conduct an epidemiological study for the purposes of the application. The EIA consultants propose to do a desktop study of international literature and findings to date.

Based on the result of a literature study, the EIA Consortium will, as appropriate, make recommendations on surveillance/monitoring, which are deemed essential, should the project be authorized.

7.4 RECOMMENDED SCOPE OF WORK FOR THE ENVIRONMENTAL IMPACT REPORT (EIR)

This Environmental Scoping Study for the proposed PBMR DPP at Koeberg, Western Cape Province aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project. A number of issues for consideration were identified through the EIA processes for both the 302 MW(t) PBMR DPP and the 400 MW(t) PBMR DPP (current process). No environmental fatal flaws have been identified as a result of the proposed project. However, a number of potentially significant environmental impacts have been identified as requiring further detailed study (See tables 7 and 8 of this report). Therefore, an EIA is required to be undertaken in order to provide an assessment of these potential impacts and recommend appropriate mitigation measure, where required. A summary of the potentially significant impacts/issues/concerns that require further detailed study within the EIA phase of the study is provided below.

a) Impacts of a strategic nature

These impacts relate to Policy Issues and Alternatives (Technological as well as geographical).

The Consultant concludes that a comprehensive assessment of the technological and site alternatives within the EIA phase is not recommended. However, the EIA will describe and report on the strategic issues to contextualise the proposed PBMR DPP.

b) Impacts of a site specific nature

For the purposes of the EIA Study, the impacts, issues and concerns to be assessed and reported on are grouped as follows:

- technical or suitability aspects;
- biophysical or sensitivity aspects;
- social impacts

- economic aspects,

7.4.1 TECHNICAL ASPECTS

The scope of technical aspects is the following:

- Geotectonics of the Koeberg site:

  The base geological studies/data as reported by Andersen Geological Consulting (AGC) and Seismic characteristics of the site as reported by the Council for Geoscience (CGS) for the 302 MW(t) PBMR DPP were comprehensive and requires no further additions due to variability over time. (Personal communication with AGC and CGS).

  No further assessment required.

- Groundwater characteristics of the site:

  The base data for the site, both qualitatively and quantitatively to determine pathways, was reassessed by Dr M Levin and found to be non-variable, and applicable.

  No further assessment required.

- Physio-chemical characteristics of the marine environment:

  These characteristics were assessed by SHECape Environmental Consultants and found to be adequate and non-variable to that used for the 302 MW (t) PBMR DPP.

  Should the thermal outflow be higher than 2.5m3/s, a reassessment of this aspect would be required.

- Meso and micro meteorological characteristics of the Koeberg site and region:

  SHECape Environmental Consultants conducted an assessment of the Meteorological characteristics of the site and found only limited and insignificant variances due to the addition of resent data.

  A quantitative assessment of emission dispersion for operational and accident events need to be conducted.

- Surrounding population density around the proposed plant:

  The base data as applied to the 302 MW(t) PBMR DPP was based on the latest population census with updates and projections to the year 2010. The Consultants assessed and regard the data as viable and applicable for the assessment of impacts of releases (operational and accident events) under various meteorological conditions, on the population.

- Infrastructure capability e.g. roads, telecoms, medical and emergency services, water supply, sewage facilities, housing and associated facilities:

Although the base data as reported in the EIR for the 302 MW(t) PBMR DPP was assessed by the Consultants and found to be valid and applicable for the 400 MW(t) PBMR DPP assessments, aspects such as the infrastructure capability, population dynamics and land use implications will be confirmed.

7.4.2 BIOPHYSICAL ASPECTS

The scope of biophysical aspects includes the following:

- Marine fauna and flora and the effect of the additional thermal outflow on such sea life:

  The base studies by UCT remains valid and no additional studies will have to be conducted.

- Terrestrial fauna and flora and the effect of the proposed plant on such life:

  The Consultants concluded that the assessments and impacts as reported in the EIR for the 302 MW(t) PBMR DPP remains valid for the 400 MW(t) PBMR DPP.

  No further assessments will be needed in this regard.

- Archeological/Paleontological characteristics of the proposed plant location:

  The impacts on these attributes will remain the same as for the 302 MW(t) PBMR DPP and the consultants conclude that no further assessments will be required in this regard.

- Visual impact:

  Interdesign Landscape Architects reassessed the visual impact of the changed building design and concluded that a new impact assessment will have to be conducted in view of better methodology that has been developed since 2002.

- Noise

  Due to design changes and increased power outputs of the proposed plant, the noise emissions may be significantly different from those assessed during the 302 MW(t) EIA. A reassessment of this issue should be conducted for the 400 MW(t) PBMR DPP EIA.

- Waste impacts, i.e. gaseous, liquid and solid:

  Impact (radiological and non-radiological) of the 400 MW(t) PBMR DPP will need to be re-assessed.

7.4.3 SOCIAL ASPECTS

- Conventional Safety and Security impacts
- Radiological, safety and security aspects as per Table 8.

- Impact on health

  A literature study on the epidemiology of radiological induced exposures will be conducted and recommendations made on the monitoring that may be required as part of plant operations. This aspect would be addressed in accordance with the category 1 requirement of the NNR/DEAT Cooperative Governance Agreement.

- Impact on job creation.

  This aspect should be re-assessed.

- Impacts on spatial planning from a local and sub-regional point of view.

  The West Coast Biosphere policy will be used to assess the impact of the 400 MW(t) PBMR DPP.

- Institutional capacity impacts, i.e. the NNR, DME, Departments of Health, Transport, Water Affairs and Forestry and Metropolitan Councils. This also relates to the emergency services and planning capability within these authorities.

- Social impacts.

7.4.4 ECONOMIC ASPECTS

- Impact on o-tourism in the region around Koeberg:

  Vecon Economic and Development Consultants assessed the validity of the conclusions for the 302 MW(t) PBMR DPP and conclude that the findings remain valid. Major tourism stakeholders to be consulted and findings confirmed.

- Legal impact and financial provisions

  An assessment of the legal impact and mechanism for adequate and legally required financial provisions

- Impact on supply side management. (Generation Capacity).

- Economics of the technology

- Local and regional benefits.

7.4.5 ISSUES WITH A RADIOLOGICAL DIMENSION

These issues are listed Table 8. The issues will be included in the EIA and will be addressed in accordance with the cooperative governance agreement between DEAT and the NNR. The level of information and assessment that will be consulted in the final EIR is determined by the above agreement.

7.4.6 CUMULATIVE EFFECTS

During the EIA phase possible links between impacts will be established. The cumulative effects of linked impacts will be assessed, i.e.:

- transport;
- radioactive waste and releases;
- water use/disposal (cooling and potable).

7.4.7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An EMP for the construction and operation/maintenance cycle of the proposed 400 MW(t) PBMR DPP will be compiled an issued to the authority for consideration for a Record of Decision.

7.4.8 THIRD PARTY REVIEW

Third party review of the EIA process and EIR will be undertaken by an independent review panel appointed by DEAT.

CHAPTER 8: APPENDICES

8.1 APPENDIX 1: ADVERTISEMENTS

8.1.1 AFRIKAANS ADVERTISEMENT

KENNISGEWING VAN 'N OMGEWINGSIMPAKSTUDIE (OIS) VIR DIE VOORGESTELDE 400 MW(t) MODULÊRE KORRELBEDREAKTOR (MKBR) DEMONSTRASIE KRAGSTASIE

VOORGESTELDE AKTIWITEIT

Ingevolge Regulasie 4(6) van die regulasie soos bekend gemaak in staatskennisgewing no. R 1183 in terme van Artikel 26 van die Wet op Omgewingsbewaring (Wet 73 van 1989), word hiermee kennis gegee van die voorneme van Eskom Holdings Bpk, om die volgende aktiwiteit uit te voer:

'n Aansoek om omgewingsmagtiging vir die voorgestelde Modulêre Korrelbedreaktor (MKBR) demonstrasie kragstasie met 'n nominale kapasiteit van 400 MW (t) by die Koeberg kragstasie terrein in die Wes-Kaap.

Die aansoek om die voorgestelde aktiwiteit is by die nasionale Departement van Omgewingsake en Toerisme ingehandig.

'n OIS en publieke deelnameproses sal onderneem word om belanghebbende en geaffekteerde partye (BGPs) van die voorgestelde 400 MW (t) MKBR demonstrasie kragstasie in te lig en om insae tot die OIS proses te bied. 'n Omgewingsbestekopname en 'n omgewingsinvloed verslag vir die voorgestelde MKBR demonstrasie kragstasie sal voorberei word en aan BGPs voorgelê word vir kommentaar.

DIE APPLIKANT EN DIE KONSULTANT:

Eskom Holdings Bpk is die applikant en het MAWATSAN as die omgewingskonsultant aangestel om die OIS vir die 400 MW(t) MKBR demonstrasie kragstasie te behartig.

REGISTRASIE VIR BGPS:

BGPs word vriendelik genooi om te registreer by MAWATSAN om aan die proses deel te neem:

MAWATSAN

Aandag: Ian MacFadyen

Posbus 13540, Hatfield, Pretoria, 0028

Faks: +27 12 362 2463 en Tel: +27 12 362 2908

Fokusgroep- en publiekevergaderings word beoog om sodoende inligting oor die voorgestelde projek aan BGPs te verskaf. Die publieke vergaderings sal op die volgende datums plaasvind:

Kaapstad: 9 November 2005 **– Milnerton Sport Klub, Theo Marais Park, Koebergstraat, Milnerton**, om **18h30**

Atlantis: 10 November 2005 **– Hartebeeskraal Veeldoelige Gemeenskapsentrum, Nottinghamstraat,** om **18h30**

Midrand: 15 November 2005 **– Eskom Konferensiesentrum, Dalestraat, Halfway House,** om **18h30**

Durban: 17 November 2005 **– Durban Uitstalsentrum,** 11 Walnutstraat, om **18h30.**

'n Agtergrondinligtingsbrosure is beskikbaar op aanvraag en projek inligting sal ook beskikbaar wees gedurende die duur van die OIS op die webwerf www.pbmr-EIA.co.za.

8.1.2 ENGLISH ADVERTISEMENT

NOTICE OF AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED 400 MW(T) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT

THE PROPOSED ACTIVITY

in terms of regulation 4(6) of the regulations published in government notice no. r. 1183 under section 26 of the environment conservation act (act no. 73 of 1989) notice is hereby given of Eskom Holdings Limited's intent to carry out the following listed activity:

An application for the environmental authorization for a proposed Pebble Bed Modular Reactor PBMR) Demonstration Power Plant (DPP) with a nominal capacity of 400 MW(tl) located on the Koeberg Power Station Site in the western cape.

The application for this proposed activity has been submitted to the national department of environmental affairs and tourism.

An EIA and public participation process will be conducted to inform Interested and Affected parties (I&APs) of the proposed 400 MW(t) PBMR DPP and to invite input into the EIA process. A scoping report and an Environmental Impact Report (EIR) for the proposed 400 MW(t) PBMR DPP will be prepared and submitted to I&APs for comment.

THE APPLICANT & CONSULTANT

Eskom Holdings Limited is the applicant and has appointed Mawatsan as the consultant to conduct the EIA for the 400 MW(t) PBMR DPP.

I&AP REGISTRATION AND PUBLIC PARTICIPATION

I&APs are cordially invited to register with Mawatsan to participate in the process as outlined in the notice.

MAWATSAN

<u>Attention</u> *: Ian MacFadyen*

PO Box 13540, Hatfield ,Pretoria, 0028

Fax +27-12-362-2463 and Tel +27-12-362-2908

In order to inform I&APs of the proposed PBMR DPP project, focus group and public meetings will be held. The public meetings will take place at the following locations and times:

Cape Town: **9 November 2005** - Milnerton Sports Club, Theo Marais Park, Koeberg Road, Milnerton, At 18h30

Atlantis**:** **10 November 2005 -** Hartebeeskraal Multi Purpose Community Center**,** Nottingham Street, At 18h30

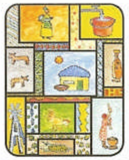
Midrand**:** **15 November 2005** - Eskom Convention Centre, Dale Road, Halfway House, At 18h30

Durban**:** **17 November 2005 -** Durban Exhibition Center, 11 Walnut Road, At 18h30

A background information document is available on request and project information will also be available on the website (www.pbmr-eia.co.za), for the duration of the EIA.

8.2 APPENDIX 2: BACKGROUND INFORMATION DOCUMENT

Environmental Impact Assessment for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) on the Koeberg Power Station site in the Western Cape



MAWATSAN

INTRODUCTION

Eskom proposes to construct, commission, operate, maintain and decommission a Pebble Bed Modular Reactor (PBMR) Demonstration Power Plant (DPP) with a nominal thermal output of 400 MW to assess the technological, environmental and socio-economic viability of the technology.

The proposed project is in response to:

- Assessments of the projected electricity demand and supply in South Africa: The Department of Minerals and Energy performs Integrated Energy Planning to identify future energy demand and supply requirements. The National Electricity Regulator (NER) performs National Integrated Resource Planning to identify the future electricity demand and supply requirements. Similarly Eskom assesses the projected electricity demand and supply through a process called the Integrated Strategic Electricity Plan. Through these processes, the most likely future electricity demand is forecast based on long-term Southern African economic scenarios. This information provides the framework for Eskom and South Africa to investigate a wide range of supply and demand-side technologies and options. This planning process identified that South Africa will require additional "peaking electricity generating capacity" by 2007 and additional "base load electricity generating capacity" by 2010.
- In the longer term (2020 and beyond), the existing power stations will start to come to the end of their useful life, hence replacement power stations will be required over and above those required to cater for growth in demand. As part of an ongoing effort to evaluate the viability of all supply-side options, a number of power generation technologies, not yet implemented in South Africa on a commercial basis, are being evaluated in terms of technical, socio-economic and environmental aspects. These research, development and demonstration investigations include:
  - Underground high head pumped storage (hydro) schemes using worked out mines.
  - Underground coal gasification.
  - Ultra Fines coal.
  - Wind energy.
  - Pebble Bed Modular Reactor (PBMR) technology.
  - A solar thermal power plant.
  - Photovoltaic and biomass gasification applications as part of the Government's Integrated Rural Development Programme.

PBMR DPP

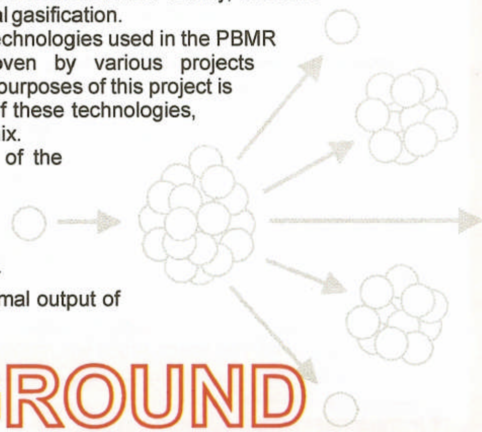
INTRODUCTION (Continues)

Preliminary results of these studies indicate that it is necessary to validate the assumptions and modelling of some of these options through demonstration/ pilot plants. The research and demonstration period for new technologies may take a number of years to consider the long-term technical, operational and socio-economic aspects. A demonstration/ pilot plant would provide sufficient information to make a decision on the commercial use of a technology.

The proposed PBMR DPP is one of these demonstrations. Other demonstration/pilot plants either already in operation or in the feasibility planning stage include large-scale solar thermal technology, a wind demonstration facility, biomass gasification and underground coal gasification.

While individual aspects of the technologies used in the PBMR DPP have already been proven by various projects throughout the world, one of the purposes of this project is to demonstrate the integration of these technologies, within the South African energy mix.

The proposed activity consists of the construction, commissioning, operation and maintenance and decommissioning of a Pebble Bed Modular Reactor (PBMR) Demonstration Power Plant (DPP) with a nominal thermal output of 400 MW(t).



BACKGROUND INFORMATION

A comprehensive EIA has already been conducted for a similar project. The following paragraphs provide information on the previous EIA, as well as on its relationship to the current process.

The original intention of Eskom was to build a 302 MW(t) PBMR Demonstration Plant on the Koeberg Site. An environmental impact assessment for this plant commenced in 1999 when Eskom appointed a consortium of independent consultants to perform the EIA. An extensive scoping and special study programme was undertaken, including comprehensive public participation through numerous interactions (focus group meetings, open days and public meetings), with periods for comment being provided during the Scoping and EIA phases. This culminated in the submission of the Final Environmental Impact Report to the Department of Environmental Affairs and Tourism (DEAT) in October 2002. The evaluation of the Final EIR by DEAT and an International Review Panel appointed by DEAT was undertaken, leading to the issuing of a positive Record of Decision by the DEAT Director-General in June 2003. Appeals against the Record of Decision were submitted to the DEAT Minister during July and August 2003.

2

An application was brought before the Cape High Court on behalf of Earthlife Africa (Cape Town) in September 2003 to have the Record of Decision issued by the DEAT DG reviewed and set aside. The Court judgement was handed down in January 2005. In this judgement the Cape High Court ruled in favour of the application, set aside the Record of Decision, and required the DEAT DG " .... to afford the applicant and other interested parties an opportunity of addressing further written submissions to him along the lines as set out in this judgment and within such period as he may determine and to consider such submissions before making a decision anew on the second respondent's application."

Since the completion of this EIA, the decision was made to increase the power output of the DPP from 302 MW(t) to 400 MW(t). This change in output requires that a new application be launched. All the environmental impacts of the 400 MW(t) PBMR DPP will be identified and assessed. Information sourced during the "302MW(t) PBMR EIA" will be considered where relevant and appropriate. All relevant information will be included into the scoping process. All issues and comments raised during the public participation process will be noted, incorporated into an issues and response register and incorporated into the scoping report. I&APs will have the opportunity to review the scoping report to verify the accuracy and completeness of the issues.

THE PROPOSED ACTIVITY

The proposed PBMR DPP is a graphite moderated, helium cooled, nuclear reactor, configured as an electricity generating power station. The PBMR DPP uses a direct gas turbine cycle to convert the heat, generated by nuclear fission in the reactor and transferred to the helium coolant, into electrical energy by means of a horizontally configured turbo-generator.

Fuel for the proposed PBMR DPP will consist of spherical pebbles (approximately 60 mm in diameter) that contain Triso coated Uranium Oxide kernels (up to 10% enriched), which a embedded in a pure graphite matrix.

Provision will be made to accommodate all spent fuel on the site for the 40 year design l of the plant subject to statutory prescription. Radioactive waste (excluding spent fuel) v be managed on site, and disposed of at the Vaalputs repository, as in the case of tl current Koeberg nuclear power plant and in accordance with statutory prescription.

The proposed PBMR DPP will be connected to the Eskom national transmission netwo within the Koeberg power station site. A widening of a portion of the road to the Koebe power station from the R27 turnoff and the construction of the internal roads on tl Koeberg power station site for access to the PBMR DPP site are also proposed. Tl proposed PBMR DPP would to a large extent make use of existing Koeberg infrastructu and services.

3

THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Mawatsan is the appointed independent consultant to implement the EIA process. The following sections provide more detailed information on this process.

Environmental impact assessment regulations

In terms of the EIA regulations (Government Notice no's R1182,R1183 and R1184 o 1997 in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), there are a number of listed activities that could potentially have substantial detrimental effects or the environment and which are required to be subjected to Environmental Impac Assessment (EIA) processes.

The proposed 400 MW(t) PBMR Demonstration Power Plant includes activities that fal within the ambit of the following listed activities:

Activity 1. The construction, erection or upgrading of-
- (a) facilities for commercial electricity generation with an output of at least 10 megawatts and infrastructure for bulk supply;
- (b) nuclear reactors and facilities for the production, enrichment, processing, reprocessing, storage or disposal of nuclear fuels and wastes;
- (c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation-
- (ii) manufacturing, storage, handling, treatment or processing facilities for any such substance;
- (d) roads, railways, airfields and associated structures;

Activity 2. The change of land use from-
- (c) agricultural or zoned undetermined use or an equivalent zoning to any other land use;

Activity 9. Scheduled processes listed in the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965):
- 29. Power generation processes: That is to say, processes in which-
- (c) any fuel burning appliance is used that is not controlled in terms of Part III of this Act, excluding appliances in private dwellings. This activity is related to the D-generator, which is used as an auxiliary source and for a short term only. It is not related to the primary generation of electricity.

The study area

The proposed PBMR DPP will be located at the Koeberg Power Station site in the Western Cape. The Koeberg nuclear power station is situated north of Ouskip, Var Riebeeckstrand and Melkbosstrand and to the east of the R27 on the farm Duynefonteir 34. The site is located about 2 km from the Duynefontein residential area, 30 km north o Cape Town and 10 km south of Atlantis. The proposed PBMR DPP site will be situatec within the existing Access Control 1 security fence of the Koeberg nuclear power statior site. It will therefore be on land currently used for nuclear power generation.

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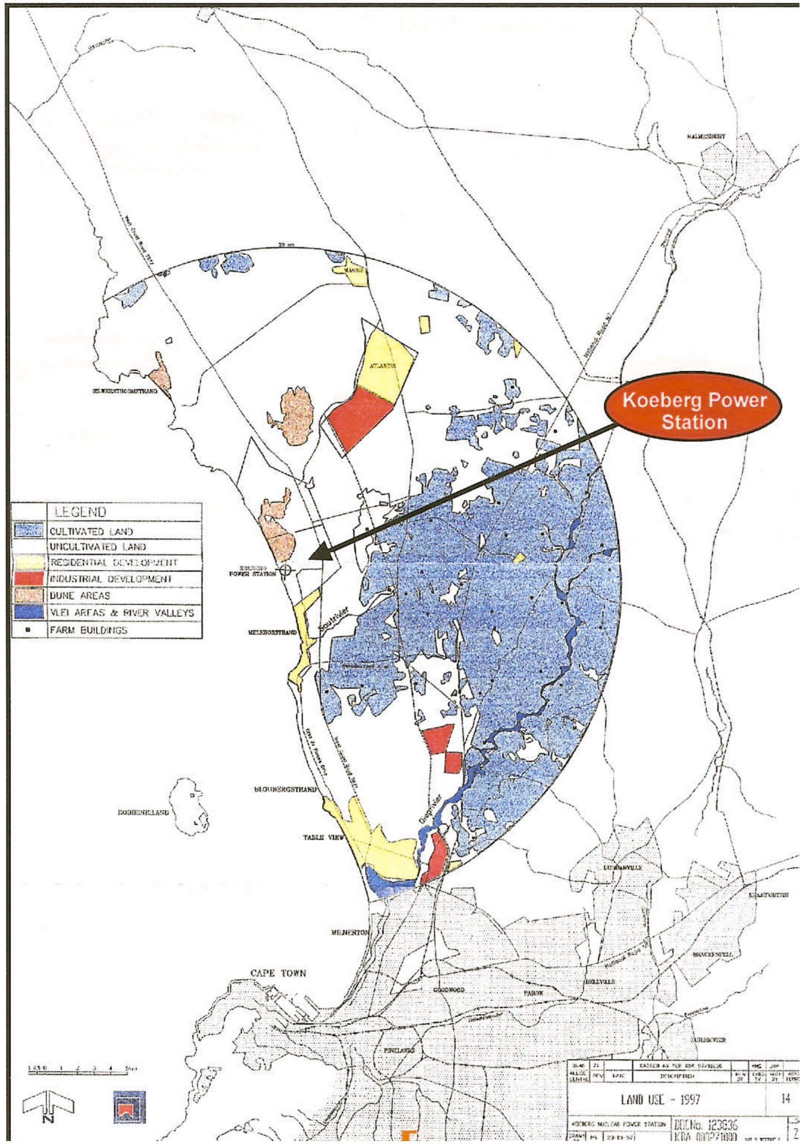
Locality of Koeberg power station site



Locality of the Koeberg power station site & the approximat location of the proposed PBMR DPP on the site

THE PUBLIC PARTICIPATION PROCESS ACTIVITIES

A comprehensive public participation process will be implemented during the Scoping and EIA phases of the project. The focus will be on informing interested and affected parties (I&APs) of the proposed development and of the significant differences between the 302 MW(t) and 400 MW(t) PBMR DPPs. Issues and comments raised during the previous public participation process will be collated and incorporated into the Scoping and EIA phases of the current process.

Aims of the Public Participation Process

Mawatsan will be responsible for the Public Participation Process. The Public Participation Process is structured to:

- Enable early involvement of I&APs in the environmental assessment process through a variety of mechanisms, adapted as required in response to issues, concerns and challenges. This involvement will be ongoing until a decision is reached by the authorities;
- Provide I&APs with ongoing information regarding the proposed project and related impacts;
- Ensure continuous transparency and informed decision-making;
- Promote communication with I&APs;
- Ensure that the I&APs' viewpoints are addressed and considered by the regulating authorities; and
- Facilitate a constructive process that enables I&APs and stakeholders such as the authorities, project proponents and specialists to work together to enhance the positive benefits of the project and limit the negative impacts associated with the project.

Components of the public participation process

The public participation process will consist of the following activities:

- Notification of I&APs regarding the EIA process, consultation activities and availability of reports and decisions by the authorities, using a variety of mechanisms.
- Interviews with a variety of I&APs in respect of the PBMR demonstration plant.
- Focus Group Meetings with relevant sectoral groups (groups of role-players with similar interests, such as the business sector, tourism, agriculture, local government, etc.).
- Public Meetings that will be widely advertised. These will provide I&APs with information and opportunities to record concerns, issues and suggestions, as well as to identify other I&APs.
- A website (www.pbmr-eia.co.za) is available. This contains relevant project documentation, links to appropriate documentation as well as an opportunity to make comments and register as I&APs.

Contact: Mr Ian MacFadyen: (01)2 362 2908/Fax(012) 362 2463
pbmr@mawatsan.co.za

7

Why is your participation important?

Everyone has the right to be involved in decisions that may affect their lives. Participation by Interested and Affected Parties is in everyone's best interest because:

- It provides opportunities for I&APs and the authorities to obtain clear, accurate and understandable information about the proposed project;
- It provides members of the public with the opportunity to provide comments (both positive and negative) regarding the environmental impacts of the proposed project;
- It provides affected parties with the opportunity to suggest ways for reducing or mitigating any negative impacts of the project, or for enhancing its benefits;
- It will enable the project proponent to incorporate the needs, preferences and values of I&APs into their decisions;
- It contributes toward maintaining a healthy, vibrant democracy.

Registering as an Interested and Affected Party

In order to register as an I&AP you are requested to:-

- Respond to the relevant newspaper advertisements;
- Complete and submit the registration sheet included in the Background Information Document;
- Attend public events; and
- Provide Mawatsan with your contact details.

As a registered I&AP you are entitled to be informed about public events, to receive project documentation, and to be afforded the opportunity to comment and raise issues and concerns throughout the process. You will also receive notifications to inform you of the availability of the Scoping and EIA reports and the opportunity to comment thereon. On completion of the environmental specialist studies, the Draft Environmental Impact Report (EIR) will be compiled and made available for public comment. All registered I&APs will be informed of the availability of this document and the public meetings to discuss the draft EIR.
If you consider yourself an I&AP for the proposed project, we urge you to make use of the opportunities created by the Public Participation Process to become involved.

Public meeting

A number of Public Meetings are scheduled to introduce the proposed project to I&APs. These events are as follows:

Milnerton	**9 November 2005**	**Milnerton Sport Centre at 18h30**
Atlantis	**10 November 2005**	**Hartebeeskraal Multi Purpose Centre at 18h30**
Midrand	**15 November 2005**	**Eskom Convention Centre at 18h30**
Durban	**17 November 2005**	**Durban Exhibition Centre at 18h30**

The main aim of the public meeting is to provide I&APs with more information on the proposed project and to explain the process to be followed, note their issues and concerns and answer questions. We invite you to attend the public meetings to ensure that you are kept informed of the project and that your issues and concerns can be formally recorded and addressed.

8.3 APPENDIX 3: COMMENTS AND REGISTRATION SHEET

REGISTRATION & COMMENTS

Please complete this form and return it to Mawatsan:

Mr. Ian MacFadyen
P.O. Box 13540, Hatfield, 0028
Tel: (012) 362 2908 Fax: (012) 362 2463
E-mail: pbmr@mawatsan.co.za
www.pbmr-eia.co.za

PERSONAL DETAILS

Title:______________Initials______________Surname:________________________________

Organisation/ Firm (if applicable):____

Position/ Nature of involvement (e.g. property owner): ______________________________

Street address:____

Postal address: ____

Tel and area code: (Work) __________________ (Home) ____________________________

(Cell) ________________________(Fax) ___________________________

(E-mail) ____

COMMENTS / QUESTIONS:

1. What potential impacts do you foresee?

2. What issues and concerns would you like to raise with regard to these anticipated impacts?

3. Are there any stakeholders that you feel we should consult with (please state their names and contact info)?

8.4 APPENDIX 4: FOCUS GROUP MINUTES

8.4.1 FOCUS GROUP MEETING: AFRIKAANS HANDELS INSTITUUT

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 400 MW(T) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT (PBMR DPP) ON THE KOEBERG POWER STATION SITE IN THE WESTERN CAPE[5]

Date: 29 November 2005

Time: 11:00

Venue : AHI Office Pretoria

DRAFT MINUTES

WELCOME

Dr D de Waal thanked Mr. J de Villiers for making time available for the briefing.

ATTENDANCE

Mr. J de Villiers, Dr. D de Waal, Mr. I MacFadyen.

PRESENTATION

Dr D de Waal explained the background of the project and indicated the core aspects of the PBMR DPP, the EIA process and the consultation process.

A background information documents was supplied to Mr. J de Villiers for his information and distribution. Mr. J de Villiers indicated that the AHI and others including Sasol had, had a meeting in the past where they expressed support for the whole concept of the PBMR.

He did however say that there was concern expressed at the time regarding the storage of the spent fuel.

Mr de Villiers asked where the spent fuel would be stored. Dr D de Waal responded by saying that the legislation setting out Government Policy on the storage of radio active material had gone before parliament the previous week. At present the spent fuel of the KNPS is stored on site. It is intended to store the PBMR DPP spent fuel on the site as well. Low level and intermediate levels radioactive waste is disposed in Vaalputs.

[5] Note: This is not a verbatim reflection of the meeting, but an attempt to reflect the presentations and discussion session in a clear and concise manner.

Mr de Villiers enquired on the size of the proposed PBMR DPP compared to Koeberg. The response was that the area set aside at Koeberg for the PBMR is very small in relation to the total area of the power station.

Mr. J de Villiers indicated that the AHI has already indicated that they support the process in principle, as it was their opinion that the technology was clean and safe with few problems.

CONCLUSION

Dr D de Waal thanked Mr. J de Villiers for his time and inputs and closed the meeting at 11h30.

8.4.2 FOCUS GROUP MEETING: PELINDABA WORKING GROUP

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 400MW(t) PBMR DPP AT KOEBERG NPS SITE IN THE WESTERN CAPE

Date: 1 DECEMBER 2005

Time: 16:00

Venue: Professional Aviation Lanseria

DRAFT MINUTES

WELCOME AND INTRODUCTION

The meeting was opened by Mr. R Garbett who thanked everyone for attending. He indicated that more people had been invited to the meeting but had unfortunately not been able to attend. He requested Mr. W Lombaard to proceed with his presentation.

PRESENTATION AND DISCUSSION

Mr. W Lombaard explained the purpose of the focus group meeting as to provide information and to provide the attendees the opportunity to ask questions and raise issues. He set out the procedure to be followed from the pre scoping phase through to the Record of Decision.

Mr. R Garbett asked if they wished to appeal who the appeal should be directed to. Mr. W Lombaard confirmed that the appeal should be directed to the Minister of the Department of Environmental Affairs and Tourism. He landed out Background Information Documents and said if more information was required it should be requested.

Mr. W Lombaard explained the back ground to the previous process and indicated that Earthlife Africa had brought a court action against the PBMR process as the authorities had not given the public the opportunity in the final stages to comment. The court upheld Earthlife Africa's submission.

Ms C Garbett asked how Eskom had prepared without a demonstration plant and how the procedures were tested. Mr. W Lombaard explained how the components making up the PBMR were tested.

Ms. C Garbett asked who hears the submissions and judges if the process can proceed. Mr. W Lombaard indicated that it was the Minister of Environmental Affairs and Tourism. He asked Ms. C Garbett if their main interest was the fuel plant at Pelindaba. Ms Garbett indicated that Pelindaba was not their main interest, but that the whole PBMR aspect was of concern to them.

Mr. M Phalane asked which government department was responsible for the PBMR DPP. Mr. W Lombaard confirmed that it was the Department of Mineral and Energy, but that the DEAT was responsible for the EIA..

Mr. G Sayce asked how Pelindaba fits into the process. Mr. W Lombaard indicated that Pelindaba would manufacture the fuel pebbles.

Mr. G Sayce confirmed that his main area of concern was the impact that the process would have on the safety of Lanseria airport.

Mr. R Garbett said his concern was that if a nuclear related accident occurred no aircraft owner or property owner would be covered by insurance.

Mr. W Lombaard asked if they had lodged an appeal with the Minister regarding the Pelindaba Fuel plant. Ms. C Garbett confirmed that they had but had not received a response.

Mr. G Sayce said he was at the meeting as an observer and would report back to his board. Mr. W Lombaard suggested that they make contact with DEAT and update them regarding the insurance implications.

Mr. R Garbett expressed the view that the government would have to take responsibility for any insurance related claim not covered as a result of a nuclear related accident.

Mr. M Phalane said Earthlife Africa would take it further and would if necessary caucus the Minister of Environmental Affairs and Tourism.

Mr. G Sayce indicated that the flight path of aircraft arriving or leaving Pelindaba at present was over Pelindaba.

Mr. W Lombaard set out the time frames for the process. The scoping report to the authorities would be submitted in March 2006. Ms. C Garbett expressed the view that the process was very technical and the time available was not enough. Mr. W Lombaard said that if they wished to comment now it would be acceptable and their submission to DEAT could request more than 30 days to study the report. He said the draft Environmental Impact Report would be submitted for comment between June – July 2006. The final Impact Report would start in August 2006.

Ms C Garbett asked why the process was being rushed and where the public could participate? Mr. W Lombaard said the public would have an opportunity to submit issues. He said that exemptions for two issues had been applied for, namely alternative energy sources and not for alternative sites.

Mr. M Phalane said the government needs to make an effort to look at alternatives.

Mr. R Garbett asked if this EIA is for a demonstration model PBMR will a further EIA be required if the process goes beyond a demonstration model. Mr. W Lombaard confirmed that it would be the case.

Ms C Garbett asked why it could not be built at Vaalputs? Mr. W Lombaard replied that it needs water, and therefore needs to be built next to the coast or near a dam.

Mr. R Garbett asked why the demonstration model had to be so large? Mr. W Lombaard explained that it was necessary to prove the technology economics.

Mr. R Garbett asked if the PBMR in Germany was approximately the same size. This was confirmed by Mr. W Lombaard.

Ms C Garbett said the one in Germany had, had an accident. Mr. W Lombaard said he was unaware of it. It was agreed by Messrs R Garbett and M Phalane that a copy of the accident report would be supplied to Mr. W Lombaard

Mr. W Lombaard said he has a record of all nuclear accidents that have taken place but he has no record of any PBMR accident. He asked for the information to be supplied to him.

Mr. R Garbett stated that he would accept that Mr. W Lombaard would be balanced in terms of his approach to EIA.

Mr. W Lombaard stated that Dr D de Waal was due to have a meeting with Earthlife Africa in Cape Town and he would request him to take the issue of the PBMR accident up with them to obtain further information.

Ms C Garbett asked if South Africa imported uranium. Mr. W Lombaard confirmed that South Africa imported enriched uranium

Mr. M Phalane commented on the fact that there had been a visit to South Africa by Iranian Officials.

Ms C Garbett made the point that she believes the process is flawed because of the lack of independence of the consultants. Mr. W Lombaard said he had commented at one stage to DEAT that the applicant should pay money into a fund and the fund then pays for independent consultants.

Mr. R Garbett asked about the way forward. Mr. W Lombard spelt out the process to be followed. He said the draft minutes would be sent back for comment. He stated that it must be remembered that sensitive and private information of the applicant cannot be supplied to the general public. He made the comment that if there was something that was not in the public domain then one could apply for it to be made available in terms of the Access to Information Act.

Mr. R Garbett asked about the containment of the fuel. Mr. W Lombaard explained about the fuel and the reactor control process. He made mention of a small PBMR operating in China.

Mr. R Garbett asked how long the fuel balls would be contained. Mr. W Lombaard explained for 40 years at the reactor and this could be extended by another 40 years, effectively for the life of the plant.

Mr. M Phalane said if the German company holds the patent what protection would the tax payers of South Africa have that the Germans wont withdraw the patent.

Ms C Garbett asked if we export PBMR technology who must take back the used fuel? Mr. W Lombaard said it should be remembered that Eskom is the client and that the PBMR company holds the license.

Mr. K Nair said it must be remembered that Eskom does not develop technology. He said that various technologies were being tested by Eskom including wind.

Ms C Garbett asked why Eskom does not try other forms of technology and “drop” nuclear. Mr. W Lombaard asked that everything be checked carefully in the scoping report and if any of the issues that have been mentioned are not recorded to please add. He also said that at some point in the process the PBMR Company would have to transfer capacity to Eskom .

CLOSURE

Mr. R Garbett asked if there were any other questions or issues. Mr. R Garbett thanked everyone for coming and thanked Mr. W Lombaard for the balanced and professional manner in which he had presented the presentation and answered issues and questions in an informative way.

The meeting closed at 17h30.

ATTENDANCE REGISTER

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8.4.3 WESSA NGO ENVIRONMENTAL FORUM FOCUS GROUP

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 400 MW(t) PBMR DPP AT KOEBERG NPS SITE IN THE WESTERN CAPE

DATE: 2 DECEMBER 2005

TIME: 10:00

VENUE: WILDLIFE AND ENVIRONMENTAL SOCIETY OF SOUTH AFRICA – JHB OFFICES FOCUS GROUP MEETING: NGO ENVIRONMENTAL FORUM

DRAFT MINUTES

WELCOME AND INTRODUCTION

Mawatsan received an opportunity for a presentation in a NGO Forum meeting that had been organised by WESSA and various other NGO environmental organizations.

Ms. Carla Hudson introduced Dr D de Waal and Ian MacFadyen to the attendees. She then requested Dr D de Waal to present his presentation regarding the PBMR.

PRESENTATION

Dr D de Waal explained the EIA process. He confirmed that we have had public meetings and identified where they had taken place. The meeting was informed that Focus Group Meetings were in the process of taking place and this was one of them. It was confirmed that two exemptions had been applied for from DEAT. The one exemption was the need to identify alternative energy sources and the other was for the public participation process to identify alternative sites i.e. Thyspunt and Bantamsklip. Once the presentation had been completed Dr D de Waal asked if there were any questions or comments.

DISCUSSION

An attendee asked how the waste would be dealt with. Dr D de Waal replied that the spent fuel would be stored at Koeberg for a period of 40 years and this could if necessary be extended for another 40 years. He commented that certain low level waste would be transported to Vaalputs and stored there. He explained the role of DEAT and certain other government departments in the process.

An attendee asked what the energy requirement and waste production per kilogram would be. Dr D de Waal stated 165 KW per day. He said additional information would be available in the scoping report.

An attendee asked how other technologies were being assessed. Dr D de Waal indicated that Eskom was in the processes of assessing a variety of technologies, wind and gas being amongst them. He said that the issue would be dealt with in more detail in the information document that was in the process of being developed. He added further that one of the arguments being presented was why the same amount of money was not being spent on other forms of technology. He explained that the different forms of technology were at different levels of development.

Attendee asked if the process was totally "locked" into the use of uranium or was their potential to use other forms of fuel.

Dr D de Waal responded by saying that at this stage the focus was on the use of uranium. He explained that it must be remembered that the proposed reactor was not a commercial reactor. Should the technology prove viable it would only become commercial around 2015.

Ms C Hudson asked if the proposed PBMR was to be the only one or one of many. Dr D de Waal said if the technology proved economically viable it would be one of many.

MS I Waidje said there could be a potential problem from a neurological point of view with the accumulation of uranium in the body as a chemical.

Dr D de Waal said a response would be formulated and he would come back to her.

Mr Caveney asked about the transport of the fuel and the potential for environmental pollution. Dr D de Waal explained where the fuel would come from, its transportation to Pelindaba and its subsequent move to Koeberg.

Ms. C Hudson asked if there were any further questions and then adjourned the meeting.

CONCLUSION

Ms. C Hudson thanked Dr D de Waal for his presentation. Dr D de Waal distributed BID's to the attendees and left additional copies with Ms. C Hudson.

ATTENDANCE REGISTER WESSA NGO FORUM

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8.4.4 DEPARTMENT OF MINERALS AND ENERGY - FOCUS GROUP

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 400MW(t) PBMR DPP AT KOEBERG NPS SITE IN THE WESTERN CAPE

Date: 11 January 2006

Time: 09h00

Venue: DME offices-Pretoria

WELCOME

Mr. W A Lombaard thanks the DME officials for their time and willingness to attend a meeting.

OVERVIEW OF THE EIA PROCESS

Mr. Lombaard gives the meeting an overview of the EIA process followed, as well as of the issues raised by I&APs to date. The presentation used at the public meetings is used as the basis for this overview. Mr. Maqubella of the DME thanks Mr. Lombaard for the overview.

WASTE MANAGEMENT PROCESS FOR SPENT FUELS.

Mr. Maqubella informs the consultants that DME will in communication with the NNR determine the requirements for the management of the spent fuel at the PBMR DPP, and that these requirements will form part of the licence requirements of the said plant.

APPROVAL OF THE PBMR DPP SAFETY CASE.

In response to a question from the consultants on the process to approve the safety case of the proposed PBMR DPP Mr. Maqubella responds that this is a phased and protracted process. The process should be sufficiently advanced at the submission of the EIR to the authorities to enable the NRR to support the DEAT in their decision making process.

DETAILED FEASIBILITY REPORT.

The consultants put forward their approach to this issue raised by I&APs. In terms of this approach the consultants view the detailed feasibility of the proposed PBMR DPP as part of the strategic issues related to the proposed plant that falls outside of the EIA for the demonstration plant and that this issue will only be noted but not assessed by the consultants in the EIR. Mr. Maqubella agrees with the approach and states that the consultants have to focus on the demonstration plant and its associated site specific environmental impacts. Feasibility will be handled as part of the decision to apply the PBMR technology as generating technology at a later stage. This consideration will be done by DME, NRR, DEAT, ESKOM and Government at the stage where a decision has to be taken to commercialise the PBMR technology.

FINANCIAL PROVISIONS.

Mr. Maqubella states that the applicant (ESKOM) accepts liabilities related to financial provisions associated with the proposed PBMR DPP upon hot commissioning of the proposed plant. A statement on the provisions made for long term management and custodianship of radio active waste and spent fuel should be included EIR.

GOVERNMENT SUPPORT.

The officials of the DME state that although the proposed PBMR DPP is supported by the government it is not a given that approval shall be granted for the construction of the demonstration plant. All requirements for licensing and approval must be complied with. This statement follows from an issue raised by I&APs that it appears that the PBMR DPP will receive approval irrespective of the outcome of the EIR and other approval processes.

LOCAL SKILLS.

DME officials expressed the requirement that the EIR must assess the level of local skills to maintain and operate the proposed PBMR DPP, as well as the skills development process to be put in place by ESKOM to develop adequate local skills.

HELIUM SUPPLY.

Mr. Maqubella expressed the requirement that the EIR should assess the supply of adequate helium resources for the proposed PBMR DPP.

ATTENDANCES REGISTER.

An attendance register was circulated. The register is attached.

NAME AND SURNAME	ORGANISATION	POSTAL ADDRESS	CONTACT DETAILS	
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8.4.5 VAALPUTS PUBLIC SAFETY FORUM - FOCUS GROUP

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 400MW(t) PBMR DPP AT KOEBERG NPS SITE IN THE WESTERN CAPE

Date: 1 February 2006

Time: 10h00

Venue: Vaalputs , Northern Cape**:** Garing Conference Room

WELCOME AND INTRODUCTION

The Mawatsan Team were invited to make a short presentation at the Vaalputs Public Safety Forum meeting. This meeting had been arranged by NECSA, and included representatives from a variety of communities. When reaching the appropriate item on the agenda, Mr. Lombaard made the following presentation.

PRESENTATION

EIA PROCESS - MR. LOMBAARD

Mr. Lombaard described the EIA process to be followed for the new application for the 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant. He said that the construction, commissioning, operation, maintenance and decommissioning of the demonstration plant all form part of this EIA process.

Mr. Lombaard specified that the EIA application is lodged in terms of the old and not the new regulations. The application would be submitted to the national Department of Environmental Affairs and Tourism. The Western Cape Environmental Affairs Department would be the commenting authority. He said that exemption for the public participation process on the site alternatives was being considered.

He said that the Public Participation Process aimed to inform I&APs of the progress made to date on the EIA, to confirm their details and register any new I&APs. He said that background information documents were made available at the meeting. He indicated that additional information could be obtained from the website, at the public meeting and focus group meetings. He said that newspaper advertisements were placed in the several newspapers and that public meetings were held in several of the major centres.

Mr. Lombaard said that provisional issues had been identified for investigation. These form part of the specialist studies that emanated from the previous process. However new issues that may need to be addressed could also be raised. He said that the issues included technical issues, biophysical issues, social impacts and economic impacts.

Mr. Lombaard indicated that a formal cooperative governance framework between DEAT and the NNR was developed. He highlighted that the NNR is still the responsible authority on nuclear safety issues. Such issues however will be identified as part of the EIA.

Mr. Lombaard gave a description of the category of issues and how these would be handled by each authority – please refer to the attached presentation. Mr. Lombaard indicated that it is important to take note that the EIA process could be concluded before the NNR makes a decision in terms of its nuclear licensing process. However, all issues that pertain to the NNR decision making process would be identified in the EIA.

ELECTRICITY DEMAND AND SUPPLY - MR. LOMBAARD

Mr Lombaard then continued with a brief presentation on the electricity demand and supply status in South Africa. He said that the electricity demand is increasing steadily, both the total amount of electricity used each year as well as the peak demand required each day and specifically in the winter periods. He stated that coal power stations are the main source of electricity and that they are situated close to the source of coal which keeps the transportation costs as low as possible. Eskom's energy mix also includes pumped storage schemes, nuclear power generation at Koeberg, two small kerosene-fuelled gas turbines and hydro electricity generation.

He said that the current Eskom net generation capacity, excluding the imported electricity, is about 36 400 MW and that the 2007 peak demand will exceed the current net generation plus the normal reserve margin capacity. New new generation capacity will be necessary immediately, to cater for the growing demand, and later (after 2020) to also cater for the replacement of older power stations when it is no longer economically viable to operate such stations.

Mr. Lombaard emphasised that the primary energy sources available in South Africa for electricity generation are coal and uranium. He noted that importing gas or oil is possible but expensive. He said that renewable energy sources, especially ones with high potential in South Africa, such as solar, are being investigated. He said that different energy sources are been considered and that several pilot projects are planned or are underway. He said that a hybrid of the energy sources would probably be the most suitable way to cater for the demand for electricity in South Africa. He stated that this public meeting forms part of the Environmental Impact Assessment for the proposed 400 MW(t) PBMR Demonstration Power Plant (DPP).

OVERVIEW OF THE PROPOSED PBMR DPP - MR. LOMBAARD

Mr. Lombaard gave a brief overview of the proposed PBMR DPP. He said that it is a small power station that would generate 165 MW. He said that it is a high temperature design, which makes it more efficient. Furthermore it makes use of Helium gas to remove the heat from the nuclear fuel – the hot helium gas then drives the turbine. He said that the PBMR is graphite moderated, which slows the neutrons that target the uranium atoms. He explained that the resulting nuclear reaction produces heat energy, which then through the turbo-generator is converted into electrical energy. He said that the design is called Pebble Bed because the fuel is in a spherical shape like a pebble. Very small particles of uranium dioxide, each about the size of a sugar grain, are coated with layers of silicon carbide and pyrolitic carbon. These particles are embedded in graphite to form a fuel sphere or pebble about the size of a tennis ball. He explained that approximately 400 000 pebbles are needed in such a power plant.

Mr. Lombaard described the principles of generating electricity from a thermal (heat) source. Heat can be obtained from burning wood, coal, oil etc. This heat in turn is used to boil water and create steam. The steam is used to turn a turbine which turns a generator. The generator consists of copper wires and a magnetic field. When copper wires turn inside a magnetic field, electricity flows through the copper wires. Instead of boiling water and creating steam, one can also heat a gas and use the hot gas to drive the turbine. He said that in the PBMR design the heat is produced by the nuclear reaction in the uranium in the pebble fuel. The heat is removed by the helium gas which then drives the gas turbine. The turbine causes the generator to turn and generate electricity.

DISCUSSION

An attendee enquired when the process would be finalised. Mr. Lombard explained that it depends upon the EIA process and the various government decisions, but anticipated that the EIA process would-be completed towards the last quarter of the year 2006.

Me. E Groeners wanted to know why not build another Koeberg type rector and what the difference was between the Koeberg rector and the proposed PBMR DPP. Mr. Lombaard explained that whilst both utilised a nuclear reaction as the heat source, the designs were substantially different. The fuels are different, the designs are different. Different gases are used as the driving mechanisms, (Water in the case of Koeberg and Helium in the case of the PBMR). Koeberg requires active safety and operational control while the PBMR is designed to according to passive control precipices. The sizes of the reactors are also different, with Koeberg substantially larger than the PBMR DPP.

An attended enquired as to how many of these reactors Eskom intends building. Dr de Waal responded that they are uncertain, as they are only involved in the demonstration PBMR DPP. It could however be expected that, if the studies and demonstrations are successful, that there would be an intention by Eskom to build more of the reactor –either locally or for export.

CONCLUSION

Mr Lombaard presented a CD copy of the draft scoping report and thanked the chairperson for the opportunity.

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3. A CAROLISSEN	Necsa, PELINDABA
4. BW CORNELISSEN	DTEC SPRINGBOK
5. C BEYLEVELD	Necsa, PELINDABA
6. C BRANDT	NOURIVIER
7. C CLOETE	GARIES
8. C CLOETE	TWEERIVIER ONTWIKKELINGS FORUM
9. CD CLOETE	SAPS GARIES
10. D DE WAAL	MAWATSAN
11. D KGOMO	DME
12. D KORDOM	KAMIESKROON
13. E CLAASEN	PAULSHOEK - ONDERVOORSITTER
14. E GROENERS	DTEC KIMBERLEY
15. E STEENKAMP	SOEBATSFONTEIN
16. G BINAS	KLIPFONTEIN ONTIKKELINGS FORUM
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19. G S WOLFAARDT	SAPD NOODDIENSTE
20. J BEUKES	KAMASIES
21. J BRAND	ROOIFONTEIN
22. J CLOETE	KHEIS
23. J JOOSTE	LEKIEFONTEIN
24. J KRIEL	LELIEFONTEIN
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ATTENDEE	ORGANISATION
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27. J STUURMAN	CDW – INKDM - WKPA
28. K STUURMAN	NAALWERKPROJEK
29. M BRANDT	ROOIFONTEIN
30. M CLOETE	HONDEKLIPBAAI
31. M MOSTERT	NECSA SEKURITEIT
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40. S JOSEPH	NOURIVIER
41. S VAN NIEKERK	NUWEFONTEIN PRIM - KLIPRAND
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44. W LOMBAARD	MAWATSAN
45. Y OORTMAN	KLIPRAND

8.5 APPENDIX 5: MINUTES OF PUBLIC MEETINGS

8.5.1 MILNERTON PUBLIC MEETING

Milnerton Sports Club 9 November 2005 18:30

Environmental Impact Assessment for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) on the Koeberg Power Station site in the Western Cape[6]

WELCOME

Dr. de Waal welcomed the attendees and introduced the project team. No apologies were received. The agenda was read and approved.

PURPOSE OF THE MEETING

Dr. de Waal stated that the purpose of the meeting was to provide interested and affected parties with information on the proposed project, as well as on the previous Environmental Impact Assessment (EIA) process and thereby provide an information base for this project. Dr. de Waal said that this was the start of the scoping process and that I&APs should ensure that their details are registered with Mawatsan. This is to ensure that the I&APs are kept informed on the progress of the process. He emphasised that this public participation process forms part of a new application to the relevant departments. Dr. de Waal enquired whether all attendees are English speaking. No members of the audience indicated that an alternative language would be required during the communication. He then introduced Mr. Tony Stott.

PRESENTATION ON THE ELECTRICITY DEMAND AND SUPPLY IN SOUTH AFRICA

Mr. Stott gave a presentation on the electricity demand and supply status in South Africa. He said that Eskom generates approximately 95% of South Africa's power. The remaining 5% is generated by large corporations such as Sappi, Sasol and Municipalities such as the City of Johannesburg, City of Tshwane and the City of Cape Town.

He said that the electricity demand is increasing steadily, both the total amount of electricity used each year as well as the peak demand required each day and specifically in the winter periods. He stated that coal power stations are the main source of electricity and that they are situated close to the source of coal which keeps the

[6] Note: This is not a verbatim reflection of the meeting, but an attempt to reflect the presentations and discussion session in a clear and concise manner.

transportation costs as low as possible. Eskom's energy mix also includes pumped storage schemes, nuclear power generation at Koeberg, two small kerosene-fuelled gas turbines and hydro-electricity generation.

He said that the current Eskom net generation capacity, excluding the imported electricity, is about 36 400 MW. Mr. Stott went on to say that the 2007 peak demand will exceed the current net generation plus the normal reserve margin capacity. He said that it is assumed that power stations would last for 50 years and that new generation capacity will be necessary, to cater for the growing demand, and later (after 2020) to also cater for the replacement of older power stations when it is no longer economically viable to operate such stations.

He said that the Department of Minerals and Energy is responsible for integrated energy planning and that the National Electricity Regulator develops the National Integrated Resource Plan for long term planning of electricity generating options. Eskom also plans for future generation options through a process called Integrated Strategic Electricity Planning.

Mr Stott emphasised that the primary energy sources available in South Africa for electricity generation are coal and uranium. He noted that importing gas or oil is possible but expensive. He said that renewable energy sources, especially ones with high potential in South Africa, such as solar, are being investigated.

Mr. Stott said that Eskom had several initiatives that promote awareness on energy efficiency on a commercial and an industrial level. He indicated that the National Electricity Regulator set an objective of a 152 MW saving for 2004, and that 197 MW was saved. He said that even with such initiatives – more electricity generating capacity would be needed.

Regarding new electricity generating capacity, Mr. Stott said that several technologies for producing cleaner power using coal are being explored. These include a pilot underground coal gasification project. A solar pilot project is being planned, that could produce 100 MW. Similarly, wind generation is also under investigation. He said that the option also exists to import electricity from Southern African countries, such as the DRC. These however were challenging due to the long (~ 4000 km. from DRC) transmissions lines that would be required. Mr. Stott said that on the nuclear side, the PBMR technology is being investigated. The PBMR plant at Koeberg would be a demonstration plant.

Mr. Stott summarised that the need to expand on the availability of current electricity generating capacity exists. He said that different energy sources are been considered and that several pilot projects are planned or are underway. He said that a hybrid of the energy sources would probably be the most suitable way to cater for the demand for electricity in South Africa. He concluded in saying that Environmental Impact Assessments are being conducted for Open Cycle Gas Turbine projects, pumped storage schemes, a new coal-fired power station, and a solar thermal plant. He stated that this public meeting forms part of the Environmental Impact Assessment for the proposed 400 MW(t) PBMR Demonstration Power Plant (DPP).

After concluding the presentation on the electricity demand and supply in South Africa, Mr. Stott gave a presentation on the background to the PBMR EIA, the previous EIA process and the court case that followed.

Mr. Stott gave a brief overview of the proposed PBMR DPP. He said that it is a small power station that would generate 165 MW. He said that it is a high temperature design, which makes it more efficient. Furthermore it makes use of Helium gas to remove the heat from the nuclear fuel – the hot helium gas then drives the turbine. He said that the PBMR is graphite moderated, which slows the neutrons that target the uranium atoms. He explained that the resulting nuclear reaction produces heat energy, which then through the turbo-generator is converted into electrical energy. He said that the design is called Pebble Bed because the fuel is in a spherical shape like a pebble. Very small particles of uranium dioxide, each about the size of a sugar grain, are coated with layers of silicon carbide and pyrolitic carbon. These particles are embedded in graphite to form a fuel sphere or pebble about the size of a tennis ball. He explained that approximately 400 000 pebbles are needed in such a power plant.

Mr Stott briefly described the principles of generating electricity from a thermal (heat) source. Heat can be obtained from burning wood, coal, oil etc. This heat in turn is used to boil water and create steam. The steam is used to turn a turbine which turns a generator. The generator consists of copper wires and a magnetic field. When copper wires turn inside a magnetic field, electricity flows through the copper wires. Instead of boiling water and creating steam, one can also heat a gas and use the hot gas to drive the turbine. He said that in the PBMR design the heat is produced by the nuclear reaction in the uranium in the pebble fuel. The heat is removed by the helium gas which then drives the gas turbine. The turbine causes the generator to turn and generate electricity.

In terms of the previous EIA process for the 302 MW(t) design of the PBMR, Mr. Stott said that the final EIR was submitted in June 2000, where after the Department of Environmental Affairs and Tourism (DEAT) Director-General issued the applicant (Eskom) with a positive Record of Decision (ROD). In January 2005 the RoD was set aside by the Cape High Court on the basis that interested and affected parties (I&APs) had not been given an opportunity to comment on the final EIR directly to the Director-General. The Cape High Court ordered the Director-General to provide I&APs a further comment period, and to consider such submissions before making a decision anew on the EIA. Mr. Stott indicated that the judgment is available on the website. He said that the RoD was not overturned as a result of a flawed EIA, but that an augmented commenting period was required on the Final EIR.

Mr Stott said that the design of the PBMR DPP had evolved since the EIR was submitted. The power output of 302 MW(t) that was proposed in the previous process had changed to 400 MW(t) and the turbine design is now horizontal instead of vertical .In addition the footprint of the building is also slightly larger. He concluded in saying that the changes warranted a new application to be lodged.

Dr. de Waal thanked Mr. Stott for his presentation and requested that questions be kept for after the presentation to be made by Mr. Lombaard on the EIA process to be followed.

EIA PROCESS

Dr de Waal described the EIA process to be followed for the new application for the 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant. He said that the construction, commissioning, operation, maintenance and decommissioning of the demonstration plant all form part of this EIA process.

Dr de Waal specified that the EIA application is lodged in terms of the old and not the new regulations. The application would be submitted to the national Department of Environmental Affairs and Tourism. The Western Cape Environmental Affairs Department would be the commenting authority. He said that exemption for the public participation process on the site alternatives was being considered.

He said that the Public Participation Process aimed to inform I&APs of the progress made to date on the EIA, to confirm their details and register any new I&APs. He said that background information documents were made available at the meeting. He indicated that additional information could be obtained from the website, at the public meeting and focus group meetings. He said that newspaper advertisements were placed in the several newspapers and that public meetings were held in several of the major centres.

Dr de Waal said that provisional issues had been identified for investigation. These form part of the specialist studies that emanated from the previous process. However new issues that may need to be addressed could also be raised. He said that the issues included technical issues, biophysical issues, social impacts and economic impacts.

Dr de Waal indicated that a draft scoping report would be made available for a period of 30 days for public comment and that a final scoping report including the comments received would be sent to the authorities thereafter. He said that notification of the IER would be sent to all I&APs, and that comments on the EIR would go to DEAT.

Dr de Waal indicated that a formal cooperative governance framework between DEAT and the NNR was developed. He, however highlighted that the NNR is still the responsible authority on nuclear safety issues. Such issues however will be identified as part of the EIA. Dr de Waal gave a description of the category of issues and how these would be handled by each authority.

Dr de Waal indicated that the EIA process could be concluded before the NNR makes a decision in terms of its nuclear licence process. However, all issues that pertain to the NNR decision making process would be identified in the EIA.

DISCUSSION

How long will the RSA coal reserves last? Mr. Stott indicated that the average estimate is that the coal reserves will last for 100 years due to the increased cost of coal mining.

Where the mothballing of Eskom's closed down power stations subject to an EIA? Mr. Stott replied that as part of the mothballing process, an application was made to DEAT and authorization obtained.

The question was raised whether the emissions of the coal power stations are conforming satisfactorily to legislation? It was indicated that the coal power stations does confirm. Various emission reduction technologies have been introduced (e.g. Fabric filters, sulphur injections, etc.) to maintain Registration certificates limits.

A participant asked if consumer behaviour and moderation are factored into Eskom's future anticipated growth scenarios. Mr. Stott replied that this was indeed the case.

There was a request for a cost comparison between the various supply technologies. Mr. Stott indicated the following cost comparison:

- Coal cost about $1200/kWh.
- Nuclear about $1500 – 2000/kWh.
- Solar about $20 000/kWh.

A participant asked if consumer behaviour and moderation are factored into Eskom's future anticipated growth scenarios. Mr. Stott replied that this was indeed the case.

In reply to a question on how the costs for the various technologies are calculated, Mr. Stott indicated that the life cycle costing approach is applied.

A participant enquired whether it would not be feasible for the RSA to consider the reduction of the supply voltage since this could lead to substantial generation savings. Mr. Harris from Eskom commented that the suggestion is not feasible since the output of a station is not related to the voltage system. Implementing such a system will incur huge cost without any benefit.

The question was raised as to what energy losses are experienced during transmission and whether Eskom exports electricity? Mr. Stott indicated that the RSA uses an integrated transmission network to ensure quality and reliability of supply. Given the long distances of transmission the losses can be up to 7%. In addition, Mr. Stott stated that in 2004 about 16 000 GWh was exported and 14 00 GWh was imported.

A participant asked on what the basis electricity growth scenarios were based and also enquired whether it makes provision for inherent growth due to new entrances to the market?

Mr. Stott replied that the scenarios make provision for inherent growth as well as for new entrants. Thirty (30) years ago only 50% of the population had access to electricity. By

2012 Eskom aims to raise the figure to 100%. Mr. Stott also indicated that the split between industrial and domestic is about 80%: 20%.

There was a suggestion that Eskom should consider the supply of electricity to local communities on a direct basis rather than off the grid? Mr. Stott responded that Eskom is in support of off-grid supply of electricity and furthermore is considering this option via various renewable technologies as well as the affordability of these options

There was a question on why did Eskom increase the output of the PBMR from 110 MW(e) to 165 MW(e). Mr. McGowan responded that the current design evolved from analysis made by PBMR Limited into international requirements for power generating plants. Internationally generation plants are connected to supply grids in 300 MW(e) or 600 MW(e) units. This relates to the proposed 400 MW(t) output. Furthermore the PBMR Limited design team, with inputs from international companies such as Mitsubishi, concluded that a horizontal turbine/generator is more appropriate than a vertical design.

Earthlife Africa (ELA) stated that the economical Feasibility Study and Business Plan for the PBMR were not available to I&APs in the previous EIA. Will it be available in this EIA, together with other information which Earthlife Africa wishes to study in order to meaningfully participate in the EIA? Mr. McGowan stated that the first Business Plan of the PBMR (Pty) Ltd was an over estimation of the market potential of the plant, given the design at that stage and therefore not feasible. The current Business plan is seen as more realistic and feasible.

A viewpoint was raised that a review period of 30 days for the Scoping Report is too short and 45 calendar days is more appropriate, given the mass of information that the I&APs need to work through. Dr D de Waal responded that the review period for the draft scoping reports will be 30 calendar days and that this will afford I&APs sufficient time to comment on the document. He however noted the request for longer review time

A participant asked how the current EIA address would address nuclear safety issues, seen in the light of the Cape High Court Ruling directing that the DG for Environment Affairs could not abdicate his responsibility in this regard to the DG of DME?

Dr de Waal responded that the DEAT and the NNR have reached an agreement on how radiological and nuclear safety issues will be dealt with within the EIA. This agreement will form part of the Draft Scoping Report

ELA indicated that:

- They and the public will require timely information in generally and on safety issues in order to participate in the EIA and to make decisions.
- The EIA cannot direct or address policy issues e.g. nuclear waste policy given the EIA's status.

- ELA requests focus groups meetings to discuss and debate specialist issues and reports.

Dr de Waal stated that the comments are noted and the participation of the ELA will be accommodated within the EIA process

It was asked whether magnetic radiation (EMR) from power lines form part of the EIA. Mr. Stott responded that the new lines that will link the PBMR to the National grid will transect Eskom property only. These lines will be about 700 meters in length. EMR will be within the prescribed limits of the ACT and will not form part of the EIA.

There was a question on whether the property of 150 hectare near the N7 road and Melkbosstrand, which was bought 12 years ago for an electricity substation, is linked to the PBMR? Mr. Stott indicated that there is no link between the projects.

It was stated that certain persons have contracted cancer while in the employment of Eskom and that Eskom is allegedly withholding medical records from such employees at Koeberg. Can Eskom be trusted? Mr. Stott stated that employees' rights with regard to their medical status are strictly respected and they have full access thereto. He further said that it is equally important for Eskom to know the medical status of employees to exercise the diligence and safeguards with regard to employees' health. No employee at Koeberg or member of the public, have contracted cancer as a result of Koeberg's operation.

ELA requested where they can make input into the process of alternatives? They stated that it would appear that the NO-GO alternative is the only option given the demonstration nature of the project. Mr Stott responded that alternatives were considered in the previous EIA and Koeberg NPS site was found to be best suited for the demonstration module PBMR. The NO-GO option will be addressed in the scoping report. Dr de Waal stated that ELA is welcome to submit their comments with regard to alternatives and that this issue will also be addressed in the scoping report.

ELA indicated that the viewpoint that the issues of health, safety and alternatives were poorly addressed in the previous EIA. Dr de Waal said that the viewpoint is noted.

A participant asked what the purpose of the project was. Mr. T McGowan responded that the project is for the establishment of a life cycle demonstration plant that needs to confirm the integration of the various technology components of the plant in an efficient and cost effective manner.

It was also asked why Eskom choose dangerous and potentially harmful technologies for demonstration, and what would happen if the PBMR is not feasible? Mr. Stott replied that Eskom is pursuing various other technologies for demonstration. However if the PBMR is not feasible it will be decommissioned and dismantled.

A participant asked what responsibility Eskom will take if things go wrong with the PBMR? Mr. Stott replied that Eskom is and remains responsible for all of its power stations, which will include the PBMR.

ELA requested access to the economic feasibility studies that have been conducted for the PBMR. Dr de Waal replied that ELA's request is noted, but that the feasibility report falls outside of the scope of this EIA.

ELA also asked what the commercial relationship between Eskom and the PBMR is. They said it appears that public funds are used to develop a commercial product for a private company? They also asked why Eskom is paying for the EIA? Mr. Stott responded that Eskom is a shareholder in the PBMR Company and furthermore also funds the EIAs for all of its other demonstration projects.

A participant stated that in the previous EIA, health and epidemiological studies were of a desktop nature and that this EIA needed more information on this aspect. Dr de Waal replied that Epidemiological studies are not feasible nor a prerequisite for the EIA, due to a number of reasons. The EIA thus have to be guided by international experience, results and findings, which will again be assessed within the EIR.

A participant indicated that the PBMR is a safe, clean and cost-effective technology and must be promoted. There is a concern that the EIA studies and authorizations are taking too long and thereby erodes South Africa's competitive advantages as a supplier technology to international markets. Dr de Waal replied by stating that due process must be followed, but that the concern is noted.

A question was asked on how would non-English speaking persons be accommodated in the EIA process? Dr de Waal responded that although the documentation is mostly in English, the consultants will endeavour to address this issue on request.

It was stated that scoping documents cannot be reviewed during holiday periods and needs to be available in public libraries other than Tableview. Dr de Waal stated that holiday periods does not count for review time although the draft Scoping Report may be out before year-end. The documents will be placed in various public libraries around Cape Town and Koeberg residential areas.

A participant stated that economics is a core issue in the debate and asked how does Eskom track the economics of other new or emerging technologies? Mr Stott stated that there is an energy committee that specifically looks/tracks emerging technologies and their economics.

It was requested if any construction of the PBMR have been started at Koeberg yet? Mr. Stott replied that no construction activities for the PBMR have been started at Koeberg. Such activity will only start when all of the required authorizations have been obtained.

CLOSURE

Dr. de Waal thanked all the attendees and said that the minutes would be distributed in due time. He said that I&APs should ensure that their details are on the attendance registers in order to allow us to keep them informed. The meeting closed at 20:50.

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8.5.2 ATLANTIS PUBLIC MEETING

Atlantis Beestekraal Community Hall 10 November 2005 18:30 – 20:20

. Environmental Impact Assessment for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) on the Koeberg Power Station site in the Western Cape

WELCOME

Dr. de Waal welcomed the attendees and introduced the project team. No apologies were received. The agenda was read and approved.

PURPOSE OF THE MEETING

Dr. de Waal stated that the purpose of the meeting was to provide interested and affected parties with information on the proposed project, as well as on the previous Environmental Impact Assessment (EIA) process and thereby provide an information base for this project. Dr. de Waal said that this was the start of the scoping process and that I&APs should ensure that their details are registered with Mawatsan. This is to ensure that the I&APs are kept informed on the progress of the process. He emphasised that this public participation process forms part of a new application to the relevant departments. Dr. de Waal enquired whether all attendees are English speaking. No members of the audience indicated that an alternative language would be required during the communication. He then introduced Mr. Tony Stott.

PRESENTATION ON THE ELECTRICITY DEMAND AND SUPPLY IN SOUTH AFRICA

Mr. Stott gave a presentation on the electricity demand and supply status in South Africa. He said that Eskom generates approximately 95% of South Africa's power. The remaining 5% is generated by large corporations such as Sappi, Sasol and Municipalities such as the City of Johannesburg, City of Tshwane and the City of Cape Town.

He said that the electricity demand is increasing steadily, both the total amount of electricity used each year as well as the peak demand required each day and specifically in the winter periods. He stated that coal power stations are the main source of electricity and that they are situated close to the source of coal which keeps the transportation costs as low as possible. Eskom's energy mix also includes pumped storage schemes, nuclear power generation at Koeberg, two small kerosene-fuelled gas turbines and hydro-electricity generation.

He said that the current Eskom net generation capacity, excluding the imported electricity, is about 36 400 MW. Mr. Stott went on to say that the 2007 peak demand will exceed the current net generation plus the normal reserve margin capacity. He said that it is assumed that power stations would last for 50 years and that new generation capacity will be necessary, to cater for the growing demand, and later (after 2020) to also cater for the replacement of older power stations when it is no longer economically viable to operate such stations.

He said that the Department of Minerals and Energy is responsible for integrated energy planning and that the National Electricity Regulator develops the National Integrated Resource Plan for long term planning of electricity generating options. Eskom also plans for future generation options through a process called Integrated Strategic Electricity Planning.

Mr Stott emphasised that the primary energy sources available in South Africa for electricity generation are coal and uranium. He noted that importing gas or oil is possible but expensive. He said that renewable energy sources, especially ones with high potential in South Africa, such as solar, are being investigated.

Mr. Stott said that Eskom had several initiatives that promote awareness on energy efficiency on a commercial and an industrial level. He indicated that the National Electricity Regulator set an objective of a 152 MW saving for 2004, and that 197 MW was saved. He said that even with such initiatives – more electricity generating capacity would be needed.

Regarding new electricity generating capacity, Mr. Stott said that several technologies for producing cleaner power using coal are being explored. These include a pilot underground coal gasification project. A solar pilot project is being planned, that could produce 100 MW. Similarly, wind generation is also under investigation. He said that the option also exists to import electricity from Southern African countries, such as the DRC. These however were challenging due to the long (~ 4000 km. from DRC) transmissions lines that would be required. Mr. Stott said that on the nuclear side, the PBMR technology is being investigated. The PBMR plant at Koeberg would be a demonstration plant.

Mr. Stott summarised that the need to expand on the availability of current electricity generating capacity exists. He said that different energy sources are been considered and that several pilot projects are planned or are underway. He said that a hybrid of the energy sources would probably be the most suitable way to cater for the demand for electricity in South Africa. He concluded in saying that Environmental Impact Assessments are being conducted for Open Cycle Gas Turbine projects, pumped storage schemes, a new coal-fired power station, and a solar thermal plant. He stated that this public meeting forms part of the Environmental Impact Assessment for the proposed 400 MW(t) PBMR Demonstration Power Plant (DPP).

After concluding the presentation on the electricity demand and supply in South Africa, Mr. Stott gave a presentation on the background to the PBMR EIA, the previous EIA process and the court case that followed.

Mr. Stott gave a brief overview of the proposed PBMR DPP. He said that it is a small power station that would generate 165 MW. He said that it is a high temperature design, which makes it more efficient. Furthermore it makes use of Helium gas to remove the heat from the nuclear fuel – the hot helium gas then drives the turbine. He said that the PBMR is graphite moderated, which slows the neutrons that target the uranium atoms. He explained that the resulting nuclear reaction produces heat energy, which then through the turbo-generator is converted into electrical energy. He said that the design is called Pebble Bed because the fuel is in a spherical shape like a pebble. Very small particles of uranium dioxide, each about the size of a sugar grain, are coated with layers of silicon carbide and pyrolitic carbon. These particles are embedded in graphite to form a fuel sphere or pebble about the size of a tennis ball. He explained that approximately 400 000 pebbles are needed in such a power plant.

Mr Stott briefly described the principles of generating electricity from a thermal (heat) source. Heat can be obtained from burning wood, coal, oil etc. This heat in turn is used to boil water and create steam. The steam is used to turn a turbine which turns a generator. The generator consists of copper wires and a magnetic field. When copper wires turn inside a magnetic field, electricity flows through the copper wires. Instead of boiling water and creating steam, one can also heat a gas and use the hot gas to drive the turbine. He said that in the PBMR design the heat is produced by the nuclear reaction in the uranium in the pebble fuel. The heat is removed by the helium gas which then drives the gas turbine. The turbine causes the generator to turn and generate electricity.

In terms of the previous EIA process for the 302 MW(t) design of the PBMR, Mr. Stott said that the final EIR was submitted in June 2000, where after the Department of Environmental Affairs and Tourism (DEAT) Director-General issued the applicant (Eskom) with a positive Record of Decision (ROD). In January 2005 the RoD was set aside by the Cape High Court on the basis that interested and affected parties (I&APs) had not been given an opportunity to comment on the final EIR directly to the Director-General. The Cape High Court ordered the Director-General to provide I&APs a further comment period, and to consider such submissions before making a decision anew on the EIA. Mr. Stott indicated that the judgement is available on the website. He said that the RoD was not overturned as a result of a flawed EIA, but that an augmented commenting period was required on the Final EIR.

Mr Stott said that the design of the PBMR DPP had evolved since the EIR was submitted. The power output of 302 MW(t) that was proposed in the previous process had changed to 400 MW(t) and the turbine design is now horizontal instead of vertical .In addition the footprint of the building is also slightly larger. He concluded in saying that the changes warranted a new application to be lodged.

Dr. de Waal thanked Mr. Stott for his presentation and requested that questions be kept for after the presentation to be made by Mr. Lombaard on the EIA process to be followed.

EIA PROCESS

Dr de Waal described the EIA process to be followed for the new application for the 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant. He said that the construction, commissioning, operation, maintenance and decommissioning of the demonstration plant all form part of this EIA process.

Dr de Waal specified that the EIA application is lodged in terms of the old and not the new regulations. The application would be submitted to the national Department of Environmental Affairs and Tourism. The Western Cape Environmental Affairs Department would be the commenting authority. He said that exemption for the public participation process on the site alternatives was being considered.

He said that the Public Participation Process aimed to inform I&APs of the progress made to date on the EIA, to confirm their details and register any new I&APs. He said that background information documents were made available at the meeting. He indicated that additional information could be obtained from the website, at the public meeting and focus group meetings. He said that newspaper advertisements were placed in the several newspapers and that public meetings were held in several of the major centres.

Dr de Waal said that provisional issues had been identified for investigation. These form part of the specialist studies that emanated from the previous process. However new issues that may need to be addressed could also be raised. He said that the issues included technical issues, biophysical issues, social impacts and economic impacts.

Dr de Waal indicated that a draft scoping report would be made available for a period of 30 days for public comment and that a final scoping report including the comments received would be sent to the authorities thereafter. He said that notification of the IER would be sent to all I&APs, and that comments on the EIR would go to DEAT.

Dr de Waal indicated that a formal cooperative governance framework between DEAT and the NNR was developed. He, however highlighted that the NNR is still the responsible authority on nuclear safety issues. Such issues however will be identified as part of the EIA. Dr de Waal gave a description of the category of issues and how these would be handled by each authority.

Dr de Waal indicated that the EIA process could be concluded before the NNR makes a decision in terms of its nuclear licence process. However, all issues that pertain to the NNR decision making process would be identified in the EIA.

DISCUSSION

It was confirmed that Eskom has 20 years of experience with operation of the Koeberg Nuclear power station. It was then asked why it was necessary to change to an unproved design? Confirmation was given that Eskom is looking for smaller units that provides for incremental growth, short construction times, passive safety features and cost effectiveness. The PBMR is a proven technology that has been around since the late

1960's and the fact that units can be combined into a Nuclear Park also optimizes infrastructure and establishment and use.

Concern about the length of time involved in obtaining the required authorization was expressed, especially the EIA and this erodes the competitive advantage of the RSA design to market the plant internationally. The statement was noted without comment.

It was asked if nuclear standards, practices, and procedures were sufficiently demonstrated and maintained at Koeberg NPS? Mrs. Mentoor from the Atlantis community responded as fellows to the question " a delegation from the Atlantis community visited Koeberg on several occasions and learnt a great deal about the safety and operation of Koeberg. We are satisfied with the safety standards and practices, especially as far as it affects the community and its well being".

It was asked if the PBMR technology had been proven else where in the world? Mr. Stott confirmed that the technology had been tested in German Research reactor (10 MW(e)) for an extended period of 20 years. Further the Chinese are currently testing a similar type of reactor that has demonstrated the passive safety shut down capability of the technology. The RSA design is unique in its different feature components and the objective is to demonstrate the safety, efficiency and cost effectiveness of the integrated design.

An attendee inquired what the evacuation boundary for the PBMR was? Mr. Stott responded that it was 400m from the reactor building.

An attendee asked what the construction time and how many jobs would be created? Mr. Stott stated that the PBMR is a small plant (165MW(e) and the construction time would be from 2007 to 2010. During the construction phase between 400 to 500 people will be employed on site. Once operational only a small number of people will be needed (15-20) and these people will be trained by Eskom.

An attendee asked how the PBMR project would contribute to science and technology training the in the long term, especially with regard to support to schools? The applicant confirmed current supports school math and science programs and once the PBMR is a reality, Eskom will further expand their support on these subjects. Eskom already draws strongly on the skills base from Atlantis for maintenance work at Koeberg.

It was asked what would happen if there was accidental radio active release from PBMR and what contingencies are in place for Koeberg? It was alleged that Koeberg is not very safe and that the emergency plans are nor sufficient. Mrs De Villiers responded that monthly exercises and assessments Koeberg Emergency Plan (EP) and various scenarios are practiced on a proactive basis. Although Atlantis falls outside the emergency zone (16 km) radius it is included in the EP to ensure awareness and diligence from the community. Eskom maintains an open ended invitation to the members of the community to attend monthly forum meetings on these issues.

It was stated by the applicant that the fuel characteristics of the PBMR prevent a core melt down and consequently there is no need for an emergency plan. As long as Koeberg is operational a 60 km action zone (evacuation zone) will remain in force. However, the emergency and radio active addition of the PBMR will still fall within the Koeberg foot print and the evacuation zone will not enlarge of the consequence of the proposed PBMR DPP.

Once Koeberg is decommissioned the evacuation zone will come down to within the calculated distance from the PBMR plant. The world history of commercial Light Water Reactors for electricity generation, recorded no deaths, directly or indirectly related to such plants, over the past 40 years. The worst accident was at the Three Mile Island and the consequence to human life was zero.

It was inquired that how many carbon credits could PBMR earn? Mr. T Stott responded that Nuclear Power Stations cannot earn carbon credits.

Mrs. Mentoor urged and encouraged the Atlantis community/residents to attend the monthly nuclear safety meetings in Atlantis.

CLOSURE

Dr. de Waal thanked all the attendees and said that the minutes would be distributed in due time. He said that I&APs should ensure that their details are on the attendance registers in order to allow us to keep them informed.

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8.5.3 JOHANNESBURG PUBLIC MEETING

Eskom Convention Centre 15 November 2005 18:30

Environmental Impact Assessment for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) on the Koeberg Power Station site in the Western Cape[7]

WELCOME

Dr. de Waal welcomed the attendees and introduced the project team. No apologies were received. The agenda was read and approved.

PURPOSE OF THE MEETING

Dr. de Waal stated that the purpose of the meeting was to provide interested and affected parties with information on the proposed project, as well as on the previous Environmental Impact Assessment (EIA) process and thereby provide an information base for this project. Dr. de Waal said that this was the start of the scoping process and that I&APs should ensure that their details are registered with Mawatsan. This is to ensure that the I&APs are kept informed on the progress of the process. He emphasised that this public participation process forms part of a new application to the relevant departments. Dr. de Waal enquired whether all attendees are English speaking. No members of the audience indicated that an alternative language would be required during the communication. He then introduced Mr. Tony Stott.

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Mr. Stott gave a presentation on the electricity demand and supply status in South Africa. He said that Eskom generates approximately 95% of South Africa's power. The remaining 5% is generated by large corporations such as Sappi, Sasol and Municipalities such as the City of Johannesburg, City of Tshwane and the City of Cape Town.

He said that the electricity demand is increasing steadily, both the total amount of electricity used each year as well as the peak demand required each day and specifically in the winter periods. He stated that coal power stations are the main source of electricity and that they are situated close to the source of coal which keeps the transportation costs as low as possible. Eskom's energy mix also includes pumped storage

[7] Note: This is not a verbatim reflection of the meeting, but an attempt to reflect the presentations and discussion session in a clear and concise manner.

schemes, nuclear power generation at Koeberg, two small kerosene-fuelled gas turbines and hydro-electricity generation.

He said that the current Eskom net generation capacity, excluding the imported electricity, is about 36 400 MW. Mr. Stott went on to say that the 2007 peak demand will exceed the current net generation plus the normal reserve margin capacity. He said that it is assumed that power stations would last for 50 years and that new generation capacity will be necessary immediately, to cater for the growing demand, and later (after 2020) to also cater for the replacement of older power stations when it is no longer economically viable to operate such stations.

He said that the Department of Minerals and Energy is responsible for integrated energy planning and that the National Electricity Regulator develops the National Integrated Resource Plan for long term planning of electricity generating options. Eskom's also plans for future generation options through a process called Integrated Strategic Electricity Planning.

Mr Stott emphasised that the primary energy sources available in South Africa for electricity generation are coal and uranium. He noted that importing gas or oil is possible but expensive. He said that renewable energy sources, especially ones with high potential in South Africa, such as solar, are being investigated.

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Dr. de Waal thanked Mr. Stott for his presentation and requested that questions be kept for after the presentation to be made by Mr. Lombaard on the EIA process to be followed.

EIA PROCESS - MR. LOMBAARD

Mr. Lombaard described the EIA process to be followed for the new application for the 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant. He said that the construction, commissioning, operation, maintenance and decommissioning of the demonstration plant all form part of this EIA process.

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Mr. Lombaard indicated that it is important to take note that the EIA process could be concluded before the NNR makes a decision in terms of its nuclear licence process. However, all issues that pertain to the NNR decision making process would be identified in the EIA.

DISCUSSION

Mr. Mashile Phalane from Earthlife Africa, asked whether the EIA and the NNR processes would run in parallel. Dr. de Waal said that they would in principle run in parallel, however during consideration of the issues raised there would be cross references between the two processes.

Dr. van As said that the EIA process was rather confusing. He asked whether this EIA considers alternative energy forms, and whether impacts are compared. He asked whether the global impact is assessed as part of the EIA. He said that reference was made to cooperative governance, and asked whether integrated governance is necessary. He said that he understands that energy is necessary, but that energy with the least environmental impact should be used. Mr. Stott responded that all electricity generation methods need to undergo EIA's and that the environmental impacts specific to the location is explored. He said that the National Electricity Regulator conduct national studies and address issues such as global warming and the reduction of greenhouse gases. Dr. de Waal said that the EIA has a comparative framework for the cumulative impacts and that electricity protocols are determined by National Policy.

Mr. Barker said that a 30% increase in terms of generation is indicated. What effect does this have on the amount of material that would be necessary? How is the transport of material going to be handled and has alternative sites been properly evaluated? Dr. de Waal said that fuel transport forms part of a separate process. He indicated that fuel will need to be transported from Durban to Pelindaba and then to Koeberg and that this issue would be considered as part of the EIA. Dr de Waal responded that four sites have been considered as part of the process that started in 1999. He said that the factors that influenced the site selection process had remained the same and therefore does not need to be reassessed.

Mr. Phalane from Earthlife Africa asked what changes in technology took place during the design evolution and what impact it has on the fuel usage. He asked whether more pebbles would be used and whether the pebbles have been redesigned. He further asked whether an exhaustive assessment of alternatives has taken place. Dr. de Waal said that a variety of sources are used to provide electricity, but that this application does not include a comparative assessment to other sources of electricity generation. Mr. Terry McGowan said that there would be an increase in fuel caused by the increase in capacity, and that a higher output of fuel would inevitably cause a higher need for fuel. Mr. McGowan He said that the fuel used is the same as what would have been used in the previous process and that it would only be the volumes used that changes and not the fuel itself. He said that the fuel used is manufactured according to the German design. He said that the transportation needed for the fuel would be similar to that of the previous process and that there would only be a slight increase.

Ms. Mieke Barry asked whether the RoD would be released under the old Environment Conservation Act to whether the new regulations that would be promulgated soon would be taken into account. Dr. De Waal said that legislation would need to be legal before processes are structured according to it and that the new regulations have not been promulgated yet. This application would continue under the old regulations. He stated however, that the new regulations would be taken into consideration and that the Public Participation Process would send the draft document out for review and the final document out for notifications as are set out in the new regulations.

Dr. Wedlake asked whether other competing technologies have been considered and asked whether it would be possible for the consultants to compare other nuclear technologies to the proposed pebble bed technology. He asked where the pebble bed reactor would fit in, in relation to other technologies and this design in relation to designs used in other countries. Mr. McGowan said that the proposed PBMR Demonstration Power Plant is a 4th generation plant and that this design is safer that any of the previous ones. He said that the proposed system is extremely small compared to others worldwide and because it is a passive system it will shut down if there was any kind of problem with the system. Mr. Stott said that Eskom is the client of PBMR and that Eskom have considered other technologies, such as the European Pressurised Water Reactor. He said that Eskom also consider various coal alternatives.

CLOSURE

Dr. de Waal thanked all the attendees and said that the minutes would be distributed in due time. He said that I&APs should ensure that their details are on the attendance registers in order to allow us to keep them informed.

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Dr. D de Waal	Mawatsan			Tel: 012 362 2908	Fax: 012 362 2463
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8.5.4 DURBAN PUBLIC MEETING

Durban Exhibition Centre 17 November 2005 18:30

Environmental Impact Assessment for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) on the Koeberg Power Station site in the Western Cape[8]

WELCOME

Dr. de Waal welcomed the attendees and introduced the project team. No apologies were received. The agenda was read and approved.

PURPOSE OF THE MEETING

Dr. de Waal stated that the purpose of the meeting was to provide interested and affected parties with information on the proposed project, as well as on the previous Environmental Impact Assessment (EIA) process and thereby provide an information base for this project. Dr. de Waal said that this was the start of the scoping process and that I&APs should ensure that their details are registered with Mawatsan. This is to ensure that the I&APs are kept informed on the progress of the process. He emphasised that this public participation process forms part of a new application to the relevant departments. Dr. de Waal enquired whether all attendees are English speaking. No members of the audience indicated that an alternative language would be required during the communication. He then introduced Mr. Tony Stott.

PRESENTATION ON THE ELECTRICITY DEMAND AND SUPPLY IN SOUTH AFRICA

Mr. Stott gave a presentation on the electricity demand and supply status in South Africa. He said that Eskom generates approximately 95% of South Africa's power. The remaining 5% is generated by large corporations such as Sappi, Sasol and Municipalities such as the City of Johannesburg, City of Tshwane and the City of Cape Town.

He said that the electricity demand is increasing steadily, both the total amount of electricity used each year as well as the peak demand required each day and specifically in the winter periods. He stated that coal power stations are the main source of electricity and that they are situated close to the source of coal which keeps the transportation costs as low as possible. Eskom's energy mix also includes pumped storage schemes, nuclear power generation at Koeberg, two small kerosene-fuelled gas turbines and hydro-electricity generation.

He said that the current Eskom net generation capacity, excluding the imported electricity, is about 36 400 MW. Mr. Stott went on to say that the 2007 peak demand will

[8] Note: This is not a verbatim reflection of the meeting, but an attempt to reflect the presentations and discussion session in a clear and concise manner.

exceed the current net generation plus the normal reserve margin capacity. He said that it is assumed that power stations would last for 50 years and that new generation capacity will be necessary immediately, to cater for the growing demand, and later (after 2020) to also cater for the replacement of older power stations when it is no longer economically viable to operate such stations.

He said that the Department of Minerals and Energy is responsible for integrated energy planning and that the National Electricity Regulator develops the National Integrated Resource Plan for long term planning of electricity generating options. Eskom's also plans for future generation options through a process called Integrated Strategic Electricity Planning.

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DISCUSSION

Mr. Lakani requested that attendees indicate their affiliation. Dr de Waal requests attendees to indicate affiliation. Eskom/PBMR Limited had nine attendees, Consultants had four attendees, General public two attendees, and interested organisations five attendees.

Mr. Lakani enquired why ELA members were not invited and notified individually. Dr. de Waal responded that ELA Offices in Cape Town and Johannesburg was notified and that they indicated that they would notify their membership of all public meetings and of the Scoping Process.

Dr. de Waal requested attendees to ensure that their names and contact details on the attendance register are correct and complete.

Mr. Murphy asked Mr. Stott whether the demand curve he has shown includes future domestic and other demands for electricity. Mr. Stott confirmed that it does.

Mr. Lakani requested that the percentage domestic demand, - commercial demand, and bulk user demand be made available to IA&Ps. Dr. de Waal responded that this would be done in the Issues Register to be compiled following the public participation process.

Mr. Lakani stated that wind and solar electricity generation could be double that indicated by Mr. Stott, and why that was not indicated in the presentation made by Mr. Stott? Mr. Stott responded that as indicated on the presentation, the information in the presentation comes from the Energy Research Institute of the University of Cape Town.

Mr. Lakani stated that wind generation is economically viable, and that Eskom should do more research into this area and present the public with the true facts. He further stated that the Eskom test wind facility does not comply to international standards because the generator towers are not high enough, only 50 m, and that Eskom is therefore biased in their assessment of wind generation. It was indicated that this would be responded to in the minutes. The response is as follows:

The largest turbine at Klipheuwel has a rotor at 60m. At the time of installation the largest mobile crane was used - a turbine with a 80m rotor would have been impossible to install. 80m is not an international standard, the turbine size depends on the wind conditions, capacity etc

Mr. Moulton commented that Eskom does not give sufficient attention to the development of Pumped Storage Generation. He further states that all renewable energy sources are not reflected in the information presented by Mr. Stott.

Mr. Murphy asked whether the PBMR technology is the only nuclear option. Mr. Stott replied that all nuclear options are investigated and the development thereof monitored by Eskom.

Mr. Lakani stated that Eskom investment into the assessment of proven technologies is disproportionate. He states that the investment into PMBR is R 1.9 Billion whereas the investment into the assessment of all other options is R 20 to R 30 million. Mr. Stott responded that as stated in the Eskom 2005 Annual Report the total Research, Development and Demonstration expenditure in the 15 months ending march 2005 was R 263 million, of which R 35 million was for the PBMR.

Mr. Lakani stated that Eskom should allocate equal amounts of funds to each of the available and viable options of electricity generation. The comment was noted.

Mr. Lakani asked that the shareholding in PBMR Limited be made known.

Mr. Lakani asked why the PBMR was not commercialised in Germany if it was proven. Mr. Stott replied that the German AVR facility demonstrated different fuel and fuel handling technologies associated with a pebble bed type reactor, whereas the proposed PBMR demonstration plant will include the above technology components, combined to a turbine, generator and associated components to demonstrate the electricity generating capability of the plant.

Mr. Murphy asked whether Eskom is considering other nuclear options such as fusion technology. Mr. Stott responded that other nuclear options are considered. Fusion technology is still being internationally researched and is many tens of years away from commercial implementation.

Mrs. Herbst reminded the meeting that this application is for a PBMR DPP and not a process to compare technology options.

Dr. van As asked what the mandate of Eskom is with regards to electricity generation. Mr. Stott responded that it is the mandate of Eskom to provide 70% of the national demand in a cost effective and affordable manner that is sustainable. He further stated that Eskom does not have a mandate to perform fundamental (i.e. basic physics) research.

Mr. Moulton stated that it is critical to supply affordable electricity as it is one of the factors that determine economic growth. Mr. Stott added that the price of electricity is not determined by Eskom, but by the National Electricity Regulator.

Mr. Lakani asked why Eskom is supporting the least job intensive option if job creation is one of the objectives of Eskom. Mr. Stott explained that Eskom's mandate is to supply affordable and reliable electricity, and provide electricity generating capacity, and thereby stimulate the economy and job creation.

Mr. Murphy requested that the presentations made at the meeting be attached to the minutes for distribution. These will be attached.

Mr. Lakani stated that the BID distributed at the meeting is insufficient for I&APs to participate in the process, and that full and comprehensive information be made available to I&APs. Furthermore that I&APs be offered sufficient time to review and respond to information and documentation. The comments were noted.

Mr. Murphy asked how the design of the current application compares to that of the previous application. Mr. Stott referred back to his slides and further explained the evolution of the 302 MW(t) design to the 400 MW(t) design.

Mr. Lakani brings it to the attention of the meeting that the High Court Judgement presented by Mr. Stott is not the full judgement. Mr. Stott indicates that he extracted the conclusions and order from the Court judgement and not the background information. Mr. Stott confirmed that the full judgement is available on the PBMR web site.

Mr. Murphy asked why changes were made to the PBMR design. Mr. T McGowan responded that the current design evolved from analysis made by PBMR Limited into international requirements for power generating plants. Internationally generation plants are connected to supply grids in 300 MW(e) or 600 MW(e) units. This relates to a 400 MW(t) output. Furthermore the PBMR Limited design team, with inputs from international companies such as Mitsubishi, concluded that a horizontal turbine/generator is more appropriate than a vertical design.

Mr. Lakani stated that the economics of the PBMR is one of the major issues of concern. He stated that the estimated total cost of the PBMR has increased to R 15b.

Mr. Lakani asks how many orders PBMR Limited has for the PBMR plant. Mr. Terry McGowan responds that there currently were none.

Mr. Murphy asked if the South African taxpayer is required to gamble on the PBMR, and what about considering other 4th generation nuclear options. Mr. Terry McGowan responded that PBMR is one of the first of the 4th generation options that are available. France is investigating 4th generation nuclear technology, and may even be a future investor in the PBMR.

Mr. Murphy stated that he is not convinced of the walk away safety features of the PBMR, and that the public should be presented with other 4th generation technologies. Why did Eskom decide on the PBMR as a 4th generation option? Mr. Terry McGowan responded that PBMR is one of the first available 4th generation options, and that PBMR Limited keeps track of all developments internationally.

Mr Lakani made a statement that the PBMR Safety Case is poorly developed and would not be approved in other parts of the world, that there is no market internationally for the PBMR, that there is no expression of interest internationally, and that the PBMR is developed to keep national nuclear experts and engineers in jobs. He requested that the Safety Case Report be released to the public for review. He further stated that transport of uranium and fuel be made part of this EIA, and enquired into the status of the ROD pertaining to these aspects that where issued. Dr. de Waal responded that the latter issue is the subject of another application brought by a different applicant and that enquiry into the status relating to the mentioned application and associated ROD should be made with DEAT.

Mr Lakani requested to place on record that ELA demands that Environmental-, Social, and Economic Aspects be included in this EIA process. It was placed on record.

Mr. Murphy requested clarification on a statement he has read that it is safe to place a PBMR reactor in an oil refinery. Mr. Terry McGowan responds that it would be possible to do this safely.

Mr. Murphy asked whether it is feasible to run a turbine on helium, considering cost and availability of helium. Mr. McGowan confirmed that it is feasible.

Mr. Lakani enquired whether a review panel similar to that in the first EIA process will be established by DEAT. Dr. de Waal responded that DEAT is in the process to establish a review panel.

Mr. Lakani stated that ELA demands to be included in the review panel. Dr. de Waal responded that the composition of the review panel is the prerogative of DEAT.

Mr. Murphy stated that the issue of walk away safety in the event of a fire that escalates to a carbon combusting fire should be included in the EIA. This assessment should include breaching of the reactor by malicious intent. Mr. Terry McGowan responded that this is a requirement of the Safety Case Process of the National Nuclear Regulator.

Mr. Murphy stated that the issue of long term custodianship and management of the nuclear waste should be included in the EIA.

Dr. van As commented that additional generation capacity is required, and in his opinion coal and nuclear is the most suitable to supply in the demand. He indicated his support for nuclear power.

Mr. Murphy responds to Dr. van As and stated that it is not a matter of a choice between coal and nuclear, and that other options must also be brought into the debate.

Mr Lakani asked why Eskom, according to the presentation by T Stott, not consider wind as a significant future contributor to the energy mix? Mr. Lakani stated that if 2% of the coast line of South Africa is used for wind generation, and 2% of the surface area for solar generation it would be possible to double the current generating capacity of Eskom. The response is that wind generation is significantly more expensive than conventional power generation and wind has a low capacity factor, in other words the wind only blows for a relatively small amount of time per year in SA. The typical average per annum would be about 20% for moderate areas and 25-30% for high wind areas. The rest of the time no power will be generated. Coastal areas are sensitive, as such land use is quite restricted.

Mr. Lakani requested a list of the focus group meetings held by the consultants. It was indicted that this would be available in the scoping report.

Mr. Moulton stated that there is a risk that should this technology not be sited in South Africa that PBMR Limited may take it to a neighbouring country with the associated loss of investment in South Africa. He referred examples of lost investment that went to Mozambique.

Mr. Lakani requested to place on record that the review times for the public indicated by Mr. Lombaard in the presentation on the program is too short and should be at least 60 days. He further stated that he wants to review the final EIR before it is submitted to DEAT.

Mr. Lakani on behalf of ELA requests to place on record that they reject the PBMR DPP. He also requested a copy of the Cooperative Governance Agreement between NNR and DEAT.

CLOSURE

Dr. de Waal thanked all the attendees and said that the minutes would be distributed in due time. He said that I&APs should ensure that their details are on the attendance registers in order to allow us to keep them informed.

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Muna Lakane	ELA			

8.6 APPENDIX 6: DATA SET VALIDATION

8.6.1 EVALUATION AND DISCUSSION OF THE MARINE ENVIRONMENT AND THE POTENTIAL IMPACT OF THE PEBBLE BED MODULAR REACTOR

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ABSTRACT

EVALUATION AND DISCUSSION OF THE MARINE ENVIRONMENT AND THE POTENTIAL IMPACT OF THE PEBBLE BED MODULAR REACTOR.

Comparisons of Marine Environment:

Introduction:

Studies regarding the marine ecology have been conducted at Koeberg since the late 1970's. These studies included the impact on the marine life as well as the behaviour and extend of the so called 'Warm Water Plume".

Marine Life:

Three distinct phases, pre-operational, transitional and operational (1987 – 2005) have found neither significant specie diversity changes nor colonisation by opportunistic warm water species. It can thus be stated with confidence that the physical as well as the operational effects of Koeberg on the marine life in the vicinity or the Power Station, is statistically insignificant.

Warm Plume:

The last measurement of the characteristics of the Warm Water Plume was carried out by Rattey and Potgieter in 1987[(1)]. In 1989 Rattey and Potgieter [(2)] completed an interpretation of the physical oceanographic data for a period of 1985 to 1988. Since then no new work was carried out to determine if the plume does behave differently. However, since no major physical, nor meteorological differences have been observed over the last 17 years, the analysis contained in the above references can be accepted with confidence.

Sea Temperature Data:

No anomalous sea temperature data have been recorded during the period 2004 to 2005. The anomalous event of 1999 when an intake temperature exceeding 22°C was recorded did not occur again [(3)]. No significant physical characteristics have changed during the last number of years.

Discussion and Conclusion:

The potential influence of the envisaged Pebble Bed Modular Reactor on the Marine Life, due to a difference of either the physical characteristic or volume changes of the Warm Water Plume can be regarded as minimal and therefore of low significance.

The above conclusion is based upon a release rate of $1.7m^3$/sec at a release temperature of 40°C which results in a rise of the Koeberg outfall temperature of just more that 0.5°C. However, should the volume of water be a significant percentage of the current $80m^3$/sec pumping rate of Koeberg, or at a significant higher temperature, a thorough analysis needs to be conducted to determine the potential effect on the marine ecology.

As demonstration, should the design of the PBMR result in a $2.5m^3$/sec outfall at 50°C, and released into the Koeberg outfall, the outfall temperature will rise with about 2°C and 0.6°C at 1 kilometre distance with only 2 Koeberg condenser cooling pumps running.

References:

1 Rattey, D and Potgieter, F; Warm Water Plume Report, Koeberg Nuclear Power Station, August 1987.
2 Rattey, D and Potgieter, F; Interpretation of Physical Oceanographic Data for Koeberg 1985 – 1988, July 1989.
3 Potgieter, F; Koeberg Inlet Sea Temperatures, Probable Extremes, CWI-2133, January 2003.

8.6.2 METEOROLOGICAL ANALYSIS AND COMPARISON OF 2003 AND 2004 WITH PREVIOUS LONG TERM AND 2001, 2002 DATA:

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Our Reference: SHE 0566 **Your Reference:** Phase 1, Meteorology

ABSTRACT

METEOROLOGICAL ANALYSIS AND COMPARISON OF 2003 AND 2004 WITH PREVIOUS LONG TERM AND 2001, 2002 DATA:

Comparisons of Chi/Q:

Introduction:

The long term Chi/Q for Koeberg has just been updated in revision 3 of the Koeberg Site Safety Report. This covers a period from 1994 to 2004 inclusive and is based on the meteorological parameters that were recorded on the 50m level. The comparisons done in this report were done with reference to these graphs. To assist the reader these are included as figures 1 and 2.

Methodology:

The average annual Chi/q was calculated for the years 2003 and 2004 as requested. These values looked very similar and it was decided to include years 2001 and 2002 to see if there were any changes. The values were manually plotted on 2 manually generated maps namely, 100 – 1000m (in 100m segments) and 1 – 10 km (in 1 km segments). The value of $1*10^7$ was chosen as a base figure and all plots done were in relation to this figure. The values were then plotted in their respective segments on the maps. Contours were then drawn on the maps and the maps compared. As these maps were manually drawn they have not been included in this report but are available on request.

Discussion:

Probability Distribution of ground level values of Chi/Q.

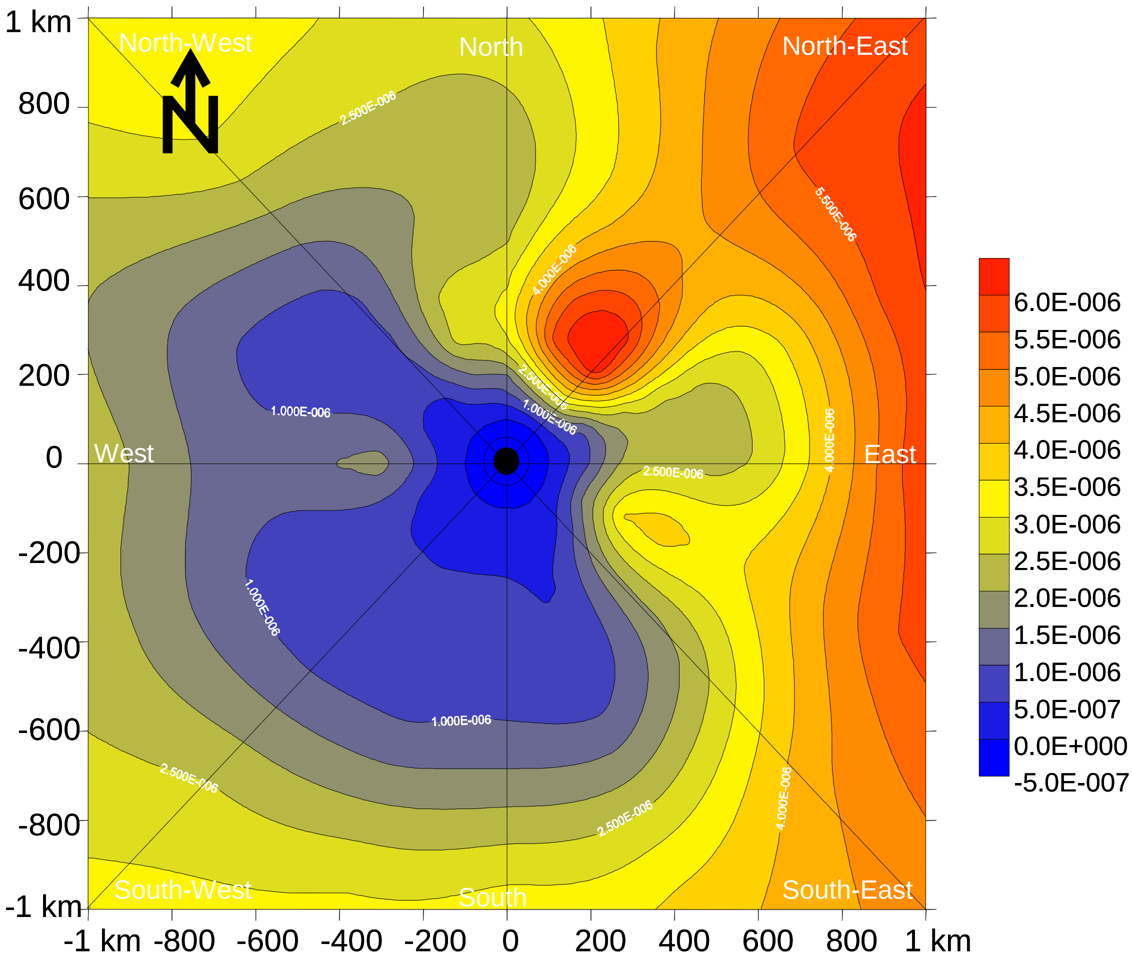
1. Period 1994 – 2004:

100 -1000m:

At the source (centre of the map) the values are zero or close to zero indicating plume skip. The major feature of the map is the high of value > 65 x 10^7 between the NE and NNE sector at 350m from the source. There are also less significant higher values to the ESE and to the W while to the WNW/NW, WSW to SSE the values are lower.

Figure 1: Probability Distribution of Ground Level values of Chi/Q Distribution

1994 – 2004 Distance from source 100m – 1 km

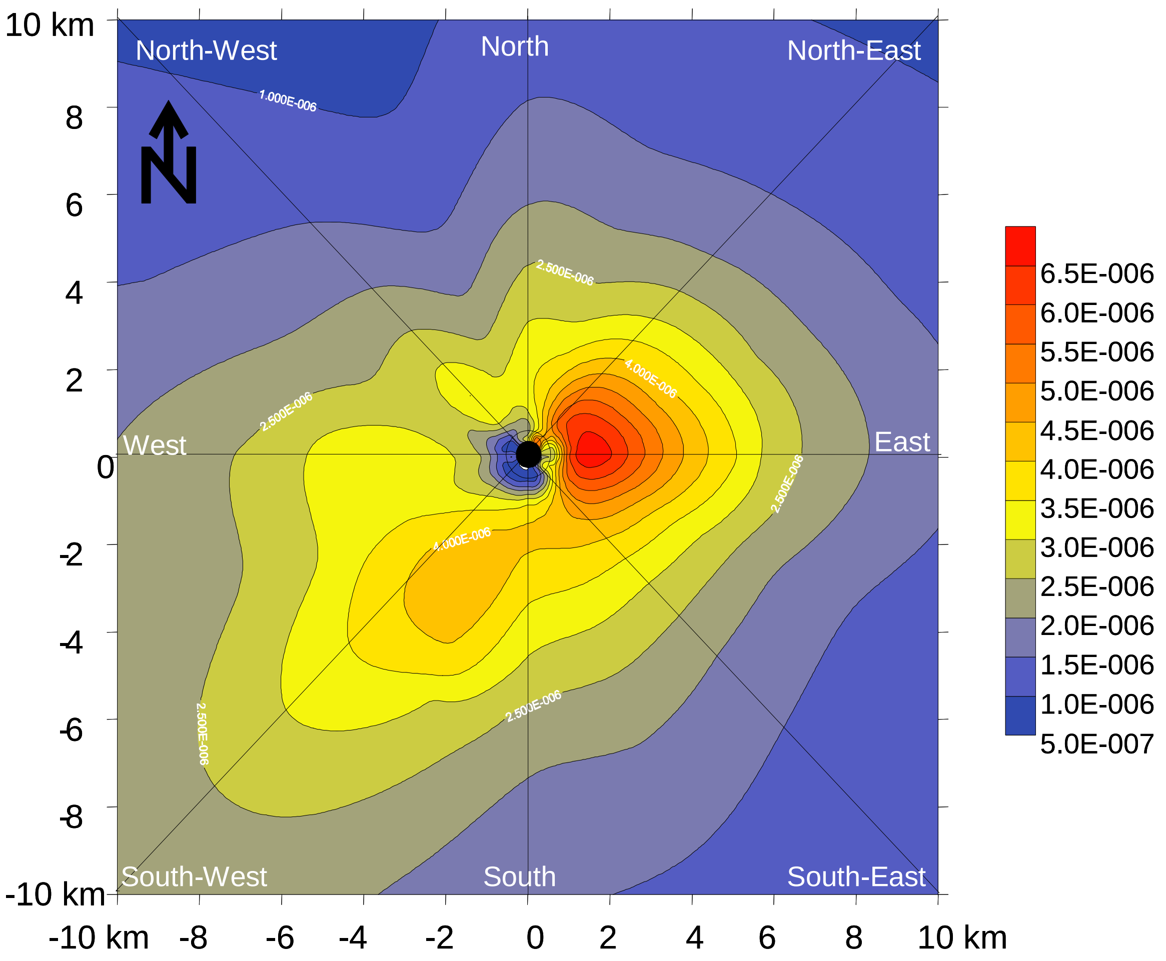


1 km – 10 km:

At the source the values are extremely low due to plume skip. The major feature on the map is the high in the ENE/ESE sectors, 65 x 10^7. There is also a less significant high to the SSW, 40 x 10^7. As the distance increase from the source the values become lower except in the NW they become lower closer to the source.

Figure 2: **Probability Distribution of Ground Level values of Chi/Q Distribution**

1994 - 2004 Distances from source 1 km – 10 km



2. Year 2001:

100 – 1000m:

Overall the values are much lower than that of the long term but the pattern is very similar. The high values between the NE and NNE sector at 350m from the source of 65 x 10^7 have decreased to 20 x 10^7. This is about one third of the long term value and was the lowest of the 4 comparable years. To the west there is a small area, 400m from source that is higher.

Averages	100m	200m	300m	400m	500m	600m	700m	800m	900m	1000m
N	2.73E-09	2.40E-06	4.85E-06	4.58E-06	3.71E-06	3.13E-06	3.05E-06	3.28E-06	3.60E-06	3.91E-06
NNE	4.65E-09	4.06E-06	8.14E-06	7.72E-06	6.28E-06	5.15E-06	4.69E-06	4.64E-06	4.75E-06	4.89E-06
NE	3.46E-09	2.99E-06	5.91E-06	5.59E-06	4.67E-06	4.25E-06	4.48E-06	5.07E-06	5.74E-06	6.36E-06
ENE	8.67E-10	8.78E-07	2.42E-06	2.89E-06	3.00E-06	3.27E-06	4.01E-06	4.90E-06	5.82E-06	6.59E-06
E	1.66E-09	1.47E-06	3.04E-06	3.04E-06	2.85E-06	3.12E-06	3.96E-06	5.06E-06	6.10E-06	7.04E-06
ESE	3.01E-09	2.69E-06	5.59E-06	5.61E-06	4.92E-06	4.52E-06	4.66E-06	5.09E-06	5.59E-06	6.04E-06
SE	1.28E-09	1.16E-06	2.51E-06	2.68E-06	2.57E-06	2.71E-06	3.17E-06	3.80E-06	4.41E-06	4.96E-06
SSE	2.38E-10	2.20E-07	5.09E-07	5.90E-07	7.11E-07	1.11E-06	1.75E-06	2.51E-06	3.21E-06	3.82E-06
S	7.73E-10	6.68E-07	1.35E-06	1.30E-06	1.21E-06	1.38E-06	1.82E-06	2.38E-06	2.95E-06	3.44E-06
SSW	6.67E-10	6.00E-07	1.27E-06	1.29E-06	1.17E-06	1.22E-06	1.46E-06	1.83E-06	2.22E-06	2.60E-06
SW	1.08E-10	9.92E-08	2.28E-07	2.82E-07	4.02E-07	7.33E-07	1.26E-06	1.86E-06	2.44E-06	2.97E-06
WSW	7.03E-10	6.11E-07	1.14E-06	9.82E-07	7.72E-07	7.92E-07	1.04E-06	1.40E-06	1.77E-06	2.08E-06
W	8.81E-10	7.65E-07	1.49E-06	1.40E-06	1.17E-06	1.12E-06	1.25E-06	1.50E-06	1.81E-06	2.07E-06
WNW	5.71E-10	4.98E-07	1.01E-06	9.89E-07	9.10E-07	1.01E-06	1.34E-06	1.78E-06	2.23E-06	2.60E-06
NW	8.05E-10	7.09E-07	1.45E-06	1.44E-06	1.33E-06	1.50E-06	1.95E-06	2.54E-06	3.12E-06	3.63E-06
NNW	1.94E-09	1.71E-06	3.50E-06	3.40E-06	2.86E-06	2.52E-06	2.48E-06	2.65E-06	2.88E-06	3.11E-06

1 – 10 km:

The values are a little lower to that of the long term and that the highest sector extends from NNE to SE with a small break in the S sector then becoming higher again the in SW sector.

Averages	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m	10000m
N	3.91E-06	4.06E-06	3.40E-06	2.81E-06	2.37E-06	2.03E-06	1.76E-06	1.57E-06	1.41E-06	1.26E-06
NNE	4.89E-06	4.29E-06	3.38E-06	2.73E-06	2.27E-06	1.93E-06	1.65E-06	1.43E-06	1.27E-06	1.15E-06
NE	6.36E-06	6.34E-06	4.97E-06	3.93E-06	3.18E-06	2.65E-06	2.27E-06	1.96E-06	1.72E-06	1.53E-06
ENE	6.59E-06	7.06E-06	5.61E-06	4.47E-06	3.63E-06	3.02E-06	2.58E-06	2.26E-06	1.97E-06	1.76E-06
E	7.04E-06	7.60E-06	5.99E-06	4.76E-06	3.84E-06	3.19E-06	2.73E-06	2.36E-06	2.07E-06	1.84E-06
ESE	6.04E-06	5.70E-06	4.44E-06	3.51E-06	2.85E-06	2.40E-06	2.05E-06	1.76E-06	1.57E-06	1.39E-06
SE	4.96E-06	5.11E-06	4.17E-06	3.42E-06	2.88E-06	2.48E-06	2.18E-06	1.91E-06	1.70E-06	1.54E-06
SSE	3.82E-06	4.56E-06	3.98E-06	3.45E-06	2.99E-06	2.63E-06	2.36E-06	2.12E-06	1.91E-06	1.75E-06
S	3.44E-06	4.18E-06	3.83E-06	3.40E-06	3.03E-06	2.73E-06	2.47E-06	2.21E-06	2.03E-06	1.87E-06
SSW	2.60E-06	3.87E-06	4.20E-06	4.08E-06	3.87E-06	3.60E-06	3.33E-06	3.08E-06	2.85E-06	2.63E-06
SW	2.97E-06	4.29E-06	4.48E-06	4.29E-06	4.02E-06	3.72E-06	3.44E-06	3.17E-06	2.92E-06	2.69E-06
WSW	2.08E-06	2.87E-06	3.18E-06	3.18E-06	3.08E-06	2.91E-06	2.74E-06	2.55E-06	2.38E-06	2.20E-06
W	2.07E-06	2.98E-06	3.35E-06	3.33E-06	3.21E-06	3.01E-06	2.81E-06	2.60E-06	2.42E-06	2.25E-06
WNW	2.60E-06	3.37E-06	3.18E-06	2.87E-06	2.57E-06	2.32E-06	2.08E-06	1.90E-06	1.73E-06	1.59E-06
NW	3.63E-06	4.08E-06	3.34E-06	2.73E-06	2.28E-06	1.93E-06	1.68E-06	1.46E-06	1.31E-06	1.16E-06
NNW	3.11E-06	3.04E-06	2.48E-06	2.03E-06	1.71E-06	1.48E-06	1.30E-06	1.14E-06	1.01E-06	8.97E-07

3. Year 2002:

100 – 1000m:

Overall the values are much lower than that of the long term and similar to that of 2001, but the pattern is very similar. The high values between the NE and NNE sector at 350m from the source of 65 x 10^7 have decreased to 25 x 10^7. This is about one third of the long term value and was the 2nd lowest of the 4 comparable years. To the west the values are low, < 10 x 10^7 and the long term small high does not exist.

Averages	100m	200m	300m	400m	500m	600m	700m	800m	900m	1000m
N	4.67E-10	4.24E-07	9.39E-07	1.00E-06	9.77E-07	1.06E-06	1.30E-06	1.61E-06	1.93E-06	2.22E-06
NNE	9.19E-10	8.30E-07	1.85E-06	2.07E-06	2.09E-06	2.23E-06	2.58E-06	3.03E-06	3.47E-06	3.85E-06
NE	1.26E-09	1.12E-06	2.38E-06	2.52E-06	2.45E-06	2.63E-06	3.14E-06	3.80E-06	4.44E-06	4.99E-06
ENE	5.67E-10	5.25E-07	1.22E-06	1.37E-06	1.45E-06	1.82E-06	2.52E-06	3.36E-06	4.17E-06	4.86E-06
E	3.83E-10	3.62E-07	8.84E-07	1.05E-06	1.20E-06	1.65E-06	2.39E-06	3.26E-06	4.09E-06	4.80E-06
ESE	8.27E-10	7.46E-07	1.63E-06	1.75E-06	1.73E-06	1.96E-06	2.50E-06	3.18E-06	3.84E-06	4.41E-06
SE	3.35E-10	2.99E-07	6.36E-07	6.62E-07	7.02E-07	9.60E-07	1.44E-06	2.02E-06	2.58E-06	3.07E-06
SSE	2.93E-10	2.58E-07	5.24E-07	5.07E-07	5.10E-07	7.16E-07	1.13E-06	1.63E-06	2.12E-06	2.55E-06
S	1.21E-11	2.77E-08	1.57E-07	2.70E-07	3.91E-07	6.01E-07	9.10E-07	1.27E-06	1.61E-06	1.92E-06
SSW	2.97E-10	2.59E-07	5.04E-07	4.63E-07	4.24E-07	5.36E-07	8.05E-07	1.15E-06	1.50E-06	1.82E-06
SW	1.33E-10	1.23E-07	2.74E-07	2.95E-07	3.59E-07	6.03E-07	1.02E-06	1.52E-06	2.00E-06	2.43E-06
WSW	4.47E-45	8.16E-17	6.72E-11	7.56E-09	7.41E-08	2.60E-07	5.51E-07	8.86E-07	1.21E-06	1.50E-06
W	6.02E-11	5.14E-08	9.57E-08	8.56E-08	9.98E-08	1.90E-07	3.52E-07	5.47E-07	7.42E-07	9.19E-07
WNW	9.35E-11	8.70E-08	2.00E-07	2.09E-07	2.16E-07	2.96E-07	4.56E-07	6.56E-07	8.63E-07	1.06E-06
NW	2.88E-11	2.53E-08	5.19E-08	6.31E-08	1.43E-07	3.73E-07	7.39E-07	1.16E-06	1.58E-06	1.95E-06
NNW	3.73E-10	3.37E-07	7.33E-07	7.72E-07	7.74E-07	9.35E-07	1.27E-06	1.69E-06	2.11E-06	2.47E-06

1 – 10 km:

The values are a little lower to that of the long term and that the highest sector extends from NNE to SE with a small break in the S sector then becoming higher again the in SW sector. This is almost exactly the same as 2001.

Averages	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m	10000m
N	2.217E-06	2.658E-06	2.378E-06	2.059E-06	1.795E-06	1.583E-06	1.41E-06	1.263E-06	1.14E-06	1.038E-06
NNE	3.846E-06	3.938E-06	3.233E-06	2.656E-06	2.233E-06	1.918E-06	1.674E-06	1.476E-06	1.316E-06	1.186E-06
NE	4.986E-06	5.067E-06	3.964E-06	3.124E-06	2.538E-06	2.119E-06	1.807E-06	1.565E-06	1.374E-06	1.221E-06
ENE	4.865E-06	5.555E-06	4.521E-06	3.642E-06	3.001E-06	2.531E-06	2.175E-06	1.895E-06	1.673E-06	1.492E-06
E	4.797E-06	5.58E-06	4.743E-06	3.974E-06	3.389E-06	2.942E-06	2.589E-06	2.297E-06	2.06E-06	1.863E-06
ESE	4.407E-06	4.846E-06	3.93E-06	3.169E-06	2.618E-06	2.213E-06	1.907E-06	1.665E-06	1.472E-06	1.316E-06
SE	3.068E-06	3.787E-06	3.286E-06	2.778E-06	2.379E-06	2.069E-06	1.824E-06	1.62E-06	1.454E-06	1.316E-06
SSE	2.554E-06	3.339E-06	3.013E-06	2.614E-06	2.28E-06	2.012E-06	1.792E-06	1.604E-06	1.449E-06	1.318E-06
S	1.922E-06	2.671E-06	2.637E-06	2.428E-06	2.21E-06	2.011E-06	1.834E-06	1.67E-06	1.53E-06	1.408E-06
SSW	1.818E-06	2.731E-06	2.866E-06	2.736E-06	2.551E-06	2.361E-06	2.179E-06	2.001E-06	1.845E-06	1.707E-06
SW	2.433E-06	3.735E-06	4.245E-06	4.263E-06	4.121E-06	3.909E-06	3.674E-06	3.418E-06	3.184E-06	2.971E-06
WSW	1.5E-06	2.432E-06	2.791E-06	2.806E-06	2.71E-06	2.568E-06	2.411E-06	2.24E-06	2.084E-06	1.943E-06
W	9.186E-07	1.714E-06	2.257E-06	2.42E-06	2.426E-06	2.353E-06	2.244E-06	2.107E-06	1.977E-06	1.855E-06
WNW	1.056E-06	1.821E-06	2.163E-06	2.202E-06	2.138E-06	2.031E-06	1.909E-06	1.776E-06	1.654E-06	1.543E-06
NW	1.946E-06	2.794E-06	2.645E-06	2.359E-06	2.095E-06	1.871E-06	1.682E-06	1.516E-06	1.376E-06	1.258E-06
NNW	2.467E-06	2.903E-06	2.422E-06	1.986E-06	1.658E-06	1.413E-06	1.225E-06	1.074E-06	9.531E-07	8.544E-07

4. Year 2003:

100 – 1000m:

Overall the pattern of values is similar to that of the long term. The high values between the NE and NNE sector at 350m from the source of 65 x 10^7 have decreased to 55 x 10^7 and is double of that of 2001/2002. To the west the values are low, < 10 x 10^7 and the long term small high does not exist.

Averages	100m	200m	300m	400m	500m	600m	700m	800m	900m	1000m
N	4.37E-10	3.91E-07	8.38E-07	8.63E-07	8.08E-07	8.50E-07	1.03E-06	1.28E-06	1.55E-06	1.80E-06
NNE	9.26E-10	8.37E-07	1.84E-06	1.94E-06	1.83E-06	1.86E-06	2.13E-06	2.52E-06	2.93E-06	3.30E-06
NE	2.86E-09	2.53E-06	5.26E-06	5.30E-06	4.70E-06	4.29E-06	4.32E-06	4.59E-06	4.93E-06	5.22E-06
ENE	2.45E-09	2.16E-06	4.44E-06	4.44E-06	3.95E-06	3.75E-06	4.01E-06	4.51E-06	5.05E-06	5.52E-06
E	1.25E-09	1.13E-06	2.49E-06	2.66E-06	2.58E-06	2.78E-06	3.38E-06	4.16E-06	4.93E-06	5.60E-06
ESE	6.75E-10	6.45E-07	1.65E-06	2.09E-06	2.35E-06	2.76E-06	3.43E-06	4.19E-06	4.91E-06	5.51E-06
SE	1.71E-10	1.73E-07	4.89E-07	6.59E-07	8.50E-07	1.25E-06	1.88E-06	2.59E-06	3.25E-06	3.81E-06
SSE	2.63E-11	2.30E-08	4.92E-08	7.76E-08	2.09E-07	5.53E-07	1.08E-06	1.68E-06	2.25E-06	2.75E-06
S	8.10E-23	7.86E-12	9.76E-10	1.59E-08	1.25E-07	4.21E-07	8.81E-07	1.40E-06	1.91E-06	2.34E-06
SSW	3.31E-11	3.31E-08	9.14E-08	1.28E-07	2.35E-07	5.16E-07	9.53E-07	1.45E-06	1.92E-06	2.32E-06
SW	1.61E-10	1.41E-07	2.83E-07	2.70E-07	2.44E-07	2.74E-07	3.75E-07	5.27E-07	7.11E-07	9.11E-07
WSW	6.42E-22	6.23E-11	6.96E-09	3.95E-08	1.40E-07	3.66E-07	7.00E-07	1.07E-06	1.43E-06	1.72E-06
W	3.96E-11	4.40E-08	1.36E-07	1.77E-07	2.22E-07	3.41E-07	5.38E-07	7.73E-07	1.01E-06	1.22E-06
WNW	9.09E-11	8.73E-08	2.17E-07	2.61E-07	3.29E-07	5.22E-07	8.43E-07	1.23E-06	1.61E-06	1.97E-06
NW	7.48E-11	7.19E-08	1.85E-07	2.37E-07	3.34E-07	5.80E-07	9.70E-07	1.42E-06	1.86E-06	2.24E-06
NNW	6.25E-10	5.51E-07	1.14E-06	1.16E-06	1.10E-06	1.22E-06	1.54E-06	1.95E-06	2.35E-06	2.70E-06

1 – 10 km:

The values are a little lower to that of the long term; otherwise it looks exactly like the long term pattern.

Averages	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m	10000m
N	1.80E-06	2.45E-06	2.38E-06	2.15E-06	1.93E-06	1.74E-06	1.57E-06	1.42E-06	1.30E-06	1.19E-06
NNE	3.30E-06	3.72E-06	3.17E-06	2.65E-06	2.25E-06	1.94E-06	1.70E-06	1.50E-06	1.34E-06	1.21E-06
NE	5.22E-06	4.63E-06	3.52E-06	2.74E-06	2.21E-06	1.84E-06	1.56E-06	1.35E-06	1.18E-06	1.05E-06
ENE	5.52E-06	5.36E-06	4.15E-06	3.24E-06	2.61E-06	2.16E-06	1.83E-06	1.57E-06	1.37E-06	1.21E-06
E	5.60E-06	5.99E-06	4.75E-06	3.76E-06	3.05E-06	2.55E-06	2.17E-06	1.87E-06	1.64E-06	1.46E-06
ESE	5.51E-06	5.57E-06	4.33E-06	3.39E-06	2.73E-06	2.27E-06	1.93E-06	1.66E-06	1.45E-06	1.29E-06
SE	3.81E-06	4.29E-06	3.52E-06	2.88E-06	2.41E-06	2.06E-06	1.79E-06	1.57E-06	1.40E-06	1.26E-06
SSE	2.75E-06	3.61E-06	3.24E-06	2.81E-06	2.45E-06	2.16E-06	1.92E-06	1.72E-06	1.55E-06	1.41E-06
S	2.34E-06	3.21E-06	3.05E-06	2.74E-06	2.47E-06	2.22E-06	2.02E-06	1.83E-06	1.67E-06	1.53E-06
SSW	2.32E-06	3.15E-06	3.24E-06	3.09E-06	2.90E-06	2.70E-06	2.51E-06	2.31E-06	2.14E-06	1.98E-06
SW	9.11E-07	2.40E-06	3.36E-06	3.64E-06	3.64E-06	3.52E-06	3.35E-06	3.14E-06	2.94E-06	2.76E-06
WSW	1.72E-06	2.56E-06	2.94E-06	2.99E-06	2.92E-06	2.78E-06	2.63E-06	2.45E-06	2.29E-06	2.14E-06
W	1.22E-06	2.13E-06	2.69E-06	2.84E-06	2.81E-06	2.71E-06	2.58E-06	2.41E-06	2.26E-06	2.12E-06
WNW	1.97E-06	3.02E-06	3.12E-06	2.94E-06	2.71E-06	2.49E-06	2.28E-06	2.09E-06	1.92E-06	1.77E-06
NW	2.24E-06	2.96E-06	2.69E-06	2.35E-06	2.05E-06	1.82E-06	1.62E-06	1.45E-06	1.31E-06	1.19E-06
NNW	2.70E-06	2.99E-06	2.46E-06	2.00E-06	1.67E-06	1.42E-06	1.23E-06	1.08E-06	9.57E-07	8.58E-07

5. Year 2004:

100 – 1000m:

Overall the pattern of values is similar to that of the long term. The high values of 65 x 10^7 in the NE sector have increased to 80 x 10^7 and this is the highest of the 4 years and almost 4 times the value that was recorded in 2001. To the west the values are a little higher than normal, > 25 x 10^7.

Averages	100m	200m	300m	400m	500m	600m	700m	800m	900m	1000m
N	8.45E-10	7.57E-07	1.61E-06	1.60E-06	1.40E-06	1.37E-06	1.56E-06	1.88E-06	2.22E-06	2.54E-06
NNE	1.64E-09	1.49E-06	3.31E-06	3.53E-06	3.27E-06	3.10E-06	3.20E-06	3.47E-06	3.78E-06	4.05E-06
NE	4.31E-09	3.82E-06	7.93E-06	7.81E-06	6.60E-06	5.64E-06	5.31E-06	5.36E-06	5.56E-06	5.77E-06
ENE	2.33E-09	2.10E-06	4.62E-06	4.87E-06	4.51E-06	4.36E-06	4.65E-06	5.18E-06	5.74E-06	6.22E-06
E	2.15E-09	1.90E-06	3.90E-06	3.86E-06	3.46E-06	3.51E-06	4.14E-06	5.05E-06	5.95E-06	6.72E-06
ESE	1.82E-09	1.66E-06	3.79E-06	4.21E-06	4.10E-06	4.07E-06	4.34E-06	4.77E-06	5.21E-06	5.57E-06
SE	4.47E-10	4.28E-07	1.09E-06	1.38E-06	1.57E-06	1.91E-06	2.46E-06	3.09E-06	3.69E-06	4.18E-06
SSE	9.51E-12	8.21E-09	2.28E-08	6.10E-08	2.08E-07	5.68E-07	1.11E-06	1.74E-06	2.34E-06	2.86E-06
S	4.90E-15	7.73E-10	9.43E-09	3.93E-08	1.69E-07	5.00E-07	1.00E-06	1.58E-06	2.12E-06	2.59E-06
SSW	9.55E-45	1.75E-16	1.44E-10	1.63E-08	1.60E-07	5.61E-07	1.19E-06	1.91E-06	2.62E-06	3.24E-06
SW	2.91E-21	2.87E-10	3.22E-08	1.60E-07	4.06E-07	8.40E-07	1.44E-06	2.09E-06	2.71E-06	3.24E-06
WSW	2.03E-22	1.97E-11	2.32E-09	2.56E-08	1.73E-07	5.67E-07	1.18E-06	1.87E-06	2.53E-06	3.09E-06
W	1.43E-10	1.29E-07	2.97E-07	3.94E-07	5.62E-07	9.23E-07	1.47E-06	2.08E-06	2.67E-06	3.18E-06
WNW	1.15E-10	1.07E-07	2.44E-07	2.68E-07	3.10E-07	4.77E-07	7.70E-07	1.12E-06	1.47E-06	1.77E-06
NW	2.56E-10	2.32E-07	5.25E-07	6.12E-07	7.13E-07	9.82E-07	1.43E-06	1.94E-06	2.44E-06	2.86E-06
NNW	1.03E-09	9.22E-07	1.99E-06	2.05E-06	1.86E-06	1.80E-06	1.97E-06	2.25E-06	2.56E-06	2.83E-06

1 – 10 km:

The values are a little higher to that of the long term and the high to the SW extends to the western sector.

Averages	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m	10000m
N	2.54E-06	3.081E-06	2.814E-06	2.474E-06	2.181E-06	1.94E-06	1.74E-06	1.566E-06	1.42E-06	1.297E-06
NNE	4.051E-06	3.935E-06	3.227E-06	2.654E-06	2.231E-06	1.914E-06	1.67E-06	1.472E-06	1.313E-06	1.182E-06
NE	5.77E-06	5.032E-06	3.876E-06	3.044E-06	2.465E-06	2.052E-06	1.746E-06	1.509E-06	1.323E-06	1.174E-06
ENE	6.218E-06	5.759E-06	4.394E-06	3.418E-06	2.753E-06	2.284E-06	1.939E-06	1.673E-06	1.465E-06	1.299E-06
E	6.72E-06	6.876E-06	5.407E-06	4.29E-06	3.512E-06	2.952E-06	2.532E-06	2.203E-06	1.944E-06	1.734E-06
ESE	5.574E-06	5.021E-06	3.821E-06	2.971E-06	2.392E-06	1.983E-06	1.682E-06	1.451E-06	1.27E-06	1.125E-06
SE	4.184E-06	4.447E-06	3.627E-06	2.955E-06	2.468E-06	2.108E-06	1.832E-06	1.61E-06	1.432E-06	1.286E-06
SSE	2.858E-06	3.876E-06	3.502E-06	3.03E-06	2.633E-06	2.315E-06	2.056E-06	1.837E-06	1.656E-06	1.504E-06
S	2.591E-06	3.518E-06	3.339E-06	3.01E-06	2.708E-06	2.445E-06	2.218E-06	2.013E-06	1.838E-06	1.688E-06
SSW	3.243E-06	4.762E-06	4.666E-06	4.267E-06	3.864E-06	3.502E-06	3.185E-06	2.895E-06	2.647E-06	2.434E-06
SW	3.237E-06	4.423E-06	4.535E-06	4.309E-06	4.023E-06	3.73E-06	3.45E-06	3.174E-06	2.931E-06	2.716E-06
WSW	3.093E-06	4.267E-06	4.21E-06	3.904E-06	3.587E-06	3.29E-06	3.02E-06	2.763E-06	2.541E-06	2.347E-06
W	3.185E-06	4.256E-06	4.19E-06	3.875E-06	3.549E-06	3.246E-06	2.972E-06	2.715E-06	2.493E-06	2.299E-06
WNW	1.77E-06	2.531E-06	2.575E-06	2.42E-06	2.237E-06	2.058E-06	1.892E-06	1.733E-06	1.595E-06	1.473E-06
NW	2.861E-06	3.404E-06	2.927E-06	2.465E-06	2.107E-06	1.831E-06	1.612E-06	1.431E-06	1.283E-06	1.161E-06
NNW	2.826E-06	2.911E-06	2.402E-06	1.979E-06	1.667E-06	1.433E-06	1.252E-06	1.105E-06	9.867E-07	8.892E-07

6. Conclusions:

In summary the major differences between the long term and the 4 years are:

100 – 1000m:

1. The highest concentration occurrence in the NE sector is very prominent in 2003/2004 but is significantly lower in 2001/2002. The concentration value is the highest in 2004 and the lowest in 2001.
2. The general distribution pattern remains the same throughout the years except for minor changes. The biggest differences are the changes in the values of concentration.
3. The high in the SW sector is not there in 2003 but rather occurs in the S/SSW.

1 – 10 km:

1. The general concentration pattern is maintained throughout the time period covered. There is a high to the E and another secondary high concentration to the SW.
2. The differences in values are not as significant as they are in the 100-1000m data and map.

In general terms the differences in the near field area, namely less than 1 km distance from the release source does seem significant.

7. Recommendation:

Further work needs to be done in order to determine the significance of the differences found in the years analysed.

8.6.3 PBMR UPGRADE 300 TO 400 MW(T): IMPACT ON GEOHYDROLOGY – DR M LEVINE

The upgrade of the PBMR Power Plant to 400 MW(t) will not have any additional impact on the aquifers on the site as those set out below for the 300 MW plant. It is noted that the footprint of the 400 MW(t) plant will be slightly larger that that of the 300 MW plant. However, it is noted that in the case of the PBMR Reactor building, the intention is to waterproof the entire structure below ground level either with an external membrane or additives to the concrete. This will prevent any ingress of groundwater into the structure or contamination of groundwater from sources inside the building.

IMPACT OF THE PMBR PLANT

Two scenarios are considered namely, under normal conditions and during an incidence. Only impact on the water environment is considered as atmospheric releases are considered elsewhere.

- Under normal conditions

  Any possible release of radioactivity during normal operational conditions reaching the primary aquifer on site will flow towards the sea as previously explained. The quantification of releases from the PBMR is addressed elsewhere and this section only deals with the subsequent movement of any activity that is deposited into the groundwater. The movement of such activity will be restricted to the PBMR site in stagnant or faster flowing zones. At maximum it will follow the general groundwater flow which is west to south-westerly towards the sea. Monitoring boreholes installed before commissioning will detect any possible contamination of groundwater before it can impact on the groundwater used by residents for gardening to the south of the site.

- Under incident conditions

  Any activity reaching the groundwater will follow the general regional flow pattern, which is west to south-westerly. The levels and movement may be restricted by the design of the site and freedom of movement of groundwater around or through the site. Monitoring boreholes should be installed on and away from the site to monitor any impact on the groundwater used by residents for gardening to the south of the site. Details on movement of activity in the environment are addressed elsewhere.

It is concluded that the impact on the groundwater will be restricted to the site and within its boundaries. Any pollution contaminating the groundwater will eventually move out of the system to the ocean. Impact area(s) can be controlled and monitored until contamination levels have decreased to acceptable levels. No contamination will be drawn into the well fields to the northeast, from contaminated groundwater in the vicinity of the site as shown by the CSIR modelling.

EMP

In order to avoid or minimise any impact by the PMBR plant on the groundwater environment it is necessary to plan and program certain actions into the construction and operational phases of the PMBR project. This will allow early detection of any deviation from the norm and timely action can be taken to address the incident.

- During construction

  It is assumed that information regarding boreholes drilled to investigate the suitability of a proposed site will be archived for reference and as baseline data. These boreholes all lie within the construction zone and will probably not be preserved as monitoring boreholes. It is therefore necessary to make provision for the drilling and construction of boreholes for monitoring before construction of the facility commence. The locality of the boreholes will be determined by the site-specific geological and geohydrological information. This information should be obtained from a geohydrological investigation of the proposed site before construction.

  Based on the Koeberg experience provision for at least six monitoring boreholes should be made. At least three boreholes should be placed upstream and three downstream. Two are to be drilled on the centreline (in the direction of flow) of the structure, the remaining boreholes are to be located adjacent to the structure but far enough to detect and monitor the pluming effect of any contamination. It will be necessary to drill at an upstream and downstream borehole locality, two boreholes, one monitoring the primary and one monitoring the secondary aquifer at that locality.

  It is important to note that similar to the situation during Koeberg site de-watering, leaking of saline groundwater from the confined Malmesbury aquifer will impact on the quality of the primary aquifer in the vicinity of the excavations. It is important that this impact be closely monitored during and after construction. Observing the tritium isotope levels in the monitoring boreholes can monitor mixing of groundwater from the two aquifers. The primary aquifer display a rain water tritium signal whereas the secondary aquifer contains zero tritium. The mixing will fall in-between these values. Monitoring of the water levels (pressure levels) in the monitoring boreholes will also be an important indicator of mixing during construction.

  The following actions are recommended during the construction phase:

  - Care must be taken when drilling monitoring holes that no contamination of the primary aquifer occur therefore boreholes drilled into the secondary aquifer should be sealed off as leakage into the primary aquifer can cause flow and alter flow patterns in the primary aquifer.
  - The impact on the primary aquifer by saline water intrusion before and after de-watering should be monitored monthly and recorded in order to understand

future groundwater flow in the vicinity of the building structures. In this respect monitoring of water levels, water quality and tritium isotope levels will be important indicators. This can continue for several years after construction until the conditions return to that recorded before construction.

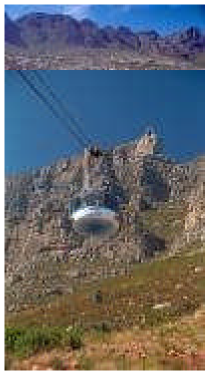
- The water level in the monitoring boreholes should be recorded weekly for at least one full hydrological cycle to establish the impact of the rainy and dry seasons on the water level.
- It is recommended that base line water quality and environmental isotope data is obtained from any new borehole drilled on or near the site. Base line data should be collected as soon as the boreholes are constructed and should continue at least two years before commissioning. Water sampling should be taken monthly for quality and stable isotopes. Tritium level in the monitoring boreholes as baseline data is absolutely vital and only need to be sampled annually.
- Water quality (at least EC) should be monitored weekly, through at least one hydrological cycle to establish the impact of the rainy season on the quality.
- At least one rainwater sample per season should be collected for environmental isotope analysis to serve as background value. Combined sample of a period of rainfall will be preferable. This should be taken in consultation with the isotopes laboratory.
- Monitoring of the most important indicators such as electrical conductivity (EC), pH temperature should be done on site while the normal macro chemical analysis and isotope analysis is done at the laboratories. Any parameter that is considered important in the future operation of the PMBR could be added to the list.

DURING OPERATION

The following actions are recommended during the operational phase of the project:

- For the first year monthly samples should be taken from the monitoring boreholes and any other point considered important, for water quality testing. Intervals can be changed to quarterly after one year, however, should any anomalous values be obtained, sampling must be more frequent until the problem is solved.
- Environmental isotope analysis should be checked annually. Especially tritium should be done, PBMR Site south of the KNPS PBMR Site south of the KNPS as this isotope could be an early indicator of operational contamination.
- Water levels should be monitored monthly and if any anomalous values are recorded then the readings must be more frequently until the problem has been resolved.

8.6.4 COMPARATIVE ASSESSMENT OF THE ENVISAGED IMPACT ON TOURISM



PREPARED BY:

ECON
Development
Economist

December 2005

EXECUTIVE SUMMARY

The tourism industry has developed into one of the key elements of the Cape Town economy. As an indication, **Wesgro** estimated that the tourism industry accounted for about 9.8% of the provincial Gross Regional Product (GRP), and employed about 9.6% of the provincial workforce in 2002. It is therefore imperative that all steps be taken to nurture and promote the tourism industry.

Perceptions amongst potential tourists play a critical role in the attractiveness of an area. The role and impact of perceptions were clearly illustrated in the dramatic change in destination preference that occurred after the 9/11 terrorist attacks. After the terrorist attacks, many international tourists perceived America to be dangerous and preferred to spend their holidays in locations that they perceived to be safer, such as South Africa.

The construction and operation of the PBMR DPP may also evoke negative perceptions amongst potential tourists, and it is therefore important to gauge their perceptions about nuclear technology and if the existence of a PBMR DPP may have any effect on their decision to come to Cape Town.

The original study, performed in 2002, found that the existence of the PBMR DPP would have no material effect on the tourism industry. In fact, the tourism industry may even benefit, as some of the people involved in the PBMR DPP (e.g. engineers and technicians) stay at local tourism establishments. The research methodology and approach followed in the original 2002 study was technically sound and the results and findings can be considered credible.

The new impact assessment process of the PBMR DPP has progressed from the Application stage, to the present Scoping stage, and it was decided to investigate the necessity to conduct a new study to establish the possible impact that the PBMR DPP may have on the local tourism industry. This study will consist of two phases, with the goal of phase 1 being to determine if a new study is necessary. If phase 1 finds that a new study is required, the study will progress to phase 2, which will involve the study itself.

The survey conducted in phase 1 of this study confirmed the finding of the original study, as the majority of those interviewed were of the opinion that the PBMR would have no effect on the local tourism industry. However, very few were aware of the original study, and most were of the opinion that a new study should be conducted to confirm these views. The main value added with such a new study is that it will offer the local tourism industry the opportunity to take part in a structured and transparent process (survey) to ensure that the findings are accurate and reliable.

It is therefore recommended that:

- A new study should be conducted to assess the possible impact the planned PBMR may have on the local tourism industry.
- To add value, the study should be structured along the following approach:
  - A large survey amongst tourists to capture their views and opinions (the original survey focussed predominantly on the tourism establishments such as accommodation facilities). A sample size of 500 is recommended.
  - This survey should be conducted during the peak tourism period to ensure that the survey be performed in the peak season period. As such, phase 2 of the study should commence in January 2006.
  - The survey methodology and the questionnaire should be developed in close collaboration with the main tourism stakeholders namely: Cape Town Routes Unlimited (CTRU) and Cape Town Tourism.
  - Parallel to the tourist survey, structured interviews should be held with about 50 stakeholders in the Cape Town tourism industry.
  - The findings should be communicated to the tourism stakeholders by means of a presentation.

8.7 APPENDIX 7: WITHDRAWAL OF THE APPLICATION FOR EXEMPTION.

8.7.1 NOTIFICATION OF WITHDRAWAL OF APPLICATION FOR EXEMPTION TO AUTHORITIES

MAWATSAN

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Chief Director: Environmental Impact Assessment
Department Environmental Affairs and Tourism
Private Bag X447
Pretoria
0001

Attention: Mr C Agenbach

12 January 2006

Dear Sir,

Application and Plan of Study for the Proposed 400MW(t) PBMR DPP.
Withdrawal of the Application for Exemptions on Alternatives

We refer to your letter of 8 November 2005 and the subsequent meetings with Mr. D Smit on 29 November 2005 and Mrs L.Bothma, D. Smit and yourself on 21 Dec 2005

We thank you for the responses to the Application and the Plan of Study for a proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) at the Koeberg Power Station Site in the Western Cape.

The meeting of 29 November and 21 December 2005 fully clarified the DEAT's requirements contained in the letter of acceptance of the mentioned Application and Plan of Study for Scoping (POSS). W

With reference to your point 12 of the numbered points in your letter of 8 November 2005, namely that a dedicated application for exemption is required by the Department, Mawatsan wishes to state and respond as follows:

- The request for the granting of Exemption on alternatives (technology and site), as indicated in the text of the Application in the prescribed format of the Western Cape Dept of Environment Affairs and Development Planning, is herewith withdrawn from the Application and the issues will be dealt with in the scoping processes, Scoping Report and the EIR within the context of the demonstration nature of the proposed PBMR DPP.
- This letter should be included with and considered part of the Application as submitted to the DEAT and the DEA&DP: Western Cape for the purposes of the record.

I trust that you find this arrangement in order and will be pleased to receive the Departments acceptance thereof.
With kind regards

Original signed by O.F. Graupner for Dr D de Waal

Dr. D de Waal.

Cc Melanie Webber (Western Cape Department of Environment Affairs and Development Planning)

8.7.2 NOTIFICATION OF WITHDRAWAL OF APPLICATION FOR EXEMPTION TO PUBLIC

MAWATSAN

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Dear Sir/Madam 02 March 2006

WITHDRAWAL OF THE APPLICATION FOR EXEMPTION FOR SPECIFIC ACTIVITIES IN TERMS OF THE EIA APPLICATION FOR THE PROPOSED 400 MW(t) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT (PBMR DPP.

This notification serves to inform you that the Application for exemption for assessing

- Alternatives for Energy and Technology; and
- Geographical (Site) alternatives.

which formed part of the Application for the proposed PBMR DPP to the national Department of Environmental Affairs, has been withdrawn by Eskom, the Applicant.

These aspects will be dealt with in both the draft and final EIR for the proposed PBMR DPP.

Comprehensive site alternative assessments and public participation processes were implemented during the 302 MW(t) PBMR DPP environmental assessment. The information from this previous process was evaluated and is still considered valid. It therefore has been utilised in the assessment of the site alternatives during the 400 MW(t) PBMR DPP EIA process.

The energy and technology alternatives are motivated in terms of Eskom's integrated strategic electricity planning (ISEP) process, which stems from the prerogatives set by government in terms of the White Paper on national energy policy, the integrated energy plan (IEP) of the Department of Minerals and Emergy and the national integrated resource plan (NIRP) of the National Electricity Regulator (NER).

If you have any further enquiries, please contact the following people:

CONTACT DETAILS:	**WHO TO CONTACT:**
MAWATSAN P. O. Box 13540 Hatfield, 0028 **Tel**: (012) 362-2908 **Fax**: (012) 362-2463 **e-mail**: pbmr@mawatsan.co.za	**Requests for Scoping Reports on CD-Rom**: Mr. Ian MacFadyen **Comments on the Draft Scoping Report**: Ms Manni Khan or Mrs. Martie Moolman (in writing please) **Other queries**: Mrs. Martie Moolman or Dr David de Waal

Kind regards

David de Waal
MAWATSAN

8.8 APPENDIX 8: ISSUES REGISTER

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
STRATEGIC ISSUES			
9 Nov 2005	Unknown participant	1. Were the Eskom's mothballed stations subject to EIA's before they were decommissioned?	RODs were obtained for Grootvlei and Camden. The Komati ROD was received on 13 December 2005.
9 Nov 2005	Unknown participant	2. Are the emissions of the coal stations satisfactorily and conforming to legislation?	The emissions conform to current legislation.
9 Nov 2005	Unknown participant	3. What is the ratio of expenditure on the various demonstration technologies?	A copy of NIRP 2 is attached in Appendix 15. NIRP 2 indicates the integrated energy picture.
9 Nov 2005	Unknown participant	4. Is consumer behaviour and demand side management factored into Eskom's future growth scenarios?	Yes.
9 Nov 2005	Unknown participant	5. What is the cost comparison between the various supply technologies?	A copy of NIRP 2 is attached in Appendix 15. NIRP 2 indicates the integrated energy picture.
9 Nov 2005	Unknown participant	6. How much has been spent on the PBMR to date?	Since 1993 the current investors have spent R 2b on research for plant and fuel

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
9 Nov 2005	Unknown participant	7. How is the cost for the various technologies calculated?	A copy of NIRP 2 is attached in Appendix 15. NIRP 2 indicates the integrated energy picture.
9 Nov 2005	Unknown participant	8. Should the RSA not consider the reduction of the supply voltage since this could lead to substantial generation savings?	The suggestion is not feasible since the output of a station is not related to the voltage of the system.
9 Nov 2005	Unknown participant	9. What energy losses are experienced during transmission?	SA uses an integrated transmission network to ensure quality and reliability of supply. Given the long distances of transmission the losses can be up to 7%
9 Nov 2005	Unknown participant	10. Does Eskom export electricity?	In 2004 about 16 000 GWh was exported and 14 000 GWh was imported
9 Nov 2005	Unknown participant	11. On what are the electricity growth scenarios that were presented based? Is it inherent growth or for new entrants to the market?	The scenarios make provision for inherent growth as well as for new entrants. Thirty (30) years ago only 50% of the population had access to electricity. By 2012 Eskom aims to raise the figure to 100%. The split between industrial and domestic is about 80%:20%
9 Nov 2005	Unknown participant	12. Should Eskom not consider the supply of electricity to rural communities on a direct basis rather than off the grid?	Eskom are considering this option via various renewable technologies as well as the affordability of these technologies.
9 Nov 2005	Unknown participant	13. The Economical Feasibility Study and Business Plan for the PBMR were not available to I&APs in the previous EIA. Will it be available in this EIA, together with other information	Non commercially sensitive information relating to the PBMR DPP will be made available. Due to the fact that this is a demonstration plant the economic

DATE	ISSUE RAISED BY	ISSUE		RESPONSE
			which Earthlife Africa (ELA) wishes to study to meaningfully participate with the EIA?	feasibility will be developed from the results of the demonstration.
9 Nov 2005	Unknown participant	14.	Is the proposed Uranium mining in Beaufort-West linked to the proposed PBMR project?	There is no link.
9 Nov 2005	Unknown participant	15.	What foreign investors does the PBMR have?	British Nuclear Fuels Limited (BNFL)
9 Nov 2005	Unknown participant	16.	A property of 150 hectare near the N7 road and Melkbosstrand was bought 12 years ago for an electricity substation. Is this linked to the PBMR?	No
9 Nov 2005	Unknown participant	17.	Certain persons have contracted cancer while in the employment of Eskom. Eskom is allegedly withholding medical records from such employees at Koeberg. Can Eskom be trusted?	No employee at Koeberg has developed an occupational related cancer as a result of Koeberg's operation. Employees have access to their personal medical records.
9 Nov 2005	Unknown participant	18.	Why does Eskom choose dangerous and potentially harmful technologies for demonstration? What will happen if the PBMR DPP is not feasible?	Eskom does not choose dangerous and harmful technologies for demonstration. If the PBMR DPP is not feasible it will be decommissioned and dismantled
9 Nov 2005	Unknown participant	19.	What responsibility does Eskom take if things go wrong with the PBMR DPP?	Eskom is and remains responsible for all of its power stations, which will include the PBMR DPP
9 Nov 2005	Unknown participant	20.	ELA requires access to the economic feasibility studies that have been conducted	Non commercially sensitive information relating to the PBMR DPP will be made

DATE	ISSUE RAISED BY	ISSUE		RESPONSE
			for the PBMR.	available. Due to the fact that this is a demonstration plant the economic feasibility will be developed from the results of the demonstration.
9 Nov 2005	Unknown participant	21.	What is the commercial relationship between Eskom and the PBMR. It appears that public funds are used to develop a commercial product for a private company? Why is Eskom paying for the EIA?	Eskom is purchasing the PBMR DPP from PBMR Limited, as such there is a contractual relationship between the parties. Under the new Shareholders Agreement PBMR Limited is SA Government majority owned. Eskom will be the owner/operator of the PBMR DPP, and as such is the EIA applicant.
9 Nov 2005	Unknown participant	22.	The PBMR is a safe, clean and cost-effective technology and must be promoted. There is a concern that the EIA studies and authorisations are taking to long and thereby erodes SA's competitive advantage as a supplier of the technology to international markets.	Comment noted.
9 Nov 2005	Unknown participant	23.	If the PBMR is so safe, clean and economical ELA would want to have access to the economic feasibility study	Comment noted. Non commercially sensitive information relating to the PBMR DPP will be made available. Due to the fact that this is a demonstration plant the economic feasibility will be developed from the results of the demonstration.

DATE	ISSUE RAISED BY	ISSUE		RESPONSE
9 Nov 2005	Unknown participant	24.	Economics is a core issue in the debate. How does Eskom track the economics of other new or emerging technologies?	There are Eskom Committees that specifically looks /tracks emerging technologies
10 Nov 2005	Unknown participant	25.	Eskom has 20 years of experience with the operation of the Koeberg Nuclear Power Station. Why change to an unproven design?	Eskom is evaluating new generation options on an ongoing basis, including the PBMR Technology.
10 Nov 2005	Unknown participant	26.	There is a concern about the length of time involved in obtaining the required authorisations, especially the EIA and this erodes the competitive advantage of the RSA design to market the plant internationally	Comment noted.
10 Nov 2005	Mrs Mentoor	27.	" A delegation from the Atlantis community visited Koeberg on several occasions and learnt a great deal about the safety and operation of Koeberg. We are satisfied with the safety standards and practises, especially as far as it affects the community and its well being"	Statement noted
10 Nov 2005	Unknown participant	28.	How will the PBMR project contribute to science and technology training in the longer term, especially support to schools on these subject?.	Eskom already supports several school maths and science programmes, including one in Atlantis. The DTI runs a program, PBMR Human Research and Innovation Frontier Program (PHRIFP). The aim of this program is to form 8 university departments in nuclear science, and to provide bursaries.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
15 Nov 2005	Dr van As	29. Would the global impacts be assessed as part of the EIA	The National Electricity Regulator conduct national studies and address issues such as global warming and the reduction of greenhouse gasses.
15 Nov 2005	Dr van As	30. Understands the need for energy, but energy with least environment impacts should be used	Comment noted
15 Nov 2005	M Phalane - ELA	31. Has an exhaustive assessment of energy alternatives been considered?	A variety of energy sources are used to produce electricity. This application does not include a comparative assessment of other electricity generation processes.
15 Nov 2005	Dr R Wedlake	32. Have other competitive technologies been considered?	Eskom has considered other technologies such as the European Pressurised Water Reactor, as well as various coal alternatives.
15 Nov 2005	Dr R Wedlake	33. Would there be a comparison of nuclear technologies?	Eskom has considered other technologies such as the European Pressurized Water Reactor.
15 Nov 2005	Dr R Wedlake	34. Where would the PBMR technology fit in relation to other technologies?	According to the energy Policy, the PBMR is one of a number of energy alternatives.
15 Nov 2005	Dr R Wedlake	35. Where would the PBMR design fit in relation to other designs used in other countries?	The proposed PBMR DPP is the first of the 4th generation technologies which encompasses safety systems which are passive. This technology will have application in any country, which has an

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			existing nuclear infrastructure.
17 Nov 2005	Mr. Lakane	36. Why does Eskom, according to the presentation by T Stott, not consider wind as a significant future contributor to the energy mix? According to ELA by utilizing 2% of our coast line, wind could double the current generating capacity,	Wind generation is significantly more expensive than conventional power generation and wind has a low capacity factor, in other words the wind only blows for a relatively small amount of time per year in SA. The typical average per annum would be about 20% for moderate areas and 25-30% for high wind areas. The rest of the time no power will be generated. Coastal areas are sensitive, as such land use is quite restricted.
17 Nov 2005	Mr. Lakane	37. Eskom wind tests it was not done to international standards, only 50m high as opposed to 80m internationally	The largest turbine at Klipheuwel has a rotor at 60m. At the time of installation the largest mobile crane was used - a turbine with a 80m rotor would have been impossible to install. 80m is not an international standard, the turbine size depends on the wind conditions, capacity etc.
17 Nov 2005	Mr. Lakane	38. Not all renewables are reflected in information on presentation.	Eskom has a research programme managed by its Research and Technology Services International (TSI) division, looking at renewable energy sources for power generation. The two major areas under investigation are solar and wind power.
17 Nov 2005	Mr. Lakane	39. What percentage of the electricity growth shown by T Stott represents large users and what percentage represents residential	The split between industrial and domestic is about 80%:20%

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			users?	
17 Nov 2005	Mr. Murphy	40.	What about other nuclear technologies? Amongst others Fusion.	Fusion is experimental. Eskom is however keeping track of all other developing energy generation alternatives.
17 Nov 2005	Mr. Lakane	41.	Dis-proportional investment by Eskom in PBMR relative to other proven technologies. PBMR R 35 b, Other R 255 m, ELA statement.	PBMR figure given is incorrect, the budget is on record as a R 14 b budget for the PBMR Company in total and includes the design and construction of the PBMR DPP, the pilot fuel plant and US design certification costs. There will be a dis-proportionate spending due to the level of technology development associated with the PBMR DPP.
17 Nov 2005	Mr. Moulton	42.	What is Eskom's mandate in terms of electricity generation?	The ability to develop and manage the entire extended electricity value chain. In terms of the Electricity Act, no 41 of 1987, Eskom is required to supply electricity under the control of the National Electricity Regulator. The regulator stipulates areas to be supplied, tariffs, and quality of supply.
17 Nov 2005	Mr. Lakane	43.	The estimated cost of the PBMR is R 15b. This is significantly up from estimates during previous EIA. Why is Eskom still considering this in the light of the higher cost, compared to other alternatives?	PBMR is not different from other innovative technologies considered and investigated by Eskom.
17 Nov 2005	Mr. Lakane	44.	If the PBMR business case is based on the export market, how many orders are there, or	ELA view noted. Business case based on only 100 nuclear reactors into the world

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
		how many potential customers? ELA makes statement that there are none.	market, which represents 2% of the nuclear capacity gap over the next 25 years.
17 Nov 2005	Mr. Murphy	45. Following on from above. Should the SA tax payer be asked to gamble?	This is a decision that was taken at cabinet level.
17 Nov 2005	Mr. Murphy	46. Why does the graph of future generation only reflect coal generation and not other renewable and technologies?	The purpose of the graph is to reflect current generating capacity. Future generation capacity and options are illustrated and discussed in the National Integrated Resource Plan.
17 Nov 2005	Mr. Lakane	47. How much attention is given to solar, considering that 2% of SA surface areas utilized will double current generation capacity?	Concentrated solar power is being investigated by Eskom. An EIA has been initiated for a 100 MW demonstration plant in the Upington area.
17 Nov 2005	Mr. Moulton	48. It is possible that the process is too protracted in SA, that Eskom will place this technology in another country	Noted
17 Nov 2005	Mr. Moulton	49. How long will the RSA coal reserves last?	Base on current consumption the estimate coal reserve is 100 years.
17 Nov 2005	Mr. Lakane	50. Current NNR CEO used to be the Manager of Licence at the PBMR Limited, can not be referee and player.	Comment noted.
17 Nov 2005	Mr. Lakane	51. ELA publicly rejects the PBMR	Comment noted.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
17 Nov 2005	Mr. Lakane	52. How is transport and fuel manufacturing going to be addressed?	This is the topic of a separate EIA application.
17 Nov 2005	Mr. Lakane	53. Concerns relating to the NNR process.	In terms of the NNR Act public hearings will be conducted to allow for input.
17 Nov 2005	Mr. Lakane	54. Demands a multi stakeholder review panel.	DEAT will establish a review panel, and the composition of the panel is the prerogative of DEAT.
1 December 2005	Mr. D Sayce	55. How does Pelindaba fit into this EIA process?	Pelindaba is the proposed site for the manufacturing of fuel. However, this is the topic of a separate EIA application by NECSA.
1 December 2005	Mr. Garbett	56. A nuclear accident at Pelindaba could render insurance of aircraft at Lanseria null and void. Furthermore that the government should take responsibility for the claims in such an event.	This issue should be directed to DEAT in terms of the EIA application for the proposed Fuel plant at NECSA.
1 December 2005	Mr. Sayce	57. The flight path of aircraft using Lanseria is overhead of Pelindaba.	Issue should be taken up with DEAT in terms of the fuel plant ROD.
1 December 2005	Mr. Phalane, Ms Garbett.	58. Alternatives should be assessed and not only the PBMR DPP.	Eskom has a research programme managed by its Research and Technology Services International (TSI) division, looking at renewable energy sources for power

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
			generation. The major areas under investigation are renewables, coals and nuclear.
1 December 2005	Mr. Phalane	59. What protection does the SA tax payer have in the light that a German company holds the patent to the PBMR DPP?	The protection provided is encompassed in the legal framework of the licence.
1 December 2005	Ms. Garbett	60. Should PBMR Company export the technology, will South Africa be responsible for the disposal of all the spent fuel?	As per international conventions, and accepted international contractual principles spent fuel has to be maintained and managed by the country that operates the facility.
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	61. Climate change is an inescapable reality, as is the current energy crisis facing the Western Cape. WESSA therefore suggests that there is an urgent need for South Africa to develop a comprehensive and holistic energy strategy that is broadly debated and accepted in the public realm. A participatory and transparent approach is essential to ensure public support. Such a strategy should include an in-depth assessment of our current and future energy requirements, including mechanisms to reduce demand through behavioural change and energy saving technology. There is a need to explore the social, environmental and economic costs and benefits of all energy generating options available to us, including nuclear. It is our opinion that existing policies and plans have failed to achieve the above. We suggest that only once this has been	The national Energy White Paper explicitly states that nuclear is an option for the future, conditional to its social, economic and environmental suitability. However the evolvement of the policy into specific directives for the future is still a long way of and many of the current Demonstration projects will inform the Energy Policy directive. Current reality points to a bottoms up rather than a top down approach.

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		achieved, and a decision taken that nuclear energy is in fact a path we wish to follow, should we consider testing new nuclear technologies for possible wider roll-out.	
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	The lack of a comprehensive and holistic energy strategy and a lack of transparency have, and will undoubtedly continue to, cloud this EIA process. This must not be allowed to happen. As the Draft Scoping Report (DSR) rightly points out, this EIA process is not the correct forum to address broader strategic issues around energy supply alternatives. However, these issues do need to be addressed and debated somewhere as they directly inform the need and desirability of the proposed development of the PBMR DPP.	The EIR will address the issue of technology alternatives within the ambit of their broad social environmental and economic advantages and disadvantages. The cost aspect of the technologies can also only be handled within broad international experience terms.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	62. Issues that are significant but fall outside of the scope of the DSR for the PBMR DPP: The DSR states that certain issues of a strategic nature cannot be addressed in the EIA due to the site and activity's specific nature of the process. These so-called strategic issues are not specified. It is therefore not clear whether these issues are limited to those contained in table 6, DSR page 70.	The strategic issues relate to those listed in table 6. The strategic aspects have been included in the final Scoping report and will be dealt with in the EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	63. Issues that are significant but fall outside of the scope of the DSR for the PBMR DPP: Items 1, 6 and 9 of table 6 pertain to the issue of economic impacts. The NEMA principle in section 2(3) requires development to be	The strategic issues relate to those listed in table 6. The strategic aspects have been included in the final Scoping report and will be dealt with in the EIR.

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			socially, environmentally and economically sustainable. NEMA principles must be taken into account in the preparation of environmental impact reports required for the granting of permission of certain prescribed activities. Furthermore NEMA section 23(2)(b) refers to the general objective of integrated environmental management which is to identify potential impacts on the environment socio economic conditions and cultural heritage with a view to minimizing negative impacts and promoting compliance with the principles of environmental management set out in section 2.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	64.	Issues that are significant but fall outside of the scope of the DSR for the PBMR DPP: It is submitted that items 1, 6 and 7 relate to the costs and economic viability of the PBMR and are therefore relevant considerations for these assessments as required in terms of NEMA. It is submitted that assessing socio economic sustainability would include assessing the impact on the use of public funds to develop a nuclear technology given the scale of expenditure involved, and would therefore also include an assessment of the financial viability of the pebble bed as an electricity generating option.	The issue of the use of public funds should be taken up with the DME.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of	65.	Issues that are significant but fall outside of the scope of the DSR for the PBMR DPP: Item	Comment noted.

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	Earthlife Africa (Cape Town)	9 deals with the issue of an international market for the future PBMR technology. As stated in the first EIA "the purpose of the proposed plant is to assess the techno economic viability of the technology of the South African and international application for electricity generation and other commercial applications". In the previous EIR it is stated, "the stated commercial potential of the PBMR for global application although outside of the scope of the EIA will be addressed to some degree within the EIR". It is inconsistent to totally exclude this consideration in current EIA. If local markets and real economic potential are identified as issues under economic aspects then by implication international markets should not be excluded from the EIA.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	66. Dissemination of information: Eskom's CEO has stated that they will accept liability for any accidental and operational problems caused by the PBMR. Eskom needs to quantify this risk that has been assumed, especially as it is risk that is excluded from every standard property and aviation insurance policy. Whichever way the liability ultimately falls, South African public will bear the loss, either via state owned Eskom or PBMR government majority owned or directly by government.	The NNR act will require Eskom to have liability insurance therefore the insurer underwrites the risk and not the South African government.

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7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	67. Insurance: Standard property and aviation insurance policies exclude any claims for damage or destruction of property as a result of a nuclear accident. The South African public would therefore shoulder the financial burden of any accidental damage as this risk will be underwritten by the government. Insofar as the government may not be able to pay for such risk the burden will fall on the property owners that fall within the potential danger zones. In terms of the climatic conditions the areas that could be affected would be extensive and financially of such a level that could undermine the entire economy. The proximity of the World Heritage Sites to Cape Town and Pelindaba which are both at risk should be considered and weighed carefully before embarking on this experiment. The loss of either is a risk that should not be undertaken on such a dubious experiment without absolute proof that there is no safety risk. The applicant has acknowledged that safety is not yet proven which should be sufficient reason to abandon the PBMR. Eskom should also reaffirm its undertaking that it will, as it has stated, shoulder the financial risks of the PBMR.	The NNR act will require Eskom to have liability insurance therefore the insurer underwrites the risk and not the South African government. Eskom has an insurer and will fund the proposed PBMR DPP proportional to the share that they hold.

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		The worst case scenario cost should be calculated and factored into the risks of PBMR development.	Comment noted
	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	68. The public should be aware of and given full details of the German PBMR accident that was the reason that Germany abandoned PBMR and is now phasing out nuclear technology.	The consultants do not have information on this accident. The consultants did indicate in a meeting with the Pelindaba Working Group that they did not have information on this accident and requested that this information be made available for consideration in the EIA process via the working group.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	69. Fuel manufacture defects present serious technical difficulties and unacceptable risks to the public and safety in general.	The issue of fuel integrity will be addressed in the EIR. Please refer to table 8 in chapter 7.
COMMENTS REGARDING THE PREVIOUS EIA			
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City	70. During the first PBMR EIA process (1999 - 2003), City comment was submitted and included extensive input from relevant services including Town Planning, Economic	Mawatsan confirms that the CCT indeed appealed against the RoD on the EIA of 2003

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	Manager		Development, Transport and Roads, Emergency Services and City Health. Political endorsement of City comments was obtained in order to ensure that the inputs to the EIA reflected the City's interests broadly. The City's comment at that time concluded that the final EIR was an inadequate basis for a decision to proceed with the PBMR at Koeberg as key environmental risks and concerns raised by the City were not assessed. Key issues raised by the City were omitted from the EIA. The City appealed against the approval of the EIA in 2003.	However, most of the issues raised by the CCT were addressed and assessed in the Final EIA of Oct 2002.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	71.	Eskom have now initiated a second EIA process for a PBMR to be located at Koeberg. The proposed PBMR has potentially significant spatial, health, transport, environmental and safety implications for the City over the 40 year lifespan of the nuclear plant, plus the additional time during which high level nuclear waste is stored at Koeberg. The proposal also has significant implications for the future supply of electricity and for economic development in the region.	Mawatsan acknowledges the Issues the CCT submitted and will address and or assess them during the EIR phase. These issues relate to spatial planning and use, health, safety and transport of nuclear materials and the storage of spent fuel/high level nuclear waste for the life of the proposed PBMR DPP and thereafter. The economic and supply issues will likewise be addressed.
GENERAL COMMENTS: KEY ISSUES RAISED IN THE PREVIOUS CCT APPEAL				
6 March		72.	Many of the concerns and issues raised by the City were not reflected in the previous	These issues were addressed in the EIR 2002. However, the degree of detail appears to

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2006			EIA and subsequent ROD and conditions of approval for the PBMR. These concerns and issues formed the basis for the City's Notice of Appeal and included - High level nuclear waste storage at Koeberg: Financial and environmental costs Current and future emergency planning measures: Costs to the CCT Health monitoring, health risk assessment and ambient radiation monitoring The City of Cape Town's role as a key stakeholder A number of important principles and requirements of the National Environmental Management Act 107 of 1998 These issues have not been sufficiently addressed in the Draft Scoping Report (DSR).	be the contention of the CCT. These issues will again be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR)
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	73.	Financial and environmental costs of waste: The full life cycle financial and environmental costs of storing the high level nuclear waste from the PBMR at Koeberg for the 40 year life span of the plant, and until a final depository for nuclear waste is licensed some time in the future must be addressed in the EIA.	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental	74.	Costs of emergency planning: The costs of current and future emergency planning and related infrastructure are direct costs due to	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report

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	Management) for City Manager		the activity and should thus be borne by the developer, not the City of Cape Town. There is no indication in the DSR of how current and future emergency planning measures are to be addressed.	(FSR).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	75.	Health risks and radiation monitoring: Health monitoring is needed both to reassure the public and surrounding communities, and to timeously identify any health impacts that may occur. The City Of Cape Town requested (during the previous EIA comment process) that a health risk assessment be undertaken. The DSR proposes that the health issue will be addressed by means of an international literature review. This approach is questioned as there are no PBMRs of equivalent scale or technology combinations operating elsewhere in the world. Applicability of the information found via the literature review to this particular project may therefore be questionable. The Directorate: City Health have requested that a team of respected epidemiologists undertake an "independent and unbiased study to generate sufficient epidemiological evidence".	These issues will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR). The health issue does not relate to the technology, but rather the radiological component of the plant under adverse or normal operating conditions and the NNR's standard for such releases. International studies on the subject of health risk incorporates all kinds of nuclear plant and hence the consultants recommendation to follow international best practice and knowledge. Such a study will involve a prolonged period (about 10 years) and the result will be within that of international conclusions. Current monitoring of staff and environmental media at Koeberg nuclear power station indicate results that are well within the standards of the NNR and the

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			international norms. Mawatsan will appoint an independent and internationally recognised specialist to conduct the literature review and to advise on the health and environmental monitoring .
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	76. The City of Cape Town's role as a key stakeholder: The City's role in service delivery, emergency services, land use management, housing delivery and community health was emphasised in comments submitted by the City during the previous EIA process. The current 2006 EIA must include an assessment of the role of the City and its existing and future obligations in terms of relevant legislation and the effect that approval of the proposed PBMR could have on City functions and services.	The impact of the proposed PBMR DPP on the CCT's functions and services will be assessed See chapter 7 of the Final Scoping Report (FSR): " Institutional Capacities"
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	77. Principles contained in the National Environmental Management Act (NEMA): The CCT raised a number of key principles contained in NEMA that must be taken into account in the EIA.	Comment noted.
RADIOLOGICAL ASPECTS/ISSUES			
10 Nov 2005		78. Are nuclear standards, practises and procedures sufficiently demonstrated and maintained at Koeberg NPS?	Yes, Koeberg operates within the NNR requirements.

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10 Nov 2005		79. Has the PBMR technology been proven elsewhere in the world?	The reactor and fuel technology was extensively tested and proven in Germany. The Chinese are currently demonstrating a similar German Pebble Bed Fuel and reactor design.
10 Nov 2005		80. What distance is the evacuation boundary for the PBMR?	The design objective is 400 meters exclusion zone from the reactor building
10 Nov 2005		81. What will happen if there is an (accidental) radioactive release from the PBMR and what contingencies are in place for Koeberg?. There are allegations that Koeberg is not so safe and that the emergency plans are not sufficient.	Koeberg is safe. Koeberg is bench marked against international nuclear peer groups and operates within the NNR licence requirements. Nevertheless an emergency plan approved by the NNR and which includes the local authorities is in place and is regularly exercised and evaluated. Eskom maintains an open ended invitation to members of the community to attend monthly forum meetings on these issues
10 Nov 2005		82. Due to the fuel characteristics of the PBMR a core melt down is not physically possible and consequently there is no need for an emergency plan.	Comment noted.
10 Nov 2005		83. The world history of commercial Light Water Reactors (LWRS) for electricity generation, recorded no deaths, directly or indirectly related to such Plants, over the past 40 years.	Comment noted

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		The worst accident was at Three Mile Island plant and the consequence on human life was zero	
17 Nov 2006	Mr. Murphy	84. If the technology was proven in Germany, why was the PBMR not commercialised in Germany?	Germany was in the process of commercialising this technology when the government at the time stopped the process.
17 Nov 2005	Mr. Murphy	85. What if there is ingress of oxygen? Not convinced of the walk away safety of the plant. What about a scenario where the containment of the reactor is breached, even forcefully (9/11),	This issue is considered in the Safety Analysis Report of the Safety Case to be presented to NNR, as a category 3 issue in terms of the process prescribed NNR/DEAT Cooperative Governance Agreement.
17 Nov 2005	Mr. Lakane	86. Safety Case put to NNR would not be accepted in other parts of the world.	As a member state of the IAEA South Africa has to comply with its requirements. Therefore the NNR process adheres to international standards. This issue is a category 4 issue and will be dealt with in terms of the Cooperative Governance Agreement between the NNR and DEAT.
TECHNICAL ASPECTS/ISSUES			
9 Nov 2006		87. Why did Eskom increase the output of the PBMR from 110 MW(e) to 165 MW(e)?	Design change initiated by PBMR Limited, and resulted from market studies and plant economics.
9 Nov 2005		88. How long does the spent fuel pebbles last when stored? Where will they be stored and	The spent fuel will be stored on site in the specially constructed tanks within the

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			what ultimately will happen to them?	reactor building for the life of the station i.e. 40 years plus. The coating around the uranium kernels are made of materials that will virtually last indefinitely. These coatings retain the radioactive materials within the pebbles and allows the pebble to cool down radioactively as well as thermally. The ultimate destination of the pebbles will be determined by National Policy on Radioactive Waste.
9 Nov 2005		89.	Does electro-magnetic radiation (EMR) from power lines form part of the EIA?	The position of the Department of Health on electro-magnetic radiation originating from power lines is that it has no effect on exposed persons or the environment. As such this will not be included in the EIA. Reference: www.doh.gov.co.za.
9 Nov 2005		90.	Has any construction of the PBMR been started at Koeberg yet?	No construction activities for the PBMR have been started at Koeberg. Such activity will only start when all of the required authorisations have been obtained
10 Nov 2005	Mr. Longden-Thurgood	91.	Eliminating all carbon dioxide emitting power stations will not achieve the full reduction in carbon dioxide emissions without eliminating its emission from motor vehicle exhausts.	Comment noted
10 Nov 2005		92.	How much Carbon credits can the PBMR	At this point in time Nuclear Power Stations

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		earn?	can unfortunately not earn Carbon credits
15 Nov 2005	Mr Barker	93. An increase of 30% in generation is indicated. What effect does this have on the fuel requirements?.	Increase in the fuel requirement will be of the same order.
15 Nov 2005	Mashiule Phalane - ELA	94. What technology changes took place during the design evolution and what impact will that have on fuel usage?	The increase in capacity would lead to a slight increase in fuel usage (see above).
15 Nov 2005	Mashiule Phalane - ELA	Would more pebbles be used, and would the pebbles be redesigned?	More pebbles would be used. The pebbles are the same as would be used for the 302 MW(t) process.
17 Nov 2005	Mr. Moulton	95. How does the current design compare with the previous design, why the changes?	Design changes are reflected on the Eskom web site and the PBMR web site. Information document contains information on this specific issue, i.e. evolution of the technology. Upgrade to 400 MW(t) is based on commercial requirements of the market for power plant.
17 Nov 2005	Mr. Murphy	96. Is it feasible to run a turbine on helium? Availability and cost of helium.	Helium operated turbines have been built and operated and have been proven to work well.
17 Nov 2005	Mr. Lakane	97. Custody of long term waste, how is this ensured?	National Radioactive Waste Management Policy and Strategy address long term management of waste.

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17 Nov 2005	Mr. Murphy	98. Without the nuclear part, only the helium powered turbine/generator is demonstrated. Is this of value?	The DPP will demonstrate the integrated performance of reactor and the turbine for the efficient use of helium as a heat transfer agent.
29 Nov 2005	Mr. J de Villiers	99. Concern regarding the storage and management of spent fuel.	The legal framework for this issue is in place, i.e. National Radioactive Waste Management Policy and Strategy.
1 December 2005	Ms Garbett	100. How did Eskom develop a design if all the parts where not tested?	The individual components of the PBMR are either from proven of the shelf technology, or was tested although not necessarily in combination.
1 December 2005	Ms. Garrett	101. Why can the PBMR DPP not be build at Vaalputs?	Alternative sites where assessed, and Koeberg found to be the most desirable. The plant requires cooling water which is not available at Vaalputs and neither does the required infrastructure for such a plant exist.
1 December 2005	Mr. Garbett	102. Why is it necessary for the demonstration module to be on scale?	The proposed plant is a demonstration plant and not a pilot plant and therefore has to be on full scale.
1 December 2005	Mr. Garbett	103. Was the reactor in Germany more or less the same size as the proposed PBMR DPP reactor?	The German AVR reactor was 15 MW(e) and the THTR was 300 MW(e).
1 December 2005	Mr. Garbett	104. He has seen information on an accident that occurred in the German reactor, and offers	The PBMR limited is aware of incidents that occurred during these programmes.

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		to supply it to the consultants.	
1 December 2005	Ms. Garbett	105. Will the enriched uranium for the fuel be imported?	Yes
1 December 2005	Mr. Garbett	106. How long will the spent fuel be contained in the PBMR Building?	The PBMR DPP is designed to store the full complement of spent fuel of its full life cycle inside the plant building. Low level radioactive waste will be managed via the Koeberg radioactive waste management facility.
1 December 2005	Mr. Garbett	107. How will the waste be managed?	The PBMR DPP is designed to store the full complement of spent fuel of its full life cycle inside the plant building. Low level radioactive waste will be managed via the Koeberg radioactive waste management facility
2 Dec 2005	Attendant at Wessa Focus Group Meeting	108. Is the proposed PBMR DPP totally dependant on uranium, as a fuel?	Yes.
2 Dec 2005	Ms I Waidje	109. There could be a potential problem with uranium from a neurological point of view.	There is no human exposure to uranium in the PBMR DPP
14 Dec 05	Mr W de Pinho	110. Total infrastructure is unable to deal with an emergency.	Viewpoint noted
10 March 2006	RCH Garbett CT Garbett	111. The ability of the applicant to manufacture fuel for the PBMR without defects was previously questioned by us as we	The issue of fire has been included for assessment in the EIR – see table 8, chapter

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	Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	understand that this was a problem with the previous HTR in Germany. We believe that this may pose a threat to the safety of the operation PBMR and believe that in depth research should take place in respect of the problems that German technology over decades was unable to overcome. Fire hazards of PBMR fuel should be dealt with in detail.	7.
SOCIAL ISSUES			
10 Nov 2005		112. What is the construction time and how many jobs will it create?	The PBMR is a small Plant (165 MW(e)) and the construction time will be from 2007 to 2010 (about 3 years) At any one time during construction about 400 to 500 persons will be employed on the site During operation only a small number of persons will be needed (about 100)
17 Nov 2005	Mr. Lakane	113. Why is Eskom supporting the least job intensive option, i.e. PBMR	Eskom support growth by providing affordable electricity
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	114. The applicant points out in respect of social aspects that 'the conclusions of the 302MW(t) PBMR DPP are regarded as valid for the 400MW(t) PBMR DPP and no further assessment will be required (p88 of the DSR).	Please refer to Section 1.2.1, where it is stated that baseline data sets that were generated during the previous EIA and recorded in the environmental impact report (EIR) that are considered to be valid

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		A similar approach is taken in respect of economic aspects, in respect of which it is stated that 'Vecon Economic and Development Consultants assessed the validity of the conclusions for the 302MW(t) PBMR DPP and conclude that the findings remain valid'.	in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. Also refer to table 7 and 8 in Chapter 7 of the Scoping Report, which indicates the process that would be followed to assess each identified significant impact.
ECONOMIC ASPECTS/ISSUES			
10 Nov 2005		115. What is the construction time and how many jobs will it create?	The PBMR is a small Plant (165 MW(e)) and the construction time will be from 2007 to 2010 (about 3 years). At any one time during construction about 400 to 500 persons will be employed on the site. During operation only a small number of persons will be needed (about 100).
17 Nov 2005	Mr. Moulton	116. Electricity must be kept affordable to ensure economic growth; will PBMR contribute to economically feasible electricity?	The purpose of the demonstration programme is to assess the viability of the technology
14 Dec 2005	Mr. W de Pinho	117. Such a large sum of money for a test hit – it could be better spend on providing housing, water new roads and a better country to live in, protecting the environment.	Comment noted
14 Dec 2005	Mr. W de Pinho	118. The technology will pass you by, before you can make any money with your market	Viewpoint noted.

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		segment. This is another tax payers white elephant.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	119. General: On page 80 of the DSR under the issues designated "economic impacts" the issue "expenditure and support for the dismantling and rehabilitation" is indicated. The "recommendations" column states that "that the potential impacts (before and after mitigation) should be assessed during the EIA phase. Recommendations should be made regarding appropriate mitigation measures required to minimize impacts." This recommendation does not appear to make sense and also appears to contradict the recommendation contained in item 6 of table 6 on page 70 which suggests that the use of public funds to develop a nuclear technology is not an issue that falls within the EIA.	The issue of adequate financial provision for decontamination, rehabilitation is include for assessment during the EIA. This report has been amended to prevent an interpretation of the contradiction indicated in the comment.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	120. Dissemination of information: the costs and future availability of imported enriched uranium make it difficult to predict the future costs of operating the PBMR. It is clear that costs of power fuelled by enriched uranium will grow progressively more expensive and renewable such as wind, solar, small hydro, hydro, geothermal which will costs zero to fuel and will only bear a relatively minor cost of maintenance.	Comment Noted: However, base load options in this instance are being evaluated in the National Integrated Resource Plan and Eskom Integrated Strategic Electricity Programme. In addition to this, wind, solar, and pump storage schemes are all being assessed as part of Eskom's demonstration initiatives in order to evaluate the best energy options for providing the country with electricity. Uranium costs are a small component of the

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			overall plant costs and are predictable.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	121. A direct comparison of routine maintenance and operational fuel costs of PBMR vs. alternative energy sources should be undertaken.	This exercise will be undertaken as part of the demonstration process and will include various other comparisons as well.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	122. Dissemination of information: the escalating costs which are difficult to accurately predict (as has been amply demonstrated by the applicant who estimated in 1998 a cost of R847 million, which had grown by 1358% to 11.5 thousand million in 2002 and currently stands at around R16 thousand million rand) a budget overrun of 1889%. Details of the consequential economic risks that are inherent in the PBMR which includes the risk that the PBMR experiment may be decommissioned and abandoned as it may not be suitable for commercial purposes. These economic risks (excluding any potential accidental damage) are currently estimated at a loss to the taxpayer of R16 thousand million rand, excluding the costs of dealing with the resultant high level waste for hundreds of thousands of years as a legacy	Please refer to chapter 7 of this scoping report where it indicates what financial issues will be assessed.

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		by Eskom to future generations.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	123. Dissemination of information: the applicant should give a detailed explanation of the rationale for ignoring the recommendations of the well respected auditing firm PriceWaterhouseCoopers (PWC) following a due diligence survey in which they concluded that "high probability of loss fell outside an the benchmark parameters for projects of this nature". The international market potential crucial to the financial viability was regarded by PWC as uncertain and PWC recommended that Eskom withdraw from the PBMR project.	Commercial aspects do not fall within the scope of an EIA and the issue should be referred to the DEAT.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	124. The document entitled "The economic risk to electricity consumers of the Pebble Bed Modular Reactor" is relevant and pertinent issues are to be included in the Scoping Report.	This information is attached to this report, and considered as part of the EIA. Please refer to appendix 9.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty	125. The public should be advised that the PBMR is a non commercial and only exists because government has subsidised the development to date and is willing to do so into the future irrespective of the apparent lack of viability.	Comment noted.

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	Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd		
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	126. Dissemination of information: Explanation of how viability was assessed when the only firm order on the horizon is from Eskom itself and that is not at the cost of production of the PBMR but at the cost of the next best alternative, meaning that the Eskom orders will be subsidised by the taxpayer.	Comment noted. Advised that the comment be referred to the DME for their attention.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	127. Dissemination of information: The impact on Eskom prices to consumers should the cost of using PBMR technology if it falls between failure and success i.e. that it works but not as well as PBMR hope and production costs of energy are higher than alternatives.	The NER regulates pricing.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty	128. Dissemination of information: That there is clear transparency surrounding the various PBMR supplier companies – orders placed against delivery, cancellation fees,	These are commercial issues and fall outside the EIA scope. However, when contracts are placed, they are made public.

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	Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	shareholders.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	129. Details of international purchases (past present and future) should be detailed. Reasons why purchases and orders were placed prior to EIA completion should be detailed.	Comment noted. The EIA deals with the environmental impacts of this project and not the commercial aspects.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	130. PBMR is a private company albeit the SA government (and the public they represent) is its majority shareholder. The applicant should justify in detail why further public funds be expended at the public expense for DME to deal with the following high level radioactive waste, NNR to assess decontamination process and finally the costs of dealing with long term waste for hundreds of thousands of years at the expense of the taxpayer and the public and not the PBMR company (while to some extent this may be academic there is one outside shareholder being subsidised at the SA public's expense).	Comment noted. The financial provision will be assessed during the EIA.

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10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	131. Details of the financial model in respect of amounts allocated for disposal, monitoring and long term storage for all nuclear waste generated and period of time that applicant will pay to dealt with such waste. The previous figure was R2.7 billion, is this figure included n the PBMR development costs?	Financial provision/guarantees for radiological waste materials generated during the life of the plant will be reflected in the EWIR.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	132. Will the government give a grant in respect of nuclear waste generation – if so, what amount?	This issue to be resolved via government policy. Comment to be directed to the DME.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	133. Details of financial guarantees that will be place should the PBMR company fails to deal with the pollution it creates via the PBMR.	Financial provision/guarantees for radiological waste materials generated during the life of the plant will be reflected in the EWIR.

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10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	134. The costs of the PBMR have escalated by well over a 1000% since 1998, substantially diminishing its perceived comparative competitiveness, which conclusion in any event appears even then to have been founded on dubious and speculative information, and certainly on merit was not a selection of technology of choice, rendering the continued pursuit of the PBMR ill-advised and perhaps even reckless.	Comment noted.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	135. The applicants claim that the PBMR forms a part of a so called "strategic energy mix". However this does not detract from the grave shortcoming of the PBMR, the enormous waste of public funds being poured into a technology that may well be obsolete before it can be proven to be either safe or commercially viable, funded at the expense of our impoverished communities who stand to loose about 15 billion rand on this experiment.	Comment noted.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation	136. Details of financial guarantees that will be place should the PBMR be the cause of catastrophic failure – directly or indirectly.	Financial provision/guarantees for radiological waste materials generated during the life of the plant will be reflected in the EWIR.

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	Services (Pty) Ltd		
EIA PROCESS ASPECTS/ISSUES			
9 Nov 2005	Ms O Andrews	137. The review period of 30 days for the Scoping Report is too short and 45 calendar days are more appropriate, given the mass of information that the I&APs need to work through.	Comment noted. The POS for Scoping approved by DEAT, indicates 30 calendar days review period for the draft Scoping Report, and 45 calendar days for the Draft EIR.
9 Nov 2005	Mrs L Mc Daid	138. Most of the consultants/specialists that worked on the previous EIA were ex employees of Eskom. For the current EIA totally independent consultants must be employed.	The consultants sign a sworn declaration of independence and previous employment record does not disqualify a consultant from acting professionally and objectively.
9 Nov 2005	Mrs L Mc Daid	139. How will the current EIA address nuclear safety issues, since the High Court Ruling directed that the DG for Environment Affairs cannot abdicate his responsibility in this regard to the DG of DME?	The High Court did not rule on this issue. However, the DEAT and the NNR have reached an agreement on how radiological and nuclear safety issues will be dealt with within the EIA. This agreement will form part of the Final Scoping Report.
9 Nov 2005	Ms O Andrews	140. The ELA &public will require timeous information generally and on safety issues to participate in the EIA and to make decisions. The EIA cannot direct or address policy issues e.g. nuclear waste policy given the EIA's status	Comment noted.

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9 Nov 2005	Mrs L Mc Daid	141.	ELA requests focus group meeting to discuss and debate specialist issues and reports.	Focus group meeting will be arranged.
9 Nov 2005	Ms O Andrews	142.	Where does ELA make input into the process of alternative sites? It would appear that the NO-GO alternative is the only option given the demonstration nature of the project.	That is correct. Alternatives were considered in the previous EIA and Koeberg NPS site was found to be best suited for the demonstration module PBMR.
9 Nov 2005	Ms O Andrews	143.	The issues of Health, safety and alternatives were poorly addressed in the previous EIA.	Statement noted.
9 Nov 2005		144.	What is the purpose of the project?	The project will assess the integrated functional integrity and operability of a full scale reactor/power generation unit.
9 Nov 2005	Unknown participant	145.	In the previous EIA, health and epidemiological studies were of a desktop nature. This EIA will need more information.	For the purposes of the EIA application, this EIA study, will not conduct an epidemiological study, but a desktop study of international literature to date. Based on the results of this study recommendations will be made on aspects deemed essential to the EIA process and the proposed PBMR DPP.
9 Nov 2005	Unknown participant	146.	Scoping documents cannot be reviewed during holiday periods and needs to be available in public libraries other than Tableview.	Holiday time does not count for review time although the draft Scoping Report may be out before year end. The documents will be placed in various public libraries around Cape Town and Koeberg residential areas.

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9 Nov 2005	Unknown participant	147. Most of the consultants/specialists that worked on the previous EIA were ex employees of Eskom. For the current EIA totally independent consultants must be employed.	The consultants sign a sworn declaration of independence and previous employment record does not disqualify a consultant from acting professionally and objectively.
9 Nov 2005	Unknown participant	148. How will the current EIA address nuclear safety issues, since the High Court Ruling directed that the DG for Environment Affairs cannot abdicate his responsibility in this regard to the DG of DME?	The High Court did not rule on this issue. However, the DEAT and the NNR have reached an agreement on how radiological and nuclear safety issues will be dealt with within the EIA. This agreement will form part of the Draft Scoping Report.
9 Nov 2005	Unknown participant	149. The ELA &public will require timeous information generally and on safety issues to participate in the EIA and to make decisions. The EIA cannot direct or address policy issues e.g. nuclear waste policy given the EIA's status	Comment noted.
9 Nov 2005	Unknown participant	150. ELA requests focus group meeting to discuss and debate specialist issues and reports.	Focus group meeting will be arranged.
9 Nov 2005	Unknown participant	151. Where does ELA make input into the process of alternative sites? It would appear that the NO-GO alternative is the only option given the demonstration nature of the project.	Alternatives were considered in the previous EIA and current scoping report and the Koeberg NPS site was found to be best suited for the demonstration module PBMR.
9 Nov 2005	Unknown participant	152. The issues of Health, safety and alternatives were poorly addressed in the previous EIA.	Statement noted

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9 Nov 2005	Unknown participant	153. What is the purpose of the project?	The project will assess the integrated functional integrity and operability of a full scale reactor/power generation unit.
9 Nov 2005	Unknown participant	154. In the previous EIA, health and epidemiological studies were of a desktop nature. This EIA will need more information	For the purposes of the EIA application, this EIA study, will not conduct an epidemiological study, but a desktop study of international literature to date. Based on the results of this study recommendations will be made on aspects deemed essential to the EIA process.
9 Nov 2005	Unknown participant	155. How will non-English speaking persons be accommodated in the EIA process?	The EIA is conducted in English. However, the consultant will endeavour to address special requests on merit.
9 Nov 2005	Unknown participant	156. Scoping documents cannot be reviewed during holiday periods and needs to be available in public libraries other than Tableview.	Holiday time does not count for review time although the draft Scoping Report may be out before year end. The documents will be placed in various public libraries around Cape Town and Koeberg residential areas
10 Nov 2005	Mr. Longden-Thurgood	157. The DEAT commissioned an international review of the EIR which was not offered for sight by the I&APs. in absence of any guidance in the ECA, who should be responsible for commissioning the international review. There is nothing to prevent DEAT from establishing its own international review commission.	DEAT is in the process of appointing a review panel.

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10 Nov 2005	Mr. Longden-Thurgood	158. The independence of the specialists contracted to carry out specific tasks is critical.	The EIA consultants have to demonstrate their independence by means of a formal declaration of independence, which requires compliance to a number of factors.
10 Nov 2005	Mr. Longden-Thurgood	159. The DEAT commissioned an international review of the EIR which was not offered for sight by the I&APs. in absence of any guidance in the ECA, who should be responsible for commissioning the international review. There is nothing to prevent DEAT from establishing its own international review commission.	DEAT is in the process of appointing a review panel. The panel composition is the prerogative of the DEAT.
10 Nov 2005	Mr. Longden-Thurgood	160. The independence of the specialists contracted to carry out specific tasks is critical	The EIA consultants have to demonstrate their independence by means of a formal declaration of independence, which requires compliance to a number of factors.
15 Nov 2005	Mashiule Phalane - ELA	161. Would the PBMR EIA and the NNR processes run in parallel?	The processes would run in parallel. However, there would be cross referencing between the two processes.
15 Nov 2005	Mr Barker	162. How will the fuel transport be addressed. Will it be addressed as part of this EIA.	The fuel manufacturing process, including the transportation thereof, is the subject of a separate EIA.
15 Nov 2005	Mr Barker	163. Have alternative sites been properly evaluated	All the potential sites have been assessed during the 302 MW(t) process. The site assessment results have been evaluated

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			and the conclusions remain the same.
15 Nov 2005	Dr van As	164. Would the EIA consider alternative energy forms and are the impacts compared	No, this EIA is activity and site specific. Alternative technologies will be discussed to contextualise the PBMR DPP.
15 Nov 2005	Mieke Barry	165. Would the ROD be issued under the old regulations, and would the new regulation be taken into account.	This application is done under the old regulations (which are still in force) but would consider aspects of the new regulations.
17 Nov 2005	Mr. Lakane	166. NEMA requires environmental, Social and economics to be included in EIA's. This is demanded in this process by ELA, placed formally on record	Comment noted.
17 Nov 2005	Mr. Lakane	167. Place on record that the BID is insufficient when compared to the information level requested in the previous EIA, as well as the potential importance of the proposed activity from an environmental point of view. Demands more information, more detail, especially on issues such as the economics.	Noted. BID is sufficient for its purpose to give information to I&APs to decide whether they want to participate or not. PBMR EIA web site contains more information.
17 Nov 2005	Mr. Lakane	168. Review times should only start once all information is disseminated, and should be at least 60 days.	Comment noted. The POS for Scoping approved by DEAT, indicates 30 calendar days review period for the draft Scoping Report, and 45 calendar days for the Draft EIR.
15 Nov 2005	Mashiule Phalane - ELA	169. Would the PBMR EIA and the NNR processes	The processes would run in parallel.

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		run in parallel?	However, there would be cross referencing between the two processes.
15 Nov 2005	Mr Barker	170. How will the fuel transport be addressed. Will it be addressed as part of this EIA.	The fuel manufacturing process, including the transportation thereof, is the subject of a separate EIA.
15 Nov 2005	Mr Barker	171. Has alternative sites been properly evaluated?	All the potential sites have been assessed during the 302 MW(t) process. The site assessment results have been evaluated and the conclusions remain the same.
15 Nov 2005	Mieke Barry	172. Would the ROD be issued under the old regulations, and would the new regulation be taken into account?	This application is done under the old regulations (which are still in force) but would consider aspects of the new regulations.
17 Nov 2005	Mr. Lakane	173. NEMA requires environmental, social and economics to be included in EIA's. This is demanded in this process by ELA, placed formally on record.	A full EIA will be implemented.
17 Nov 2005	Mr. Lakane	174. Place on record that the BID is insufficient when compared to the information level requested in the previous EIA, as well as the potential importance of the proposed activity from an environmental point of view. Demands more information, more detail, especially on issues such as the economics of the PBMR DPP.	Noted. The BID is sufficient for its purpose to give information to I&APs to decide whether they want to participate or not. PBMR EIA web site contains more information.

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17 Nov 2005	Mr. Lakane	175.	Review times should only start once all information is disseminated, and should be at least 60 days.	Comment noted. The POS for Scoping approved by DEAT, indicates 30 calendar days review period for the draft Scoping Report, and 45 calendar days for the Draft EIR.
17 Nov 2005	Mr. Lakane	176.	Why is Eskom supporting the least job intensive option, i.e. PBMR	Eskom support growth by providing affordable electricity
17 Nov 2005	Mr. Moulton	177.	Electricity must be kept affordable to ensure economic growth; will PBMR contribute to economically feasible electricity?	The purpose of the demonstration programme is to assess the viability of the technology .
29 Nov 2005	Mr. J de Villiers	178.	AHI is in support of the PBMR technology as an energy option.	Comment noted.
1 Dec 2005	Mr Garbett	179.	To whom should appeals be directed to?	Appeals should be lodged with DEAT.
1 Dec 2005	Mr. Phalane	180.	Which Government Department is responsible for the fuel plant?	Department of Minerals and Energy. The NNR regulates the licensing of the plant.
1 Dec 2005	Ms Garbett	181.	Very technical process, adequate time should be allowed for comments.	Comment noted. The POS for Scoping approved by DEAT, indicates 30 calendar days review period for the draft Scoping Report, and 45 calendar days for the Draft EIR.
1 Dec 2005	Ms. Garbett	182.	Doubt the independence of the Consultants.	Consultants are required to sign a declaration of independence.

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1 Dec 2005	Ms. Garbett	183. Who judges the EIA process and determines if the activity can proceed?	The DEAT has the authority to decide on the EIA application.
1 Dec 2005	Mr Garbett	184. To whom should appeals be directed to?.	Appeals should be lodged with DEAT.
14 Dec 20 05	Mr W de Pinho	185. The venue for the Milnerton meeting was unsuitable – lost to much in understanding.	Comment noted
14 Dec 20 05	Mr W de Pinho	186. This new EIA has not given us enough essential information for one to make a proper decision	Please refer to the scoping report, which provides additional information.
14 Dec 2005	Mr. W de Pinho	187. Such a large sum of money for a test hit – it could be better spend on providing housing, water new roads and a better country to live in, protecting the environment.	Comment noted.
14 Dec 2005	Mr. W de Pinho	188. The technology will pass you by, before you can make any money with your market segment. This is another tax payers white elephant.	Comment noted.
14 Dec 20 05	Mr W de Pinho	189. The venue for the Milnerton meeting was unsuitable – lost too much in understanding.	Comment noted. The Milnerton venue will be avoided in future.
14 Dec 20 05	Mr W de Pinho	190. This new EIA has not given us enough essential information for one to make a proper decision.	Please refer to the scoping report, which provides additional information.

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6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	191.	While studies from the previous EIA may be a useful starting point to inform this EIA process, WESSA urges that this new process be used as an opportunity to rectify and improve on the shortcomings of the previous EIA. WESSA trusts that information from the previous EIA will be critically reviewed and that the opportunity to update and supplement specialist information previously provided will be used.	Information that will be used will be revaluated and supplemented to inform the EIR for the 400 MW(t) PBMR DPP.
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	192.	WESSA trusts that the public will have an opportunity to review all information submitted to the decision-makers.	Information used for the EIR will be published as part of the draft and Final EIRs.
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	193.	Nuclear energy is a contentious issue worldwide and there are compelling arguments both for and against South Africa exploring this technology further. WESSA calls for wide and inclusive public debate on the subject. We do not believe that processes dealing with nuclear technology in South Africa have been open and transparent. This in itself has led to public mistrust, fear, difficulty in assessing proposals and has led to a great deal of frustration and time wastage on all sides.	Although the EIA is for a specific Plant, the process has certainly opened much debate on the subject of nuclear, albeit – as WESSA states - in the wrong arena. This complicates the issue for all involved. Mawatsan recommends that WESSA's requirement be directed to the Director General and/or Minister of the Department of Minerals and Energy for attention.
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	194.	WESSA suggest that safety issues be carefully assessed in this EIA process, including risks from unpredictable catastrophic events and sabotage (recent events at Koeberg	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report

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		indicate that the latter is possible, if not likely).	(FSR).
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	195. The need for the proposed PBMR DPP: It is useful to bear in mind that the stated purpose of the PBMR DPP is not to solve our energy crisis, but to "assess the technological, environmental and economic viability of the technology" (page 1 of the DSR). We understand that the proposed development will contribute little to our generation capacity. Considering this, we believe that it is imperative that the DSR establishes what the need for such an 'experiment' is. Without a clear energy strategy as discussed above, this will be difficult to do.	The need for the Plant is quite clear, namely to find a technology that is: • modular and can be added onto in future, • site independent with short construction time, • safe, dependable and environmentally suitable • low capital, operational and maintenance cost (affordable) • uses fuel that is readily available. The northern hemisphere is richly endowed with natural gas and oils to utilise gas turbine technology, which the RSA unfortunately does not have in abundance. Although renewable energy technologies conform to much of the above criteria, which by no means are a comprehensive list, they cannot provide bulk energy on a sustainable basis and are extremely costly. This, however, does not disqualify them from inclusion in the overall energy mix, which for a long time to come will be strongly coal based in the RSA.

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6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	196. The need for the proposed PBMR DPP: The need to expand our nuclear energy production is clearly still under debate and the specific need to explore PBMR technology has not, as far as we are aware, been identified.	See point above
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	197. The need for the proposed PBMR DPP: It is unclear why we need to explore and test this technology, where other already-tested methods exist and similar technology is being tested elsewhere. There are substantial public concerns around nuclear energy in general and concerns around the feasibility, cost and potential environmental impacts of the proposed PBMR in particular. It must therefore be demonstrated that the technology is both necessary and desirable. The precautionary principle (as set out in the National Environmental Management Act (NEMA) (Act 107 of 1998)) must be observed. Thus far the DSR has failed to do this	See point 195 above. The absence of knowledge in the public domain cannot invoke the precautionary principle of NEMA, but rather that which exist in the specialist areas of government and other institutions. Should this principle have been at stake in this project, the DSR would definitely have pointed this out
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	198. Alternatives: Consideration of alternatives is a cornerstone of the EIA process. This is an important mechanism to help identify the best practical environmental option, as required by NEMA. This means that the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP See chapter 7 of the Final Scoping Report (FSR)

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		must be perused. Given that the purpose of the proposed development is not to supply energy, but to test technology, we agree with the assertion in the DSR that the range of alternatives that should be considered here is indeed limited. We are nevertheless concerned that the consideration of alternatives, as suggested in the DSR, is far too limited. We also reiterate our suggestion that the alternative methods of energy production and demand reduction must be explored at a strategic level as a matter of urgency.	
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	199. The no-go alternative: We believe that the dismissal of the 'no go' alternative is unjustified at this early stage of the EIA process. According to the DSR "…the no-go option was not considered during the scoping process as the no-go option would imply that the technology would be lost from the suite of actions included in the White Paper on Energy". We suggest that the logic of this is flawed. The White Paper, a policy document, cannot dictate the decisions made in terms of other legislation (in this case NEMA and the Environmental Conservation Act (Act 73 of 1989)). Furthermore, the 'no go' in terms of this application would not necessarily mean that the technology would be lost from the suite of actions included in the White Paper on Energy. An application to implement the technology elsewhere	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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			could be successful. Implementing the no go would not necessarily spell the end of all nuclear technology in South Africa as it is specifically PBMR technology that is in question here. It is worth noting that the White Paper does not specifically prescribe the construction of a PBMR demonstration plant. We therefore suggest that the no go alternative continues to be included and considered in this impact assessment process, as is legally required.	
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	200.	Location alternatives: We suggest that the location alternatives were prematurely dismissed based on unclear reasoning. It is not clear how the various alternative sites were originally selected and on what information the comparative assessment was based. Was this information up to date? How were the criteria selected? Were these weighted and if so, how? Was public input sought?	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	201.	Location alternatives: We believe that conducting a comparative assessment during Scoping is inappropriate, as Scoping should involve information gathering not assessment. The comparative assessment should therefore have been part of the Environmental Impact Report. We suggest further that alternative sites should continue to be considered and assessed as part of this EIA process, unless they are found to be	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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			completely unsuitable. The public should have an opportunity to review information on which the assessment is based and suggest additional criteria for consideration. Transparency in this regard is key.	
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	202.	Location alternatives: Two major concerns with the proposed Koeberg site are: 1) The proximity to a major urban center and 2) The risk implications of locating the PBMR adjacent to an existing nuclear power station - should there be a major incident at either plant what would the knock-on effect be? These issues do not appear to have been adequately considered in the comparative assessment.	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	203.	Technology alternatives: What, if any, technology alternatives are available that will fall within the limited scope of the stated purpose of the project? This needs to be discussed and explored further. DEAT's Criteria for Determining Alternatives in EIA (2004) states that "Failure to consider alternatives adequately from the outset is symptomatic of a biased process…."	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	204.	The relationship between this EIA decision making process and the National Nuclear Regulator (NNR) is confusing. WESSA is concerned that project-specific radiological issues are relegated to the NNR. We believe	Project specific radiological issues will be evaluated by the NNR to inform the DEAT.

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			that the public must have an opportunity to review and comment on all relevant information that informs the decision made by DEAT. Naturally radiological issues should be considered in such a decision. Issues considered by the NNR should therefore inform the EIA process.	
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	205.	WESSA is concerned with the exclusion of issues as described in Table 6 (page 70) which lists significant issues that, according to the DSR fall outside the scope of the EIA for the PBMR DPP. Is the proposed PBMR financially viable as an electricity generating option? What is the environmental impact of uranium mining? What are the implications of the absence of approved procedures/regulations to deal with spent nuclear fuel and how does this relate to the precautionary principle? Should public funds be used to test this technology? Is there a market for future PBMRs? These are all highly pertinent questions, directly related to the need and desirability of the proposed development. We believe that these issues should be explored in this EIA process and that to dismiss them is unjustified.	<u>Financial viability:</u> One of the purposes of the PBMR DPP is specifically to confirm the financial aspects of the technology as postulated by the PBMR (Pty) Ltd <u>Uranium mining:</u> The PBMR is not linked to any uranium mining locally. The enriched uranium will be imported from international suppliers. <u>Procedures for Spent Fuel:</u> The NNR has specific safety and security standards for the management of spent fuel. Spent fuel at Koeberg is managed in accordance with these standards. <u>Use of public funds:</u> This is a matter for government to decide and falls outside of the ambit of this EIA <u>Market(s) for future PBMRs:</u> On a global scale there is a large market need to replace existing plant that has

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			reached the end of their life as well as to cater for new demand due to growth in economies Should the PBMR confirm all of the postulated characteristics (some of which were mentioned above as criteria for the need of the Plant), then there will definitely be a potential significant market for PBMR technology, both for electricity generation and other commercial applications <u>General:</u> These issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	206. WESSA is further concerned that other important issues directly relevant to the proposed development will not, according to the DSR, be considered in this EIA process. For example, transportation of nuclear fuel will apparently not be dealt with, as this will be considered in another EIA. WESSA does not support the piece-meal consideration and authorization of activities directly related to a proposed development. How will these separate EIA processes inform each other?	The issue of fuel manufacture and transport (FM&T) is under consideration by the Minister for Environmental Affairs and was dealt with in the previous EIAs for the PBMR (Eskom) and FM&T (NECSA).
6 March 2006	WESSA Western Cape Region: Samantha Ralston	207. WESSA believes that the ability to manage radioactive waste in the long term must be	The previous EIA clearly pointed out the absence of a Policy and strategy to address

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	(Environmentalist)		addressed. We are therefore concerned that issues surrounding the storage, management and disposal of the high level waste in the long term will also not be explored in this EIA process - the DSR states that these issues will be considered by the Department of Minerals and Energy (DME). We suggest that it is inappropriate to place this responsibility on solely the DME and that issues concerned with the operation and entire lifecycle of the PBMR DPP are key to the EIA process. We urge that a holistic view of the proposed development and its potential impacts be taken.	the intermediate management and long term disposal of high level waste (HLW) and directed the relevant authorities to formulate and publish such policy. Internationally there are advanced technologies and practises for the safe keeping and management of HLW. However, no sites for the long term disposal of HLW have been established. RSA law obligates the DME with the function of radioactive waste disposal, which ito NEMA must be discharged in cooperation with other government bodies and agencies. However, the presence of specific policy or repository facilities, is not a prerequisites for the establishment of a PBMR or other nuclear facility.
6 March 2006	WESSA Western Cape Region: Samantha Ralston (Environmentalist)	208.	WESSA suggest that safety issues be carefully assessed in this EIA process, including risks from unpredictable catastrophic events and sabotage (recent events at Koeberg indicate that the latter is possible, if not likely).	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City	209.	Development must be socially, environmentally and economically sustainable: The generation and storage on site at Koeberg of high level nuclear waste which potentially poses a significant threat to	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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	Manager		human health and the environment cannot be considered sustainable. The presence of this waste effectively sterilises the site for any alternative use and the location of the existing and any future new nuclear plants has an impact on the future sustainable development of the West Coast region.	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	210.	That waste is avoided …and otherwise disposed of in a responsible manner: Insufficient information is provided in the DSR on the volumes and radioactivity of waste likely to be generated. No long-term repository for high level waste exists and the DSR therefore indicates that waste will be stored on the site for the lifetime of the plant (pg 30 of DSR). This issue continues to be of concern to the City Of Cape Town (as indicated in the appeal submitted to the Minister of Environmental Affairs and Tourism in August 2003). The DSR indicates that waste impacts will be addressed in the forthcoming EIA (pg 88) but the precise scope of these studies is not clear. The radioactivity and volumes of the spent fuel and other waste components is not indicated in the DSR and no clarity is given with regard to how radioactive waste will be stored or managed.	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	211. That a risk averse and cautious approach is applied which takes into account the limits of current knowledge about the consequences of decisions and actions: Locating a 'demonstration' plant adjacent to a large and growing city does not appear to be a risk averse or cautious approach. It is questioned whether it is wise or appropriate to 'test the operability, safety and maintainability of the integrated plant system' in an urban environment where there are growing human populations located 2 km away from the proposed plant and there is significant urban growth northwards (pg 45 of DSR indicates that there is growth north of Milnerton and Table View). The presence of the Koeberg Nuclear Power Station already creates an opportunity cost in terms of city planning and this will be further extended by the existence of the PBMR and the presence of radioactive waste on the site for an indefinite period. There does not appear to be any comparable nuclear plant elsewhere in the world at a similar scale and combination of technology components, which would enable a reasonable assessment of potential risk and impact. Page 119 of the DSR states that the proposed PBMR design is 'unique in its different feature components'.	The issue of "opportunity cost" will be addressed within the context of Spatial planning in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	212.	Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its lifecycle: The potential costs of the PBMR and the lifecycle costs of storing and final disposal of nuclear waste must be assessed. Decommissioning of the PBMR and the final disposal of nuclear waste should be addressed in the EIA. The national Policy on Radioactive Waste and the agreement between DEAT and the NNR both provide a framework for the assessment of the potential impacts of the proposed PBMR throughout its lifecycle.	These issues will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	213.	Investigation of the potential impact, including cumulative effects of the activity and its alternatives on the environment, socio-economic conditions and cultural heritage: The DSR indicates that alternatives (site and technology) will not be assessed in the EIA. However, Eskom were requested by DEAT to scope Pelindaba as a potential site (pg 12). The DSR does not present a balanced evaluation of the two sites and instead the point of departure seems to be 'Is there a better site than Koeberg?' Information contained in the DSR indicates that the Pelindaba site may be feasible,	The issues of technology and site alternatives will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR). The use of a green field or brown field site will not change the findings on the suitability of a demonstration plant. The difference will come into the cost of developing the sites to accommodate the PBMR. The issue of wet or dry cooling, apart from licensing safety, again is largely a matter of cost that can be calculated into the final cost appreciation of the technology.

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		albeit at a higher direct (infrastructural) cost. However, factors such as the savings incurred by not having to transport fuel to the Cape (as it is manufactured at Pelindaba) do not appear to have been included. Table 1 (pg 24) fails to fully evaluate the costs and benefits of these two sites. For example, there is no indication of the volumes of cooling water required or the feasibility of installing a dry cooling system. In an inherently water-scarce country, dry cooling systems must be regarded as increasingly important. The Directorate: Water Services of the CCT have requested that security of water supply also be considered (are there two separate supply points?). Given the scarcity of water sources, the omission of a dry cooling system as a process alternative is questioned. The feasibility of the PBMR is proposed to be evaluated in a situation where a nuclear power plant is already located, with readily available infrastructure and expertise. No comparable site would exist for potential future PBMRs in South Africa and thus any viability studies based on the Koeberg situation would be misleading. The DSR is not required to make detailed	The two plants will operate simultaneously. Koeberg will continue to operate for about another 20 years. The cumulative impact of the two Plants will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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			evaluations but the forthcoming EIA should undertake a balanced and comprehensive assessment of both sites. There is no indication that the proponents have applied to DEAT for an exemption from considering alternative sites and technologies. It is not clear from the report how long Koeberg will continue to operate and whether the PBMR and Koeberg will be operating at the same time. If so, what are the cumulative implications in terms of safety and security and other impacts? What would be the impacts on Koeberg should there be a significant incident at the PBMR (or vice versa)?	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager.	214.	Investigation of mitigation measures to keep adverse impacts at a minimum as well as the option not to implement the activity: The 'no go' option is necessary to assist in determining whether the PBMR should be included in the suite of options for energy supply. Even though this is a 'demonstration plant', it will run for a full life cycle with the associated costs and benefits and is therefore very similar to a commercial plant. The ISEP identifies options to be investigated – not only in terms of techno-economic feasibility, but also in terms of environmental impact and social acceptability. Therefore	The NO-GO option will be addressed in the EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR).

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		the no go option must remain part of the EIA.	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager.	215. Public information….independent review and conflict resolution in all phases of the investigation and assessment of impacts: The City has previously requested that an independent 3rd party review of the EIA be undertaken prior to decision-making by DEAT. This request is repeated for the current EIA.	The issue will be addressed by the DEAT in the current EIA decision process for the 400 MW(t) PBMR DPP.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager.	216. Legal Framework: The draft Scoping Report (section 6.2.2) lists the Land Use Planning Ordinance (Ordinance 15 of 1985) as relevant to the current application. However, the fact that a rezoning application to the City of Cape Town is required, is not mentioned. This requirement has been raised by the City during the previous EIA process. The City of Cape Town would be the relevant authority for an application in terms of LUPO for a PBMR demonstration plant to be located at Koeberg. In terms of the relevant legislation, the decision-making authority would be elevated to the Provincial Government of the Western Cape only if an objection or appeal is submitted by another government body.	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. The requirement of application for rezoning to the CCT will be explicitly addressed in the EIR. However, it is not part of this Application and remains the prerogative of the Eskom (applicant) as to when such application will be lodged with the CCT.
6 March 2006	City of Cape Town: Keith	217. Future electricity supply and evaluation of	

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	Wiseman (Manager: Integrated Environmental Management) for City Manager.	the alternative supply options: The DSR states that SA will need additional peak generation capacity by 2007 and additional base load capacity by 2010. The PBMR DPP, if approved, would be operational by around 2012. However, the proposed DPP is also in response to the need to evaluate a number of power generation technologies not yet implemented in South Africa on a commercial basis in terms of technical, socio-economic and environmental aspects. Clarification is sought on the following aspects of the proposed evaluation of the technical, socio-economic and environmental aspects: • What other supply side generation options are being investigated for the Western Cape? • What criteria will be used to both evaluate the PBMR DPP and to compare it to the above alternative supply options? • Will the data and information to be used for this evaluation be open to the public and other stakeholders for review?	Supply side options being considered in the Western Cape are wind energy and gas; The criteria listed below have been approved by the NER's Advisory and Review Committee (ARC) and are intended to give guidance in determining whether an option is formally included in the base case. Only proven technologies are included in the base case. However this is a demonstration plant and not a base load plant. Demonstration alternatives are not compared with each other, they are evaluated on their own merits. Pricing is determined by the NER.

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		• How will the price of PBMR's be determined? How will this influence the average cost of the electricity to the City? • Under what circumstances would the PBMR DPP be 'decommissioned and dismantled', as stated in the DSR?	Decommissioning and dismantling will occur if the demonstration proves that the technology integration is not viable or if the technology reaches the end of its life.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager.	218. The notes of the meetings held do not include an attendance list which makes it difficult to gauge level of participation.	The Final Scoping Report will contain copy of the attendance registers for the public meetings that were conducted as part of the Scoping Phase.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager.	219. At several of the meetings, questions were raised which were not answered or only partially answered. An attempt has been made to address the issues in the issues trail but information provided is still very superficial. (Example, the request for the Safety Case Report – pg 133). Each issue needs to be clearly addressed in an issues trail and not just 'noted'.	See chapter 5.5 of the FSR.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	220. Issues raised in the previous EIA have apparently been 'included (where appropriate) into this process' (pg 59). It is not clear on what basis issues have been incorporated or dropped. It is recommended that a full list of issues be included in the final scoping report together with an indication of which ones will not be	These aspects as defined in chapter 7 of the FSR are considered to be relevant to the EIR and will be recommended as the TOR for the Plan of Study for the EIR phase to the DEAT's acceptance. The DEAT remains at liberty to add to the content of the PoS.

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		considered any further.	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	221. The DSR reports that an interested and affected party noted that the current NNR CEO used to be the Manager of Licence at the PBMR and therefore could not be both referee and player. In the response to this issue, the comment is 'noted'. If this is indeed the case, the neutrality of the NNR is to be questioned and must be addressed.	This issue was recorded but clearly falls outside of the scope of the EIA. If the proponent of the statement feels strongly about the " neutrality" of the CEO it needs to be directed to the minister of the DME for address.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	222. The newly formed Regional Electricity Distributor, or RED 1, does not appear to have been involved in the scoping process.	RED 1, as is the case with all other I&APs, can participate with the process as and when they require. The process was widely advertised and they will be made aware of the FSR.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	223. The web site has been dysfunctional. For example, repeated attempts to download the ISEP have been unsuccessful.	Eskom apologises. The National Integrated Resource Plan is made available on the website. A hardcopy can be made available. This document is included in the final Scoping document.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	224. Pg 1 Introduction of the DSR. The introductory sections of the report should indicate the regulatory framework for EIAs and also note that South Africa is a member of the International Atomic Energy Agency. It should also indicate to what extent the proposed project is a modification of a nuclear plant versus a brand new	The FSR has been amended to direct the reader to the full chapter that deals with Legal framework. The DSR and the FSR sufficiently defines the scope of the PBMR as a technology

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		technology.	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	225. Pg 11 of the DSR: Coal - South Africa has committed to a reduction of 10% use of coal from 2012 due to climate change issues. This is not reflected in the statements with regard to energy sources.	Comment: Mr Moosa, Eskom's Chairman made a statement during the Climate Change Conference: " Mr Moosa reiterated Eskom's aspiration of reducing the percentage of coal in our primary energy mix by 10% by 2012.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	226. Pg 17 of the DSR: Pelindaba: Pelindaba is located west of Pretoria and not east as stated in the DSR.	The adjustment has been made in the FSR
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	227. Pg 28 of the DSR: Pelindaba infrastructure: Why was supporting infrastructure for the PBMR at Pelindaba 'dismantled'? Would the site be technically feasible if such infrastructure were still in place?	The dismantling formed part of the fuel manufacturing plant for Koeberg that was sold to China. The alternative sites described in the DSR are all technically feasible/suitable. The difference in the sites manifest in the cost of developing infrastructure and the impact thereof on the Environment (Economic, social and biophysical).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	228. Pg 30 of the DSR: Waste management: Clarification and further detail is needed with regard to the proposals to "accommodate all spent fuel" on site 'processing' of low and medium level waste. Would low and medium level waste also be stored on-site or	Low and Intermediate level waste will be transported and disposed of at Vaalputs as indicated in the FSR.

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			would it be transported to Vaalputs for disposal?	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	229.	Pg 31 of the DSR: Demonstration of the commercial performance: Will data on the "key commercial parameters … such as construction costs, plant availability and efficiency, operational and maintenance costs and mid – life upgrade requirements" be available to the public? How will the cost savings of locating the plant at an existing nuclear site be calculated in order to estimate the comparable costs for a green field site remote from such infrastructure?	The commercial parameters of the Plant will be determined. The site related cost becomes a factor of engineering calculation based on experience and estimate that is either added on to the Plant cost.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	230.	Pg 32 of the DSR: Tunnels: Why would underground tunnels connect the reactor building with the services and ancillary buildings?	This is part of the safety design of the Plant and will contain infrastructure elements such as cables, etc.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	231.	Pg 42 of the DSR: Faults: There is insufficient information on the stability (or otherwise) of the three faults.	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. See chapter 7 of the Final Scoping Report (FSR): " Geotectonics".
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City	232.	Pg 45 and 88 of the DSR: Urban growth: There is brief mention of growth northwards of Milnerton and Tableview. This issue needs to be comprehensively addressed in the EIA, making reference to all relevant planning	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP See chapter 7 of the Final Scoping Report (FSR): " Spatial Planning.

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	Manager		documents (not only the West Coast Biosphere Policy as mentioned on pg 88).	
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	233.	Pg 47 of the DSR: Occupational categories: What is "…the case for 26% of the population of the WC"?	The FSR has been amended.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	234.	Pg 86 of the DSR: Thermal outflow: How reliable is the thermal outflow figure given? Should the worst case scenario not be considered?	The figure is reliable and the impact of "spikes" in the outflow temperature will not significantly impact on the receiving water body and its biota. The assessment that will be conducted in the EIR will look at the combined impact of both Koeberg and the PBMR DPP on full load.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	235.	Pg 111 of the DSR: Feasibility and Business Plan availability: When will these documents become available?	The "Feasibility Report or DFR as it is often referred to, was commissioned by the DME. I&APs may approach DME for a copy.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	236.	Pg 112 of the DSR: Decommissioning: What will the costs of decommissioning and dismantling be should the project prove unsuccessful and who would bear them?	The issue will be addressed in the current EIR for the 400 MW(t) PBMR DPP. The cost of dismantling, etc will be for Eskom's account.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental	237.	Pg 145 of the DSR: Meteorological analysis: The report indicates that further work is	The issue will be addressed in the EIR for the 400 MW(t) PBMR DPP.

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	Management) for City Manager		needed. Is this to be addressed in the EIA?	See chapter 7 of the Final Scoping Report (FSR).
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	238.	Pg 147 of the DSR: Geohydrological investigation: It is stated that further geohydrological work is required before construction. Is this information not required for the EIA and EMP?	The EMP will address this aspect as will the EIR.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	239.	Future desalination plants: The Directorate: Water Services has requested that future planning by Eskom should take into consideration that the City of Cape Town may require desalination plants alongside the Cape west coast.	This issue must be taken up with Eskom directly and not through the EIA process. However, Eskom will be notified of the request.
6 March 2006	City of Cape Town: Keith Wiseman (Manager: Integrated Environmental Management) for City Manager	240.	Fuel manufacture and transportation: It must be explained how the information from the fuel manufacture and transportation EIA will be integrated into the EIA for the PBMR.	There will not be integration of information since it is two separate EIAs, conducted by separate entities, viz a viz Eskom and NECSA. The Minister for Environment Affairs is yet to provide his ruling on the appeal against the RoD for the NECSA EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	241.	Unless the report and the processes it envisages are materially reconsidered and restructured, any resultant final scoping report (and environmental impact assessment ("EIA") which may follow) will be defective in terms of the applicable legislation. We note in this regard that the	Comments submitted by LRC on behalf of Earthlife Africa were considered and included n the report. It is assumed that the timing comment relates to the NNR processes. The framework within which the consultants are addressing the NNR/DEAT nuclear related aspects are

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		report is often vague and uncertain in meaning, and that the timing of important decisions is left open. This renders the report and the processes set out therein procedurally unfair to Earthlife and other interested and affected parties ("I&APs").	indicated by the cooperative governance agreement between the parties. Please also refer to section 1.1.5 where the anticipated activity timeframes are indicated.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	242. It is noted with concern that the applicant seems to take the approach that certain issues that were considered during the EIA for the 302MW(t) PBMR do not need not be considered in the current scoping process for the proposed 400 MW(t) PBMR DPP because these issues had been considered during the earlier EIA, or alternatively that some issues assessed under the previous EIA do not need to be reassessed in the current EIA (refer page 7 of DSR).	It appears that there is a misinterpretation regarding the utilisation of previous information. As indicated in paragraph 1.2.1 only valid base datasets would be utilised.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	243. The applicant states at p68 of the DSR that 'A number of issues for consideration were identified through the EIA processes for both the 302MW(t) PBMR DPP (undertaken in 2001 and 2002) and the 400MW(t) PBMR DPP (current process). From the evaluation of these issues, recommendations are made regarding further detailed studies that are required to be undertaken in the environmental impact assessment phase." The applicant sets out issues identified as potentially having a detrimental impact on	Table 7 and 8 in Chapter 7 of the Scoping Report, were amended to clearly indicate the process that would be followed to assess each identified significant impact.

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		the environment on pages 70 to 88 of the DSR. For some of these issues, the applicant refers to studies or assessments that were conducted during the EIA for the 302MW(t) PBMR DPP, and reaches the following conclusion in respect of a number of these issues: "No further assessment required" (refer p86 & 87 of DSR).	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	244. We submit that the applicant's approach is erroneous and bad in law. It is an established principle of administrative law that, where a fresh application is made to a decision-maker, the decision-maker cannot rely on decisions it made in some earlier application dealing with the same or a related subject-matter. This principle also has an important procedural dimension because interested and affected parties ('I&APs') must be given a proper opportunity to participate in the fresh application. Even if it could be argued that some matter in issue in the fresh application was the same as one assessed or decided as part of the earlier application, then fresh evidence or fresh perspectives may be adduced on that issue in the course of the fresh application. The scoping report should provide for this but fails to do so.	Please refer to Section 1.2.1, where it is stated that baseline data sets that were generated during the previous EIA and recorded in the environmental impact report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. There is no intention to rely on decision from the previous EIA.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	245. The applicant has pursued a new and different application for authorisation, namely for approval to construct a 400 MW(t) PBMR DPP. This is clear from the DSR…	Please refer to Section 1.2.1, where it is stated that baseline data sets that were generated during the previous EIA and recorded in the environmental impact

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	Town)		(refer p2 and p7 of DSR). In our view, the applicant had no choice but to make a new application given the change in the subject matter of two applications. The extract from the judgment quoted at page 2 of the DSR (namely that the DG's decision was to be set aside as flawed but should not result in the whole process having to commence afresh) applies only to the EIA for the 302 MW(t) PBMR DPP. We submit that the applicant cannot lawfully rely on any reports or assessments conducted during the EIA for the 302MW(t) PBMR DPP in support of its new and legally distinct application for authorization to construct a 400 MW(t) PBMR DPP. Any and all such reports must be updated and included in the EIR for the 400 MW(t) PBMR DPP, and I&APs must have a full opportunity to comment and make representations on these reports. Failure to do so will render the current EIA irregular and procedurally unfair, and any decision on scoping or on authorization would fall to be set aside on review.	report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. There is no intention to rely on decision from the previous EIA. The public will have an opportunity to comment and make representations on these reports as part of the EIR review process.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	246.	Identity of the Applicant: The current Applicant, Eskom Holdings Limited ("Eskom"), is not the proper or correct applicant. We say so because, on the information	PBMR (Pty) Ltd is the developer of the technology, and Eskom is a client of the technology.

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	Town)		available, it is PBMR (Pty) Limited that owns the technology and intends to construct the PBMR DPP. According to the Detailed Feasibility Report ("DFR") made available during the previous EIA, Eskom's purchasing of the PBMR DPP from PBMR (Pty) Limited is conditional upon it being successfully commissioned (p32 of the DFR). In our view, until such time as Eskom decides to purchase the PBMR DPP, it is PBMR (Pty) Limited that will be the owner of the PBMR DPP and would be the correct applicant for authorisation.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	247.	If PBMR (Pty) Limited is not the applicant, the following difficult questions arise: How can any conditions of an authorisation granted to Eskom be enforced against PBMR (Pty) Limited in the period prior to successful commissioning i.e. before Eskom purchases the PBMR DPP from PBMR (Ply) Limited? If Eskom is authorised to build the PBMR subject to conditions, who will be responsible for complying with these conditions in the event that commissioning of the PBMR DPP is not successful and if Eskom declines to purchase it? For example, who will be responsible for decommissioning the unsuccessful plant?	PBMR (Pty) Ltd is the developer of the technology, and Eskom is a client of the technology.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of	248.	We submit that the correct identity of the applicant and its capacities are material	PBMR (Pty) Ltd is the developer of the technology, and Eskom is a client of the

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	Earthlife Africa (Cape Town)	issues. The applicant has to fulfil any conditions set as part of the environmental assessment process. The responsibilities of a particular applicant are recognised in the White Paper on Energy Policy ("the White Paper") which states (at p68) that in respect of nuclear installations: "the potential exists for acute exposures and catastrophic accidents and therefore require a special liability regime with compulsory financial security (and) sophisticated safety assessment to ensure that the risk is engineered to acceptably low levels…" (emphasis added) We point out that the Environment Conservation Act ("ECA") makes no provision for the transfer of EIA authorisations from one proponent of an activity to another. In addition, in terms of section 25 of the National Nuclear Regulator Act, nuclear authorisations are not transferable. It is therefore not possible for Eskom to transfer its authorisation to PBMR (Pty) Limited pending its conditional purchasing of the PBMR DPP.	technology.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	249. Failure to properly consider the "no-go" option: No application has been made under Section 28A of the ECA for exemption from the requirement to consider the 'no-go'	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.

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			option.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	250.	Failure to properly consider the "no-go" option: the applicant states in the DSR that "...the no-go option was not considered during the scoping process, as the no-go option would imply that the technology will be lost from the suite of actions included in the White Paper on Energy". We submit that this approach is wrong. The White Paper on Energy ('the White Paper') is a policy document and it cannot lawfully change the scope of legislation or obviate enquiries to be made or decisions that have to be taken in terms of legislation. Moreover, and importantly, the White Paper in any event does not seek or purport to do that in respect of the "no-go. option. In short, the White Paper offers no support for excluding consideration of the "no-go" option in respect of PBMR DPP, as the DSR does.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	251.	Failure to properly consider the "no-go" option: The exclusion of the "no-go" option seeks to improperly limited the range of relevant matters to be considered and to in effect fetter the discretion expressly afforded to the decision maker to refuse to authorise the proposed activity under section 21(3) of the ECA.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre	252.	Failure to properly consider the "no-go"	Please refer to chapter 2 where it is

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	(Cape Town) on behalf of Earthlife Africa (Cape Town)	option: Section 24(4)(c) of the NEMA requires that procedures for the investigation, assessment and communication of the potential impact of activities must ensure, as a minimum, with respect to every application for an environmental authorization, the investigation of mitigation measures to keep adverse impacts to a minimum, as well as the option of not implementing the activity.	indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	253. Failure to properly consider the "no-go" option: The White Paper on Energy states that it would not be prudent to exclude nuclear energy as a supply option. The policy suggests the evaluation of all candidate energy supply and demand resources in an unbiased fashion but, importantly, does not seek to prescribe the construction of demonstration plants for specific options, let alone the specific technology of the PBMR.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	254. Failure to properly consider the "no-go" option: The White Paper instead refers to the need to utilize integrated resources planning ("IRP") methodologies to evaluate future energy supply option, and these are described as methodologies for decision making which are concerned with the acquisition of least cost energy resources, taking into account the need to maintain adequate, reliable, safe and environmentally sound energy services for all customers. The	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.

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		IRP approach includes: • the evaluation of all candidate energy supply and demand resources in an unbiased manner; • the systemic consideration of a full range of economic environmental social and technological factors; • the consideration of risks and uncertainties posed by different resource p the facilitation of public consultation in the utility planning process.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	255. Failure to properly consider the "no-go" option: It is clear that while there is some merit in the assertion that all candidate energy supply and demand resources will be evaluated, the nature of that evaluation is not spelt out. Construction of a demonstration PBMR DPP is not mandated. Since the decision making process is concerned with the acquisition of least cost energy resources this suggests that prior to actually testing technology the least cost approach would need to be applied. It is submitted that this approach would curtail the future development of the PBMR in light of its high costs relative to other technologies.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of	256. Failure to properly consider the "no-go" option: The fact that the proposed activity is	Please refer to chapter 2 where it is indicated how alternatives will be dealt

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	Earthlife Africa (Cape Town)		for a demonstration PBMR is not a valid reason for excluding the 'no go' option. Neither the ECA nor the EIA regulations contemplate excluding the 'no-go option' from consideration. To do so would defeat the entire object of having to apply for authorisation to undertake an activity identified under GN R1182.	with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	257.	Failure to properly consider the "no-go" option: The Applicant's suggestion that comparisons will be made with other technologies should the PBMR DPP prove viable does not satisfy legal requirements. The EIA regulations require that all identified alternatives be described in the Scoping Report. Feasible alternatives must then be described in the Plan of Study for impact assessment phase. The EIR must then include a description of each alternative and a comparative assessment of each alternative.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	258.	Failure to properly consider the "no-go" option: It is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including the 'no-go' option. Should the relevant authority fail to do so, any decision under regulation 6(3)(a) or (b) will fail to be set-aside on judicial review.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.

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7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	259. Failure to establish need: The DSR fails to require that the EIA establish that there is indeed a legitimate need for the construction of the PBMR DPP.	Please refer to section 1.1.2
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	260. Failure to establish need: We note that the applicant contends that the PBMR DPP is required in order to validate the assumptions and modelling of some of the supply side power generation technology options, and to assess technical, operational and socio-economic aspects (see page 5 of the DSR). We submit that the applicant has failed to specify what technical aspects need to be demonstrated, and that as a consequence the legitimacy of establishing the PBMR DPP for research purposes is not apparent.	Please refer to section 1.1.2 regarding the rationale for the project. Please refer to sections 1.1.5 and 3.2.1 where the demonstration aspects are indicated.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	261. Failure to establish need: The applicant's claim that there is a need for a demonstration module PBMR is disputed. There are alternative energy sources available to meet the country's energy needs (the National Electricity Regulator states that electricity needs for the next 25 years can be met without new nuclear power). It is also pointed out that the applicant's rationale is contradictory: it claims that the PBMR design is inherently safe and is based on technology proven elsewhere in the world, but then	Thomas report attached to this scoping report in appendix 9 and this information will be considered during the EIA. The consultants also have not received the international review results.

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		claims that the demonstration module is required to test its technical feasibility. Nuclear specialists have cast doubt on the economic feasibility of the plant. One critic is Steve Thomas, whose initial report on the PBMR in South Africa is in the public domain but finds no mention in the DSR. Thomas is one of the experts on the Department of Minerals and Energy's International Panel of Experts, who have reviewed the technical and economic feasibility of the proposed PBMR. This review has never been made available to the public, despite a formal application made under the Promotion of Access to Information Act 2 of 2000.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	262. Failure to establish need: no alternatives to the PBMR are to be assessed in terms of the DSR. To date public acceptance for the PBMR technology has not been properly evaluated and crucial information has been withheld from the public. Integrated resource planning has to take place. The process required in the Energy Policy is not being followed. In addition, the applicant has failed to adequately specify a legitimate purpose and need for a demonstration module PBMR.	Please refer to chapter 2 where it is indicated how alternatives will be dealt with.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	263. Failure to establish need: Chapter 3 of the submission made by Earthlife Africa in respect of the draft EIA for the 302 MW(t) PBMR pointed out that the construction of a	Please refer to sections 1.1.2, 1.1.5 and 3.2.1 in this regard. It is one of the purposes of an EIA to assess

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	Town)		demonstration model PBMR will require the expenditure of a considerable amount of public funds, and may also expose taxpayers to future decommissioning and clean-up costs. In addition, the hazardous nature of a nuclear installation means that the building of such a plant will increase the risk of a nuclear accident, while there will be unavoidable adverse impacts on the environment resulting from increased discharges of radioactive material and radioactive waste, and the production of high level radioactive waste. In the case of the current EIA we likewise argue that as a result of the cost, risk and increased environmental impact associated with the establishment of a new nuclear power plant, the scoping report for the EIA should set out a legitimate purpose and need for a new plant. This is required in order to ensure that the decision-maker can properly assess whether the possible benefits of the proposed development outweigh its potential environmental and socio-economic impacts.	whether the possible benefits of a proposed development outweigh its potential environmental and socio-economic impacts.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	264.	Plan of study for scoping: It is noted that the Plan of Study for Scoping ("POS") purports to limit the discussion of alternatives. We object to the legality of decision-making process flowing from the POS in the light of the fact that no right was afforded to the public to comment on the Plan of Study. Regulation	With inputs from I&APs the EIA has evolved to include an assessment oft alternatives, as indicated in this scoping report. Therefore the POS for EIR will include a process of assessment of alternatives.

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		3(1)(f) of the EIA Regulations stipulates that the applicant is responsible for the public participation process to ensure that all I&APs, including government departments that may have jurisdiction over any aspect of the activity, are given the opportunity to participate in all the relevant procedures contemplated in these regulations. No opportunity appears to have been afforded to Earthlife or any other I&APs to participate in the POS procedure.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	265. Plan of study for scoping: By failing to afford interested and affected parties an opportunity to participate in the Plan of Study for Scoping procedure, the EIA applicant has failed to comply with the requirements of Regulation 3(1)(f). The applicant has also failed to comply with the requirements of administrative justice as set out in sections 3 and 4 of the PAJA. It has prejudiced interested and affected parties who have been denied an opportunity to participate in important procedures such as that determining how environmental issues and alternatives will be identified. It has also prevented Earthlife and other interested and affected parties from making representations on the proposed POS to the decision for consideration. As a consequence, the EIA process is fatally flawed.	The consultants respect this viewpoint, but do not agree. I&APs have had an opportunity to consider the draft scoping report and there has been a comprehensive public participation process. One of the core purposes of the scoping process is to identify aspects and issues to be considered during the EIA. The I&APs have participated substantively in this process. Please refer to section 2.2 and 2.3 regarding alternatives.

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7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	266. Failure to identify key issues: Regulations 6(b) and (c) of GNR 1183 provide that a Scoping Report must include a brief description of how the environment may be affected and a brief description of environmental issues identified. In addition, under the PAJA. a decision-maker is required (amongst other things) to take relevant considerations into account. The DSR does not provide a description of how the environment may be affected by the construction and operation of the proposed PBMR DPP, and the on-site storage of spent nuclear fuels, under abnormal or emergency conditions (as opposed to normal operating conditions).	The issues mentioned in here have been included in tables 7 and 8 of chapter 7. These issues will be comprehensively assessed during the EIA phase as described in chapter 7. A brief description of the associated impacts is provided in table 7 and 8.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	267. Failure to identify key issues: The LRC submit that key issues that should be described in the DSR include: The potential impact of the PBMR DPP on the operation and management of the existing Koeberg Nuclear Power Station in the event of an abnormal or emergency event at the PBMR DPP, and visa versa; The potential impact of the PBMR DPP on the environment in the event of a catastrophic incident.	Please refer to table 7 and 8 of chapter 7.

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7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	268.	Failure to consider alternatives: The Draft Scoping Report appears to identify three categories of alternatives to the proposed PBMR DPP. It then attempts to preclude the further investigation of two of these alternatives (the energy I technology option and the 'no-go' option), and also presents an assessment of the third alternative (site alternatives) as a fait accompli.	Please refer to chapter 2 of this report.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	269.	Failure to consider alternatives: It is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including energy I technology options, the 'no-go' option and site alternatives. The applicant should also be requested by the relevant authority to remove the comparative assessment of site alternatives from the Draft Scoping Report. Should the relevant authority fall to do so, any decision under regulation 6(3)(a) or (b) will fall to be set-aside on judicial review.	These issues will be dealt with in the EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	270.	Failure to consider alternatives – Energy and Technology Alternatives: The DSR fails to describe energy and technology alternatives identified during the Scoping phase of the EIA.	Please refer to chapter 2 where it is indicated that a comparative assessment of the supply side alternatives included in ISEP will be addressed I the EIR.

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		Instead, the applicant presents information regarding the energy policy, the DME's integrated energy plan, the NER's national integrated resource plant, and the applicant's own strategic electricity planning process. It is submitted that none of this information is relevant to the DSR, nor does this information justify the applicant's disregard of Regulation 6(d) of the EIA Regulations.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	271. Failure to consider alternatives – Energy and Technology Alternatives: the applicant has made the assumption that other energy and technology alternatives are not relevant to the scope of the entire EIA process for the proposed PBMR DPP. It is stated at page 55 of the DSR under the heading 'Assumptions of the Study' that "This report and its investigations are project-specific for a demonstration plant, and consequently the environmental team did not evaluate any other energy or technology alternatives". It is submitted that this assumption is ill founded. There is no provision in the ECA or the EIA regulations that empowers an applicant to ignore alternatives because of the 'project specific' nature of an EIA application. In fact, it is submitted that most EIA applications are project specific. For example, if an applicant were to apply for	With inputs from I&APs the EIA has evolved to include an assessment of alternatives, as indicated in this scoping report. Therefore the POS for EIR will include a process of description of alternatives.

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			authorisation to construct a medical waste incinerator, does the 'project specific' nature of the application preclude a description of identified technology alternatives (such as autoclaving or sterilisation) in the DSR? The answer is clearly that it does not. The term "project specific" is also improperly manipulated in the DSR, which seeks to hive off "project specific" radiological matters to the NNR.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	272.	Failure to consider alternatives – Energy and Technology Alternatives: energy and technology alternatives were raised during the Scoping process. For example, the following alternatives are identified: • wind electricity generation; • solar electricity generation; • pumped storage generation; • non-PBMR nuclear technology options. We submit that other alternatives that should also be described in the Scoping Report include solar thermal chimneys and tidal current (as these have the potential to provide 24-hour energy).	Please refer to chapter 2 where it is indicated that a description of the supply side alternatives included in ISEP will be addressed in the EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	273.	Failure to consider alternatives – Energy and Technology Alternatives: By failing to describe all the alternatives identified, the Applicant has not complied with the	The alternatives will be considered and described in the EIR to contextualise the PBMR DPP.

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	Town)		mandatory legal requirements of the EIA Regulations. In the circumstances, it is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including energy and technology options. Should the relevant authority fail to do so, any decision under regulation 6(3)(a) or (b) will fall to be set-aside on judicial review.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	274.	Failure to consider alternatives – Geographical / Location Alternatives: An analysis of the DSR reveals that instead of describing geographical I location alternatives identified during the Scoping phase of the EIA in accordance with the EIA Regulations, the Applicant has improperly sought to pre-determine the issue by including a comparative assessment of alternatives in the DSR. The EIA Regulations clearly stipulate that a comparative assessment of all the alternatives should be reported in the Environmental Impact Report.	Refer to section 2.3 of the scoping report for a description of geological alternatives. This discussion will b included in the EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	275.	Failure to consider alternatives – Geographical / Location Alternatives: The Applicant also seeks to introduce information and assessment from a previous and legally	Refer to section 2.3 of the scoping report for a description of geological alternatives. This discussion will be included in the EIR.

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	Town)	separate and distinct EIA into the DSR, and inevitably concludes that the alternatives are less desirable than the proposed Koeberg site. It is submitted that the Independent Consultant is not legally competent to incorporate information from a previous and legally distinct EIA and adjudicate it to be 'valid' at the Scoping Phase of an EIA, as discussed in paragraph one above. At the very least such information, including any underlying reports upon which the information relies, should be made available to I&APs for critical comment. Various factors (including the lapse of time between the previous comparative site assessment and the current application; the possibility that new interested and affected parties may wish to comment, changes in site conditions such as the precarious state of the Koeberg reactor and the like) could influence the results of a comparative site assessment undertaken in respect of the new proposed 400 MW(t) PBMR DPP. These results could differ significantly from the results from those of the comparative site assessment undertaken in the EIA for a 302 MW(t) demonstration model PBMR. To preclude interested and affected parties from participating in a comparative assessment or having the opportunity to provide comment on alternatives sites in respect of the proposed 400 MW(t) PBMR DPP would render the current EIA process unfair, and any	As indicated in paragraph 1.2.1 only validated base datasets would be utilised.

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			decision to accept the draft Scoping Report would be subject to be set aside on review.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	276.	The assertion that all potential environmental impacts have been identified through studies and public participation is misleading wrong and without any foundation. It is possible that further issues will be identified in the process of comment on the DSR which this submission is a part of. There is still a public comment period to follow, and the scoping report should provide for this in respect of potential environmental impacts.	Comment addressed in section 5.4 of this report.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	277.	The DSR refers in paragraph 5.4 to a screening process to consider which issues are significant. However a scientific set of criteria and a proper ranking procedure has not been set out in this document. For example there is no justification why the proximity of a nuclear reactor (Koeberg). and an ailing one to boot, to the proposed PBMR reactor is not considered a site criterion whereas history and archaeology e.g. the existence of significant fish traps is treated as a relevant consideration. The relative importance of the various criteria applied to the assessment of alternatives is not ranked.	This is screening process, of which the criteria are provided in section 5.4. The ranking of issues, with the associated procedure will be indicated in the EIR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape	278.	Assumptions of the Study: The DSR states that it is assumed that where relevant and appropriate studies undertaken during the	Please refer to Section 1.2.1 and section 5.4 , where it is stated that baseline data sets that were generated during the previous EIA

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	Town)		302MW PBMR EIA are acceptable for use in the current EIA process. It is disputed that any study and in particular the economics and safety studies of the first EIR are acceptable for use the current EIA process. … The current report is defective in that it does not provide for the proper assessment, nor does it disclose for comment and debate foundational documents. LRC refer to the following documents which should be disclosed: • The Safety Report • The Detailed Feasibility Report • The report of the International Panel of Experts Technical and Economic Feasibility Report • General Operating Rules • Operating Technical Standards • Probabilistic Risk Assessment	and recorded in the environmental impact report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. There is no intention to rely on conclusions from the previous EIA. The safety aspects will be evaluated as part of the NNR safety case. However relevant information will be included in the environmental impact report in accordance with the NNR/DEAT cooperative agreement.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	279.	Assumptions of the Study: In the context of safety, a major deficiency in the DSR is its failure to provide for an assessment of the probabilities and consequences of a catastrophic event affecting the PBMR and/or the adjacent Koeberg. This is a mandatory relevant consideration in the	This issue has been included for assessment in the EIR – see table 8, category 2.

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		assessment process under the legislation and also has been identified as a major concern in the White Paper. … Pursuant to s197(1) of the Constitution, all decision-makers have a duty to loyally execute the lawful policies of the government of the day.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	280. We also dispute that all information provided by Eskom was correct and valid even at the time that it was provided. In this regard we refer to and incorporate by reference herein the LRC's submissions in respect of the 302MW(t) PBMR DPP as well the two expert reports referred to above.	LRC's opinion noted.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	281. Reliance placed in the report on the co-operative agreement between DEAT and the NNR ("the co-operative agreement"): The reliance placed upon the co-operative agreement between the NNR and DEAT undermines the scoping process and has resulted in an improper DSR. The co-operative agreement and the DSR draw an unjustified and indefensible distinction between "radiological/radiation issues of a generic nature not directly related to the project" (category 1) and "radiological/radiation issues of a generic nature directly related to the project" (category 2), and then provide that the latter category will generally be addressed in the	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement be addressed to DEAT and the NNR.

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			formal "Safety Case" to be submitted by the applicant to the NNR. But the site specific issues lie at the heart of the environmental assessment process which has to be undertaken by DEAT.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	282.	Reliance placed in the report on the co-operative agreement between DEAT and the NNR ("the co-operative agreement"): It is totally unclear what is meant by the assertion that issues in category 2 "will be 'tracked' within the EIA process"; and that the environmental practitioner will provide "responses to issues" and "answers to issues".	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	283.	Reliance placed in the report on the co-operative agreement between DEAT and the NNR ("the co-operative agreement"): DEAT cannot delegate its decision-making functions to the NNR or, alternatively and in any event, has not purported to do so, so it cannot let the NNR set conditions as part of the EIA process, as the DSR proposes.	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	284.	Reliance placed in the report on the co-operative agreement between DEAT and the NNR ("the co-operative agreement"): The EIA process also cannot be left open-ended yet the DSR and the co-operative agreement envisage precisely this, by saying that if input from the NNR is not available for processing as part of the EIA process, the DEAT will "refer	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR.

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			these issues to the NNR process and make all (DEAT) decisions conditional on this process".	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	285.	Reliance placed in the report on the co-operative agreement between DEAT and the NNR ("the co-operative agreement"): I&AP's could be denied procedural fairness and a proper opportunity to comment on any input provided by the NNR or any purported decision made by the NNR under guise of the EIA process 7.1 and 7.2	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	286.	Summary of issues identified: Paragraph 7.1.1 of the DSR incorrectly reflects the economic issues identified in the scoping report for the 302MW(t) PBMR DPP. In terms of this report para 7.4.4 economic aspects were limited to: • the economic potential of a local based nuclear industry • impact on eco tourism in the region around Koeberg • impact on supply site management based on the assumption that the plant proves viable. The issue of life cycle costing was added later at the request of the Department of Environment Affairs & Tourism. The plan of study for the first EIA reflected the following issues under the title "Economic Aspects" and	Your comment noted and addressed in section 7.1 of this report.

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			included those issues mentioned above as well as life cycle costing and markets for PBMR. It thus denied that the items: • impacts on spatial planning and land use; and • economics of the technology were raised as an issue under the heading "Economic Aspects" in the first EIA. Impacts on spatial planning were mentioned without reference to land use under "social impacts". The plan of study for the first EIA did not simply include as an issue "safety and security impacts". This issue was stated In a restricted form, namely "conventional safety and security impacts (i.e. excluding radiological aspects for which the NNR findings will Inform the EIR)".	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	287.	Mitigation measures to manage environmental impacts: the application for authorization states that 'the EIR for the 302 MW (t) PBMR DPP contained a comprehensive environmental management plan for the construction and operation/maintenance of the proposed project. The mitigation measures and recommendations regarding management of environmental impacts will be amended/augmented, as appropriated for the 400 MW (t) PBMR DPP."	An EMP for the proposed 400 MW(t) PBMR DPP will be submitted as part of the EIR for public consideration. Only validated base datasets would be utilised.

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		This approach is objectionable. Mitigation, which is a requirement for an EIA should take place before authorization. However it is being deferred to an environmental management plan, which presumably is drawn up after the record of decision. Regulation 8(a)(ii) of GNR1183 states that an environmental impact assessment must contain a description of each alternative including particulars on the possibility of mitigation of each identified impact. The practice of deferring mitigation to an environmental management plan, which usually is located in one of the conditions of the record of decision, is legally improper.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	288. Gaps in knowledge and underlying assumptions: The application for authorization contains no list of gaps in information predictive measures used and underlying assumptions. This is unacceptable given that the design is not final and the safety assessment has not been completed.	Refer to section 5.5.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	289. Environmental aspects with no radiological dimension: Table 7 of the DSR contains a summary of the screening assessment Under waste management generation of radioactive waste is included, It is not clear why this is included under a section dealing with environmental aspects with no	This issue has been corrected in table 8 of this report.

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		radiological dimension.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	290. Environmental aspects with no radiological dimension: A second section on waste management is included on page 77 and relates to "continued management of radioactive waste". However no assessment of the impacts of waste management is in fact recommended, rather it is suggested that the issue of continued management of radioactive waste is merely to be considered by the Department of Mineral & Energy Affairs. This is an abdication of responsibility to continue the impact of generation of large quantities of radioactive waste.	The issue will be assessed in the EIR and mitigation included in the EMP for consideration by the public, the applicant and the authorities.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	291. Environmental aspects with no radiological dimension - the impact of waste management during the decommissioning of the plant: Storage/management of long-term high-level waste. It is recommended that issues are considered by the Department of Mineral & Energy and included in the National Waste Policy. This constitutes an abdication of responsibility to consider the impacts of storage and management of long-term high-level waste.	The issue will be assessed in the EIR and mitigation included in the EMP for consideration by the public, the applicant and the authorities.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	292. Environmental aspects with no radiological dimension - the impact of waste management during the decommissioning of the plant: Decontamination of irradiated	Comment noted.

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			materials. Here the issues are to be assessed by the NNR process and to inform the EIA process. It is submitted that any input provided by the NNR should take place before completion of decision making in terms of the EIA process, and be subject to procedural rights to comment by I&AP's and critical decisional scrutiny by the DEAT.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	293.	Environmental aspects with no radiological dimension - the impact of waste management during the decommissioning of the plant: Long-term disposal at the Vaalputs facility. Here the issues are to be considered by the DME and included in the National Waste Policy. Once again there is an abdication of responsibility to consider the assessment of impacts of long-term disposal of the Vaalputs facility (e.g. increased traffic, effects on adjacent communities of increased risk of accidents in the transportation of nuclear hazardous waste etc).	Comment noted.
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	294.	Environmental aspects with no radiological dimension - the impact of waste management during the decommissioning of the plant: Dismantling of the plant, disposal of plant material and high-level waste storage plant. Under this item waste management also includes the issue of radiological waste. Issues are to be assessed by the NNR process and to inform the EIA	Comment noted.

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			process. The NNR process should precede the final ROD for the EIA.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	295.	Environmental aspects with no radiological dimension: the management of waste, It's storage and transportation, and the issue of decontamination of the site are issues that are not novel in the sphere of nuclear management. The environmental impacts of the generation of a known or easily estimable amount of nuclear waste can readily be ascertained from the available knowledge on the matter within the nuclear industry. There is no justification for deferring the consideration of the impacts hereof to other departments as is suggested in the DSR. The legislative provisions in terms of which for example the DME is to consider storage and management of waste are not spelled out. This precludes an evaluation of whether there will be substantial compliance with the assessment requirements of the ECA if this is indeed a lawful approach. The same applies to the Issue of decontamination of the site. Why does the DEAT need the NNR to deal with this issue? The consultants can draw up expert reports so that the DEAT can discharge its responsibilities of assessing the impacts hereof before giving a record of decision. If not, the approach adopted by the	Comment noted. The NNR is the Department with the jurisdiction in this case.

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			consultants needs to be properly justified in the DSR.	
7 March 2006	Legal Resources Centre (Cape Town) on behalf of Earthlife Africa (Cape Town)	296.	Application for exemption: It is noted that Eskom's EIA Application under section 21 of the Environment Conservation Act 73 of 1989 (ECA) includes a reference to an application for exemption in terms of s28A of ECA. In terms of this application, Eskom sought exemption from the process to assess energy/technology alternatives and site alternatives, and from the associated public participation process. We are advised that Eskom has withdrawn this application. This fact should be recorded in the DSR in order for it not to be misleading.	Please refer to section 1.2.1 of this report. A notice of the withdrawal of the application was forwarded to registered I&APs. Please refer to appendix 7.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	297.	Dissemination of information: The scoping report should include a means of communicating the costs, risks and possible benefits clearly, fairly and objectively with all communities in South Africa in each of the official language groups (not only in English & Afrikaans) and in a manner that is clear and understandable for the average citizen with a basic level of education and average IQ. While some I&APs may not understand highly technical information, they should be given an equal opportunity, which is there constitutional right, to be briefed on all material aspects of the proposed PBMR,	As far as is reasonable possible, the EIR will be written in a non technical and clear and understandable language. The IER will be available in English, with executive summaries available in the regional language of the Koeberg area. This process takes place in terms of the relevant legislation. The public are consulted as part of the EIA process.

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		which should be presented in an honest, straightforward, readily understandable format. South African communities, whom would benefit from the 14 thousand million rand of public funds that may be wasted should the PBMR experiment [not prove successful], should be consulted and opinions canvassed.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	298. The specialist studies that have been made in respect of the EIA for the 302MW(t) PBMR DPP are not acceptable for this new application except in circumstances that are absolute insofar as no other result could reasonably be concluded and that the parameters of the specialist studies remain unchanged.	Please refer to Section 1.2.1, where it is stated that baseline data sets that were generated during the previous EIA and recorded in the environmental impact report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. There is no intention to rely on conclusions from the previous EIA.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation	299. On what basis is it deemed that the level of information and assessment that will be consulted in the final EIR should be determined y the agreement between DEAT and the NNR. We do not accept the proposed lack of public participation in the aforementioned agreement and call for transparency.	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR.

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	Services (Pty) Ltd		
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	300. We reject the exemption applied for in respect of disregarding alternative energy sources and alternative sites.	The application for exemption has been withdrawn. Please refer to section 1.2.1 of the scoping report.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	301. Matters raised in previous documents prepared by the I&AP for the previous PBMR EIA to be included in the Scoping report.	This information will be attached to this report and considered in this EIA. Please refer o appendix 13.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation	302. The NO-GO option: the proponent's argument is irrational as there is no point in spending R14 billion (of taxpayer's funds) on a demonstration plant that is not commercially viable. Similarly to wait until it is known if the PBMR DPP is viable or not, before making detailed comparisons with other technologies makes no sense	Please refer to section 2.2 where it indicates that the no-go option will be considered in the EIR.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
	Services (Pty) Ltd	whatsoever. This should more appropriately be called the NO-SENSE option.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	303. A clear picture of "cradle to grave" environmental impacts of the PBMR including the building and development impacts, the fuel plant impacts, the ongoing uranium mining impacts, the enrichment impacts, the transport impacts, should be undertaken with a comparison to other technologies, with a 20, 30, 40 year projected running costs versus alternatives.	Issues relating to fuel manufacture and transport are the subjects of a separate EIA.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	304. It is common cause that the following are just some of the unknown aspects in respect of the PBMR DPP and answers will only be known after spending 14 billion rand and 2-7 years after the PBMR DPP is complete and operational: • Safety • Viability • Power generating ability and sustainability • Ability to retain helium within the pressure boundary • Operational costs • Construction costs	Relevant departments within the DME will evaluate the financial aspects and safety aspects of this DPP. The EIA will evaluate the environmental and social and economic aspects of this project.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
		• Cost of power to consumers • Operational costs • Maintenance costs and maintainability • Plant availability and efficiency • Performance under different conditions of key mechanical components. • Reliability of power generation • Commercial viability The applicant should inform the public on how in light of the above the decision to proceed meets ethical criteria for use of public funds and the potential risk to health safety and environment.	
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	305. Emission of gaseous chemical compounds during fuel manufacture needs to be assessed on both workers and the environment. Full details of the noxious and offensive gas application content for permit should be provided.	Issues relating to fuel manufacture and transport are the subject of a separate EIA.
7 March 2006	RCH Garbett CT Garbett	306. Details of the content of all applications for permits required by the PBMR should be disclosed.	Please refer to section 6.5 of this report.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
	Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd		
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	307. Issues described in the DSR as "significant issues falling outside of the scope of the EIA for the PBMR DPP": These issues are all relevant and we object to the applicant not dealing adequately or at all with any of these issues.	The issues will be dealt with in a manner to contextualise the PBMR DPP.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	308. Details of greenhouse gas emissions and radioactive gas emissions should be detailed. Why does Eskom misrepresent the PBMR as a clean power to the general public.	Issue included in the scope of the EIA. Please refer to table 8 of chapter 7.
7 March 2006	RCH Garbett CT Garbett	309. Full disclosure of potential hazards to "receiving" populations should be detailed and explained fully to those "receiving	The EIA process is a public process and the EIR is a public document. Any impacts (hazards) assessed in terms of this process

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
	Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	populations".	will be fully disclosed.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	310. The radiological / radiation issues and the NNR evaluation must be available to I&APs during the EIA phase. It is not acceptable that the NNR evaluation is made a condition of the RoD. I&APs will be unable to comment on these issues.	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the agreement should be addressed to DEAT and the NNR. This report with the issues and comments raised will be presented to DEAT.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	311. The radiological / radiation issues must be addressed in the EIA. The consultation between the NNR and DEAT must be open to public review and comment to ensure objectivity and public participation.	The *co-operative agreement* is a process indicated by DEAT and the NNR and followed by the consultants. Comments on the cooperative agreement should be addressed to DEAT and the NNR. This report with the issues and comments raised will be presented to DEAT.
7 March 2006	RCH Garbett CT Garbett	312. In view of the lack of participation of the majority of the SA citizens we reject the claim	The intention of the draft scoping report is not to ignore these issues, but to indicate that sufficient baseline data exist for these

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
	Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	in the DSR that no further study is required.	issues to be assessed.
7 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust maleng Farm cc fessional Aviation Services (Pty) Ltd	313. The full details of total waste by weight and volume over 40 year design life to be generated should be detailed in the EIA.	This information would be required for assessment and would therefore be included in the EIR.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	314. We intend to oppose and reject the scoping report and to enforce our rights should the applicant refuse to incorporate direct and accurate comparisons between alternative energy technologies and the PBMR into the EIA; such alternatives to be fully assessed and publicly and impartially debated.	Please refer to section 2.1.5 where it is indicated that a comparative assessment of the supply side alternatives included in ISEP will be addressed in the EIR
10 March 2006	RCH Garbett CT Garbett	315. The applicant has now brought a new application for a new PBMR and therefore may not rely on information from a previous	Please refer to Section 1.2.1, where it is stated that baseline data sets that were generated during the previous EIA and

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
	Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	and failed application.	recorded in the environmental impact report (EIR) that are considered to be valid in the context of the proposed 400 MW(t) DPP will be validated and reassessed as part of the 400 MW(t) PBMR DPP EIA process. There is no intention to rely on conclusions from the previous EIA
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	316. Sustainable renewable alternatives will be cleaner and will have a kinder footprint on the planet and its people and have developed considerably both technologically and in competitiveness since the previous EIA. To disregard these vital attributes in order to sustain a notional number of technologies is not rational – to refuse to consider them as a replacement at all is disingenuous.	Comment noted. Eskom is considering these alternative technologies and has put up demonstration plants to decide their future role in the overall generation suite.
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	317. The PBMR has been identified by the applicant and government in the White Paper on energy as one potential energy source. However this does not justify blindly continuing with a project without prudently & diligently assessing other energy sources that may be proven, commercially viable, superior, less hazardous, may accomplish the PBMR function efficiently and more economically, at least within a more acceptable timeframe than the PBMR's scheduled commercial roll out date of 2015 (assuming there are no unforeseen delays	A description of the alternative technologies will be provided within the EIR to contextualise the PBMR DPP.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
		and the experiment actually works)	
10 March 2006	RCH Garbett CT Garbett Wat Props Pty Karee Trust Itumaleng Farm cc Professional Aviation Services (Pty) Ltd	318. We do not accept that the motivations of alternative energy assessments developed in terms of Eskom's ISEP process were either satisfactory or valid as alleged by the applicant. We do not believe that any policy overrides the necessity and good sense for a properly conducted EIA. The applicant is morally duty bound not to try to use sharp tactics to avoid their obligations towards the public.	A description of the alternative technologies will be provided within the EIR to contextualise the PBMR DPP.
27 March 2006	Wilhelm Alheit	319. How has the waste disposal facility been sited & designed to contain the radiation hazard?	The high level radiactive waste will be contained within a disposal facility designed to accommodate and store such waste for 40+40 years The low level and inter-mediate radioactive waste will be disposed at Vaalputs.
27 March 2006	Wilhelm Alheit	320. How long after decommissioning will the level of radioactivity constitute a health hazard?	The spent fuel is contained and managed in a manner that contains no risk to public health.
27 March 2006	Wilhelm Alheit	321. During this time, what is required in terms of monitoring and maintenance of the facility?	This is prescribed by the NNR.
27 March 2006	Wilhelm Alheit	322. Has such activities been costed and discounted into the current costing of the	NER Determines pricing and not Eskom.

DATE	ISSUE RAISED BY	ISSUE	RESPONSE
		project/electricity or would future generations have to bear the costs	
27 March 2006	Wilhelm Alheit	323. Consideration of alternatives (full life cycle costing) - How does the PBMR compare with e.g. wind farms (cost per unit of electricity) if full future costs of managing nuclear waste disposal sites are considered?	Refer to NIRP 2, in appendix 15.

8.9 APPENDIX 9: DOCUMENTATION FROM LRC

8.9.1 LRC SUBMISSION ON THE DSR

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LEGAL COMPLIANCE ANALYSIS

OF THE

DRAFT ENVIRONMENTAL SCOPING REPORT ("DSR")

FOR A

PROPOSED 400 MW(T) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT (PBMR DPP)

(Rev 1 Jan 2006)
AT THE

KOEBERG POWER STATION SITE

Submitted by:

THE LEGAL RESOURCES CENTRE (CAPE TOWN) On behalf of:

EARTHLIFE AFRICA (CAPE TOWN)

7 March 2006

1. INTRODUCTION

This submission is made on behalf of Earthlife Africa (Cape Town) (“Earthlife”).

The draft scoping report (“the DSR”) for the proposed 400MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (“PBMR DPP”) is fundamentally flawed in a number of respects, as set out further below.

Unless the report and the processes it envisages are materially reconsidered and restructured, any resultant final scoping report (and environmental impact assessment (“EIA”) which may follow) will be defective in terms of the applicable legislation. We note in this regard that the report is often vague and uncertain in meaning[1], and that the timing of important decisions is left open. This renders the report and the processes set out therein procedurally unfair to Earthlife and other interested and affected parties ("I&APs").

In Limine

The current relevance of the court orders made in Earthlife Africa (Cape Town) v Director-General: Department of Environmental Affairs & Tourism & another, 26 January 2005 (“the earlier case”)

It is noted with concern that the applicant seems to take the approach that certain issues that were considered during the EIA for the 302MW(t) PBMR do not need not be considered in the current scoping process for the proposed 400 MW(t) PBMR DPP because these issues had been considered during the earlier EIA, or alternatively that some issues assessed under the previous EIA do not need to be reassessed in the current EIA.

For example, the applicant states at p7 of the DSR that:

'The change in output of the PBMR DPP from 302MW(t) to 400MW(t) required a new EIA application. This includes both a scoping phase and an EIA phase (including public participation). This has taken con gnisance of appropriate assessments and results generated during the previous EIA and recoded in the environmental impact report (EIR) that are still valid in the contect of the proposed 400MW(t) DPP. Therefore, not all the required assessments/studies will be repeated.'[2] (emphasis added)

Furthmore, the applicant states at p68 of the DSR that:

> *'A number of issues for consideration were identified through the EIA processes for both the 302MW(t) PBMR DPP (undertaken in 2001 and 2002) and the 400MW(t) PBMR DPP (current process). From the evaluation of these issues, recommendations are made regarding further detailed studies that are required to be undertaken in the environmental impact assessment phase."*

The applicant sets out issues identified as potentially having a detrimental impact on the environment on pages 70 to 88 of the DSR. For some of these issues, the applicant refers to studies or assessments that were conducted during the EIA for the 302MW(t) PBMR DPP, and reaches the following conclusion in respect of a number of these issues:

> *'No further assessment required.'*[3]

In addition, the applicant points out in respect of social aspects that 'the conclusions of the 302MW(t) PBMR DPP are regarded as valid for the 400MW(t) PBMR DPP and no further

1 See for example para 8. 2 below

2 Page 7 DSR.

3 For examples, see pages 86 and 87 of the DSR.

assessment will be required.'[4] A similar approach is taken in respect of economic aspects, in respect of which it is stated that 'Vecon Economic and Development Consultants assessed the validity of the conclusions for the 302MW(t) PBMR DPP and conclude that the findings remain valid'.[5]

We submit that the applicant's approach is erroneous and bad in law. It is an established principle of administrative law that, where a fresh application is made to a decision-maker, the decision-maker cannot rely on decisions it made in some earlier application dealing with the same or a related subject-matter. This principle also has an important procedural dimension because interested and affected parties ('I & APs') must be given a proper opportunity to participate in the fresh application. Even if it could be argued that some matter in issue in the fresh application was the same as one assessed or decided as part of the earlier application, then fresh evidence or fresh perspectives may be adduced on that issue in the course of the fresh application. The scoping report should provide for this but fails to do so.

The court set aside the decision of the Director-General ("DG") of the Department of Environmental Affairs and Tourism ("DEAT") to grant the application for authorisation to construct the 302 MW(t) PMBR DPP. That court order provided and envisaged that Earthlife (and other I&APs) would be afforded an opportunity to make representations on the final Environmental Impact Report ('EIR') before the DG would decide anew on whether to authorise or refuse the application to construct the 302 MW(t) PBMR DPP. To this end the court envisaged that Earthlife and other I&APs could be afforded an opportunity to make representations on the final EIR without the entire EIA for the 302 MW(t) PBMR DPP having to commence *de novo.*

The DG, however, did not call for representations to be made, and the applicant has subsequently abandoned the application to construct a 302MW(t) DPP.

4 Page 88 of the DSR.

5 Ibid.

Furthermore, the applicant has pursued a new and different application for authorisation, namely for approval to construct a 400 MW(t) PBMR DPP. This is clear from the DSR, wherein it is stated that:

> *'The legal opinion submitted to the parties indicated that the applicant, Eskom, should submit a new application for an environmental impact assessment for the evolved design.'*[6] (emphasis added)
>
> and
>
> *'The change in output of the PBMR DPP from 302MW(t) to 400MW(t) required a new EIA application. This includes both a scoping phase and an EIA phase (including public participation).* '[7](emphasis added)

In our view, the applicant had no choice but to make a new application given the change in the subject matter of two applications.

The extract from the judgment quoted at page 2 of the DSR (namely that the DG's decision was to be set aside as flawed but should not result in the whole process having to commence afresh) applies only to the EIA for the 302 MW(t) PBMR DPP.

We submit that the applicant cannot lawfully rely on any reports or assessments conducted during the EIA for the 302MW(t) PBMR DPP in support of its new and legally distinct application for authorization to construct a 400 MW(t) PBMR DPP. Any and all such reports must be updated and included in the EIR for the 400 MW(t) PBMR DPP, and I&APs must have a full opportunity to comment and make representations on these reports. Failure to do so will render the current EIA irregular and procedurally unfair, and any decision on scoping or on authorization would fall to be set aside on review.

6 Page 2 of the DSR.

2. IDENTITY OF THE APPLICANT

The current Applicant, Eskom Holdings Limited ("Eskom"), is not the proper or correct applicant. We say so because, on the information available, it is PBMR (Pty) Limited that owns the technology and intends to construct the PBMR DPP. According to the Detailed Feasibility Report ("DFR") made available during the previous EIA, Eskom's purchasing of the PBMR DPP from PBMR (Pty) Limited is conditional upon it being successfully commissioned (p32 of the DFR). In our view, until such time as Eskom decides to purchase the PBMR DPP, it is PBMR (Pty) Limited that will be the owner of the PBMR DPP and would be the correct applicant for authorisation.

If PBMR (Pty) Limited is not the applicant, the following difficult questions arise:

- How can any conditions of an authorisation granted to Eskom be enforced against PBMR (Pty) Limited in the period prior to successful commissioning i.e. before Eskom purchases the PBMR DPP from PBMR (Pty) Limited?
- If Eskom is authorised to build the PBMR subject to conditions, who will be responsible for complying with these conditions in the event that commissioning of the PBMR DPP is not successful and if Eskom declines to purchase it? For example, who will be responsible for decommissioning the unsuccessful plant?

We submit that the correct identity of the applicant and its capacities are material issues. The applicant has to fulfil any conditions set as part of the environmental assessment process. The responsibilities of a particular applicant are recognised in the White Paper on Energy Policy ("the White Paper") which states (at p 68) that in respect of nuclear installations:

[7] Page 7 DSR.

"the potential exists for acute exposures and catastrophic accidents and therefore require a *special liability regime with compulsory financial security* (and) sophisticated safety assessment to ensure that the risk is engineered to acceptably low levels…" *(emphasis added)*

We point out that the Environment Conservation Act[8] ("ECA") makes no provision for the transfer of EIA authorisations from one proponent of an activity to another. In addition, in terms of section 25 of the National Nuclear Regulator Act, nuclear authorisations are not transferable. It is therefore not possible for Eskom to transfer its authorisation to PBMR (Pty) Limited pending its conditional purchasing of the PBMR DPP.

3. FAILURE TO PROPERLY CONSIDER THE "NO-GO" OPTION

No application has been made under Section 28A of the ECA for exemption from the requirement to consider the 'no-go' option.[9]

Notwithstanding this, the applicant states in the DSR that:

> *'…the no-go option was not considered during the scoping process, as the no-go option would imply that the technology will be lost from the suite of actions included in the White Paper on Energy'*

We submit that this approach is wrong. The White Paper on Energy ('the White Paper') is a policy document and it cannot lawfully change the scope of legislation or obviate enquiries to be made or decisions that have to be taken in terms of legislation. Moreover, and importantly, the White Paper in any event does not seek or purport to do that in respect of

[8] 73 of 1989.

[9] The application for authorisation does refer to an application for exemption under s 28A of the ECA in respect of energy/technology alternatives and site alternatives. However, Earthlife has been informed that this application has been withdrawn. We comment in detail on these isues in paragraph 7 below.

the "no-go" option. In short, the White Paper offers no support for excluding consideration of the "no-go" option in respect of PBMR DPP, as the DSR does.

In amplification of our contention that the the applicant's approach is wrong, we point out the following:

- The exclusion of the "no-go" option seeks to improperly limited the range of relevant matters to be considered and to in effect fetter the discretion expressly afforded to the decision maker to refuse to authorise the proposed activity under section 21(3) of the ECA.
- Section 24(4)(c) of the NEMA requires that procedures for the investigation, assessment and communication of the potential impact of activities must ensure, as a minimum, with respect to every application for an environmental authorization, the investigation of mitigation measures to keep adverse impacts to a minimum, as well as the option of not implementing the activity.
- The White Paper on Energy states that it would not be prudent to exclude nuclear energy as a supply option. The policy suggests the evaluation of all candidate energy supply and demand resources in an unbiased fashion but, importantly, does not seek to prescribe the construction of demonstration plants for specific options, let alone the specific technology of the PBMR.
- The White Paper instead refers to the need to utilize *integrated resources planning ("IRP") methodologies*[10] to evaluate future energy supply options, and these are described as methodologies for decision making which are concerned with the acquisition of least cost energy resources[11], taking into account the need to maintain adequate, reliable, safe and environmentally sound energy services for all customers. The IRP approach includes:

10 Paragraph 7.1.5.6 of the White Paper. This paragraph also refers to the fact that government will establish guidelines for the IRP approach through new energy legislation and regulations will require the National Electricity Regulator to oversee implementation

11 id

the (1) *evaluation of all candidate energy supply and demand resources in an unbiased manner;*

the (2) *systemic consideration of a full range of economic environmental social and technological factors;*

the (3) *consideration of risks and uncertainties posed by different resource portfolios and external factors, and external factors such as the fluctuations in fuel prices* in *economic conditions; and*

the (4) *facilitation of public consultation in the utility planning process.*

It is clear therefore that while there is some merit in the assertion that all candidate energy supply and demand resources will be evaluated, the the nature of that evaluation is not spelt out. Construction of a demonstration PBMR DPP is not mandated. Since the decision making process is concerned with the acquisition of least cost energy resources this suggests that prior to actually testing technology the least cost approach would need to be applied. It is submitted that this approach would curtail the future development of the PBMR in light of its high costs relative to other technologies[12].

- The fact that the proposed activity is for a demonstration PBMR is not a valid reason for excluding the ‘no go’ option. Neither the ECA nor the EIA regulations contemplate excluding the ‘no-go option’ from consideration. To do so would defeat the entire object of having to apply for authorisation to undertake an activity identified under GN R1182.
- The Applicant’s suggestion that comparisons will be made with other technologies should the PBMR DPP prove viable does not satisfy legal requirements. The EIA regulations require that all identified alternatives be described in the Scoping Report. Feasible alternatives must then be described in the Plan of Study for impact

[12] See *The Economic Impact of the Proposed Demonstration Plant for the PBMR* by Steve Thomas – Annexure A hereto para 1.2.3

assessment phase.[13] The EIR must then include a description of each alternative and a comparative assessment of each alternative.[14]

In the circumstances, it is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations[15] and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including the 'no-go' option. Should the relevant authority fail to do so, any decision under regulation 6(3)(a) or (b) will fall to be set-aside on judicial review.

4. FAILURE TO ESTABLISH NEED

The DSR fails to require that the EIA establish that there is indeed a legitimate need for the construction of a the PBMR DPP.

We note that the applicant contends that the PBMR DPP is required in order to validate the assumptions and modeling of some of the supply side power generation technology options, and to assess technical, operational and socio-economic aspects (see page 5 of the DSR).

We submit that the applicant has failed to specify what technical aspects need to be demonstrated, and that as a consequence the legitimacy of establishing the PBMR DPP for research purposes is not apparent.

The applicant's claim that there is a need for a demonstration module PBMR is disputed. There are alternative energy sources available to meet the country's energy needs (the National Electricity Regulator states that electricity needs for the next 25 years can be met

13 Setion 7(b) of GN R1183.

14 Section 8(a) and (b) of GN R1183.

without new nuclear power)[16]. It is also pointed out that the applicant's rationale is contradictory: it claims that the PBMR design is inherently safe and is based on technology proven elsewhere in the world, but then claims that the demonstration module is required to test its technical feasibility. Nuclear specialists have cast doubt on the economic feasibility of the plant. One critic is Steve Thomas, whose initial report on the PBMR in South Africa is in the public domain but finds no mention in the DSR. Thomas is one of the experts on the Department of Minerals and Energy's International Panel of Experts, who have reviewed the technical and economic feasibility of the proposed PBMR. This review has never been made available to the public, despite a formal application made under the Promotion of Access to Information Act 2 of 2000.

The DME White Paper on Energy Policy defines the timing and constraints for the consideration of future nuclear energy projects in South Africa. In terms of this policy:

- alternatives must be considered before new nuclear power plants are built;
- public acceptance of the technology and potential environmental and socio-economic impacts must be evaluated; and
- any government decision must take place within the context of an integrated energy planning process that includes an investigation of the existing Koeberg Nuclear power plant's economic and technical performance, its long term costs, implications for safety, emergency planning, decommissioning and waste disposal.

However, no alternatives to the PBMR are to be assessed in terms of the DSR. To date public acceptance for the PBMR technology has not been properly evaluated and crucial information has been withheld from the public. Integrated resource planning has to take place. The process required in the Energy Policy is not being followed. In addition, the applicant has failed to adequately specify a legitimate purpose and need for a demonstration module PBMR.

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16 An Integrated Energy Outlook For SA Published by the National Electricity Regulator para 6-8

Chapter 3 of the submission made by Earthlife Africa in respect of the draft EIA for the 302 MW(t) PBMR pointed out that the construction of a demonstration model PBMR will require the expenditure of a considerable amount of public funds, and may also expose taxpayers to future decommissioning and clean-up costs. In addition, the hazardous nature of a nuclear installation means that the building of such a plant will increase the risk of a nuclear accident, while there will be unavoidable adverse impacts on the environment resulting from increased discharges of radioactive material and radioactive waste, and the production of high level radioactive waste. In the case of the current EIA we likewise argue that as a result of the cost, risk and increased environmental impact associated with the establishment of a new nuclear power plant, the scoping report for the EIA should set out a legitimate purpose and need for a new plant. This is required in order to ensure that the decision-maker can properly assess whether the possible benefits of the proposed development outweigh its potential environmental and socio-economic impacts.

5. PLAN OF STUDY FOR SCOPING

It is noted that the Plan of Study for Scoping ("POS") purports to limit the discussion of alternatives. We object to the legality of decision-making process flowing from the POS in the light of the fact that no right was afforded to the public to comment on the Plan of Study. Regulation 3(1)(f) of the EIA Regulations[17] stipulates that the applicant is responsible for the public participation process to ensure that all I&APs, including government departments that may have jurisdiction over any aspect of the activity, are given the opportunity to participate in all the relevant procedures contemplated in these regulations.

No opportunity appears to have been afforded to Earthlife or any other I&APs to participate in the POS procedure. This procedure is critical to the EIA given that it has the effect of determining how the subsequent Scoping procedure will be undertaken. For example, the POS includes a description of the proposed method of identifying the environmental issues and alternatives. The environmental issues and all alternatives identified must then be

described in the Scoping Report[18], the precursor to the Plan of Study for EIA and the assessment stage itself.

By failing to afford interested an affected parties an opportunity to participate in the Plan of Study for Scoping procedure, the EIA applicant has failed to comply with the requirements of Regulation 3(1)(f). The applicant has also failed to comply with the requirements of administrative justice as set out in sections 3 and 4 of the PAJA. It has prejudiced interested and affected parties who have been denied an opportunity to participate in important procedures such as that determining how environmental issues and alternatives will be identified. It has also prevented Earthlife and other interested and affected parties from making representations on the proposed POS to the decision for consideration. As a consequence, the EIA process is fatally flawed.

6. FAILURE TO IDENTIFY KEY ISSUES

Regulations 6(b) and (c) of GNR 1183 provide that a Scoping Report must include a brief description of how the environment may be affected and a brief description of environmental issues identified. In addition, under the PAJA, a decision-maker is required (amongst other things) to take relevant considerations into account.

We point out that the DSR does not provide a description of how the environment may be affected by the construction and operation of the proposed PBMR DPP, and the on-site storage of spent nuclear fuels, under abnormal or emergency conditions (as opposed to normal operating conditions).

We submit that key issues that should be described in the DSR include:

[18] Regulation 6(c) and (d) of GN R1183.

- the potential impact of the PBMR DPP on the operation and management of the existing Koeberg Nuclear Power Station in the event of an abnormal or emergency event at the PBMR DPP, and visa versa;
- the potential impact of the PBMR DPP on the environment in the event of a catastrophic incident.

7. FAILURE TO CONSIDER ALTERNATIVES

The EIA regulations[19] require that a Scoping Report must include, amongst other things, a description of all alternatives identified.[20]

The proper identification and assessment of alternatives in an EIA process is a central feature of EIA as it affords the decision-maker with the opportunity to determine whether to authorise the proposed activity, or whether to authorise an alternative (technology and/or site alternative) to the proposed activity, or alternatively to refuse the application altogether (the 'no go' option). This scenario is expressly contemplated in section 21(3) of the ECA, which stipulates that:

> *'The Minister or competent authority… may at his or her discretion refuse or grant the authorisation for the proposed activity or an alternative proposed activity…'*

The Draft Scoping Report appears to identify three categories of alternatives to the proposed PBMR DPP. It then attempts to preclude the further investigation of two of these alternatives (the energy / technology option and the 'no-go' option), and also presents an assessment of the third alternative (site alternatives) as a *fait accompli.*

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19 GN R1183 of 5 September 1997 (as amended).

20 Regulation 6(d) of GN R1183 of 5 September 1997 (as amended).

On the grounds set out below, it is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including energy / technology options, the 'no-go' option (dealt with in paragraph 3 above) and site alternatives. The applicant should also be requested by the relevant authority to remove the comparative assessment of site alternatives from the Draft Scoping Report.[21] Should the relevant authority fail to do so, any decision under regulation 6(3)(a) or (b) will fall to be set-aside on judicial review.

(i) Energy and Technology Alternatives

The DSR fails to describe energy and technology alternatives identified during the Scoping phase of the EIA.

Instead, the applicant presents information regarding the energy policy, the DME's integrated energy plan, the NER's national integrated resource plant, and the applicant's own strategic electricity planning process. It is submitted that none of this information is relevant to the DSR, nor does this information justify the applicant's disregard of Regulation 6(d) of the EIA Regulations.

It is noted further that the applicant has made the assumption that other energy and technology alternatives are not relevant to the scope of the entire EIA process for the proposed PBMR DPP. It is stated at page 55 of the DSR under the heading 'Assumptions of the Study' that:

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21 This comparative assessment and the underlying data must be made available to Earthlife and other I&APs for comment during the EIA phase, whereafter the relevant authority will need to consider whether it is satisfied that information from a previous and legally distinct EIA can lawfully be incorporated into a new EIA. We submit that the previous EIA was abandoned, and that the DG became *fun ctus oficio* as a consequence. The current application for authorisation is for a 400 MW(t) PBMR DPP, and the EIA should have commenced *de novo*.

'This report and its investigations are project-specific for a demonstration plant, and consequently the environmental team did not evaluate any other energy or technology alternatives'.

It is submitted that this assumption is ill founded. There is no provision in the ECA or the EIA regulations that empowers an applicant to ignore alternatives because of the 'project specific' nature of an EIA application. In fact, it is submitted that most EIA applications are project specific. For example, if an applicant were to apply for authorisation to construct a medical waste incinerator, does the 'project specific' nature of the application preclude a description of identified technology alternatives (such as autoclaving or sterilisation) in the DSR? The answer is clearly that it does not. The term "project specific" is also improperly manipulated in the DSR, which seeks to hive off "project specific" radiological matters to the NNR.

A brief perusal of Appendix 4 to the DSR (Focus Group Minutes) reveals that energy and technology alternatives were raised during the Scoping process. For example, the following alternatives are identified:

- wind electricity generation;
- solar electricity generation;
- pumped storage generation;
- non-PBMR nuclear technology options.[22]

We submit that other alternatives that should also be described in the Scoping Report include solar thermal chimneys and tidal current (as these have the potential to provide 24-hour energy).

By failing to describe all the alternatives identified, the Applicant has not complied with the mandatory legal requirements of the EIA Regulations.

In the circumstances, it is submitted that the relevant authority must exercise the powers granted to it in regulation 6(2) of the EIA Regulations and request the applicant to amend the Draft Scoping Report by listing all alternatives identified, including energy and technology options. Should the relevant authority fail to do so, any decision under regulation 6(3)(a) or (b) will fall to be set-aside on judicial review.

(ii) Geographical / Location Alternatives

An analysis of the DSR reveals that instead of describing geographical / location alternatives identified during the Scoping phase of the EIA in accordance with the EIA Regulations, the Applicant has improperly sought to pre-determine the issue by including a comparative assessment of alternatives in the DSR. The EIA Regulations clearly stipulate that a comparative assessment of all the alternatives should be reported in the Environmental Impact Report.[23]

To compound the severity of this error, the Applicant also seeks to introduce information and assessment from a previous and legally separate and distinct EIA into the DSR, and inevitably concludes that the alternatives are less desirable than the proposed Koeberg site. It is submitted that the Independent Consultant is not legally competent to incorporate information from a previous and legally distinct EIA and adjudicate it to be 'valid' at the Scoping Phase of an EIA, as discussed in paragraph one above. At the very least such information, including any underlying reports upon which the information relies, should be made available to I&APs for critical comment. Various factors (including the lapse of time between the previous comparative site assessment and the current application; the possibility that new interested and affected parties may wish to comment, changes in site conditions such as the precarious state of the Koeberg reactor and the like) could influence

22 See page 131 of Draft Scoping Report.

the results of a comparative site assessment undertaken in respect of the new proposed 400 MW(t) PBMR DPP. These results could differ significantly from the results from those of the comparative site assessment undertaken in the EIA for a 302 MW(t) demonstration model PBMR. To preclude interested and affected parties from participating in a comparative assessment or having the opportunity to provide comment on alternatives sites in respect of the proposed 400 MW(t) PBMR DPP would render the current EIA process unfair, and any decision to accept the draft Scoping Report would be subject to be set aside on review.

8. RE PARAGRAPH 5.4

The assertion that all potential environmental impacts have been identified through studies and public participation is misleading wrong and without any foundation. It is possible that further issues will be identified int the process of comment on the DSR which this submission is a part of. There is still a public comment period to follow, and the scoping report should provide for this in respect of potential environmental impacts.

The DSR refers in paragraph 5.4 to a screening process to consider which issues are significant. However a scientific set of criteria and a proper ranking procedure has not been set out in this document. For example there is no justification why the proximity of a nuclear reactor (Koeberg), and an ailing one to boot[24], to the proposed PBMR reactor is not considered a site criterion whereas history and archeology e.g. the existence of significant fish traps is treated as a relevant consideration[25]. The relative importance of the various criteria applied to the assessment of alternatives is not ranked.

23 Regulation 8(b) of GN R1183.

24 There is oblique reference to Koeberg's problems at p 82-3 of the report but it is wholly unclear how or by whom the issues set out at p 82 to 84 of the report are going to be assessed (if at all) during the scoping or assessment process.

25 Table Once results of assessment of alternative sites DSR p24 onward

The DSR states that it is assumed that where relevant and appropriate studies undertaken during the 302MW PBMR EIA are acceptable for use in the current EIA process.

It is disputed that any study and in particular the economics and safety studies of the first EIR are acceptable for use the current EIA process. We attach the critical analyses of Dr Steve Thomas (economics – Annexure “B”) and Dr Gordon Thompson (safety- Annexure “C”) in this regard, which raise serious questions about the quality of the reports in first EIA. The current report is defective in that it does not identify these issues and does not provide for the proper assessment, nor does it disclose for comment and debate foundational documents. Here we specifically refer to the following documents, which should be disclosed:

1. the Safety Report
2. the Detailed feasibility Report
3. the report of the International Panel of Experts Technical and Economic Feasibility Report.
4. General Operating Rules
5. Operating Technical Standards
6. Probabilistic Risk Assessment

In the context of safety, a major deficiency in the DSR is its failure to provide for an assessment of the probabilities and consequences of a catastrophic event affecting the PBMR and/or the adjacent Koeberg. This is a mandatory relevant consideration in the assessment process under the legislation and also has been identified as a major concern in the White Paper. See that document at p 68 (quoted above) and also at p 71. Pursuant to s 197(1) of the Constitution, all decision-makers have a duty to loyally execute the lawful policies of the government of the day.

We also dispute that all information provided by Eskom was correct and valid even at the time that it was provided. In this regard we refer to and incorporate by reference herein the LRC's submissions in respect of the 302MW(t) PBMR DPP as well the two expert reports referred to above.

10. RELIANCE PLACED IN THE REPORT ON THE CO-OPERATIVE AGREEMENT BETWEEN DEAT AND THE NNR ("THE CO-OPERATIVE AGREEMENT")

The reliance placed upon the co-operative agreement between the NNR and DEAT undermines the scoping process and has resulted in an improper DSR. We say so for the followiong reasons:

1. The co-operative agreement and the DSR draw an unjustified and indefensible distinction between "radiological/radiation issues of a generic nature not directly related to the project" (category 1) and "radiological/radiation issues of a generic nature directly related to the project" (category 2), and then provide that the latter category will generally be addressed in the formal "Safety Case" to be submitted by the applicant to the NNR. But the site specific issues lie at the heart of the environmental assessment process which has to be undertaken by DEAT;
2. It is totally unclear what is meant by the assertion that issues in category 2 "will be 'tracked' within the EIA process"; and that the environmental practitioner will provide "responses to issues" and "answers to issues"[26].
3. DEAT cannot delegate its decision-making functions to the NNR or, alternatively and in any event, has not purported to do so, so it cannot let the NNR set conditions as part of the EIA process, as the DSR proposes;
4. The EIA process also cannot be left open-ended yet the DSR and the co-operative agreement envisage precisely this, by saying that if input from the NNR is not available for processing as part of the EIA process, the DEAT will "refer these issues to the NNR process and make all (DEAT) decisions conditional on this process".

26 DEAT NNR memorandum "Annexure A" para 3.4

The processes criticized in points 3 and 4 above suffer from the further defect that I & AP's could be denied procedural fairness and a proper opportunity to comment on any input provided by the NNR or any purported decision made by the NNR under guise of the EIA process.

It is denied that the co operative agreement creates a " definitive check and balance to the public that diligent governance will be applied at all times" as is claimed in paragraph 4 thereof.

11. RE CHAPTER 7: SUMMARY OF ISSUES IDENTIFIED

Paragraph 7.1.1 of the DSR incorrectly reflects the economic issues identified in the scoping report for the 302MW(t) PBMR DPP. In terms of this report para 7.4.4 economic aspects were limited to:

(a) the economic potential of a local based nuclear industry

(b) impact on eco tourism in the region around Koeberg

(c) impact on supply site management based on the assumption that the plant proves viable.

The issue of life cycle costing was added later at the request of the Department of Environment Affairs & Tourism. The plan of study for the first EIA reflected the following issues under the title "Economic Aspects" and included those issues mentioned above as well as life cycle costing and markets for PBMR. It thus denied that the items:

(1) impacts on spatial planning and land use; and

(2) economics of the technology

were raised as an issue under the heading "Economic Aspects" in the first EIA. Impacts on spatial planning were mentioned without reference to land use under "social impacts". The plan of study for the first EIA did not simply include as an issue "safety and security impacts"[1].

This issue was stated in a restricted form, namely "conventional safety and security impacts (i.e. excluding radiological aspects for which the NNR findings will inform the EIR)".

12. ISSUES THAT ARE SIGNIFICANT BUT FALL OUTSIDE OF THE SCOPE OF THE DSR FOR THE PBMR DPP[27].

The DSR states that certain issues of a strategic nature cannot be addressed in the EIA due to the site and activity's specific nature of the process. These so-called strategic issues are not specified. It is therefore not clear whether these issues are limited to those contained in table 6, DSR page 70.

Items 1, 6 and 9 of table 6 pertain to the issue of economic impacts. The NEMA principle in section 2(3) requires development to be socially, environmentally and economically sustainable. NEMA principles must be taken into account in the preparation of environmental impact reports required for the granting of permission of certain prescribed activities[28]. Furthermore NEMA section 23(2)(b) refers to the general objective of integrated environmental management which is to identify potential impacts on the environment socio economic conditions and cultural heritage with a view to minimizing negative impacts and promoting compliance with the principles of environmental management set out in section 2.

It is submitted that items 1, 6 and 7 relate to the costs and economic viability of the PBMR and are therefore relevant considerations for these assessments as required in terms of NEMA. It is submitted that assessing socio economic sustainability would include assessing the impact on the use of public funds to develop a nuclear technology given the scale of expenditure involved, and would therefore also include an assessment of the financial viability of the pebble bed as an electricity generating option.

27 DSR para 7.2

28 *Minister of Public Works v Kyalami Ridge Environmental Association* 2001(3) SA1151 ,at 1 176E-F

Item 9 deals with the issue of an international market for the future PBMR technology. As stated in the first EIA [29] "the purpose of the proposed plant is to assess the techno economic viability of the technology of the South African and international application for electricity generation and other commercial applications". In the previous EIR it is stated,[30] "the stated commercial potential of the PBMR for global application although outside of the scope of the EIA will be addressed to some degree within the EIR". It is inconsistent to totally exclude this consideration in current EIA. If local markets and real economic potential are identified as issues under economic aspects then by implication international markets should not be excluded from the EIA[31].

13. MITIGATION MEASURES TO MANAGE ENVIRONMENTAL IMPACTS

We note that the application for authorization states that 'the EIR for the 3O2 MW (t) PBMR DPP contained a comprehensive environmental management plan for the construction and operation/maintenance of the proposed project. The mitigation measures and recommendations regarding management of environmental impacts will be amended/augmented, as appropriated for the 400 MW (t) PBMR DPP."

This approach is objectionable. Mitigation, which is a requirement for an EIA should take place before authorization. However it is being deferred to an environmental management plan, which presumably is drawn up after the record of decision. Regulation 8(a)(ii) of GNR1183 states that an environmental impact assessment **must** contain a description of each alternative including particulars on the possibility of mitigation of each identified impact. The practice of deferring mitigation to an environmental management plan, which usually is located in one of the conditions of the record of decision, is legally improper.

29 Page 1 Executive Summary
30 Chapter 1, page 2

31 GAPS IN KNOWLEDGE AND UNDERLYING ASSUMPTIONS

The application for authorization contains no list of gaps in information predictive measures used and underlying assumptions. This is unacceptable given that the design is not final and the safety assessment has not been completed.

15. ENVIRONMENTAL ASPECTS WITH NO RADIOLOGICAL DIMENSION[32]

Table 7 of the DSR contains a summary of the screening assessment. Under waste management[33] generation of radioactive waste is included. It is not clear why this is included under a section dealing with environmental aspects with no radiological dimension.

A second section on waste management is included on page 77 and relates to "continued management of radioactive waste". However no assessment of the impacts of waste management is in fact recommended, rather it is suggested that the issue of continued management of radioactive waste is merely to be considered by the Department of Mineral & Energy Affairs. This is an abdication of responsibility to continue the impact of generation of large quantities of radioactive waste.

The impact of waste management during the decommissioning of the plant is divided into three sections, as follows:

1 Storage/management of long-term high-level waste. It is recommended that issues are considered by the Department of Mineral & Energy and included in the National Waste Policy. This constitutes an abdication of responsibility to consider the impacts of storage and management of long-term high-level waste.

31 EIA 1, para 3.3.2, page 15

32 Page 70

33 Page 76

2 Decontamination of irradiated materials. Here the issues are to be assessed by the NNR process and to inform the EIA process. It is submitted that any input provided by the NNR should take place before completion of decision making in terms of the EIA process, and be subject to procedural rights to comment by I and AP's and critical decisional scrutiny by the DEAT

3 Long-term disposal at the Vaalputs facility. Here the issues are to be considered by the DME and included in the National Waste Policy. Once again there is an abdication of responsibility to consider the assessment of impacts of long-term disposal of the Vaalputs facility (e.g. increased traffic, effects on adjacent communities of increased risk of accidents in the transportation of nuclear hazardous waste etc).

4 Dismantling of the plant, disposal of plant material and high-level waste storage plant. Under this item waste management also includes the issue of radiological waste. Issues are to be assessed by the NNR process and to inform the EIA process. The NNR process should precede the final ROD for the EIA.

The general point should be made that the management of waste, its storage and transportation, and the issue of decontamination of the site are issues that are not novel in the sphere of nuclear management. The environmental impacts of the generation of a known or easily estimable amount of nuclear waste can readily be ascertained from the available knowledge on the matter within the nuclear industry. There is no justification for deferring the consideration of the impacts hereof to other departments as is suggested in the DSR. The legislative provisions in terms of which for example the DME is to consider storage and management of waste are not spelled out. This precludes an evaluation of whether there will be substantial compliance with the assessment requirements of the ECA if this is indeed a lawful approach.

The same applies to the issue of decontamination of the site. Why does the DEAT need the NNR to deal with this issue? The consultants can draw up expert reports so that the DEAT can discharge its responsibilities of assessing the impacts hereof before giving a record of decision. If not, the approach adopted by the consultants needs to be properly justified in the DSR.

16. OTHER NOTES

On page 80 of the DSR under the issues designated “economic impacts” the issue “expenditure and support for the dismantling and rehabilitation” is indicated. The “recommendations” column states that “that the potential impacts (before and after mitigation) should be assessed during the EIA phase. Recommendations should be made

regarding appropriate mitigation measures required to minimize impacts.” This recommendation does not appear to make sense and also appears to contradict the recommendation contained in item 6 of table 6 on page 70 which suggests that the use of public funds to develop a nuclear technology is not an issue that falls within the EIA.

On page 82, mention is made of the ELA/DG/DEAT ruling and it is stated that more information is needed regarding epidemiological studies. However no clarification is given of the responsibilities of either the NNR or DEAT in regard to this issue.

This constitutes a material failure to consider highly relevant issues.

17. APPLICATION FOR EXEMPTION

It is noted that Eskom’s EIA Application under section 21 of the Environment Conservation Act 73 of 1989 (ECA) includes a reference to an application for exemption in terms of s28A of ECA[34]. In terms of this application, Eskom sought exemption from the process to assess energy/technology alternatives and site alternatives, and from the associated public participation process. We are advised that Eskom has withdrawn this application. This fact should be recorded in the DSR in order for it not to be misleading.

34 EIA Application, section 12, page 19.

Angela Andrews

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7 March 2006

Annexure A

Issues for consideration in the environmental impact assessment

In addition to the issues mentioned in the above submission the following issues should be pertinently considered in the environmental impact assessment.

1. Impact of a graphite fire
2. Physical, economic and social impact of a catastrophic incident
3. Economic and safety impacts of generating a significant quantity of high level of radioactive waste without there being provision for a safe long term depository
4. Impact of release/s (venting) of additional radiation into the atmosphere to avoid a major accident and the likelihood of this taking place
5. Impact on spatial planning and land use for the City of Cape Town as a result of the construction of the PBMR on the Koeberg site
6. Impact of the proposed expenditure of R14.5 billion on the availability of funds for alternative sustainable energy research
7. Impact of lack of secondary containment on safety and economics of the plant

8.9.2 SAFETY OF THE PROPOSED SOUTH AFRICAN PEBBLE BED MODULAR REACTOR:

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SAFETY OF THE PROPOSED SOUTH AFRICAN
PEBBLE BED MODULAR REACTOR:
Technical issues, status of knowledge,
and their documentation

by

Gordon Thompson

7 December 2004

A report for

Legal Resources Centre Cape Town, South Africa

About the Institute for Resource and Security Studies

The Institute for Resource and Security Studies (IRSS) is an independent, nonprofit, Massachusetts corporation, founded in 1984. Its objective is to promote sustainable use of natural resources and global human security. In pursuit of this mission, IRSS conducts technical and policy analysis, public education, and field programs. IRSS projects always reflect a concern for practical solutions to resource and security problems.

About the author

Gordon Thompson is the executive director of IRSS and a research professor at Clark University, Worcester, Massachusetts. He studied and practiced engineering in Australia, and received a doctorate in applied mathematics from Oxford University in 1973. Dr. Thompson has been based in the USA since 1979. His professional interests encompass a range of technical and policy issues related to international security and protection of natural resources. Dr. Thompson has conducted numerous studies that address the environmental and security impacts of nuclear facilities, and options for reducing these impacts.

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Abstract

A type of commercial fission reactor known as a pebble bed modular reactor (PBMR) is currently under development in South Africa. This report addresses the reactor's safety, defined here as the potential for an unplanned release of radioactive material to the environment. The release could be caused by human error, equipment failure, natural forces, or acts of malice or insanity. Documents relevant to the safety of the PBMR are discussed here, especially a Final Environmental Impact Report (FEIR) and a Safety Analysis Report (SAR). Technical issues of PBMR safety are summarised, and the treatment of these issues in the FEIR and SAR is reviewed.

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1. Introduction

This report addresses the safety of the proposed South African pebble bed modular reactor (PBMR), a nuclear fission reactor under development in South Africa for commercial application in that country and internationally. Reactors of a similar design have operated in other countries. The design concept of the South African PBMR draws heavily from German experience. Eskom, South Africa's national electricity generating company, proposes to build and operate a demonstration plant, employing this design concept, at the site of the existing Koeberg nuclear power station.[1]

In this report, the word "safety" refers to the potential for an unplanned release of radioactive material to the environment. A high level of safety corresponds to a low potential for unplanned release. The release could be caused by human error, equipment failure, natural forces (e.g., earthquake), or acts of malice or insanity. An unplanned release is distinct from the comparatively small, planned release of radioactive material that accompanies the operation of any reactor.

The industrialised world has accumulated a half century of experience with commercial nuclear power. During that period, this industry has become controversial, and is opposed by many people. Proponents of nuclear power have recognized that significant problems must be overcome if the industry's prospects are to improve. A study group at the Massachusetts Institute of Technology (MIT) has identified four such problems: cost; safety; radioactive waste; and proliferation of nuclear weapons.[2] The proposed South African PBMR will be judged by its ability to overcome each of these problems. This report focuses on the safety of the proposed PBMR, but that focus does not imply that other problems are less important or have been resolved.

In June 2000, Eskom and its partners applied to the South African Department of Environmental Affairs and Tourism (DEAT), seeking authorisation to build and operate the proposed PBMR demonstration plant at the Koeberg site. This application was supported by a Final Environmental Impact Report (FEIR) dated October 2002.[3] Authorisation was granted in June 2003, with various stipulations.[4] The FEIR made reference to a Safety Analysis Report (SAR), and included a portion of that SAR as Annexure 23 to the FEIR.[5] IRSS's understanding is that no other portion of the SAR has been published. The authorship, table of contents and date of completion of the SAR have not been disclosed.

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1 FEIR, 2002.

2 MIT, 2003, page ix.

3 FEIR, 2002.

4 Olver, 2003a.

5 SAR/FEIR Annexure 23.

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Statements about the safety of the proposed PBMR were made in the FEIR and the available portion of the SAR. These documents are reviewed here. (See Sections 6.1 and 6.2, below.) Neither document is found to be a complete or scientifically defensible assessment of the safety of the PBMR. To IRSS's knowledge, no other document has been published in South Africa that addresses the safety of the proposed PBMR to more than a superficial extent.

Assessment of the safety of a reactor requires access to design information. This report relies primarily on design information that has been provided to the US Nuclear Regulatory Commission (NRC) and the US Department of Energy (DOE) as part of an effort to promote the eventual sale of South African PBMR technology in the USA. IRSS is not aware of any document published in South Africa that provides more than superficial information about the design of the proposed PBMR. Neither the FEIR nor the available portion of the SAR provided design information beyond a superficial level.

The design of the proposed PBMR has passed through at least two substantial changes since 2001, as discussed in Section 2.2 of this report. These changes, and the absence of a prototype reactor, indicate that the proposed PBMR should be considered as a design concept rather than a design that is ready to be built. Design changes of the magnitude that have occurred for this PBMR can substantially affect the safety of a reactor. Thus, no significant conclusions can be drawn regarding the safety of the proposed PBMR until two conditions have been satisfied. First, the design must have been finalised. Second, the final design must have been subjected to a safety assessment performed according to best international practice. Section 7.1 of this report discusses the features of such an assessment.

The remainder of this report begins, in Section 2, with a discussion of the basic features of the proposed PBMR and the evolution of its design. Section 3 describes safety issues that are relevant to this reactor. Criteria that have been set forth for judging the safety of the PBMR, and the safety of modern reactors in general, are summarised in Section 4. Processes for assessing safety are discussed in Section 5. Available information about safety assessment for the proposed PBMR is reviewed in Section 6, with special attention to the FEIR and the available portion of the SAR. Section 7 summarises the current status of knowledge about the safety of the proposed PBMR, and the actions needed to improve this knowledge. Conclusions are set forth in Section 8, and a bibliography is provided in Section 9. Footnotes cite entries in the bibliography.

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2. Characteristics of the proposed PBMR 2.1 Basic features

The proposed PBMR would use low-enriched uranium fuel in a graphite-moderated core cooled by helium. Uranium dioxide fuel kernels of about 0.5 mm diameter would be surrounded by carbon and silicon carbide layers to make TRISO coated particles of about 0.9 mm diameter. These particles would be incorporated into fuel pebbles of about 60 mm diameter.[6] Graphite pebbles would also be present in the reactor core to provide neutron reflection and moderation. Fuel and graphite pebbles would descend slowly through the core in a continuous process of draining and replenishment. Helium would pass through the reactor in a closed loop. After leaving the reactor, the helium would pass through a power conversion system employing a recuperative Brayton cycle with intercooling. A power turbine in this system would drive an electricity generator.[7]

2.2 Evolution of the design

A November 2002 report by PMBR Ltd. described the status of the design of the proposed PBMR as follows:[8]

> "The Basic Design of the plant, which will constitute a baseline for Detailed Design to proceed, has been largely completed and is currently being documented in accordance with international Nuclear Quality Assurance norms."

The report went on to say that aspects of the design would be "reviewed" and "optimized" during an extended development phase. Through this process, the "initial basic design" (PB100-00), which was the subject of the EIA and the nuclear license application, would evolve to the "final basic design" (PB100-10). The nominal power output of each unit would rise from 106 MWe to 120 MWe, reflecting an increase in operating pressure and core size. As explained below, the design has actually changed to a much greater degree than PBMR Ltd. predicted in its November 2002 report.

The design information that is publicly available in South Africa is superficial, and does not allow any conclusion to be drawn about the safety of the proposed PBMR. Better information is available in the USA, resulting from submissions and presentations to NRC and DOE. The latter information, although also limited in scope, at least allows one to understand how the design has evolved.

A report submitted to NRC in August 2001 provided a modest amount of technical information and some drawings, allowing a reader to gain a general impression of the

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6 Slabber, 2003.,

7 Nicholls, 2000

8 Ferreira et al, 2002, Section 2.1.4.1.

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PBMR design that was envisioned at that time.[9] The unit's nominal power output was 110 MWe. One significant feature of the design was that the reactor core had two regions with no separating wall. A central, cylindrical region, composed of graphite pebbles, was surrounded by an annular region composed of fuel pebbles. This configuration was to be maintained by dropping graphite pebbles onto the center of the top surface of the core while dropping fuel pebbles onto this surface at points distant from the center. Both the fuel and graphite pebbles would then move downward through the core. Some mixing of fuel and graphite pebbles would occur at the interface between the two regions. Fuel and graphite pebbles would be discharged through a single drain hole at the base of the reactor vessel. After leaving the vessel, the fuel and graphite pebbles would be separated, and would then be re-used in the core or stored as radioactive waste.

This two-region core arrangement would result in a power distribution across the core that would be more uniform than would be the case for a one-region core. If a more uniform power distribution could be achieved, this would result in a more uniform temperature distribution. Limiting the variation of temperature across the core is an important requirement for a pebble bed reactor, and concern has been expressed within NRC that the proposed PBMR may not meet this requirement.[10] An internal NRC memo

stated: 11

> "So what we may really have here is nothing at all like a uniform 900 C outlet temperature, but rather an outlet flow with very large radial and azimuthal temperature variations, perhaps on the order of plus or minus 200 C or more."

In the (US) spring of 2002, the MIT Nuclear Engineering Department conducted a design project on the dynamics of pebble motion in a PBMR.[12] The project involved experiments and theoretical modeling to estimate the movement of pebbles in a tworegion core as described above. The report on the project strongly suggests to IRSS, although the report did not state this explicitly, that the design under investigation was that of the proposed South African PBMR. Reference was made in the report to a PBMR Safety Analysis Report that was, it appears, freely available to members of the MIT team. In describing the importance of understanding pebble motion, the report stated:[13]

> "Despite its advantages over the conventional reactor as seen above, the PBMR core also has a serious problem. The neutron physics that allows reactors to predict the power/heat output and U-235 burn-up of fuel at a given location is dependent on the distribution of fuel and reflector materials, the position of

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9 Borton, 2001.

10 Experience with the AVR pebble bed reactor (reviewed in: Thadani, 2001) showed coolant temperatures exceeding 1280 C in parts of the reactor during normal operation, while the nominal average outlet temperature was 950 C.

11 Carlson, 2001.

12 MIT, 2002.

13 MIT, 2002, page I-10.

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absorbers, which are used to reduce power levels where appropriate, and the shape of the core……….In the PBMR, the positions of each fuel and reflector [graphite] pebble change. Therefore, calculation of the flux profile becomes very complicated if the distribution of pebbles within the core is not known."

In August 2003, PBMR Ltd. explained its technology in a presentation to DOE.[14] The design described in this presentation was significantly different from that submitted to NRC in August 2001. Each unit's nominal power output was increased to 160-170 MWe. Drawings indicate that the concept of a reactor core with two regions (fuel pebbles and graphite pebbles) was retained, but the regions were separated by a wall that would apparently be made primarily from graphite.[15] The height of the core barrel was increased from 15.7 m to 22 m, while its outside diameter remained at 5.85 m. In the new design, fuel and graphite pebbles would not mix at any point. Each type of pebble would be added to the top, and removed from the bottom, of the core by its own pebbletransfer system.

One can infer that the introduction of a wall between the two regions of the core was a response by the PBMR designers to the difficulty of predicting pebble motion. Sharp separation of the core regions by the wall would improve the designers' ability to predict the location of pebbles and, as a result, the power and temperature distributions across the core. However, the presence of the graphite wall would pose new safety issues. Collapse of this relatively fragile wall, spontaneously or during fault conditions, could block helium flow or increase reactivity, causing temperature spikes in parts of the core. Fault conditions could lead to collapse of the wall as a result of differential pressure between the core regions. Faults causing differential pressure could include a pipe break in one of the pebble-transfer systems.

The reactor core was not the only part of the PBMR that exhibited substantial design change between August 2001 and August 2003. In the August 2003 version a system designated CBCS – presumably being the core barrel conditioning system – provided a helium flow loop, external to the reactor vessel, that penetrated the bottom and top of the vessel. By contrast, the analogous system in the August 2001 design – the reactor pressure vessel conditioning system – penetrated the reactor vessel only at the bottom. Introducing penetrations at both the top and bottom of the vessel, as was done in the August 2003 version, would, other factors being equal, reduce the safety of the design. The potential would exist for a fault condition – such as a loss of helium from the primary cooling circuit combined with a pipe break in the CBCS – to create air flow through the core, thereby feeding combustion of fuel and graphite pebbles.

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14 Matzner, 2003a.

15 An alternative core configuration would be one in which the graphite pebbles in the central region of the core would be replaced by non-moving graphite structures. The FEIR hinted (FEIR, 2002, Section 4.20.5) that this alternative was considered. However, IRSS interprets the August 2003 presentation to DOE (Matzner, 2003a) as indicating that graphite pebbles would be used. The PBMR Ltd. website (www.pbmr.com, accessed 2 December 2004) referred to the use of fuel pebbles and graphite pebbles.

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Beginning in the latter part of November 2004, the website of PBMR Ltd. was altered to reveal yet another design of the PBMR, one that was substantially different from both the August 2001 and August 2003 designs.[16] The nominal power output per unit would be approximately 165 MWe. The limited information provided for the new design included several schematic diagrams. These drawings did not show the reactor core. No naming or explanation of systems or structures was provided. This limited information was sufficient to show that the design of the entire plant, outside the reactor vessel, had been radically altered since August 2003.

The drawings that were revealed in November 2004 indicated that the power turbines, turbo-compressors and electricity generator would share a common, horizontal axis, and would be coupled together by drive shafts. This arrangement would necessitate the presence of rotating seals where the drive shafts penetrated the primary pressure boundary. The previous design had avoided the use of such seals. Moreover, in the new design the helium turbo-machinery would be separated from the external environment by a comparatively light-weight building, thus creating the potential for a breach of the primary pressure boundary to be caused by an external insult such as a crashing aircraft or an attack with explosives. Other parts of the primary pressure boundary would be similarly vulnerable to external insults. The potential would exist for a fault condition that creates air flow through the core, thereby feeding combustion.

In June 2000, Eskom and its partners applied to DEAT for authorisation to build and operate a PBMR demonstration plant. The discussion in the preceding paragraphs shows that the proposed South African PBMR has undergone major design changes at least twice since that application was made. At least one of these changes occurred after the FEIR was completed in October 2002. Similarly, at least one of the changes occurred after DEAT's authorisation was granted in June 2003. The changes revealed in November 2004 included an increase in nominal power output per unit to 165 MWe, compared with the nominal output of 120 MWe specified in DEAT's authorisation.[17]

This situation is puzzling. Three alternative explanations, all unsatisfying, present themselves. The first explanation is that the design of the proposed demonstration plant underwent major changes after the application to DEAT for authorisation was made and granted. If correct, this explanation indicates that the authorisation process lacked substance. The second explanation is that the design of the proposed demonstration plant was essentially frozen before the FEIR was completed, while the design of hypothetical follow-on plants has undergone major changes. If correct, this explanation indicates that the demonstration plant would be obsolete before its construction began. The third explanation is that the safety findings set forth in the FEIR were not based on an actual design of a PBMR, but rather on a design concept.[18] If correct, this explanation, like the

16 PBMR Ltd. website (www.pbmr.com), accessed on 9 November 2004, 23 November 2004 and 2 December 2004.

17 Olver, 2003a.

18 This explanation gains credence from Section 4.20.5 of the FEIR (FEIR, 2002), which discussed the PBMR's compliance with NNR safety criteria. The discussion mentioned PBMR versions with nominal

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first explanation, indicates that DEAT's authorisation process lacked substance. IRSS interprets the balance of evidence as favouring the third explanation.

3. Safety issues

3.1 Generic safety issues for a high-temperature gas-cooled reactor

In this report, the word "safety" refers to the potential for an unplanned release of radioactive material to the environment. The available types of fission reactor exhibit differing behaviours in this respect. An event that could cause an unplanned release from one type of reactor might not have this effect on a different type of reactor. Thus, at a generic level, one can compare the safety characteristics of different reactor types. The safety of a specific reactor is, however, determined not only by its generic characteristics but also by its detail design and the manner in which it is constructed and operated.

Any type of reactor could release a large fraction of its radioactive inventory if subjected to a sufficiently powerful insult. For example, a military attack with conventional or nuclear weapons could achieve this result. Below this level of severity is a spectrum of potential release-initiating events, including attack by a sub-national group, earthquake, random equipment failure, operator error, etc. The discussion here generally applies to that spectrum of events.

A high-temperature gas-cooled reactor, such as the proposed South African PBMR, can be designed to ride out events that would lead to fuel damage in other types of reactor. Notably, the reactor core can have a negative temperature coefficient of reactivity, so that power output falls naturally under fault conditions that lead to a rise in temperature. Also, the reactor can be designed so that radioactive decay heat is removed from the core by natural conduction, convection and radiation. Nevertheless, the fuel will suffer severe damage if events cause the fuel temperature to rise substantially above the design level. For the proposed PBMR, it is expected that the fraction of failed fuel will reach 100 percent if fuel temperature rises to 2400 C.[19] Thus, it is important to thoroughly understand the circumstances that could lead to high fuel temperature.

Ingress of air and/or water into the reactor core is recognized as an event that could lead to high fuel temperature and hence to severe fuel damage. A review of design issues for high-temperature pebble-bed reactors has stated:[20]

> "The hot graphite in the core reacts with air and water so that ingress of these materials may result in core damage. This is compounded by the fact that ingress may also inject positive reactivity at a rate that will result in fuel failure before the

ratings of 268 MWt and 302 MWt, the latter version having a "solid central column" in the reactor core. There was no recognition of the safety significance of variations in design.

19 Borton, 2001, Figure 11.

20 Gougar et al, 2003, pp 288-289.

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> negative reactivity feedback of the subsequent temperature increase can prevent it. Proper design must include an assessment of water and air ingress reactivity."

Safety issues for pebble-bed reactors were identified at a workshop held in the USA in October 2001.[21] Three selected issues are summarised in this paragraph. One issue was that test data for the fuel pebbles have been obtained by holding fuel at a fixed temperature. There had been no tests involving temperature transients that could lead to thermal shock to the silicon carbide cladding of the fuel particles. A second issue was that the reaction of air with graphite can be catalysed by transition metals and cesium hydroxide. A third issue was that irradiated graphite can release energy under hightemperature conditions, potentially exacerbating these conditions. In regard to the third issue, a report on the workshop by Dana Powers stated:[22]

> "Though most seem to be aware of the Wigner energy that can be stored in irradiated graphite at low temperatures, there does not seem to be a keen awareness of the radiation damage that can occur in graphite at high temperatures. These high temperature radiation damage processes involve higher energies than the Wigner effect. The energy stored in graphite by these radiation damage processes will be released if the graphite is heated to sufficiently high temperatures in an accident or if the graphite is chemically reacted. It is not apparent that accident analyses have considered this source of stored energy in predicting the response of the reactor."

An Annexure to the FEIR responded to this concern as follows:[23]

> "Again the absence of a PBMR expert at the meeting dr. Powers attended was regrettable as the irradiation dependent properties play an important role in the design and much work on being able to predict these from past experiments is presently in progress. PBMR has combined the knowledge and database of several graphite experts from around the world to ensure that the best possible data are used."

This response evaded the issue. To the extent that the response had substance, it revealed that PBMR proponents were still studying the irradiation-dependent properties of graphite. A scientifically credible assessment of this issue is needed, but was not provided in the FEIR. A credible assessment would not attempt to evade the issue by claiming that high-temperature conditions are so unlikely that they should not be considered. Instead, the assessment would provide strictly scientific information about the high-temperature release of energy from irradiated graphite.

An issue that arises in any discussion of the safety of a high-temperature gas-cooled reactor is the design of the secondary envelope that surrounds the primary pressure

21 Powers, 2001.

22 Powers, 2001, page 6.

23 FEIR, 2002, Annexure 10, Issue 5.1.4.1.3.

boundary, and the risk implications of that design.[24] Some analysts argue that a closed containment structure, as is used for light-water reactors in the USA, should be used. Others argue for a vented confinement structure, as is envisioned for the proposed South African PBMR. This issue is addressed further in Section 3.3, below.

3.2 Vulnerability to acts of malice or insanity

There is a rich history of events showing that acts of malice or insanity pose a potential threat to civilian nuclear facilities around the world.[25] Consider some examples. Nuclear power stations under construction in Iran were repeatedly bombed from the air by Iraq in the period 1984-1987. Yugoslav Air Force fighters made a threatening overpass of the Krsko nuclear power station in Slovenia -- which was operating at the time -- a few days after Slovenia declared independence in 1991. So-called research reactors in Iraq were destroyed by aerial bombing by Israel in 1981 and by the United States in 1991. In 1987, Iranian radio threatened an attack by unspecified means on US nuclear power stations if the United States attacked launch sites for Iran's Silkworm anti-ship missiles. Bombs damaged nuclear power stations under construction in Spain in 1977 and in South Africa in 1982. Anti-tank missiles struck a nuclear power station under construction in France in 1982. North Korean commandos were killed while attempting to come ashore near a South Korean nuclear power station in 1985. These and other events illustrate the "external" threat to nuclear power stations. Numerous crimes and acts of sabotage by nuclear-power-station personnel illustrate the "internal" threat.

The attacks of 11 September 2001 on buildings in New York and Washington have drawn new attention to the threat of attack on nuclear power stations. Governmental and non-governmental entities in various countries have studied this threat.[26] In the USA, the National Strategy for The Physical Protection of Critical Infrastructures and Key Assets, published in February 2003, identifies nuclear power stations as key assets, defined as

follows: 27

> "Key assets represent individual targets whose destruction could cause large-scale injury, death, or destruction of property, and/or profoundly damage our national prestige, and confidence".

Continuing concern in the USA about the threat of attack on nuclear power stations was evident in a November 2004 report from the US Central Intelligence Agency (CIA) to the US Congress, which stated in part:[28]

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24 See, for example: Williams, 1991; Kugeler and Phlippen, 2001; Kugeler et al, 2001; Powers, 2001; Thadani, 2001; Borton, 2002b 25 Thompson, 1996

26 See, for example: POST, 2004.

27 White House, 2003, page 7.

28 CIA, 2004, page 8.

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> "In addition, we are alert to the very real possibility that al-Qa'ida or other terrorist groups might also try to launch conventional attacks against the chemical or nuclear industrial infrastructure of the United States to cause panic and economic disruption."

A determined, sophisticated group planning an attack on a nuclear power station could employ a variety of modes and instruments of attack. Table 3-1 shows some potential modes of attack, and the corresponding defenses that are currently provided by nuclearpower-station licensees in the USA pursuant to NRC requirements.

Table 3-1

Potential Modes and Instruments of Attack on a Nuclear Power Station[29]

Mode of Attack	Characteristics	Present Defenses at Nuclear Power
Commando-style attack	• Could involve heavy weapons and sophisticated tactics • Successful attack would	Alarms, fences and lightly-armed guards, with offsite backup
Land-vehicle bomb	• Readily obtainable • Highly destructive if	Vehicle barriers at entry points to Protected Area
Anti-tank missile	• Readily obtainable • Highly destructive at point	None if missile launched from offsite
Commercial aircraft	• More difficult to obtain than before 11 September 2001 • Could destroy larger	None
Explosive-laden smaller aircraft	• Readily obtainable • Could destroy smaller,	None
10-kilotonne nuclear weapon	• Difficult to obtain • Assured destruction if	None

29 Adapted from Table 1 of: Thompson, 2003.

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A form of explosive that might be used in an attack on a nuclear power station is a shaped charge. These have many civilian and military applications, and have been used for decades. They are used, for example, as human-carried demolition charges or as warheads for anti-tank missiles. The largest known shaped charge was the German MISTEL, developed late in World War II. This warhead was 2 m in diameter, weighed 3,500 kg and contained 1,700 kg of explosive. It was carried in the nose of an unmanned bomber aircraft. The Japanese used a smaller version of this device, the SAKURA bomb, for kamikaze attacks against US warships.[30]

A US government laboratory has developed, and described in a published report, a shaped charge specifically intended to penetrate large thicknesses of rock or concrete. 31 This device is intended for mounting in the nose of a cruise missile. The charge is a cylinder with a diameter of 71 cm and a length of 72 cm. It has a total mass of 410 kg and contains 270 kg of Octol explosive. When tested in November 2002, this device created a hole of 25 cm diameter in tuff rock to a depth of 5.9 m. The charge's purpose is to be the first stage of a "tandem" warhead, opening a hole in rock or concrete so that the second stage can penetrate deeply into the attacked structure before exploding.

One means of carrying a warhead to a nuclear power station would be a general-aviation aircraft, piloted remotely or by a suicidal pilot. In illustration, a Beechcraft King Air 90 will carry a payload of up to 990 kg at a speed of up to 460 km/hr.[32] A used King Air 90 can be purchased in the USA for US$0.4-1.0 million.[33] Such an aircraft could be used for a precision attack on a comparatively small and robust structure such as a nuclear power station. It is noteworthy that the US General Accounting Office (GAO) expressed concern, in September 2003 testimony to the US Congress, about the potential for malicious use of general-aviation aircraft, stating in part:[34]

> "Since September 2001, TSA [the Transportation Security Administration] has taken limited action to improve general aviation security, leaving it far more open and potentially vulnerable than commercial aviation. General aviation is vulnerable because general aviation pilots are not screened before takeoff and the contents of general aviation planes are not screened at any point. General aviation includes more than 200,000 privately owned airplanes, which are located in every state at more than 19,000 airports. Over 550 of these airports also provide commercial service. In the last 5 years, about 70 aircraft have been stolen from general aviation airports, indicating a potential weakness that could be exploited by terrorists."

30 Walters, 2003.

31 This citation is withheld by IRSS.

32 Raytheon Aircraft Company, "Technical Data, Beechcraft King Air C90B", 16 June 2004.

33 The website www.aircraftdealer.com, accessed 6

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3.3 Options for improving safety

Various design options are available, or could be developed, that could potentially improve the safety of a PBMR. These options include improved fuel pebbles and core structures, underground siting, a closed containment system, a filtered confinement system, or combinations of these and other options. Each option would involve some additional cost.

At the Julich Research Centre in Germany, an effort has been made to develop what Professor Kugeler of the Centre has described as a "catastrophe-free" pebble bed reactor.[35] Part of this effort has been the testing of silicon carbide coatings of 0.1-0.2 mm thickness to cover fuel and graphite pebbles and fixed graphite structures in the reactor core. If successfully developed, a silicon carbide coating could prevent self-sustaining graphite oxidation in the event of air ingress to the reactor.[36] Other parts of the Julich effort have included the scaled testing of burst-protected reactor pressure vessels, and the development of systems that use sand or other granulates to block air ingress after a vessel break.

Underground siting is a design option that could potentially improve the safety of a PBMR in two respects. First, it could protect the plant against external insults such as a crashing aircraft or an attack with explosives. Second, it could facilitate the provision of a closed containment system or filtered confinement system with a high pressure capacity, because the surrounding soil would enhance the system's strength. An outline design of an "inherently safe" 300 MWt pebble bed reactor has been described, featuring underground siting and a vented confinement system with filters and sedimentation chambers in the venting pathway.[37] It is interesting that the design of the General Atomics modular high-temperature reactor, a competitor to the South African PBMR, places the reactor and power conversion system below ground level in a concrete building.[38]

Various containment and confinement systems have been used or considered for gascooled reactors.[39] A confinement system could be built without any filtration in the vent path to the atmosphere, as is apparently envisioned for the proposed South African PBMR. Alternatively, wet or dry filter systems, perhaps combined with sedimentation chambers, could be used in the vent path.

36 The coating could also prevent the reaction of graphite with water vapour, in the event of water ingress.

38 Nuclear Energy Institute website (www.nei.org), accessed 2 November 2004.

39 Williams, 1991.

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4. Criteria for judging safety

4.1 Criteria set by the National Nuclear Regulator

South Africa's National Nuclear Regulator (NNR) has established safety criteria for licensing of the proposed PBMR. IRSS could not obtain these criteria directly from NNR, because the NNR website was inoperative. The criteria have, however, been published elsewhere. They are shown in Table 4-1.

Table 4-1

NNR Safety Criteria for PBMR Licensing[40]

Event Frequency	Safety Criteria
Category A: events with frequency more than 1 per 100 yr	Individual radiation dose limit: • 20 mSv/yr to plant personnel • 0.25 mSv/yr to the public
Category B: events with frequency more than 1 per 1 million yr but less than 1 per 100 yr	Individual radiation dose limit: • 500 mSv per event to plant personnel • 50 mSv per event to the public
Category C: Category A and B events plus events with frequency less than 1 per 1 million yr	Risk limit (where risk = expected number of fatalities per yr across a population): • for plant personnel: peak individual risk of 1 per 20,000; average risk of 1 per 100,000 • for the public: peak individual risk of 1 per 200,000; average risk of 1 per 100 million per site

Employing risk-based criteria of this type places a premium on obtaining the best possible knowledge about the probabilities and other characteristics of potential hazardous events. There are fundamental difficulties in obtaining such knowledge, as discussed in Section 5.2, below. Also, a risk-based approach to licensing can hinder the consideration of acts of malice or insanity, because quantitative probabilities cannot be estimated for such acts. This point is taken up in Section 7.2, below.

40 FEIR, 2002, Table 1.

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4.2 Other criteria

Entities other than NNR have articulated criteria for judging the safety of modern reactors, including pebble bed reactors. For example, as mentioned in Section 3.3, an effort has been made at the Julich Research Centre to develop a "catastrophe-free" pebble bed reactor. A criterion for judging the safety of such a reactor has been articulated as follows:[41]

> "Catastrophe-free nuclear technology is achieved if the radioactive substances remain contained inside the reactor plant in all possible cases of accidents so that no significant radiological consequences will result for the environment, i.e.,
>
> - no immediate fatalities;
> - no late fatalities;
> - no evacuation;
> - no relocation, and
> - no changes in eating and drinking habits."

The crucial phrase in this statement is "all possible cases of accidents". There will inevitably be varying opinions about the scope of the events to be included in this category. If that scope could be clearly delineated, this criterion would have the merit that compliance with the criterion could be demonstrated without regard for the probabilities of hazardous events.

A representative of Eskom has set forth a similar criterion for judging the safety of the proposed South African PBMR. The representative stated:[42]

> "There must be no physically credible event which can cause off-site actions to be required".

In this formulation, the crucial phrase is "physically credible event". As for the Julich formulation, opinion will vary about the scope of the events to be included.

4.3 Consideration of acts of malice or insanity

Neither of the safety criteria discussed in Section 4.2 explicitly addresses acts of malice or insanity. However, some reactor designers have explicitly included such acts within their safety criteria. For example, the designers of the PIUS reactor – a type of lightwater reactor – established safety objectives as follows:[43]

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41 Kugeler and Phlippen, 2001, page 6.

42 Nicholls, 2000, page 232.

43 Hannerz, 1983, page 3.

"Thus, we want to achieve complete protection against core melting or overheating in case of:

- any credible equipment failures;
- natural events, such as earthquakes and tornadoes;
- reasonably credible operator mistakes; and
- combinations of the above;

<u>and</u> against:

- inside sabotage by plant personnel, completely knowledgeable of reactor design (this can be considered an envelope covering all possible mistakes);
- terrorist attacks in collaboration with insiders;
- military attack (e.g., by aircraft with "off-the-shelf" non-nuclear weapons); and
- abandonment of the plant by the operating personnel."

The aspects of this safety objective that address acts of malice or insanity could be made precise. This would be done by establishing a set of "design-basis" acts of malice or insanity. That set of events could be incorporated into safety criteria of the type articulated in Section 4.2.

5. Processes for assessing safety

5.1 Safety-assessment processes in the USA

In the USA, licensing of civilian nuclear facilities is the exclusive responsibility of NRC, a federal-government agency that operates within a statutory framework established by the US Congress. Within that framework, NRC and its predecessor -- the US Atomic Energy Commission (AEC) -- have created a complex web of regulations, orders, procedures, guidance documents and other instruments that govern the granting of licenses and the oversight of licensees. As part of its standard practice, NRC requires the licensee of each nuclear facility to assess the safety of the facility. NRC has also conducted its own safety assessments. A brief sketch is provided here of the safetyassessment processes that are required or conducted by NRC, with a focus on nuclear power stations.

Before NRC grants a license to construct a nuclear facility, the applicant must complete a Final Safety Analysis Report (FSAR) for the facility. The US fleet of nuclear power stations is comparatively old, the majority of stations having operated for at least two decades. Thus, there have been no recent applications to construct a nuclear power station. The FSAR continues, however, to be part of the licensing record for each operating station. New FSARs have been prepared in recent decades for non-reactor facilities such as independent spent fuel storage installations (ISFSIs).

The FSAR for a nuclear power station is a multi-volume document containing a large amount of technical information, typically including cross-sectional drawings of the station buildings. A portion of the FSAR examines a set of "design-basis accidents" that the station could experience. These accidents do not involve severe damage to nuclear fuel, either in a reactor or after discharge from a reactor. The purpose of the examination is, indeed, to show that the hypothesised accidents do not cause severe damage to fuel. Design-basis accidents are analysed deterministically. No attempt is made to estimate their probabilities.

NRC staff review the analysis that the applicant performs while preparing the FSAR, and must approve the final version of the analysis that appears in the FSAR. The staff's approval is expressed in a Safety Evaluation Report (SER).

Operating experience and safety research have shown that the design-basis accidents considered in an FSAR do not provide a complete, realistic picture of the accident potential of a nuclear power station. Relevant operating experience includes accidents at the Three Mile Island station in 1979 and the Chernobyl station in 1986, both of which involved severe damage to fuel. In recognition of the potential for severe fuel damage, AEC began work in the early 1970s to develop the art of probabilistic risk assessment (PRA) for nuclear power stations. This work was continued by NRC when it took over AEC's regulatory role. The first major publication from this work was the Reactor Safety Study (WASH-1400), published in 1975.

The purpose of PRA in the context of a nuclear power station is to estimate the probabilities and other characteristics of potential sequences of events that involve severe fuel damage. Further information about PRA is provided in Section 5.2, below. NRC has conducted PRAs for a number of US nuclear power stations, as part of NRC's work to develop the art of PRA. Pursuant to NRC requirements, the licensee of each US nuclear power station has conducted for that station either a PRA or a less rigorous study known as an Individual Plant Examination (IPE).

Findings from PRA work guided the development in the late 1970s and early 1980s of new regulations and practices for emergency response planning in communities surrounding nuclear power stations. PRA findings came too late to affect the basic designs of the current generation of US nuclear power stations. Findings from PRAs done by NRC and licensees have, however, influenced the introduction of many plant modifications, together with many changes in maintenance and operating practices. NRC is moving toward increased reliance on PRA findings to guide its oversight of the operation of nuclear power stations, under the rubric "risk-based regulation".

A federal statute, the National Environmental Policy Act (NEPA), obliges each federalgovernment agency to prepare an environmental impact statement (EIS) when the agency takes an action with significant impacts on the environment. NRC has prepared many EISs pursuant to its obligations under NEPA, including EISs that describe the impacts of granting licenses to operate nuclear power stations. Beginning in the early 1980s, EISs associated with new operating licenses used PRA findings to estimate the offsite impacts of potential reactor accidents that would involve severe damage to fuel.

5.2 Probabilistic risk assessment

A large body of experience with nuclear-station PRAs has been accumulated. The bulk of this work has been done for light-water reactors. However, the basic principles apply to a PBMR.

In 1990, NRC completed a major PRA study -- NUREG-1150 -- that examined five nuclear power stations in the USA.[44] One and a half decades later, this study remains a reference point for PRA practice internationally. There has been no study of comparable size and scope in the intervening period. Refinements of PRA practice have occurred, within the framework set by NUREG-1150.

The author contributed to a detailed review of PRA practice that was published in 1989.[45] This review, which accounted for the work that led to NUREG-1150, showed that PRA findings can be very useful. It also showed that there are fundamental obstacles to estimating the overall risk posed by a nuclear power station. There are obstacles to identifying the significant event sequences, estimating their probabilities, understanding the relevant physical and chemical phenomena, and estimating radioactive releases to the environment. Gross errors in design, construction or operation, together with acts of malice or insanity, are simply ignored in PRAs. Events of this type could, however, be the major source of risk. Thus, in view of the various limits to PRA completeness and accuracy, decision makers should be very conservative in using PRA findings for regulatory purposes.

5.3 Assessing vulnerability to acts of malice or insanity

As stated in Section 5.2, PRAs ignore acts of malice or insanity, because quantitative probabilities cannot be estimated for such acts. However, the logical structure of PRA can be useful in studying the vulnerability of a nuclear power station to postulated acts of malice or insanity. For example, the explosion of a specified vehicle bomb could be postulated to occur at a certain location near a nuclear power station. Then, analytic techniques used in PRA could be applied to: (i) determine if the explosion would lead to a release of radioactive material from the station; and (ii) estimate the magnitude of the release.

NRC acknowledges that it has sponsored studies of this kind, typically at US national laboratories. The scope and pace of this work increased substantially after the attacks of

44 NRC, 1990.

45 Hirsch et al, 1989.

11 September 2001 in New York and Washington. However, very little information about this work and its findings has been published.[46]

State and local governments and citizen groups in the USA have argued for greater openness in assessments of the vulnerability of nuclear facilities. They argue that an EIS that accounts for acts of malice or insanity can be prepared without disclosing sensitive information, and is required by law. A lawsuit calling for such an EIS is pending before the 9th Circuit of the US Court of Appeals, in connection with the licensing of an ISFSI at the site of the Diablo Canyon nuclear power station. A citizen group, Mothers for Peace, brought this suit.[47] The states of California, Massachusetts, Utah and Washington support the suit.

6. Available information about safety assessment for the proposed PBMR 6.1 The Final Environmental Impact Report

The FEIR contained a number of statements about the safety of the proposed PBMR. The most significant statements are reviewed in the remainder of Section 6.1. Findings set forth in the available portion of the SAR, which was provided as Annexure 23 to the FEIR, are discussed in Section 6.2. In making a statement about a safety issue, the FEIR generally did not cite a specific source. It implied that its statements were backed up by its Annexures, especially Annexure 23. Making un-attributed statements in this way is a practice that falls below the standards of a nuclear-facility EIS prepared by NRC or DOE.

As mentioned in Section 3.1, overheating of fuel pebbles is a particular concern for a high-temperature pebble-bed reactor. The FEIR briefly discussed this issue, stating:[48]

> "The peak temperature that could be reached in the fuel under the most extreme foreseen conditions is 1600 C. This means that the plant cannot experience thermal fuel damage. As a further safety measure, the fuel is designed to retain its density up to temperatures of over 1700 C, and will maintain its integrity at a sustained temperature of 2000 C."

This statement is imprecise and internally inconsistent. The word "cannot" in the second sentence makes a sweeping claim that lacks any technical justification. By contrast, the phrase "foreseen conditions" in the first sentence meets the standards of rational discourse, allowing the reader to ask what conditions were foreseen. However, the FEIR did not provide any answer to that question.

46 NRC, 2004.

47 See the website: www.mothersforpeace.org.

48 FEIR, 2002, Section 2.2.6.

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A fire in the reactor core is a mechanism that could lead to severe damage to fuel. The FEIR briefly discussed this issue, stating:[49]

> "A free flow of air through the reactor is needed for a self-sustaining fire to occur. This requires the vessel head to be breached as well as a breach at the bottom of the structure and a failure of the citadel (to allow air in). The design target is such that no event can lead to this level of damage. What can occur is a graphite corrosion event caused by a single hole in the primary circuit leading to a mixing of air and helium."

This statement has the merit of disclosing that a "free flow of air through the reactor" is a condition to be feared and avoided. A reader could reasonably expect that the FEIR would discuss events that could lead to this condition, their probabilities (where predictable), and the means by which the condition could be avoided. Alternatively, a reader could expect a citation to a technical document containing such a discussion. The FEIR did not satisfy either expectation.

An accidental aircraft crash or an act of malice or insanity – a category of act that could include a deliberate aircraft crash – are potential events that deserve consideration from a safety perspective. One concern about such events is that they might create the conditions for a reactor fire. The FEIR briefly addressed aircraft crash, terrorism and sabotage, stating:[50]

> "PBMR has investigated the events of an aircraft crash {civil aircraft = Cessna 210; military aircraft = German KTA (F4 Phantom @ 227 km/hr) and commercial aircraft = Boeing 777} or terrorist attack for inclusion in the design basis and produced a methodology to mitigate the release of radioactive material into the environment. The nuclear regulatory bodies will furthermore produce a design basis for such extreme events towards the end of 2002 and this methodology will then be expanded to provide for any additional design requirements………The module building, which comprises the entire structure that houses the power plant and its ancillary systems, is designed to withstand significant external forces such as aircraft impacts and tornadoes. It is also highly resistant to explosions from potential saboteurs."

This statement raises questions, but the FEIR neither provided any answer nor cited a document that might provide an answer. Questions include: (i) what is a "methodology to mitigate the release of radioactive material"?; (ii) what is encompassed by the phrase "significant external forces"?; and (iii) what does "highly resistant" mean? Readers of this statement will also wonder if the South African nuclear regulatory bodies did produce a "design basis for such extreme events" during 2002 or subsequently, and with

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49 FEIR, 2002, Section 2.2.11.

50 FEIR, 2002, Section 2.2.10.

what effect. Moreover, were such events considered by DEAT before that department issued its authorisation of the demonstration PBMR in June 2003 and, if so, what analysis was presented to DEAT?

Safety criteria set by NNR are shown in Table 4-1. The FEIR claimed, citing the SAR, that compliance with these criteria had been demonstrated. The FEIR stated:[51]

> "The result of the preliminary analysis, based on conservative assumptions in consequence assessment modeling, confirms the compliance of the PBMR Plant (268 and 302 MWth core) with the NNR safety criteria for the public. The analysis must be verified by the NNR as part of their licensing process to assure final acceptance of the results."

This claim is discussed further in Section 6.2, where the compliance findings in the FEIR and the SAR are compared.

6.2 The Safety Analysis Report

Here, the available portion of the SAR, as provided in Annexure 23 of the FEIR, is discussed. In the remainder of this report, the acronym SAR refers to the available portion.

The SAR was poorly structured and poorly written. It did not meet the standards of a typical FSAR for a nuclear facility in the USA. It is difficult to read, and its quantitative findings could not be validated without obtaining information from many other sources.

As explained in Section 5, above, an FSAR prepared in the USA examines design-basis accidents, but does not estimate their probabilities. By contrast, a US-prepared PRA examines beyond-design-basis accidents that involve severe damage to nuclear fuel, and does estimate their probabilities. FSARs and PRAs are separate documents that are prepared according to different standards. They play different roles in the licensing process.

The SAR under review here was a hybrid that combined aspects of FSAR and PRA practices used in the USA.[52] The SAR examined a set of hypothesised licensing-basis events (LBEs) that were analogous to the design-basis accidents examined in an FSAR. As will be seen below, none of the LBEs involved severe damage to nuclear fuel. PRA techniques were used to estimate the probabilities of the LBEs and the accompanying releases of radioactive material to the environment. This information was used to determine if the proposed PBMR complied with the NNR safety criteria.

51 FEIR, 2002, Section 4.20.6.

52 FEIR, 2002, Annexure 18, Section D.

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Table 6-1 shows the LBEs that were considered in the SAR. Estimated probabilities were provided in the SAR for each of the LBE variants shown in this table. These probabilities ranged from a high of 1 per 23 plant-yr (LBE-4b) to a low of 1 per 100 million plant-yr (LBE-11a).[53]

Table 6-1

Licensing-Basis Events Considered in the PBMR SAR[54]

Basic Event	Variants
• LBE-1: loss of power conversion unit	• LBE-1a: with RCCS cooling • LBE-1b: without RCS/RSS trip • LBE-1c: without RCCS cooling
• LBE-2: control rod group withdrawal	• LBE-2a/2b: with CCS/RCCS cooling
• LBE-3: primary coolant leak with isolation	• LBE-3a/3b/3c: with SBS/CCS/RCCS cooling
• LBE-4: primary coolant leak without isolation with pumpdown	• LBE-4a: small leak • LBE-4b: heat exchanger tube leak
• LBE-5: as LBE-4 without pumpdown	• LBE-5a: small leak • LBE-5b: heat exchanger tube leak
• LBE-6: primary pressure boundary (PPB) break with isolation	• LBE-6a/6b/6c: with SBS/CCS/RCCS cooling
• LBE-7: as LBE-6 without isolation	• LBE-7a: medium break
• LBE-8: beyond-design-basis PPB break with isolation	• LBE-8a/8b: with SBS/CCS cooling
• LBE-9: as LBE-8 without isolation	• LBE-9a: with RCCS cooling
• LBE-10: large earthquake	• LBE-10a/10b: 0.3g with SBS/CCS cooling • LBE-10c: 0.4g with intact PPB
• LBE-11: large earthquake with PPB break	• LBE-11a: 0.4g with PPB break

Radioactive releases were estimated, but not for each LBE separately. They were estimated for a set of release categories: RC-1; RCF-1; RCF-2; RCP-1; RCPF-1; and RCPF-2. This analytic approach is similar to PRA practice in the USA. Table 6-2 shows the estimated potential atmospheric releases for each release category, for three selected radionuclides. A larger set of radionuclides was considered in the SAR. The quantities shown were described in the SAR as "inventory available for release", which could conservatively be assumed to be the amount released. Also shown in Table 6-2 is the total core inventory.

53 SAR/FEIR Annexure 23, Table 6.2-7.

54 SAR/FEIR Annexure 23.

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Table 6-2

Radionuclide Inventories or Potential Releases Estimated in the PBMR SAR[55]

Inventory or Potential Release	Amounts of Selected Radionuclides (Bq)		
	Xe-133	**I-131**	**Cs-137**
Core inventory	6.1 E+17	2.7E+17	1.6E+16
RC-1	9.1 E+10	5.2E+05	1.6E+04
RCF-1 immediate	4.6E+10	2.6E+05	8.0E+03
RCF-1 delayed	7.3E+11	3.3E+11	1.9E+10
RCF-2 immediate	9.1 E+10	5.2E+05	1.6E+04
RCF-2 delayed	7.3E+11	3.3E+11	1.9E+10
RCP-1	9.1E+10	3.5E+09	8.1E+10
RCPF-1 immediate	9.1E+10	3.5E+09	8.1E+10
RCPF-1 delayed	7.3E+11	3.3E+11	1.9E+10
RCPF-2 immediate	9.1E+10	3.5E+09	8.1E+10
RCPF-2 delayed	7.3E+11	3.3E+11	1.9E+10

One sees from Table 6-2 that the largest potential releases of Xe-133 and I-131 would represent about 1 part in 1 million of the core inventory of each radionuclide.[56] This result demonstrates clearly that none of the LBEs examined in the SAR involved severe fuel damage, because xenon and iodine would be liberally released from severely damaged fuel. The largest potential releases shown in Table 6-2 for Cs-137 are puzzling, because they would represent 1 part in 160,000 of the core inventory of this radionuclide, a larger release fraction than is shown for Xe-133 or I-131.[57] One would expect, from the respective volatilities of these three species, that xenon would be released more liberally than iodine, which would in turn be released more liberally than cesium.[58] Xenon is a non-reactive noble gas whose release would not be inhibited by chemical reactions or particulate deposition along the release pathway, as could occur for cesium. This anomaly in Table 6-2 requires explanation, but none was provided in the SAR. The anomaly does not affect the conclusion that none of the LBEs involved severe fuel damage.

55 SAR/FEIR Annexure 23, Tables 6.2-8 and 6.3-2.

56 For example, the estimated RCF-1 release (immediate plus delayed) of Xe-133 would be 7.8E+11 Bq, whereas the core inventory of Xe-133 would be 6.1E+17 Bq. In this instance the release would represent 1 part in 780,000 of the core inventory.

57 For example, the estimated RCPF-1 release (immediate plus delayed) of Cs-137 would be 1.0E+11 Bq, whereas the core inventory of Cs-137 would be 1.6E+16 Bq. In this instance the release would represent 1 part in 160,000 of the core inventory.

58 The boiling-point temperatures of xenon, iodine and cesium are, respectively, about –110 C, 180 C and 680 C.

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A suspicion arises that the authors of the SAR avoided examining LBEs that would involve severe fuel damage. This suspicion gains credence from a disclosure in the SAR that event sequences involving air ingress to the reactor core were excluded from examination. As is acknowledged in the FEIR, air ingress could feed combustion, potentially leading to severe fuel damage. The disclosure occurred during the SAR's discussion of LBE-9a, an event involving a "large break" in the primary pressure boundary.[59] In this context the SAR stated:[60]

> "As for the medium size break, the possibility of air ingress will be the subject of future studies to be performed on the detail design and on the premise that unlikely events also need to be analysed."

This statement reveals three significant points. First, the SAR was performed, not for a "detail design" of PBMR, but for a design concept. Second, the SAR did not address the possibility of air ingress. Third, the authors of the SAR assumed, although no evidence to this effect was presented in the SAR, that events involving air ingress would be "unlikely". The SAR attributed to LBE-9a a probability of 1 per 220,000 plant-yr.[61] Moreover, as mentioned above, the SAR considered LBEs with estimated probabilities as low as 1 per 100 million plant-yr. Should one infer that events involving air ingress would have had estimated probabilities less than 1 per 100 million plant-yr, or less than 1 per 220,000 plant-yr? The SAR provided no answer.

Both the SAR and the FEIR presented findings that purported to demonstrate compliance with the NNR safety criteria. Table 6-3 shows these findings. The quantities shown are individual risks (peak and average) as estimated in the SAR and the FEIR, together with the NNR risk limits. The risks estimated in the SAR and the FEIR supposedly encompassed all the LBEs that were considered in the SAR.

59 The SAR defined a "large break" in the primary pressure boundary as a breach with an area greater than the cross-sectional area of a pipe with a diameter of 65 mm.

60 SAR/FEIR Annexure 23, Section 6.0.4.9.2.

61 SAR/FEIR Annexure 23, Table 6.2-7.

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Table 6-3

Comparison of Findings in the FEIR and the SAR Regarding Compliance with NNR Risk Limits for the PBMR

Risk Limits and Compliance Findings (Category C events)	Risk to the Public (Risk = expected number of fatalities per yr across a population)	
	Peak Individual Risk	**Average Risk**
NNR risk limits for the PBMR[62]	5.0E-06	1.0E-08
Compliance findings in the FEIR[63]	9.7E-10	4.6E-13
Compliance findings in the SAR 64	5.8E-08	6.7E-11

One notices that the risk estimates shown in the FEIR were two orders of magnitude lower than the risk estimates shown in the SAR. Yet, the FEIR cited the SAR as the source of its estimates. This discrepancy occurred in a context where each document summarized the findings of a large body of analysis, in order to demonstrate regulatory compliance. These findings should be identical. The discrepancy between them indicates an extraordinary degree of carelessness in the preparation of one or both documents. No confidence can be placed in a document exhibiting such a low standard of preparation.

Table 6-3 shows that the risks estimated in the SAR were two orders of magnitude below the NNR risk limits. However, Table 6-2 shows that the releases of radionuclides underlying these risk estimates were five or more orders of magnitude lower than the core inventories of these radionuclides. A comparison of these tables strongly suggests that inclusion in the SAR of LBEs involving severe fuel damage would have led to risk estimates substantially higher than the NNR risk limits.

62 FEIR, 2002, Table 1.

63 FEIR, 2002, Section 4.20.5.

64 SAR/FEIR Annexure 23, Sections 6.0.10.4 and 6.0.10.4.1.

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6.3 Information from other sources

Some information about safety assessment of the proposed PBMR was available from sources other than the FEIR and SAR. For example, a presentation by PBMR Ltd. to DOE disclosed a finding that a Boeing 777 aircraft striking the PBMR would penetrate the plant's outer structure.[65] This finding is significant in view of the potential for a penetrating aircraft to cause a breach in the primary pressure boundary.

A presentation to NRC argued that water ingress to the PBMR core would be precluded during normal operation, because the water in the secondary cooling system would be at a lower pressure than the helium coolant. The presentation noted, however, that helium pressure would be reduced during maintenance outages. 66

The same presentation to NRC addressed the potential for air ingress to the core in the event of a large break in the primary pressure boundary, stating: 67

> "Depending on the location of the large break, two-way flow is conceivable and air transport to and through the reactor core is possible. Assuming that the total inventory of air in the building passes through the reactor, a fraction of <0.01 of the graphite will be oxidized."

This statement assumed that the postulated breach in the primary pressure boundary would occur without any breach in the building. Combustion would then be limited by the amount of air in the building. That assumption would not be valid if both the pressure boundary and the building were breached by the same event, such as an aircraft crash or an attack with explosive devices. Thus, it seems clear that external insults have the potential to initiate a self-sustaining fire in the reactor.

7. The status of knowledge about safety of the proposed PBMR 7.1 Current knowledge

Preceding sections of this report show that currently available knowledge provides no useful guidance to a South African decision maker who is concerned about the safety of the proposed PBMR. The FEIR and SAR were poor-quality documents that provided, by their own admission, an incomplete picture of safety. Moreover, the safety findings presented in these documents were for a design concept, not a design that was ready to be built.

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[67] Koster, undated, page 10.

[65] Matzner, 2003a.

[66] Koster, undated, pp 6-7.

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A presentation by a PBMR Ltd. representative at an October 2004 NRC conference showed that the proposed PBMR will remain a design concept for some time.[68] The presentation described test programs that are scheduled to run through 2006, in areas such as: (i) validation of helium flow codes; (ii) validation of heat transfer coefficients in a pebble bed; and (iii) performance testing of components. Preparation of a design that is ready to be built must await the completion of such programs.

7.2 Actions needed to develop improved knowledge

To develop a thorough understanding of the safety of the proposed PBMR, three major steps would be necessary. Step 1 would be to conduct a set of empirical and theoretical investigations to improve understanding of physical and chemical phenomena that relate to fuel damage. One issue that requires better understanding is the role of hightemperature radiation effects in graphite, as discussed by Dana Powers. Other issues to be better understood include: (i) the set of conditions that could lead to a self-sustaining fire in the reactor core; and (ii) the release of radioactive material in the event of a fire.

If and when a final design of the proposed PBMR emerges, the improved scientific knowledge gained in Step 1 would be used in a comprehensive safety assessment of the design, which would constitute Step 2. The safety assessment would examine the full range of potentially hazardous events, including events whose probabilities are difficult or impossible to estimate. Acts of malice or insanity would fall into this category. Analyses would be published except where they contain information that is sensitive from a security perspective. In those instances, public stakeholders would be asked to nominate independent experts who would review the analyses under protective order. Independent review would enhance the quality and credibility of the analyses.

Assuming for the moment that NNR continues to employ risk-based safety criteria, Step 3 would translate the findings of Step 2 – the safety assessment – into findings of risk. For event sequences initiated by acts of malice or insanity, this translation poses a problem, because the quantitative probabilities of the initiating acts cannot be estimated. That problem could be addressed by engaging stakeholders in democratic processes that would, for the purpose of estimating risk, assign probabilities to postulated acts of malice or insanity.

68 Wallace, 2004.

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8. Conclusions

Major conclusions are as follows:

Conclusion 1: Statements made in the FEIR and SAR about the safety of the proposed PBMR were based on the examination of a design concept, not a design that was ready for construction. The design changed radically after the FEIR was completed in October 2002, with significant implications for safety.

Conclusion 2: The FEIR and SAR were poorly written, badly constructed documents that did not meet the standards of analogous documents in the USA. Statements made in the FEIR about safety were generally not supported by analysis or by citation of another document. The quantitative findings presented in the SAR could not be validated without obtaining information from many other sources.

Conclusion 3: None of the hypothesised licensing-basis events examined in the SAR involved severe damage to nuclear fuel. Events that could cause severe fuel damage were arbitrarily excluded from examination, with no evidence being presented in the SAR regarding their probabilities. Examination of such events was deferred to "future" studies.

Conclusion 4: Ingress of air to the reactor vessel of the proposed PBMR could feed combustion of graphite in the core, leading to severe fuel damage. Given the plant design revealed on the PBMR Ltd. website in late November 2004, there are potential events that could breach the primary pressure boundary and cause a flow of air through the reactor vessel, leading to sustained combustion of graphite. These events include accidental or deliberate aircraft impact and the use of explosive devices.

Conclusion 5: The FEIR stated that the proposed PBMR "is designed to withstand significant external forces such as aircraft impacts and tornadoes" and "is also highly resistant to explosions from potential saboteurs." This statement implied that accidental or deliberate aircraft impact and the use of explosive devices should be examined in a safety analysis, but such events were not examined in the SAR.

Conclusion 6: Findings of overall risk were presented in the FEIR and SAR, purporting to show compliance with the NNR risk limits. The individual risk findings presented in the FEIR were two orders of magnitude below those presented in the SAR, demonstrating extraordinary carelessness in the preparation of one or both documents. According to the SAR, individual risks were two orders of magnitude below the NNR risk limits, indicating compliance. It is likely, however, that inclusion in the SAR of licensing-basis events involving severe fuel damage would have led to risk estimates substantially higher than the NNR risk limits.

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Conclusion 7: Neither the FEIR nor the SAR can provide, in the versions reviewed here, any useful guidance to a decision maker who is concerned about the risk posed by the proposed PBMR.

Conclusion 8: A risk-based approach to licensing, as employed by NNR, can hinder the consideration of acts of malice or insanity because quantitative probabilities cannot be estimated for such acts. This problem could be addressed by assigning probabilities to postulated acts of malice or insanity through democratic processes of stakeholder engagement.

Conclusion 9: Design options are available, or could be developed, that could potentially reduce the risk posed by a PBMR. Such options include improved fuel pebbles and core structures, underground siting, a closed containment system, a filtered confinement system, or combinations of these and other options. Each option would involve some additional cost.

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8.9.3 SAFETY OF THE PROPOSED SOUTH AFRICAN PEBBLE BED MODULAR REACTOR:

The Economic Impact of the Proposed Demonstration Plant for the Pebble Bed Modular Reactor Design

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Contents

1. Executive Summary

1.1 The Issues

This report examines the economic case put forward in the Final Environmental Impact Report (FEIR) submitted in respect of the application by Eskom to build a Demonstration Plant at the Koeberg site in the Western Cape, using the Pebble Bed Modular Reactor (PBMR) nuclear technology being developed in South Africa. The analysis of the economic impacts is required under the terms of the National Environmental Management Act.

In June 2003, the Director-General, Chippy Olver, of the Department of Environmental Affairs and Tourism (DEAT) approved (a positive 'Record of Decision' (ROD)) the Eskom's Environmental Impact Assessment for the building of a demonstration PBMR and an associated fuel manufacturing plant. Earthlife Africa (ELA) launched a High Court application in Cape Town, which sought to review and set aside this ROD.

On January 26 2005, ELA obtained a judgement in the High Court in the Cape Provincial Division which set aside the PBMR's authorisation. By August 2005, the process to authorise the demonstration PBMR had not been re-opened.

The report focuses especially on the life cycle costs of the Demonstration Plant and any commercial successor plants. In isolation, the Demonstration Plant will inevitably be a heavily loss-making project, but it is hoped by the promoters of the project that profits from an export-led programme of commercial units will more than pay for these losses. It is therefore necessary to analyse not only at the economics of the Demonstration Plant, but also the prospects for commercial sales to assess the economic case for the Demonstration Plant.

Section 2(3) of the National Environmental Management Act stipulates that the state should ensure that development must be socially, environmentally and economically sustainable[1]; while section 2(4)(i) requires that "the social, economic and environmental impacts of activities, including disadvantages and benefits must be considered, assessed and evaluated and decisions must be appropriate in the light of such consideration and assessment".

The main publicly available sources of information on the PBMR programme are:

- The Final Environment Impact Report ("FEIR") (PBMR, 2002b) prepared by the PBMR EIA Consortium for the Applicant, Eskom;
- The Detailed Feasibility Report or DFR (PBMR, 2002a) prepared by PBMR (Pty) Ltd; and
- The Register of Comments and Responses on Draft EIRs (Register of Comments, 2002) published in June 2002, which contains responses by the consultants to public comments to the Applicant, Eskom, on the draft Economic Impact Assessment "DEIR".

The main factors that must be considered in the economic analysis of the Demonstration Plant are:

- The partners in the PBMR venture, especially foreign companies;
- Safety licensing;

[1] principle 2(3)

- Construction cost and cost of other new facilities required;
- The cost of capital;
- The plant's maximum electrical output;
- Operating performance especially reliability;
- Operations & maintenance cost, including fuel supply and spent fuel disposal;
- Decommissioning cost; and
- Operating life.

Forecasts of the economic parameters are also required to assess the prospects for the commercial programme. In addition, a world market evaluation is required. The documentation provided in the FEIR provides almost none of the information required to assess the economic sustainability of the PBMR Demonstration Plant. To consider this, it is necessary to look at the life-cycle costs of the Demonstration Plant. However, given that by its nature, a demonstration plant will not be economically viable by itself, it is necessary to look at who will bear the uneconomic costs of the plant and also what the prospects of success for commercial PBMR units are.

1.2 Conclusions

1.2.1 The Demonstration Plant

Conclusion 1: Regardless of its success or otherwise, the Demonstration Plant will leave a substantial liability that will fall on South African public funds caused by the need to decommission the plant and the associated facilities, and to pay for the disposal of the spent fuel. The FEIR and the DFR do not quantify these liabilities, providing no information on spent fuel disposal and no usable information on expected decommissioning cost. However, experience in other countries suggests that decommissioning costs could be of the same order of magnitude as construction costs.

Conclusion 2: Since details of the project were made public in 1998, costs of the Demonstration Plant have escalated by a factor of more than seven. The project leadtime has slipped so that it is now apparently further away from commercial exploitation than it was in 1998 when commercial orders were forecast to take place from 2003. Now, seven years on, commercial orders are not forecast for about ten years. This shows that the developers failed to understand the scale and nature of their task. There is still considerable scope in the next phase for further cost escalation and delay due to changes to the design and construction problems. The developers' poor record to date gives little confidence in their ability to control costs and time schedules in the next, more expensive phase.

Conclusion 3: Forecasts of other economic parameters, such as operating performance, operating cost and decommissioning cost have not been updated since 1998 and appear implausibly optimistic. It is understandable that developers of a project have an optimistic view of the project's prospects – 'appraisal optimism'. However, investment decisions should be taken on the basis of sober, unbiased judgements of the most likely outcomes, not the views of the project's promoters.

Conclusion 4: PBMR (Pty) Ltd successfully diversified some of the risk away from the South African public for the feasibility phase with foreign partners, Exelon and BNFL Ltd, sharing the costs. However, the cost of this phase (about R2bn) was far more than forecast and the absolute amount paid for by the South African public was not reduced. PBMR (Pty) Ltd has spoken optimistically over the past three years about the prospects of recruiting new partners to replace Exelon and BNFL (if as seems likely it cannot participate), but nothing has come of these negotiations. Until there is solid evidence of new partners being bought in, it must be assumed that the cost of the demonstration phase will fall substantially on the South African public, through Eskom, IDC, or direct government subsidies.

1.2.2 The commercial programme

Conclusion 5. PBMR (Pty) Ltd's analysis of the world market for PBMRs is simplistic, taking no account of any of the commercial or political factors that would apply in key export markets. A particular concern is finance for export orders. This is an important issue for developing countries, which are likely to account for a significant proportion of the forecast orders. Such countries frequently have difficulty financing large investments. The World Bank and most other International Financial Institutions do not provide finance for nuclear investments. The South African PBMR could face strong competition from other types of high temperature reactor, notably a very similar Chinese design and models offered by Areva and the US company, General Atomics. Until a rigorous market analysis has been carried out and subjected to independent scrutiny, and arrangements for helping finance export orders made explicit, PBMR (Pty) Ltd's assumptions on the likely world market have no basis.

Conclusion 6. Pressure is mounting on Eskom to commit to buy large numbers (24) of commercial units even before the technology has been technically and economically proven at a cost in excess of R25bn. Eskom appears, rightly, to be holding to its position of only buying it if the PBMR is the cheapest option available, something that will not be known until the Demonstration plant is in service and has operated for some time. If Eskom is required to make such an advance commitment, it could be forced to purchase uneconomic plants, raising the price of power to consumers, and adversely affecting public welfare and the competitiveness of the South African economy.

Conclusion 7. The future of Eskom is uncertain. The South African government has been considering reforms to Eskom for a number of years, including its privatisation and its break-up into competing units. There can be no guarantee that in 2013 or later, when the first commercial orders for a PBMR might be placed that Eskom will exist in any recognisable form, much less one that can be obliged to order a particular type of power plant, especially if it does not represent the best commercial option.

1.2.3 Overall conclusions

Conclusion 8: The PBMR project is a highly risky venture. The feasibility phase has cost more than R2bn, about two thirds of which has been paid by South African public money. Despite this expenditure, there is still ample scope for the project to fail. The next phase will require a much higher level of expenditure, at least R14.5bn, with more than half of this again coming from the South African public. If the project fails, there will be significant consequences for the South African public either through higher electricity prices (if Eskom is forced to bear much of the risk) or through taxation if the government has to write-off the costs.

Conclusion 9: The National Environmental Management Act (NEMA) requires developers to demonstrate that their projects are economically sustainable. The FEIR does not provide the data necessary to make such a judgement. This information strongly suggests there is a high risk that the project will not be economically sustainable. On the available evidence, the project does not meet the requirements of the NEMA and the applicants, Eskom, should not be given approval.

Conclusion 10: The current high fossil fuel prices and the measures to reduce greenhouse gas emissions seem to give a new impetus to generation technologies that do not use fossil fuels. However, it should be remembered that previous oil price spikes (1974 and 1980) were short-lived and resulted in little nuclear investment apart from in France. Investors are unlikely to make multi-million dollar investments in new nuclear power plants on the basis of a short-term oil price spike which could have disappeared long before a nuclear plant could be brought on-line. On greenhouse gas emissions, nuclear power faces competition from renewable technologies and energy efficiency measures, options that generally do not encounter the public acceptability problems that nuclear power suffers from.

2. Introduction

This report examines the economic case for building a Demonstration Plant at the Koeberg site in the Western Cape, using the Pebble Bed Modular Reactor (PBMR) nuclear technology being developed in South Africa. An analysis of economic impacts is required under the terms of the National Environmental Management Act. The report focuses especially on the life cycle costs of the

Demonstration Plant and any commercial successor plants. In isolation, the Demonstration Plant will inevitably be a heavily loss-making project, but it is hoped by the promoters of the project that profits from an export-led programme of commercial units will more than pay for these losses. It is therefore necessary to analyse not only at the economics of the Demonstration Plant, but also the prospects for commercial sales to assess the economic case for the Demonstration Plant.

This report covers most of the main costs involved in the operation of a nuclear power plant. This report does not cover the costs of radioactive waste disposal, disposal of spent nuclear fuel, nor does it consider the cost of a catastrophic accident, although these factors are clearly important.

It also does not cover the cost of competing fossil fuel technologies. However, it should be noted that while the current high fossil fuel prices and the measures to reduce greenhouse gas emissions seem to give a new impetus to generation technologies that do not use fossil fuels, this may not lead to a revival in nuclear ordering. It should be remembered that previous oil price spikes (1974 and 1980) were short-lived and resulted in little nuclear expansion apart from in France. Investors are unlikely to make multi-million dollar investments in new nuclear power plants on the basis of a short-term oil price spike which could have disappeared long before a nuclear plant could be brought on-line. On greenhouse gas emissions, nuclear power faces competition from renewable technologies and energy efficiency measures, options that generally do not encounter the public acceptability problems that nuclear power suffers from.

3. The legal context

The analysis of the economic impacts is required under the terms of the National Environmental Management Act. Section 2(3) of the Act stipulates that the state should ensure that development must be socially, environmentally and economically sustainable[2]; while section 2(4)(i) requires that "the social, economic and environmental impacts of activities, including disadvantages and benefits must be considered, assessed and evaluated and decisions must be appropriate in the light of such consideration and assessment". Such decisions must moreover be taken in an open and transparent manner and access to information must be provided in accordance with the law[3]. The assessment of environmental impacts in terms of NEMA must include the assessment of potential impact on the socio economic conditions and the assessment of the significance of that potential impact[4].

Paragraph 7.4.4 of the Scoping Report for the proposed PBMR set out the issues and concerns to be studied for the purposes of the EIA under the heading 'Economic aspects' as follows:

- The economic potential of a local based nuclear industry for local applicatory (sic) and export, should the plant prove its techno economic viability;
- Impact on eco-tourism in the region around Koeberg, i.e. 50km radius;
- Impact on supply side management based on the assumption that the plant is viable.

The issue of life cycle costing was added by the DEAT after receipt of the plan of study for scoping.[5]

The main documents backing the case for the Demonstration Plant are the Detailed Feasibility Report or DFR (PBMR, 2002a) and the Final Environment Impact Report or FEIR (PBMR, 2002b).

3.1 Economic sustainability

The National Environmental Management Act provides no guidance on what constitutes 'economic sustainability'. For a commercial project, that is, one that does not require (public) subsidies, economic sustainability would be relatively easy to define. It would require that the facility being built would have a high probability of being profitable. However, for a demonstration plant, the issue is more difficult to define. Clearly, the PBMR Demonstration Plant will not be an economic source of electricity on a full-cost basis, that is, including the cost of construction. It is therefore necessary to examine who will pay for the uneconomic cost of construction of the plant. It may not be an economic source of power even on a marginal cost basis, that is, revenues from the sales of the electricity it produces may not even cover the running cost of the plant. It is therefore necessary to examine who will be liable for the additional uneconomic operating costs.

However, the Demonstration Plant can only be properly evaluated in the context of the commercial programme of reactor sales that it is hoped will follow from the Demonstration Plant. This is clearly acknowledged in the conclusions of the DFR (PBMR (Pty) Ltd, 2002a, p 62), which state:

In all scenarios, the PBMR is predicted to have a non-negligible effect on the South African economy. The macro-economic impact of building the demonstration plant only is small. The key benefit to the economy will come from the commercialization and sale of the PBMR on the international market. In these more optimistic scenarios, this impact is extreme, adding thousands of jobs a year and billions of South African rands to the GDP. Moreover, a larger portion of this money is anticipated to flow to the lower income groups than the average for the manufacturing sector. The results of this study indicate that the PBMR programme can add sufficient value to South Africa to offset the risks associated with building this first-of-a-kind nuclear reactor on South African soil.

Despite this, in the Register of Comments and Responses on DEIRs, the Applicant's consultants continually state (in 15 responses): 'the present EIA is limited to a single demonstration module PBMR' in response to questions about the overall programme.

This report therefore examines both the economic impact of the full life-cycle costs of the Demonstration Plant and also the likelihood that the Demonstration Plant would lead to a successful programme of sales of commercial PBMR units.

principle 2(3)

[3] Principle 2(4)(k)

[4] NEMA section 24(7)(b)

[5] DEAT Director-General's letter to the EIA consortium dated 2/5/01

To evaluate the life-cycle costs of the Demonstration Plant, it is necessary to forecast:

- Construction cost and cost of other new facilities required;
- The cost of capital;
- The plant's maximum electrical output;
- Operating performance especially reliability;

- Operations & maintenance cost, including fuel supply and spent fuel disposal;
- Decommissioning cost; and
- Operating life.

The FEIR and the DFR do not provide clear forecasts of any of these parameters.

For the commercial programme, it is necessary to evaluate the competitiveness of the PBMR against other electricity generation technologies. This would require forecasts of all the above parameters. A detailed and convincing market analysis is also required, especially for a controversial technology like nuclear power, where it may not be sufficient to provide an economically competitive product if it is not politically acceptable. Again, no serious analysis of potential markets is provided.

3.2 Provision of information

The National Environmental Management Act states that 'access to information must be provided in accordance with the law'. In its Demonstration Feasibility Report, PBMR (Pty) Ltd (PBMR (Pty) Ltd, 2002a, pp 48-49) pays lip service to this requirement. It states:

> Since nuclear has traditionally been associated with a cloud of secrecy, preconceived notions and inaccurate reporting, the overriding philosophy in PBMRCo's Public Relations philosophy has been one of open and honest communication.
>
> This approach has been to:
>
> - share as much non-proprietary information as possible with all stakeholders;
> - provide proactive awareness using available media;
> - within reasonable limits, react swiftly and professionally to enquiries from the media and other interested and affected parties;
> - follow a general approach of collaboration rather than confrontation;
> - demonstrate a readiness to listen to, take note of and act upon the legitimate concerns of interested and affected parties;
> - communicate the benefits of the project and deal constructively with any perceived negative issues; and
> - confirm Eskom's and PBMR's commitment to a transparent EIA in which all interested and affected parties are encouraged to participate.
>
> The programme is ongoing and will continue beyond the demonstration phase of the PBMR.

The DFR, the FEIR and the more general flow of information on the programme to the South African public show the hollowness of this claim. Almost none of the economic information needed to evaluate the Demonstration Plant or the PBMR programme in general has been provided. The most recent set of data was written (for a British audience) five years ago (Nicholls, 2000). Most of the data used in this report has been gleaned from international sources, mainly Nucleonics Week, which is an authoritative trade journal, but which has a negligible circulation in South Africa. There is little evidence that PBMR (Pty) Ltd has provided: 'proactive awareness using available media', particularly for the South African public. This is especially reprehensible given that PBMR (Pty) Ltd and Eskom expect the South African public to be the major financial underwriter for the project.

3.3 Earthlife Africa's legal challenge

In June 2003, the Director-General, Chippy Olver, of the Department of Environmental Affairs and Tourism (DEAT) approved (gave a positive 'Record of Decision' (ROD)) Eskom's Environmental Impact

Assessment for the building of a demonstration PBMR and an associated fuel manufacturing plant. Earthlife Africa (ELA) launched a High Court application in Cape Town, which sought to review and set aside this ROD.

On January 26 2005, ELA obtained a judgement in the High Court in the Cape Provincial Division which set aside the PBMR's authorisation. The basis of the judgement was that the ROD granting the authorisation was fatally flawed in that ELA had not been given an opportunity to make submissions to the DEAT on the FEIR even though it differed materially from the earlier report on which it was given a chance to comment. The Director-General made his decision without having heard ELA and without even being aware of the nature and substance of ELA's submission. The judge ordered that ELA be afforded an opportunity to address further written submissions on the FEIR. As of August 2005, the process to authorise the demonstration PBMR had not been re-opened.

4. The PBMR project

The Pebble Bed Modular Reactor (PBMR) is a new design of nuclear power plant developed from a German model built only as a demonstration plant in Germany, THTR 300, which was in service from 1983-89.

The main publicly available sources of information on the PBMR programme are the Detailed Feasibility Report or DFR (PBMR, 2002a) and the Final Environment Impact Report or FEIR (PBMR, 2002b). Also important is the Register of Comments and Responses on Draft EIRs (Register of Comments, 2002) published in June 2002, which contains responses to public comments on the draft Economic Impact Assessment. Note that the FEIR was substantially drafted before the withdrawal of Exelon. It contains a short section on the withdrawal of one of the partners in the project, the US utility, Exelon, but its sales projections are still based on Exelon buying the first 10 commercial units from 2006 onwards (PBMR, 2002b, p 194) even though it was by then clear that Exelon's commitment had lapsed with its withdrawal from the project. The most comprehensive independent review of the economic prospects for the PBMR programme was published by Auf der Heyde & Thomas (Auf der Heyde & Thomas, 2002). An earlier response by the Legal Resources Centre drew partly on this paper and some, mostly inadequate answers were provided by in a Register of Comments (Register of Comments, 2002).

4.1 The technology

The South African PBMR differs markedly from the designs of nuclear power plant that are dominant worldwide, the Pressurised Water Reactor (PWR, the type operating at the Koeberg site in the Western Cape, where Eskom expects to build the Demonstration Plant) and the Boiling Water Reactor (BWR) in five important respects:

- Coolant. The energy from a PWR or BWR is transferred from the nuclear core to the turbine (the equipment that transforms the heat energy into electricity) using water. The turbine, similar to that used in a conventional coal plant, is driven by steam. In a PBMR, the coolant is helium gas, which drives a gas turbine (similar to a jet aircraft engine);[6]
- Moderator. The moderator, the medium that ensures the energy of the nuclear reaction is efficiently exploited, is water in PWRs and BWRs, whereas it is solid graphite (a form of carbon) in a PBMR;
- Fuelling. In a PWR or BWR, the nuclear fuel is enriched (the proportion of the 'fissile' uranium isotope) from about 0.7 per cent in naturally occurring uranium to about 3.5 per cent. The fuel is in the form of uranium oxide fuel rods and the reactor must be shut down about once a year for about a third of the old fuel rods to be replaced with fresh fuel. In a PBMR, the fuel is expected to be enriched to about 8 per cent and is in the form of 'pebbles' the size of a snooker ball. These are continuously fed into the top of the reactor vessel and replace 'spent' pebbles, which are removed from the bottom of the reactor vessel;
- Size. A typical PWR or BWR produces an output of about 1000MW (1MW is equivalent to 1

million kilowatts), whereas an individual PBMR unit is expected to produce about 110-165MW;

- Modularity. The PBMR is conceived as modular and its economics are expected to be optimal if built in a group of 8-10 units, sharing some facilities such as the control room. PWRs and BWRs are generally built as individual self-sufficient units or in pairs.

All the major nuclear design countries have pursued high temperature gas-cooled reactor (HTGR) designs (those that use graphite as moderator and helium as coolant although not necessarily the other distinctive features of the PBMR) usually dating back to the 1950s, but none has resulted in a design that was built on a commercial basis. HTGR programmes existed in UK, France and Germany, but were abandoned, while research in Japan and USA continues only at a low level.

The PBMR is based on a German design of plant offered by a company called HTR. This company was based on an amalgamation of work carried out by two mainly German based companies, Siemens and ABB. ABB had built a demonstration plant, THTR 300, which achieved criticality (a sustained nuclear chain reaction) in 1983, but, after a very problematic history during which it operated for the equivalent of only about 30 full-power days, it was formally closed in 1989 because of a mixture of technical and economic issues. THTR 300 was somewhat larger than the PBMR (about 300MW) and also used a conventional steam turbine rather than a gas turbine (the coolant helium passed through a secondary circuit in which the energy was transferred to water) to generate the electricity. However, the 'pebble' fuel design was essentially the same as that expected to be used in the PBMR.

The PBMR has been under development in South Africa since about 1993, although it was not until 1998 that these efforts were publicised. Eskom formally took a license with HTR for pebble bed technology in 1999. The terms of this technology license have not been made public and the technology license is not discussed in the FEIR or the DFS. However, typically, a technology license would give the licensor a fee based on units sold, some rights over the new technology, and over the markets in which it could be sold.

It was expected in 1998 that work on construction of a demonstration plant would begin in 1999 and be complete before 2003 to allow commercial orders soon after (see D R Nicholls, 2000). Eskom projected that the market would be about 30 units per year, about 20 of which would be exported. In April 2000, the South African Cabinet approved Eskom's continuation and completion of a Detailed Feasibility Study (DFS) on the proposed PBMR. Subsequently, Eskom formed a company, PBMR (Pty) Ltd to develop and market the technology. PBMR (Pty) Ltd foresaw four phases: research and development (already then completed), feasibility study (then underway), demonstration, and commercial application.

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[6] Note that the Chinese version of the PBMR may use a steam cycle, at least for the initial units, in which the helium coolant passes through a heat exchanger in which steam is produced, which would drive a conventional steam turbine.

Since then, the timetable has slipped so that the Demonstration Plant, to be built at Koeberg, is not now expected to be in service before 2010 at the earliest.

4.2 The commercial arrangements

The PBMR was developed within Eskom until June 2000. Then British Nuclear Fuels Limited (BNFL), a UK government owned company active in all major aspects of nuclear power from reactor sales and servicing, fuel manufacture, wasted disposal etc became the first foreign investor in the project taking a 22.5 per cent stake in the venture. They were quickly followed by the US electric utility based in Philadelphia, PECO, taking 12.5 per cent of the venture. Subsequently PECO merged with another utility, Commonwealth Edison, to become Exelon. The South African governmentowned Industrial Development Corporation (IDC) took 25 per cent of the venture leaving 40 per cent with Eskom of which 10 per cent was reserved for an Economic Empowerment Entity, but this has not been taken up. The agreement left all the shares in PBMR (Pty) Ltd in the hands of Eskom Enterprises, a subsidiary of Eskom, but committed the partners to provide funding in proportion to their stakes in the business to the end of the feasibility phase. Then, the company would be reconstituted in preparation for the demonstration phase with the partners entitled to take a stake in the new company equal to their percentage contribution to the feasibility phase. The costs of development would be recovered as royalties from reactor sales. It is not clear whether partners that did not take up their shareholding in the reconstituted company would be able to recover their share of the development costs, for example, by selling their rights to a third party.

David Nicholls, formerly PBMR project manger in Eskom, was the first Chief Executive Officer of PBMR (Pty) Ltd. He was succeeded in this post by Nic Terblanche, also previously with Eskom, when Nicholls moved back to Eskom in August 2003. In August 2004, Jaco Kriek from IDC replaced Terblanche and Alastair Ruiters of the South African Department of Trade & Industry became the Chairman.

4.3 The cost of development

The DFR (PBMR (Pty) Ltd, 2002a, p 19) reported that costs of development to end April 2001 were R437m. with a further R80m approved in May 2001. It stated that further funding had been approved in December 2001, but the sum was not specified. In the FEIR, PBMR (Pty) Ltd (PBMR (Pty) Ltd, 2002b, p 200) said that the total amount that had been spent on the PBMR to July 2002 was R684.2m and forecast that the total amount to take the project to the end of the feasibility stage (then expected at end 2002) would be R1013m of which R461m would be provided by Eskom.

However, in August 2003, Terblanche[7] stated that PBMR development had cost R1.5bn of which R550m had come from Eskom, a total of R240m from IDC and BNFL with the balance coming from Exelon. BNFL and IDC appear to have spent much less than they were required to, Exelon spent significantly more and Eskom a little less. The additional money had been spent on further design work and letting a number of design and supply contracts. Since then, expenditure has continued on a short-term basis but it is not clear who has funded it, nor what the total development costs to date are. Terblanche[8] indicated that monthly costs were 'a lot more than' R50m even at the reduced level of activity that had prevailed since the completion of the feasibility phase. Assuming costs were just R50m per month this would mean the development costs to the end of October 2004 were in excess of R2bn. In October 2004, the government announced support of up to R500m for the PBMR venture to pay for running costs for the company and design development costs (turbine development and construction of a helium test facility were mentioned as particular requirements).[9]

[7] Nucleonics Week August 28, 2003, p 1.

[8] Financial Mail, March 26, 2004, p 14.

[9] Business Day, October 29, 2004 and Nuclear News November 2004 / Business News N°51 / 04

However, while this announcement was interpreted as government backing for the demonstration phase, these costs are most appropriately categorised as part of the feasibility phase. In February 2005, when the government's budget was announced, the government support had increased from R500m to R600m. It is not clear whether this government money was a loan or a grant or whether it represented an increase in the government's stake in the PBMR project. It remains uncertain who will fund the demonstration phase.

Overall, substantial sums have been spent on developing the PBMR, about two thirds of which was South African public money. However, the next phase of demonstration will take the level of spending to a far higher level, requiring at least seven times as much money as has been spent so far.

5. The economic aspects

For commercial facilities, those able to survive on the commercial income received, the issue of economic impact is relatively easily bounded. But, for the Demonstration Plant, which by its nature will not be profitable in isolation, the issues are broader and the data subject to a much greater level of uncertainty because of the technological immaturity of the plant design. To evaluate the economic impact of the PBMR Demonstration Plant it is useful to divide the analysis into the costs, risks and benefits of the Demonstration Plant and those involved with the commercial programme.

The main factors that must be considered in the economic analysis of the Demonstration Plant are:

- The partners, especially foreign companies;
- Safety licensing;
- Construction cost and cost of other new facilities required;
- The cost of capital;
- The plant's maximum electrical output;
- Operating performance especially reliability;
- Operations & maintenance cost, including fuel supply and spent fuel disposal;
- Decommissioning cost; and
- Operating life.

Since the Demonstration Plant will not be an economic source of power, it is necessary to estimate who will bear the losses that the Demonstration Plant will incur: taxpayers, electricity consumers or private investors? As well as estimating the value of the economic parameters it is essential to try to estimate the risks that economic performance will be worse than forecast and again, who will be liable for the costs of worse than expected performance. Of course, it is theoretically possible that performance will be better than forecast, but the history of nuclear power contains very few examples of plants that were built ahead of schedule, or with lower than forecast costs, or better than expected reliability.

The analysis for the commercial programme must be much wider ranging and include:

- The economic competitiveness of the PBMR compared to other electricity generation technologies in different markets;
- The likely world market for the PBMR;
- The South African market for PBMRs

None of these factors can be estimated with any precision at this stage and the analysis of risk and who will bear the cost of poorer than expected performance is particularly important.

Despite the legal requirement to demonstrate the 'economic sustainability' of the project, the PBMR's FEIR (PBMR (Pty) Ltd, 2002b, pp 144-202) contains only about 60 pages out of a total of nearly 500 pages on the economic aspects. Of these 60 pages, most of them are devoted to impacts on spatial planning, tourism and supply side management, with only about 10 pages explicitly covering the PBMR. Little of the information needed to assess the costs of the Demonstration Plant and the prospects of success of the subsequent programme is provided and it is necessary to look at other sources to try to glean the necessary information.

It is particularly regrettable that a report by an international Panel of Experts commissioned by the Department of Minerals & Energy (DME) to review the overall project has not been made public in any form. The report was expected to inform a Cabinet decision on the PBMR project. This Panel of fifteen international experts reviewed the overall case for the PBMR as presented in the Detailed Feasibility Study in 2001/02. They were given full access to all information they required and submitted a report to the DME in early 2002. The author of this paper was one of two experts assigned the task of reviewing the economic case.

However, the Panel members were required to promise not to disclose any information they learnt through their meetings and their report has not been made public. All the information presented here is available in publicly accessible sources. Panel members were assured by the DME that Eskom and PBMR (Pty) Ltd would not have access to their report, so it would appear that the only people that have seen the report are DME officials and Cabinet Members. PBMR (Pty) Ltd and Eskom cannot therefore claim that any of their evidence in the FEIR was endorsed by the DME review panel. Note that the DEAT also established a Review Panel to review the Draft Scoping Report for the EIR. The DEAT Panel was entirely separate from the DME's Panel, but like the DME's Panel, its report does not appear to have been made public.

It is difficult to know how the South African public can participate meaningfully in a decision on the PBMR if they do not have access to the most authoritative independent report on the project, that of the DME's International Panel. This need for information is strong because South African taxpayers and electricity consumers have funded most of the development work so far, and it seems likely they will bear an even higher proportion of the much greater costs and risks of building the Demonstration Plant. If the project proves a failure in the long-term, it will be the South African public that will end up bearing much of the cost.

There may, in some instances, be a case to withhold information contained in the Panel report or required to demonstrate the economic sustainability of the PBMR project from the public on grounds of commercial confidentiality. However, since the public is providing much of the funds the presumption should be that all information should be released and the onus should be on PBMR (Pty) Ltd to argue the case specifically where it does believe information should be withheld.

6. Demonstration Plant costs

6.1 The partners

Introducing partners to the venture has three main potential advantages:

- Sharing of development costs;
- Introduction of new skills; and
- Access to foreign markets.

The downside of having partners would be that any benefits to Eskom and the South African public would be diluted, so ideally any foreign partners should bring more than just finance to the project. Eskom brought in three partners in 2000: IDC (25 per cent), BNFL (22.5 per cent), and Exelon (12.5 per cent) leaving Eskom with 40 per cent. Eskom's partners in the development phase have fulfilled their obligation to the programme and have no further legal commitment to fund the programme, leaving the project entirely in the hands of Eskom Enterprises, although the partners will be entitled to take shares in a newly constituted PBMR company if the demonstration phase is launched.

Exelon's main contribution to the project was its promise to open up the North American market. Exelon committed to pilot the design through safety certification by the US Nuclear Regulatory Commission (NRC). Certification by the NRC (or a national regulatory authority with a comparable level of expertise and prestige) will be essential for sales to most markets outside South Africa, not just sales to the USA. Exelon also pledged to buy 10 commercial units and suggested they would buy 40 or more units in the first decade of the commercial phase. The 10 initial sales were the only apparently firm sales for the PBMR there have been (sales to Eskom are conditional on it being the cheapest generation option). These sales would have been an excellent 'shop-window' for the technology for the potentially huge US market and would allow the setting up of reactor manufacturing facilities, which subsequent commercial sales could take advantage of. As an electric utility rather than a plant designer, Exelon's technical contribution to reactor design was limited but as an experienced nuclear power user, its input would have still have been valuable.

Exelon left the project in April 2002 and, while the FEIR explains Exelon's departure on grounds of it not wishing to be a 'reactor supplier' (PBMR (Pty) Ltd, 2002b, p 192), there seem to be additional factors behind their withdrawal. The decision to enter the venture appears to have been very much a personal one by the CEO of PECO, Corbin McNeil (later joint CEO of Exelon). When he left the company, the commitment to the PBMR was quickly withdrawn.[10] John Rowe, the new CEO of Exelon was quoted as saying: 'the project was three years behind schedule and was "too speculative,"'[11]. He also said: "a detailed review that Corbin and I started late last summer yielded a recommendation from the people in charge of the project that ... [operation and testing was] three years further out than we had thought a year ago." Since then, schedules have slipped substantially further, probably by more than a further three years. Despite claims by Eskom and PBMR (Pty) Ltd that a large number of interested replacement investors existed, no replacement for Exelon has been found.

BNFL entered the venture at about the same time as Exelon and their technical contribution appears to have been in fuel manufacture. At the time they joined the venture, BNFL's Westinghouse reactor vendor subsidiary does not appear to have been involved in the decision and it is not clear whether Westinghouse has had a major input to reactor design. BNFL would provide no significant advantages in terms of access to markets.

BNFL has been in severe financial difficulties for a number of years. In fiscal year 2002, it lost £2.32bn (R25bn) and in fiscal year 2003, it lost £1.09bn (R12bn). It had liabilities of about £30bn (about R350bn) with few assets available to discharge these liabilities. In July 2003, UK government plans to part-privatise the company were abandoned and a major part of its business, waste disposal, reactor operation and reprocessing is to be taken away from it and placed in a new government agency, the Nuclear Decommissioning Agency.

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10 'Corbin was the cheerleader for this technology, and without him, it can't go forward.' Electricity Daily, April 17, 2002.

11 Energy daily, April 24, 2002.

The UK government is currently reviewing the future of its other activities. In June 2005, the British government announced it was looking to sell the Westinghouse reactor vending, nuclear fuel manufacture and reactor servicing activities leaving BNFL as primarily a clean-up company. A number of companies are reported to have expressed an interest, including Areva and GE, although by August 2005, only Mitsubishi had made a bid.[12] It is expected that completion of the sale would take until mid-2006.

It appears that BNFL's primary motivation for getting involved with the PBMR was selling fuel rather than reactor sales. Whichever the case, the management that will be responsible for BNFL's contribution to the PBMR is far from certain to be able to continue the commitment even if they wish to. Terblanche has said that BNFL could take 10-12 per cent of the next phase or 25 per cent of the fuel business.[13] This appears unduly optimistic and BNFL/Westinghouse management is not in a position to make such a commitment on behalf of the new owners.

IDC appears to have brought only finance to the venture. As it is owned by the South African government, in terms of risk reduction to the South African public, it contributed nothing. Terblanche was quoted in August 2003 as saying the IDC would take no more than 12.5 per cent of the next phase.[14] However, following a government review in January 2004, IDC is expected to take a more prominent role in the project, and in November 2004, the CEO of Eskom told the Parliamentary Portfolio Committee on Trade & Industry that IDC would be replacing Eskom as project leader.[15] It has been reported elsewhere that Eskom wants to take about 10 per cent of the PBMR Company in the demonstration phase.[16] Kriek has said that he expects the South African public sector to retain at least 51 per cent of the project through Eskom, IDC and the government.[17] On present evidence, it seems unlikely that private investors willing to take the remaining 49 per cent of the project can be found. So, as a minimum, the South African public will be asked to pay for at least half of the R14.5bn the next phase was forecast to cost in August 2005. If costs escalate or private partners cannot be found, the cost to the South African public will be much higher.

A number of other potential investors have been mooted and Eskom has had discussions with the French company, Areva, since February 2004. Areva is a publicly owned company with similar interests to BNFL.

12 Nucleonics Week, July 14, 2005, p 1.

13 Nucleonics Week, August 28, 2003, p 1.

14 Nucleonics Week, August 28, 2003, p 1.

15 Sunday Times, November 10, 2004.

16 Financial Mail, December 3, 2004, p 14.

17 Financial Mail, December 3, 2004, p 14.

However, it has its own HTGR technology, which differs significantly from the PBMR (the fuel is prismatic rather than pebbles) and which Areva claims is superior to the PBMR.[18] It does not seem likely that the two technologies could be readily merged. Areva has shown no indication of being prepared to give its technology up in favour of the PBMR. It has also indicated that it is not prepared to fund the Demonstration Plant. Its interests and its potential contribution appear very similar to those of BNFL and it may not be possible to accommodate both in the next phase even if either company was interested and had the scope to participate.

A number of other potential investors have been mentioned, but these appear to be highly speculative and by far the most realistic investors in the next phase are the existing investors with Areva as an outside chance.

The expected sale of Westinghouse may restrict the possibilities and it seems unlikely that the companies owning the world's two largest nuclear vendors, Framatome and Westinghouse, would want to co-operate even if such an arrangement was acceptable to the competition authorities.

Required information

A realistic assessment is required of what the probability of attracting funds other than from South African public sources is. An assessment of what advantages and disadvantages any identified partners would bring is also required.

6.2 Licensing efforts

It is acknowledged by all sides that for sales to most markets outside South Africa to be possible, certification by a highly experienced, high credibility nuclear safety regulatory agency is required. This is not to denigrate the competence of the South African regulatory authorities, but reflects the risk aversion of electric utilities and those that supply finance to power station construction particularly as electric utilities are exposed more to investment risk. One of Exelon's main contributions to the venture was their role in piloting the design through the US NRC procedures. The NRC had begun to review the design and had collaborated with the South African National Nuclear Regulator (NNR) on design issues but when Exelon withdrew, the NRC quickly wound down licensing activities.[19] It has been reported that PBMR (Pty) Ltd officials met with NRC officials in October 2004 to discuss design progress[20] but it does not appear that NRC is carrying out any substantial design evaluation.

Without NRC approval for its design, it is not clear that the Demonstration Plant would have much value in promoting foreign sales. Until the design had been approved by the NRC and finalised, construction cost of the commercial export design cannot be estimated accurately. If the Demonstration Plant design differed significantly from what was required by the NRC (for example if the Demonstration Plant was built without a pressure containment and the NRC indicated it would require one for any plant built in the USA) potential buyers would see construction and operation of the Demonstration Plant as having only limited demonstration value.

Required information

The FEIR should state what strategy has been developed to obtain internationally credible regulatory clearance for the commercial PBMR design and how this would fit in with the Demonstration Plant.

6.3 Construction cost and cost of associated facilities

Repaying the cost of construction of the plant has always been expected to be the major element in the overall cost of power from any nuclear power plant. Its importance has increased in the last decade as attempts to introduce competition to the electricity industry have increased the cost of capital raising the charge for repaying the construction cost.

The FEIR contains no information on the expected construction cost of the Demonstration Plant or on the commercial plants. It merely states: 'The cost to build the PBMR demonstration module will probably be available on completion of the project business plan (year end 2002).' The DFR contained no details on the cost of the Demonstration Plant.

In 1999, Nicholls (Nicholls, 2000) forecast that the construction cost would be about US$100m (then equivalent to about R600m) for a single commercial module, presumably as one of 8-10 units installed on one site. The strategic importance of this estimate was that it placed the price of the PBMR at around the US$1000/kW of installed capacity, a level above which it was widely assumed that nuclear could not compete with gas-fired technology.[21]

Nicholls22 was quoted separately as estimating the cost of the Demonstration Plant as double the settled down commercial cost with a further US$100m for a fuel sphere production plant. The total cost of the Demonstration Plant was therefore then estimated to be about US$300m or a little less than about R2bn.

18 Nucleonics Week, March 25, 2004, p 6.

19 Inside NRC, May 20, 2002, p 4.

20 Nucleonics Week, November 4, 2004, p 1.

21 The US Department of Energy's New Generation Nuclear Plant programme launched in 2002 has a target capital cost of US$1000/kW for new nuclear power plants. The PBMR (Pty) Ltd Feasibility Report (PBMR, 2002b, p 23) notes a target price of US$1000-1100/kW.

22 Nucleonics Week, October 14, 1999, p 7.

In 2002, the DFS (PBMR (Pty) Ltd, 2002b, p 23) suggested some cost increases had occurred and the target construction cost for commercial units was now placed at US$1000-1200/kW. However, there appear to have been major cost increases. These have been masked by three factors. First, it is not clear whether the current cost estimates cover as full a range of costs as the original estimates, for example, if the cost of the first fuel load was omitted (conventionally this is included in the construction cost), the apparent cost would fall masking real cost increases. Also, it is also not clear whether the new estimates are now a cost or a price (i.e. including the profit). Second, there has been some depreciation (about 10 per cent) of the Rand against the US dollar between 1998 and 2004. However, the third factor is the most important. In 1998, the design was expected to produce a net output of 110MW but commercial plants are now expected to have an output of 165MW, an increase of 50 per cent. This would allow the cost of a module to rise by 50 per cent without increasing the cost per kW.

In September 2001, Nicholls[23] admitted the original schedule for the Demonstration Plant had slipped. He then projected start of construction for 2002, with completion expected in 2005 and commercial sales to begin in 2009. There was discussion about up-rating the output of the plant to 130MW to be achieved without significant cost increases.[24] The Chief Executive of one of the partners in the project, Corbin McNeil of Exelon, was quoted in the same article as saying the upper limit on output was 150MW but he assumed the final figure would be 130MW. McNeil also stated the cost of the first module had risen to about US$300m. This article also acknowledged delays in the design work particularly with the turbine and the graphite liner

In 2002, the DFR, (PBMR (Pty) Ltd, 2002a, p 50) stated the design could be up-rated to 137MW 'without a significant increase in cost'. This meant that costs per module could increase by nearly 20 per cent whilst still remaining within the US$1000/kW target.

In April 2002, Exelon withdrew from the PBMR venture[25], although it agreed to fulfil its commitment to fund the venture until completion of the feasibility study phase, then expected to be finished in September 2002. Forecast start of construction of the Demonstration Plant had by then slipped to 2004.

By May 2002, Nicholls[26] was much less precise in his estimate of the cost of the Demonstration Plant, estimating a cost of between US$2000-5000/kW. At the bottom end of the range, assuming a unit size of 110MW and US$2000/kW and an exchange rate of US$1=R6, this would translate into a total cost of R1.3bn, while at the upper end, with 130MW and US$5000/kW, it would translate into R4bn. It is not clear whether these estimates included the cost of a fuel production facility. Nicholls still adhered to the US$1000/kW estimate for commercial orders provided these were built in groups of 8-10 per site and only after 20 units had been sold.

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[23] Nuclear News, September 2001, p 35.

By December 2002, the target output of commercial units had increased to 165MW, 50 per cent higher than originally planned. Nicholls[27] admitted that the US$1000/kW would not be achieved until 32 units had been sold. Further delays were announced in the programme. Earlier in 2002, the shareholders of PBMR (Pty) Ltd had expected to announce whether they would proceed beyond the feasibility stage by the end of 2002. This decision was postponed into an unspecified date in 2003 and appeared still not to have been taken in December 2004. In July 2003, the Demonstration Plant was expected to be 125MW with subsequent units producing 165MW.[28]

A particular issue was the supplier of the gas turbine. This would be the first-of-akind and would be the first commercial gas turbine to use helium gas as the energy carrier (normally gas turbines are driven by the exhaust gas from the combustion of the oil or gas fuel) and represents a significant engineering challenge. The contract to design the turbine was originally placed with the French company, Alstom but they were replaced in 2001 by Mitsubishi for unspecified reasons. It is not clear how far development problems with the gas turbine have delayed the programme and have increased costs.

In November 2004, PBMR (Pty) Ltd announced a major design change in the gas turbine moving to a horizontal turbine generator set rather than the three-shaft vertical configuration that had been planned. It should also be noted that the frequency of the North American electrical system is 60Hz, compared to 50Hz in Europe and South Africa.

China is 50Hz, but Japan is part 50Hz and part 60Hz. This means the speed of rotation of the gas turbine is different and generally gas turbines that produce power at 60Hz are of a significantly different design to those that produce power at 50Hz. It is not clear who would pay the cost of development of 60Hz machines for exports to the USA.

The main extra cost for the demonstration programme apart from the generating plant itself was the fuel manufacture plant expected to be built at Pelindaba. In 1999, Nicholls estimated this would cost about US$100m (R600m) but more recent forecasts for the demonstration programme have not separated the fuel plant from the reactor, so it is impossible to determine how far escalation in the cost of the demonstration programme has been the result of increases in the cost of the fuel plant.

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24 Nucleonics Week, October 11, 2001, p 1.

25 Nucleonics Week, April 18, 2002, p 1.

26 Nucleonics Week, May 2, 2002, p 10.

27 Nucleonics Week, December 19, 2002, p 1.

28 Nucleonics Week, July 3, 2003, p 1.

29 Africa News, October 29, 2004.

Once the end of the feasibility phase had been reached, the partners' commitment to fund the venture came to an end and essentially PBMR (Pty) Ltd had no further guaranteed access to funding. It was planned that in the demonstration phase, PBMR (Pty) Ltd would be reconstituted and the previous partners would have the right to take up a shareholding in proportion to the funding they had provided for the feasibility phase. It is not clear how PBMR (Pty) Ltd has been funded since the end of the feasibility phase. It appears most likely that a combination of government and Eskom money has allowed PBMR (Pty) Ltd to continue operations, albeit on a severely reduced scale.

By August 2003, PBMR (Pty) Ltd was seriously short of cash and was appealing to the South African government for support.[30] A review of the project was begun by the government in January 2004 and it gave PBMR (Pty) Ltd 'two months to propose a way forward for the PBMR.'[31] The Demonstration Plant was then projected to cost US$1.3bn (R8bn) and it was still hoped to begin site work at the Demonstration Plant in 2004. In March 2004, Terblanche estimated the cost of the Demonstration Plant would be R10bn and it could not be in full operation before 2010, implying a 2007 construction start and the launching of commercial sales after 2012.[32] Ferreira[33] broadly confirmed these figures in September 2004.

However, a August 2005 Ferreira confirmed that the estimated cost of the demonstration phase had increased again to R14.5bn.[34] If this increase of nearly 50 per cent in a little over a year is confirmed, this would add to the evidence that costs are seriously out of control. It is not clear whether the US$1000-1200/kW estimated cost for commercial units still stands.

In the period 1999-2005, the estimated cost of the demonstration programme appears to have escalated by a factor of more than seven. Until the detailed design is completed: equipment design development, for example on the turbine, has been carried out; design approval by the National Nuclear Regulator (NNR) is given; and the plant has actually been built, the cost estimates must be treated with scepticism. Experience with other nuclear projects shows these processes provide ample scope for further major cost escalation.

A particular regulatory issue is that of containment/confinement to the reactor. The containment serves to prevent the contents of the reactor escaping into the environment if there is an accident in the reactor or if there is an external accident, for example, an aircraft hitting the plant. The arguments are complex, but, in essence, it is argued (PBMR, 2002b, p 29) that a pressure producing accident is implausible so an expensive pressure-retaining containment would not be necessary. PBMR (Pty) Ltd argues that a containment that need only withstand, for example, aircraft impact would be much cheaper.

In September 2003, a spokesman for the NNR said '"At this stage, we don't have the answer" about whether a pressure-resistant containment is required, the NNR executive said. "It's a long shot to say the regulator has accepted" that confinement suffices.'[35] However, PBMR (Pty) Ltd (for Eskom) not only has to convince the South African NNC, it also has to convince a high credibility international regulator, most likely the US Nuclear Regulatory Commission (NRC). It would make no economic sense nor would it be politically acceptable for PBMR (Pty) Ltd to design one model for South African use and another (apparently safer) for international orders. So until this issue is resolved, there must be a significant risk that construction cost estimates will increase. The issue of containment is by no means the only significant licensing issue still to be resolved.

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30 Nucleonics Week, August 28, 2003, p 1.
31 Nucleonics Week, September 2, 2004, p 5.
32 Financial Mail, March 26, 2004, p 14.
33 Nucleonics Week, September 2, 2004, p 5.
34 Business Day, August 16, 2005, p 2.

Required information

An up-to-date estimate of the cost of the Demonstration Plant is required, broken down into the cost of the plant itself, the fuel supply plant and any other significant facilities. An analysis of the cause of the delays to the programme and of the factors behind the massive cost escalation that has occurred is required. An analysis of the remaining risks of cost escalation, for example from design changes, unexpected equipment development problems, should also be provided.

6.4 The cost of capital

While the construction cost of the plant has been of continual concern, there has been little debate about the cost of capital. Traditionally, the cost of capital for power plants was very low, typically a real annual rate of 5-8 per cent. This low cost of capital reflected the fact that, as monopolies, electric utilities were generally able to pass on whatever costs they incurred to consumers, so there was very little risk that the loan would not be repaid. Of course, this did not make constructing new power plants a low economic risk, it simply meant that electricity consumers were bearing the risk rather than the company. Also government-owned utilities were regarded as being fully underwritten by government and the credit rating of government owned utilities was generally the same (very high) as that of the government itself and the cost of borrowing correspondingly low.

In the past decade, with the opening up worldwide of the electricity industry to competition and the privatisation, at least in part, of many utilities, the position has changed dramatically. Many electric utilities, the potential customers for the PBMR, have been privatised and wholesale electricity markets introduced. This is planned to take place in South Africa with the splitting up of Eskom into regional distribution companies, a transmission company and a requirement to sell 30 per cent of its generation. This plan, notably the sell off of generation, appeared to be under review in October 2004 and it may be that Eskom will continue to be able to pass on the costs of its investments to consumers no matter how ill-conceived these decisions turn out to be.

However, in other markets, investment in generating plants is now a high risk to the owners of companies and the companies providing them with finance. The privatised utilities can no longer rely on government backing to support their credit rating.

35 Inside NRC, September 22, 2004, p 8.

In Britain, the country that pioneered electricity privatisation and opening to competition of electric utilities, this risk is very real. In 2003, about 40 per cent of Britain's generating capacity was owned by financially distressed companies.[36] Half of this capacity was the nuclear plants while the rest was a mixture of coal and gas-fired plants. At one point, the second largest owner of power plants in Britain was the consortium of banks that had lent money to investors and had repossessed the plants when they began to lose money.

Even before this stark demonstration of the economic risk of owning power plants, the real annual cost of capital for new generation plants in Britain was in excess of 15 per cent compared to about 6-7 per cent for investment in the parts of the industry that remained a regulated monopoly (essentially the distribution and transmission networks). In developing countries where currencies are less stable, there would be an additional risk premium on capital and, for example, the real cost of capital in Brazil would be at least 20 per cent. Given that repaying the capital charges is the largest element of the cost of nuclear power, it is easy to see if this cost is increased by a factor of 2-3, the impact on the economics of nuclear is going to significant and probably disastrous.

Nicholls (Nicholls, 2000) used a real cost of capital of 6 per cent and although this appears to have been increased to 8 per cent for subsequent analyses, this is far below the level that will be applied in many of the PBMR's target markets.

A decision to allow use of too low real cost of capital would have significant consequences, especially in a country like South Africa that has limited access to capital and very heavy demands for public spending in areas such as health and education where the returns on investment would be high and the risks low. Using capital on a low-return, high-risk project like the PBMR would risk crowding out more attractive and socially useful projects.

The issue of rate of return was raised by the Legal Resources Centre (Register of Comments (2002), 28.137), but the response suggests the person replying either did not understand the question or chose not to answer it: 'The PBMR project has been thoroughly evaluated by the respective investors on a commercial basis. Although their required Return on Investment (ROI) varies, normal commercial benchmarks were used in this evaluation process.'

Required information

The FEIR economic assessment should specify and justify the cost of capital that will apply to the Demonstration Plant and the associated facilities.

6.5 Maximum electrical output

There has been considerable confusion about the output of the Demonstration Plant, which has been variously reported as 110MW, 125MW, 137MW and 165MW. The DFR (PBMR, 2002a, p 25), stated the Demonstration Plant would be 110MW but would be modified in service to produce 125MW. The extent of the modifications necessary was not specified. It was implied that the first 10 commercial units would produce 125MW, but later units would produce 137MW. The DFR spoke of a later move to a core producing a thermal output of 400MW core and improvements in the conversion efficiency so that this would generate 200MW of electricity. The design changes necessary to achieve the 137MW output were expected to be such that earlier units could not be retrofitted to produce this higher level of output. In September 2003, Nicholls[37] was quoted as saying the Demonstration Plant would produce 125MW, while a year later, Nucleonics Week[38] reported 'the first unit would be limited to 110 MW'. In November 2004, Nucleonics Week[39] reported the thermal output of the plant would be 400MW, sufficient to generate 165MW. It reported: 'Eskom will file for revision of the EIA to take account of the higher electrical capacity' after final Record of Decision (ROD) was given.

This confusion needs to be resolved to clarify exactly what the Demonstration Plant will prove. Up-rating the output of a plant by 50 per cent is clearly not a trivial step and the International Panel discussed in detail the implications of the increase from 110MW to 125MW. If the design of the Demonstration Plant is significantly different to that of the commercial units, there must be doubts about how far the Demonstration Plant will indeed be a useful demonstration of the technology.

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[36] S D Thomas (2004) 'Evaluating the British model of electricity deregulation' Annals of Public and Cooperative Economics' 75, 3, 367-398.

Alternatively, if the design is the same but only operating at two thirds of its capability, potential buyers may not be convinced that the Demonstration Plant does demonstrate the commercial technology.

Clarification is also needed on how far regulatory approval for a 110MW unit would be transferable to a 165MW unit. In this context it should be noted that Westinghouse obtained regulatory for its new AP600 design in 1999 but this design proved not to be economic. Westinghouse up-rated the output by about 50 per cent to gain scale economies and had to begin again the process of gaining license approval in March 2002 for the replacement AP1000. Final approval by the US regulatory body, the NRC, is not expected before December 2005.[40]

It is not clear how far the up-ratings to the PBMR are due to simple changes to optimise the output of the plant (for example, operating at a higher temperature) and how far it is due to attempts to use scale economies to compensate for failing economics. It should be noted however that the design taken on from HTR produced a thermal output[41] of 226MWth, this was up-rated to 265MWth, then 300MWth and now commercial plants are expected to produce more than 400MWth, an increase on the original design of nearly 80 per cent.

Required information

Clarification is required on the expected output of the Demonstration Plant, how the design will relate to that of any subsequent commercial units. In particular it should show extent to which the Demonstration Plant will 'demonstrate' the commercial technology and how far safety licensing for the Demonstration Plant will be applicable to the commercial units.

6.6 Operating performance

For any technology with high up-front costs, operating reliability is essential for good economic performance. To illustrate this, let us assume that the load factor[42] of a nuclear plant is expected to be 90 per cent and at this level, fixed costs will represent two thirds of the overall cost of power per kWh. If load factor is actually 60 per cent, this alone will raise the overall kWh cost by a third. Extra repair and maintenance costs to reflect the issues that produced this poor performance will increase costs even more.

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37 Nucleonics Week, September 25, 2003, p 10.

38 Nucleonics Week, October 7, 2004, p 3.

39 Nucleonics Week, November 4, 2004, p 1.

40 Nuclear Engineering International, October 2004, p 5.

41 Only about 40% of the thermal energy is converted into electricity.

42 Load factor is calculated as the saleable electrical output of a plant in a given period (usually a year, or over its lifetime) as a percentage of the output it would have produced had it operated at its full design output rating uninterrupted

Reliability of nuclear power plants worldwide has been extremely variable and has generally been well below the levels forecast. For example, the Dungeness B nuclear power plant in Britain, which was selected ahead of other options partly on the basis that it would have a high lifetime load factor of 85 per cent has, after 20 years of operation, a lifetime load factor of only 36 per cent. The two existing Koeberg PWR units, also after nearly 20 years of operation, have lifetime load factors of only about 65 per cent.43

Nicholls44 forecast that the lifetime load factor of the PBMR would be 94 per cent. This is hard to justify on a number of grounds. First, it would make the PBMR more reliable than any operating reactor worldwide. In 2004, the best lifetime load factor for any nuclear plant was 93.5 per cent and only 6 out of more than 400 operating units had achieved a lifetime load factor over 90 per cent. Second, much is made by PBMR (Pty) Ltd and Eskom of PBMR's ability to 'load-follow', in other words vary its output as demand changes (PBMR (Pty Ltd, 2002a, p II and PBMR (Pty) Ltd, 2002b, p 24). Clearly if the units are operating at below their design rating 'loadfollowing' for any significant part of the year it will be impossible to achieve load factors as high as forecast and the economic performance will be similarly reduced. The ability to load-follow would be an optional feature that would also increase the construction cost.

For the Demonstration Plant, it might be expected that reliability would be poorer than for commercial units partly because of the need to carry out testing and demonstration activities, and partly because the Demonstration Plant will inevitably throw up technical problems that will only become apparent when a real plant is actually operated, and these will require shutdown for repair. If operating performance is expected to be significantly poorer than for the commercial units, this will make the power from the Demonstration Plant very expensive because the fixed costs will be spread over fewer saleable units of electrical output.

Operating performance

The forecast load factor for the Demonstration Plant should be specified and justified, and its impact on the cost of power identified.

6.7 Operations & maintenance cost

There is a common perception that once a nuclear power plant is built, the electricity is essentially free. Nuclear plants are assumed to be largely automatic and fuel costs are assumed to be low. While fuel costs are generally low, operations & maintenance (O&M) costs can be high. For example, a number of US nuclear power plants were closed down in the 1990s because it was judged it would be cheaper to pay the cost of building and operating a new gas-fired plant than paying the cost of simply operating an existing nuclear plant. Since then extensive efforts have been made in the USA to reduce costs. The USA is the only country to publish properly accounted O&M costs. In 2003, the cheapest plant to operate generated at about US 1.2c/kWh (US cents) of which, about US 0.4c/kWh was fuel cost. The most expensive plant cost US 2.6c/kWh and the median was about US 1.65c/kWh.

.43 See Nuclear Engineering International, August 2004, p 38.

44 Nucleonics Week, November 19, 1998, p 1.

No estimates of the operating cost of the PBMR have been published but Nicholls (Nicholls, 2000) estimated fuel costs at 0.4c/kWh, comparable to US figures. Given that in the same paper he forecast that total generating cost would be US 1.43c/kWh including repayment of capital, it seems likely Nicholls assumes the non-fuel O&M costs will be negligible. Given the non-fuel O&M costs alone for US plants average about US 1.2c/kWh, this assumption seems highly optimistic and cannot be accepted without detailed justification.

Required information

The O&M costs for the Demonstration Plant should be specified and justified, broken down by fuel and non-fuel costs.

6.8 Decommissioning cost

Decommissioning is an immensely complex area that cannot be fully covered here. If the South African government allows the PBMR project to proceed to the demonstration phase, it is important to note that this commits it not just to the cost of the facilities required, but also to pay for the decommissioning of the Demonstration Plant and other associated facilities such as the fuel manufacturing plant.

Decommissioning has significant economic, ethical and social dimensions as well as technical aspects. It is assumed that the 'polluter pays' principle should apply to the funding of decommissioning and this means:

- There should be clear plans to return the site to 'green-field' status after plant closure and decommissioning, i.e., the land should be fit to be released for unrestricted use including food production;
- Those that consume the electricity from the plant should pay for its decommissioning. This is generally done by creating a 'segregated' account[45] that accumulates funds provided by consumers throughout the life of the plant to pay for its ultimate decommissioning;

Decommissioning is conventionally assumed to be carried out in three phases: removal of fuel; removal of uncontaminated or lightly contaminated structures; and removal of contaminated structures, essentially the reactor itself. From a purely economic viewpoint, the incentives are always to carry out stage one as quickly as possible. A plant with nuclear fuel in it must be fully staffed because of the risk of criticality and once the fuel has been removed, the staffing level can be significantly reduced saving the labour costs. The economic incentives are to assume as long a delay for stages 2 and 3 as possible. Any fund created to pay for decommissioning will have longer to earn interest, reducing the provisions consumers must make to achieve the required sum. In practice, social and technological factors may over-ride this incentive. For example, it may be politically unacceptable to leave a potentially hazardous facility in place for several decades simply to allow the fund to accumulate sufficient interest to pay for decommissioning

The DFR (PBMR, 2002a, p 27) anticipates two possible strategies, early plant dismantling or 'safe enclosure', in which stages 2 and 3 would be delayed. The DFR does not specify the length of the delay, but it should be noted that the THTR plant in Germany is expected to be in safe enclosure for at least 30 years. The DFR states that: 'if the demonstration module is not successful, the plant will be mothballed in 'safestore' until the decommissioning of Koeberg I and II. However, negotiations with Eskom in this regard have not been finalized.'

Typically, it is assumed that the cost of decommissioning represents about a third of the construction cost. Since the decommissioning cost clearly has little direct relation to the construction cost, this indicates the immaturity of decommissioning technology and the only plants fully decommissioned worldwide are not representative. For example, they may have operated for only a short time and are little contaminated, or the plant may have been disposed of in a large hole without dismantling (Trojan, USA) or the plant is very small.

The FEIR (PBMR (Pty) Ltd, 2002b, p 201) states that 1.5 per cent of the capital cost is provided for decommissioning. It is not clear what is meant by this. Subsequent clarification by consultants (Register of Comments, 2002, 28.149) has suggested that: 'the PBMR Operator will provide 1.5 per cent of the capital cost of the plant on an annual basis over the useful life of the plant.' And that the proposed minimum provision would be based on a 15 per cent of original yet escalated, construction costs, (sic) be made available for decommissioning at the economic end of the plant (Register of Comments, 2002, 28.149).

This is still far from clear and the reliance on estimating the decommissioning as a percentage of the construction cost betrays the fact that little work has been done on estimating decommissioning costs. The FEIR does specify that a segregate (sic) fund will be set up.

Experience with the plants of similar technology to the PBMR in Germany is particularly salutary. The 15MWth pilot AVR plant (it produced heat but no power) is of similar technology to the PBMR and operated from 1967-88 before engineering problems caused its closure. The estimated cost of decommissioning and dismantling the AVR escalated from about €20-million during the early 1990s to as much as €490-million in 2002 (about R7bn).[46] So even after closure of the plant, decommissioning costs were subject to huge price escalation and if any provisions had been collected, they would have proved totally inadequate, leaving later generations to meet the cost.

The THTR 300 demonstration plant, also using pebble bed technology, was in service for only six years to 1989 but produced minimal amounts of power and is therefore likely to be lightly contaminated. It was de-fuelled only in 1995, placed in 'safe enclosure' in 1997 and it is not expected that decommissioning of the contaminated parts of the plant will start before about 2020. No recent cost estimates for decommissioning have been published. Again, if it had been assumed the plant would operate for, say 20 years and decommissioning provisions had been collected from electricity consumers on that assumption, any provisions would have been totally inadequate.

For a demonstration plant, which inevitably has a very uncertain length of operating life, it would seem more prudent to include the necessary provisions in the initial cost to reduce the risk of a shortfall in decommissioning funds if the plant operates for a shorter period than expected.

[5] A segregated account is one which the owner of the plant cannot draw on and as a result, if the owner of the plant fails financially, the decommissioning provisions are not lost.

Required information

The estimated decommissioning cost for the Demonstration Plant should be published broken down into the three main stages. The assumed timing of the three phases should also be specified and the arrangements for funding the process (how the money would be collected and kept, what rate of interest is assumed) given.

6.9 Operating life

The expected operating life of the plant will determine how long the owner has to repay the construction costs. The longer the life, the lower the annual repayments are. In practice, expected operating life is not as important as might be expected. Generally, commercial loans do not have a repayment period longer than 20 years so this is the maximum 'amortisation' period for a commercial facility.

Nicholls (Nicholls, 2000) projected a 40-year life for a commercial PBMR module. This would appear to be rather optimistic. No estimate has been given for the Demonstration Plant's lifetime. Demonstration plants often have quite a short life because they tend to be expensive to operate and once they have demonstrated (or failed to demonstrate as in the case of THTR 300) the technology, they are retired to reduce the losses consumers must bear. This is of particular concern if the decommissioning provisions are collected over the forecast operating life of the plant and this forecast proves too long.

Required information

The FEIR economic assessment should specify and justify the expected economic life (the time over which construction costs will be recovered and decommissioning provisions collected) of the Demonstration Plant

No mention is made of the operating costs. It could well be that with a relatively small fuel plant, operating unreliability and inexperience with operating PBMRs, the operating costs could be higher than those of, say, a coal plant. In this situation, Eskom would be left with a facility that would not be economic to operate even on a marginal cost basis and it would be left unused.

In evidence to the South African Parliament's Minerals and Energy Affairs Portfolio Committee, the CEO of Eskom, Thulani Gcabashe, only committed that Eskom would 'host' the demonstration unit.[47] It remains to be seen whether government is willing to provide subsidies or whether it will try to force Eskom to pass the extra costs on consumers.

Required information

The FEIR economic assessment should indicate precisely what Eskom will be expected to pay for the Demonstration Plant, how much the additional cost of power from the Demonstration Plant over and above the cost that would have been incurred if the power had been generated by commercial plants will be and who will pay these additional costs.

6.11 Analysis of risk

The PBMR project has always been a high-risk project. Thomas (Thomas, 1999) writing in 1999 said:

[46] Nucleonics Week, July 18, 2002, p 2.

[47] Sunday Times, November 10, 2004

> 'The development of the PBMR by Eskom would represent a highly risky venture which would be underwritten by tax-payers and electricity consumers.'

These risks have been amply demonstrated over the following six years. The cost of the Demonstration Plant has increased by a factor of more than seven and completion of the Demonstration Plant, expected in 1999 to be in 2003, is now still at least five years off. If the risks had, by now, all been incurred, this poor history of technology development would be of limited relevance to the decision whether to go ahead with the Demonstration Plant. In economists' jargon, 'bygones are bygones'. In other words, the development costs have been incurred and cannot now be 'unspent': what matters for decisions being taken now are the remaining costs and risks. Of course the failure to control costs and the huge slippage in the time-table must be taken into account in judging the competence of the developers, PBMR (Pty) Ltd and the likelihood that the remainder of the programme can be completed to time and cost.

The previous analysis has shown that there are still many risks. The design is far from complete, for example, a major change to the turbine generator design was announced in October 2004, the design has not received South African NNR approval, nor has substantive progress been made with approval by the US NRC. Even when these processes are complete, the history of nuclear power amply demonstrates the large risk of cost escalation during the construction phase. So the risk that costs will escalate even further is high. The statement in the Register of Comments (Register of Comments, 2002, 28.144) that 'the PBMR detailed design has been finalised.' cannot be justified. Since then, the turbine generator design has been changed, the plant output upgraded, apparently requiring significant design changes and until NNR approval is given, clarifying, for example, whether a pressure containment is needed, the design cannot be regarded as finalised. The problems in completing the design also do not provide confidence in the abilities of PBMR (Pty) Ltd nor do they augur well for the technological success of the Demonstration Plant.

Attempts to reduce the risk to the South African public have had some success, with about a third of the development cost in the feasibility phase being met by foreign companies, notably Exelon, but also BNFL. However, for the much more expensive (at least seven-fold) demonstration phase, Exelon will not participate and BNFL seems unlikely to be in a position to make a substantive contribution. Attempts to bring in other foreign investors, such as US utilities, the French company Areva and Chinese interests have not yet succeeded and it now appears likely that if the Demonstration Plant is to go ahead, it will be largely underwritten by South African public money through the government, Eskom, or IDC. This will include not only the estimate of at least R14.5bn to build the plant and associated facilities, it will also include the cost of decommissioning the plant and the extra cost of buying the electrical output over and above the cost of generating in commercial power stations.

The FEIR was seriously inaccurate even before it was published. It acknowledged the withdrawal of Exelon but the sales projections were still heavily dependent on Exelon. Exelon would buy the first commercial unit, before Eskom, and in the crucial first five years of the commercial phase when the business has to establish itself, it assumed Exelon would buy half the units sold. In the three years since the FEIR was published, the date when the first commercial units are expected to be sold has slipped by eight years and no replacement for Exelon has been found. Inevitably, the pressure is on Eskom, underwritten by South African taxpayers and electricity consumers, to step in to fill the gap.

6.12 The cost of a catastrophic accident

This report does not examine the costs that would arise if the Demonstration Plant were to cause a catastrophic accident. However, it should be noted that the 1986 Chernobyl accident in Ukraine is expected to result in costs of US$235bn in the 30 years after the accident.48. It is therefore essential that the promoter's claims that such an accident is totally impossible should be evaluated fully, and if the probability is not zero, consideration needs to be given on how such astronomic costs could be met.

6.13 The cost of waste and spent fuel disposal

This report does not examine the cost of waste and spent fuel disposal. However, a number of points should be made.

First, worldwide, no spent fuel has been disposed of yet. All fuel used to date remains in temporary surface stores or has been reprocessed to produce plutonium. Note that reprocessing does not reduce the amount of waste to be disposed of,49 it merely splits it up into different 'packages'. Until facilities have been designed and built that give the public full confidence that spent fuel can be disposed of in such a way that there is no risk that this material will be exposed to the human environment over the millions of years that it will take for the material to become harmless, the costs must be regarded as speculative.

Second, worldwide, very few waste disposal facilities for low-level and intermediatelevel waste have been built in recent years and the waste that is being disposed of is mainly going to old sites designed fifty or more years ago. Until there is more evidence of the cost of designing, building and operating waste disposal facilities that meet current safety standards and are publicly acceptable, the cost of waste disposal must also be regarded as uncertain.

Third, as with decommissioning, the cost of waste and spent fuel disposal will be incurred decades after the waste is created. If funds are put aside at the time the waste is created, these funds can be invested and can be expected to grow substantially. For example, a fund that is invested for 40 years, earning an annual real interest rate of 2.5 per cent will grow by a factor of 2.7. However, this does point to the need to establish clear procedures to take money from consumers to pay for these activities and to keep it in secure investments so the risk that it is lost is minimised.

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48 http://www.chernobyl.info/index.php?userhash=745163&navID=34&lID=2

49 In fact, reprocessing produces a large volume of additional low-level and intermediate-level waste because all the facilities and chemicals used in reprocessing become contaminated.

7. *The commercial programme*

Construction of the Demonstration Plant only makes sense if there is a high probability that it will lead to a profitable (to South African interests) stream of orders for commercial PBMRs. It is therefore essential to examine the prospects for such sales if the economic case for the Demonstration Plant is to be properly assessed.

7.1 The economic competitiveness of the PBMR

The economic competitiveness was assessed in detail by the International Panel of experts in 2002 and their report would provide a proper basis to analyse the economic prospects for the PBMR programme. The estimates given by Nicholls in 2000 (Nicholls, 2000) are clearly out of date. The information required for commercial units is:

- Construction cost;
- The cost of capital;
- The plant's maximum electrical output;
- Operating performance especially reliability;
- Operations & maintenance (O&M) cost, including fuel supply and spent fuel disposal;
- Decommissioning cost and;
- Operating life.

In some cases, for example, maximum electrical output, the information will comparable for all markets, but in others it might vary. For example: PBMR (Pty) Ltd might sell units to Eskom at a discount to the cost other customers; construction cost will vary depending on how many units are being built on the site; the cost of capital will vary from country to country according to the commercial position of the customer and the economic conditions in the export country; operating performance will vary according to whether the plant is expected to be base-load or load-following; decommissioning cost will vary according to the cost of waste disposal in the country of installation.

A key assumption will be the construction cost. Let us assume the Demonstration Plant alone (not including the fuel plant) will cost about US$1.5bn (two thirds of the R14.5bn that the demonstration programme was estimated to cost in 2004) or about US$13,600/kW if the plant produces 110MW, the gap to commercial units costing US$1000-1200 is huge. If the design can be stretched to produce 165MW at no extra cost, the cost per kW would be about US$9000/kW. This still leaves a huge reduction in costs to get down to the target levels. Some of this will come from not having to incur the technology start-up costs the Demonstration Plant would require. The rest must come from various scale economies and learning effects. These include: building ten units on a site; scale economies in manufacturing if a minimum number of units are sold. The DFR did not publish any details of these scale economies claiming the information was commercially confidential (PBMR (Pty) Ltd, 2002a, p 56)

Required information

The government should publish the report by the international Panel of Experts. Eskom should publish the latest cost and performance estimates for the commercial plants as well as the assumptions on factors such as cost of capital by market. It should also specify how the unit cost is expected to be reduced by a factor of at least nine from the Demonstration Plant to a fully commercial unit.

7.2 The likely world market for the PBMR;

PBMR (Pty) Ltd and Eskom have always been very vague about target markets and countries as wide-ranging as Chile, Cyprus, Turkey, Saudi Arabia and Egypt have all been mentioned as possible targets.

There appears to be little basis for this speculation and these markets should be discounted until there is some substantive evidence to back them up.

The DFR (PBMR (Pty) Ltd, 2002a, p 50) is ludicrously over-optimistic, given the absence of anything remotely close to a firm order, suggesting that: 'the sale of PBMR plants and fuel is more likely to be constrained by supply capacity limitations than by demand.' It backs this up saying:

> The market analysis shows that the potential exists for the market to conservatively absorb up to 235 five-pack plants (1 175 modules) over the two decades following the start-up of the demonstration plant. This represents only 3.3 per cent of the world demand for new generation capacity. Notwithstanding this excellent potential, the base-case sales scenario adopted in the enterprise business plan forecasts the sale of only 258 modules over the evaluation period of 25 years, and is therefore conservative.

Despite the fact that Exelon had already withdrawn from the project when it was published, the FEIR (PBMR, 2002b) still anticipated commercial sales beginning in 2006 with 15 units going to Exelon in the period 2006-8 and a total of 44 units by 2017. Eskom sales were expected to be at a much slower rate, starting in 2007, completing the 10-unit order by 2012 and ordering a total of 20 units by 2017. Other customers were expected to buy 76 units by 2017. So in the first 12 years of the commercial phase, the FEIR forecast sales of 140 units, a slightly faster rate of sales than the DFR.

Given that over the past decade, the volume of nuclear plant ordered has been only one or two 1000MW units a year, this seems far from conservative. In fact, it seems clear that PBMR (Pty) Ltd has carried out no detailed market analysis on a countryby-country basis and projections are simply an arbitrary percentage of an overall market for power plants. This issue was raised by LRC as Comments on the DFR (Register of Comments, 2002, 28.137) but the response does not make much sense and does not answer the question. It states;

> The market studies were based on 53 plants, only one of which is to be sold to Eskom. Thorough market studies were done as part of the business case. We are not sure on what the statement "it seems likely that the world market for nuclear power may be no more than 1 or 2 units per year" is based, especially since the world market for new power stations is about $70 million per year.

No mention is made elsewhere of 'the market studies of 53 plants'. Since $70 million would only, on PBMR (Pty) Ltd's figures, cover about half the cost of one PBMR module, it is not clear what the response means.

The fact that a significant percentage of the market is effectively closed to nuclear power by political decision is not taken into account. Even so, it should be noted the DFR represents a significant downgrading of sales forecasts to about 10 units a year from earlier when Nicholls (Nicholls, 2000) forecast 30 units per year.

This weakness was acknowledged by the new CEO of PBMR (Pty) Ltd in September 2004 when he said there was a need for 'a "much more detailed marketing strategy" with "a strong focus on customers' needs. He said marketing strategies would be tailored to a given country or customer, versus a more generic strategy followed in the past.'[50]

Such studies would quickly reveal that for much of the world, new orders for nuclear plants are not feasible. In Europe, many countries have made a decision not to build nuclear power plants, e.g., Austria, Denmark, and Norway or are phasing out nuclear power, e.g., Germany, Italy, Sweden, Belgium the Netherlands and Switzerland or not expanding existing capacity, e.g., Spain. The UK government carried out a review of nuclear power in 2003 and found no case for new nuclear power orders. France decided in November 2004 to build a new nuclear power plant of a French design, EPR, a 1500MW design based PWR technology, and it seems highly unlikely it would abandon this in favour of the PBMR. The medium-term prospects for PBMR sales in Europe therefore appear minimal.

In the USA, PBMR (Pty) Ltd's hopes were based on Exelon getting license approval for the PBMR and launching the commercial programme by ordering 10 units. It is clear this will not happen now and while some utilities offer supportive statements to the technology, as expressions of intent to buy plants, these are essentially worthless.

For example,[51] the CEO of Exelon (John W Rowe) was reported in May 2005 that:

> 'the high price of natural gas is an incentive to build new plants, but that an offsetting factor is the continuing low cost of coal. The lack of a solution for nuclear waste is also a deterrent.'

While the CEO of Dominion, another large US utility often mentioned when new nuclear orders are mooted said

> "We aren't going to build a nuclear plant anytime soon. Standard & Poor's and Moody's would have a heart attack," said Mr. Capps referring to the debt-rating agencies. "And my chief financial officer would, too."

The main expected export market therefore appears to be China, but despite several years of discussions, China has made no commitment to South African PBMR technology. Tsinghua University has the only operating PBMR in the world, a 10MW unit that went critical in 2000 using German fuel technology. Tsinghua University is collaborating with US interests from the Massachusetts Institute of Technology on a competitor to the South African PBMR.[52] Overall it is far from clear who Chinese companies will choose to collaborate with, but all experience shows that Chinese interests will try to 'indigenise' any technology they pursue so even if they do collaborate with PBMR (Pty) Ltd, and orders are placed, South African content to these sales would low and the net benefit of these sales to South Africa small.

It seems more likely that China will produce its own design of PBMR, similar to that of PBMR (Pty) Ltd, which would supply any sales in China and would compete with the South African design in world markets. Nucleonics Week reported in June 2005 that Tsinghua University's Institute for Nuclear & New Energy Technology (INET) expected to complete the design for a commercial scale of plant (about 195MW) by 2006 and have a plant in operation by 2010.[53] These forecasts may be no more realistic than those of its South African counterpart but the intention to develop an independent design rather than import technology is clear.

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50 Nucleonics Week, September 2, 2004, p 5.

51 M. Wald, 'Interest in Reactors Builds, But Industry Is Still Cautious' New York Times, May 2, 2005, p 19.

52 Nucleonics Week, November 6, 2003, p 1.

53 Nucleonics Week, June 23, 2005, p 8.

If a world market for high temperature gas-cooled reactors does develop, as well as competition from a Chinese vendor, the South African PBMR may face competition in international markets from the US vendor General Atomics and from Areva, companies that are both developing designs using prismatic fuel.

General Atomics supplied the demonstration HTGR built in the USA (Fort St Vrain) and has the advantage of being US-based and therefore politically well-placed to receive US government funds. Areva has less experience with HTGRs but its huge experience in reactor design and sales gives it advantages in international markets.

A pre-condition for any international sales appears to be obtaining safety approval from the US NRC. Without a US partner and with no sales in prospect, it is not clear why the USA should spend US taxpayers' money reviewing the PBMR design. If PBMR (Pty) Ltd is to obtain licensing approval in the USA, it seems a large proportion of the cost will therefore have to be borne by PBMR (Pty) Ltd.

Required information

The Applicant should publish the PBMR (Pty) Ltd's marketing plan and its strategy for gaining license approval from the US NRC in the FEIR

7.3 The South African market for PBMRs

In the absence of foreign markets, this leaves Eskom as the most likely customer. Eskom has committed to build and operate the Demonstration Plant. It has said it will buy 10 units, but only 'provided it's the lowest-cost alternative at the time the utility needs to add capacity'.[54] Note that the DFR (PBMR (Pty) Ltd, 2002, p 50) misleadingly does not include this caveat on cost, saying only: 'Eskom has provided PBMR (Pty) Ltd with a letter of intent covering the purchase of a demonstration plant and 10 further units.'

Eskom does not say in the FEIR whether, on current expectations of cost of a commercial unit it expects the condition that it be the 'lowest-cost alternative' to be met. Eskom should provide a detailed analysis of the economic conditions that would have to be met, including costs of the alternatives, such as coal, gas and renewables, as well as the cost of the PBMR, for the PBMR to be the cheapest alternative.

Given that commercial orders cannot be placed before about 2013, such calculations are highly speculative. In that time frame, it cannot be assumed that Eskom will exist in anything like its present form and the attractiveness of alternative technologies, such as gas-fired plant and renewables could have changed dramatically.

In the second half of 2004, pressure on Eskom to commit unconditionally to buy several commercial units increased. In October 2004, Kriek said the PBMR (Pty) Ltd's business plan 'envisages Eskom committing up front to some 4,000 MW of PBMR capacity in South Africa, which would allow "economies of scale" and development of a commercially competitive product.'[55] This plan appeared to be endorsed by the government Minister for Public Enterprises, Alec Erwin, in his midterm budget statement of November 26, 2004, when he said: 'plans include the additional generation of 4,000MW to 5,000MW of electricity from pebble bed units located around the country.' Tom Ferreira, communications manager for PBMR, said that around 4,000MW of electricity could be met by 24 PBMR units each with a generating capacity of 165MW.

[54] Nucleonics Week, August 28, 2003, p 1.

[55] Nucleonics Week, October 7, 2004, p 3.

If the cost of these units was no more than the target cost of US$1000/kW, this would mean that Eskom was being asked to commit to making an investment of at least R25bn before the technology was economically or technologically proven. It seems highly unlikely that the units bought by Eskom could be sold at this price and the figure of R25bn is therefore at the bottom end of the likely costs.

However, the signs are that Eskom itself wishes to distance itself from the project. The forecast time when new generating plant will be urgently needed is difficult to predict because of uncertainties about demand growth rates, the degree to which old plants can be refurbished and mothballed units returned to service. Steve Lennon, Eskom's MD for resources and strategy suggested that 1000MW of new peaking capacity (power stations only required for times of peak demand) would be needed each year from 2005-09 with base-load capacity (power stations that operate throughout the year) needed from 2010 onwards.[56] Clearly the PBMR, which cannot be in service as a commercial option before 2015[57] at the earliest, is of little relevance to this immediate need for new capacity.

The managerial changes in PBMR (Pty) Ltd in August 2004 when an IDC executive, Jaco Kriek, became CEO and a Department of Trade & Industry Director-General, Alastair Ruiters became Chairman, replacing the predecessor from Eskom, Nic Terblanche were reported as being 'intended to get the project out from under the management of South African utility Eskom, which does not want to be in the business of developing new nuclear technology.'[58]

This very much echoes the position taken by Exelon in 2002 when they withdrew from the project. These changes seem to be supported by the government. Nucleonics Week[59] reported:

> Up to now, the chairman of Eskom Enterprises, Eskom's subsidiary for unregulated industry, has automatically held the PBMR chairmanship, but now it's not even certain that Eskom will be represented on the board. An informed source said the government is "not eager for Eskom to continue as an investor and a potential customer," in part because that would inevitably lead to conflict-of-interest situations.

The CEO of Eskom confirmed this interpretation in evidence to the South African Parliament Portfolio Committee on Minerals and Energy. He said the IDC was to take over the leadership of the PBMR programme. Eskom would be "playing a lesser role (as a PBMR investor) as we go forward, because we are now going to take the role of customer".[60] He also seemed to suggest that the PBMR should not go forward without foreign investors. He said more international investors were needed "to be able to advance to the stage where we can construct the demonstration unit and have it commercially proven" and that Eskom would "dilute" its participation as an investor in the PBMR, and allow other investors to be brought in. He also seemed to confirm that PBMR would have to be the cheapest option if Eskom was to buy it: 'if all of our

[56] Financial Mail, December 10, 2004, p 36.

[57] The Energy Minister, Phumzile Mlambo-Ngcuka said in August 2004 that 'the pebble-bed modular reactor was at least 10 years away from becoming a commercially viable project'. Business day, August 16, 2004, p 2.

[58] Nucleonics Week, August 26, 2004, p 7.

[59] Nucleonics Week, September 2, 2004, p 5.

[60] Sunday Times, November 10, 2004.

technical and commercial criteria are met, we'll be taking the first set of units that are produced.'[61]

The South African government affirmed in October 2004 its commitment to open up the electricity generation sector to foreign investment. The Trade & Industry Minister, Alec Erwin[62], suggested that about a quarter of the investment needed up to 2009 would come from companies other than Eskom. This effectively removes from Eskom the obligation to ensure there is sufficient generating capacity for the country. It also in effect places Eskom in a competitive market. In this situation, it would be unreasonable to expect Eskom to compete with new generators if it was obliged to buy a number, specified by the government, of PBMRs regardless of whether they were the cheapest option or whether they were even required. The only logical commitment Eskom can be asked to make is that it orders PBMRs when it needs new capacity, provided it is the cheapest option available. In practice, this is a largely empty commitment because, if when it needed new capacity the PBMR was the cheapest option, it is hard to see why Eskom would not order it.

When the PBMR project was launched, it was expected to be primarily an export project producing about 30 units per year, with two thirds of the units for export. Thomas argued (Thomas, 1999) that the world market forecast was implausible and no more than one or two units per year would be sold. Six years later, the overall world market for nuclear power plants looks no more promising and PBMR (Pty) Ltd has failed to identify any firm prospects export sales.

Required information

The FEIR should specify what obligation Eskom has to purchase commercial PBMRs.

7.4 Benefits to the South African economy

The PBMR programme has always been sold to the South African public as a generator of jobs and wealth. Nicholls (Nicholls, 2000) suggested that the programme would generate 204,546 jobs and additional annual GDP of R18331m (the apparent precision of these inevitably highly speculative forecasts is grotesque). This was on the basis of a total market of 30 units per year, 20 of which were for export a local content of 50 per cent and 10 of which were for South Africa with local content of 81 per cent. The DFR (PBMR (Pty) Ltd, 2002a, p 55) projects annual sales of 10 units with local content for South African units of 69 per cent (48 per cent for the Demonstration Plant) and for export units, the South African content would be 43-65 per cent depending on the market (developed or developing country) and on how many units were sold. These are no more than targets and the actual percentage would be negotiated on an individual basis. If the market for PBMRs was disappointing or a large market was opening up, it may well be necessary to accept lower percentages rather than jeopardising sales. For example, China would be likely to require a very high local content.

Clearly the lower forecast sales volume and local content figures will dramatically reduce the jobs and economic effects forecast by Nicholls in 2000, perhaps by 75 per cent and the DFR showed figures of 63,719 jobs and GDP of R8522m (again grotesquely over-precise).

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[61] Sunday Times, November 10, 2004.

[62] Business Day, October 27, p 2.

However, it is necessary to look at how these figures were generated. The DFR projects a unit cost for commercial units of about R180m. It forecasts that 40 permanent jobs will be created at the Demonstration Plant site plus about 1400 local construction jobs for about two years. The number of people working in manufacturing plants is forecast to be about 450 (PBMR (Pty) Ltd, 2002b, p 191). If we assume local content is on average about 60 per cent, this means the direct value to South Africa of 10 orders per year would be about R1000m. The number of direct jobs created would be of the order 1000.

It is therefore clear that projections of 60,000 jobs and GDP increase of R8.5bn must be based on 'second round' effects of jobs created in the companies servicing the PBMR programme, for example the steel industry might be able to sell some more steel and in jobs created servicing the needs of the workers employed. Complex computer models of the economy as a whole are used to model these effects but the results should be treated with care (see PBMR (Pty) Ltd, 2002a, p 55-62). Any large programme of spending, if fed into this type of computer model, would produce large numbers of extra jobs and a large amount of extra GDP. For example, if the South African government embarked on a large programme of construction of pyramids, this would generate new wealth and jobs perhaps in the cement and construction sector, but the money would be entirely wasted because the pyramids would be useless. The export orders for the PBMR would generate no permanent jobs in South Africa for operators, and few if any temporary jobs for construction workers, while the pressure from customers would be to maximise their local content, so factory jobs (and second round effects on supplying industries such as the steel industry) would be much less than forecast.

Required information

Eskom should specify how many jobs will be directly created by the programme, for example as plant operators and manufacturing plant employees, specifying the assumptions that lie beneath these forecasts.

7.5 Risk analysis

The risk has always been that if international orders did not materialise, the South African public would be required to bail out the project by placing uneconomic orders. Thomas in 2000 wrote (Thomas, 2000):

> However, what will happen if Eskom does go ahead without major international collaborators and the stream of orders does not materialise? Will South African politicians have the nerve to write off the project or will plants be built ahead of need in South Africa just to keep the capability in existence? National flagship projects have a tendency to live long after they should have been killed off and South African consumers will end up paying for a series of expensive white elephants.

Even if the Demonstration Plant appears to be technologically successful (it will take several years of reliable operation before risk-averse foreign utilities will be convinced of this), that is no guarantee of international sales. PBMR (Pty) Ltd's cost projections for the commercial units are based on very large and still entirely speculative scale economies. If these are not realised, the commercial design would not be competitive.

The government appears to be acting to take control of the PBMR project away from Eskom, with IDC taking the lead role, while attempting to oblige Eskom to buy the plants. Eskom is being asked to invest more than R25bn in a technology for which the design is not even complete, let alone demonstrated and proven. To some extent, these changes will be of limited interest to the South African public. From a theoretical point of view, if the government is going to oblige Eskom to build more PBMRs than would be economically optimal, it should reimburse Eskom from taxes. However, the public may be largely indifferent whether they pay extra to subsidise PBMRs through their taxes or through their electricity bills. It will be much more concerned about the potential huge loss of public money.

8. Conclusions

The National Environmental Management Act (NEMA) requires developers to demonstrate that their projects are economically sustainable. To judge economic sustainability, it is necessary to look at the life-cycle costs of the Demonstration Plant for the Pebble Bed Modular Reactor (PBMR). The Final Environmental Impact Report (FEIR) does not provide sufficient data to assess these. However, given that by its nature, a demonstration plant will not be economically viable in isolation, to judge whether the expenditure on the next phase is justified, it is also necessary to look at what the prospects of success for commercial PBMR units are.

Eskom and PBMR (Pty) Ltd are keen to justify the Demonstration Plant on grounds of forecast benefits of a programme of commercial PBMR orders to the South African economy in the FEIR and the associated Detailed Feasibility Report (DFR). However, the FEIR does not provide any information on the economics of a commercial programme and in the responses to comments on the Draft EIR (Register of Comments, 2002), the consultants refused to answer questions on the programme stating 'the present EIA is limited to a single demonstration module PBMR'.

However, it is possible to draw conclusions on the economic sustainability of the Demonstration Plant and on any subsequent commercial programme by drawing together the information supplied by Eskom and PBMR (Pty) Ltd officials to various news media.

8.1 The Demonstration Plant

Conclusion 1: Regardless of its success or otherwise, the Demonstration Plant will leave a substantial liability that will fall on South African public funds caused by the need to decommission the plant and the associated facilities, and to pay for the disposal of the spent fuel. The FEIR and the DFR do not quantify these liabilities, providing no information on spent fuel disposal and no usable information on expected decommissioning cost. However, experience in other countries suggests that decommissioning costs could be of the same order of magnitude as construction costs.

Conclusion 2: Since details of the project were made public in 1998, costs of the Demonstration Plant have escalated by a factor of more than seven. The project leadtime has slipped so that it is now apparently further away from commercial exploitation than it was in 1998 when commercial orders were forecast to take place from 2003. Now, seven years on, commercial orders are not forecast for about ten years. This shows that the developers failed to understand the scale and nature of their task. There is still considerable scope in the next phase for further cost escalation and delay due to changes to the design and construction problems. The developers' poor record to date gives little confidence in their ability to control costs and time schedules in the next, more expensive phase.

Conclusion 3: Forecasts of other economic parameters, such as operating performance, operating cost and decommissioning cost have not been updated since 1998 and appear implausibly optimistic. It is understandable that developers of a project have an optimistic view of the project's prospects – 'appraisal optimism'. However, investment decisions should be taken on the basis of sober, unbiased judgements of the most likely outcomes, not the views of the project's promoters.

Conclusion 4: PBMR (Pty) Ltd successfully diversified some of the risk away from the South African public for the feasibility phase with foreign partners, Exelon and BNFL Ltd, sharing the costs. However, the cost of this phase (about R2bn) was far more than forecast and the absolute amount paid for by the South African public was not reduced. PBMR (Pty) Ltd has spoken optimistically over the past three years about the prospects of recruiting new partners to replace Exelon and BNFL (if as seems likely it cannot participate), but nothing has come of these negotiations. Until there is solid evidence of new partners being bought in, it must be assumed that the cost of the demonstration phase will fall substantially on the South African public, through Eskom, IDC, or direct government subsidies.

8.2 The commercial plants

Conclusion 5. PBMR (Pty) Ltd's analysis of the world market for PBMRs is simplistic, taking no account of any of the commercial or political factors that would apply in key export markets. A particular concern is finance for export orders. This is an important issue for developing countries, which are likely to account for a significant proportion of the forecast orders. Such countries frequently have difficulty financing large investments. The World Bank and most other International Financial Institutions do not provide finance for nuclear investments. The South African PBMR could face strong competition from other types of high temperature reactor, notably a very similar Chinese design and models offered by Areva and the US company, General Atomics. Until a rigorous market analysis has been carried out and subjected to independent scrutiny, and arrangements for helping finance export orders made explicit, PBMR (Pty) Ltd's assumptions on the likely world market have no basis.

Conclusion 6. Pressure is mounting on Eskom to commit to buy large numbers (24) of commercial units even before the technology has been technically and economically proven at a cost in excess of R25bn. Eskom appears, rightly, to be holding to its position of only buying it if the PBMR is the cheapest option available, something that will not be known until the Demonstration plant is in service and has operated for some time. If Eskom is required to make such an advance commitment, it could be forced to purchase uneconomic plants, raising the price of power to consumers, and adversely affecting public welfare and the competitiveness of the South African economy.

Conclusion 7. The future of Eskom is uncertain. The South African government has been considering reforms to Eskom for a number of years, including its privatisation and its break-up into competing units. There can be no guarantee that in 2013 or later, when the first commercial orders for a PBMR might be placed that Eskom will exist in any recognisable form, much less one that can be obliged to order a particular type of power plant, especially if it does not represent the best commercial option.

8.3 Overall conclusions

Conclusion 8: The PBMR project is a highly risky venture. The feasibility phase has cost more than R2bn, about two thirds of which has been paid by South African public money. Despite this expenditure, there is still ample scope for the project to fail. The next phase will require a much higher level of expenditure, at least R14.5bn, with more than half of this again coming from the South African public. If the project fails, there will be significant consequences for the South African public either through higher electricity prices (if Eskom is forced to bear much of the risk) or through taxation if the government has to write-off the costs.

Conclusion 9: The National Environmental Management Act (NEMA) requires developers to demonstrate that their projects are economically sustainable. The FEIR does not provide the data necessary to make such a judgement. This information strongly suggests there is a high risk that the project will not be economically sustainable. On the available evidence, the project does not meet the requirements of the NEMA and the applicants, Eskom, should not be given approval.

Conclusion 10: The current high fossil fuel prices and the measures to reduce greenhouse gas emissions seem to give a new impetus to generation technologies that do not use fossil fuels. However, it should be remembered that previous oil price spikes (1974 and 1980) were short-lived and resulted in little nuclear investment apart from in France. Investors are unlikely to make multi-million dollar investments in new nuclear power plants on the basis of a short-term oil price spike which could have disappeared long before a nuclear plant could be brought on-line. On greenhouse gas emissions, nuclear power faces competition from renewable technologies and energy efficiency measures, options that generally do not encounter the public acceptability problems that nuclear power suffers from.

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8.10 APPENDIX 11: WILDLIFE AND ENVIRONMENT SOCIETY OF SOUTH AFRICA SUBMISSION

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WILDLIFE AND ENVIRONMENT SOCIETY OF SA

People caring for the Earth

6 March 2006

Mr Ian MacFadyen

Mawatsan

PO Box 13540

Hatfeild

0028

By email: pbmr@mawatsan.co.za and fax: (012) 362 2463

Dear Mr. MacFayden

Comments on the Draft Environmental Scoping Report for the Proposed 400 MW(t) Pebble Bed Modular Reactor Demonstration Plant (PBMR DPP) at the Koeberg Power Station Site

The Wildlife and Environment Society of South Africa (WESSA) thanks you for the opportunity to comment on the above document. While studies from the previous EIA may be a useful starting point to inform this EIA process, WESSA urges that this new process be used as an opportunity to rectify and improve on the shortcomings of the previous EIA. WESSA trusts that information from the previous EIA will be critically reviewed and that the opportunity to update and supplement specialist information previously provided will be used. Furthermore, we trust that the public will have an opportunity to review all information submitted to the decision-makers.

Nuclear energy is a contentious issue worldwide and there are compelling arguments both for and against South Africa exploring this technology further. WESSA calls for wide and inclusive public debate on the subject. We do not believe that processes dealing with nuclear technology in South Africa have been open and transparent. This in itself has led to public mistrust, fear, difficulty in assessing proposals and has led to a great deal of frustration and time wastage on all sides.

Climate change is an inescapable reality, as is the current energy crisis facing the Western Cape. WESSA therefore suggests that there is an urgent need for South Africa to develop a comprehensive and holistic energy strategy that is broadly debated and accepted in the public realm. A participatory and transparent approach is essential to ensure public support. Such a strategy should include an in-depth assessment of our current and future energy requirements, including mechanisms to reduce demand through behavioral change and energy saving technology. There is a need to explore the social, environmental and economic costs and benefits of **all** energy generating options available to us, including nuclear. It is our opinion that existing policies and plans have failed to achieve the above. We suggest that only once this has been achieved, and a decision taken that nuclear energy is in fact a path we wish to follow, should we consider testing new nuclear technologies for possible wider roll-out.

The lack of the above strategy and a lack of transparency have, and will undoubtedly continue to, cloud this EIA process. This must not be allowed to happen. As the Draft Scoping Report (DSR) rightly points out, this EIA process is not the correct forum to address broader strategic issues around energy supply alternatives. However, these issues do need to be addressed and debated somewhere as they directly inform the need and desirability of the proposed development of the PBMR DPP.

The need for the proposed PBMR DPP:

It is useful to bear in mind that the stated purpose of the PBMR DPP is not to solve our energy crisis, but to "*assess the technological, environmental and economic viability of the technology*" (page 1 of the DSR). We understand that the proposed development will contribute little to our generation capacity. Considering this, we believe that it is imperative that the DSR establishes what the need for such an 'experiment' is. Without a clear energy strategy as discussed above, this will be difficult to do.

The White Paper on Energy does state that it would not be prudent to exclude nuclear energy as a supply option, but also suggests the evaluation of all candidate energy supply and demand resources in an unbiased fashion. In contrast the Summary Draft Status Quo and Gap Analysis: Towards the Development of an Integrated Energy Strategy for the Western Cape (June 2005) states the following: "*To maximize sustainability there needs to be a shift away from non-renewable sources of energy, and in the long-term from fossil-fuels and nuclear…*" The need to expand our nuclear energy production therefore is clearly still under debate and the specific need to explore PBMR technology has not, as far as we are aware, been identified.

It is unclear why we need to explore and test this technology, where other already-tested methods exist and similar technology is being tested elsewhere. There are substantial public concerns around nuclear energy in general and concerns around the feasibility, cost and potential environmental impacts of the proposed PBMR in particular. It must therefore be demonstrated that the technology is both necessary and desirable. The precautionary principle (as set out in the National Environmental Management Act (NEMA) (Act 107 of 1998)) must be observed. Thus far the DSR has failed to do this.

Alternatives

Consideration of alternatives is a cornerstone of the EIA process. This is an important mechanism to help identify the best practical environmental option, as required by NEMA. This means that the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term must be perused. Given that the purpose of the proposed development is not to supply energy, but to test technology, we agree with the assertion in the DSR that the range of alternatives that should be considered here is indeed limited. We are nevertheless concerned that the consideration of alternatives, as suggested in the DSR, is far too limited. We also reiterate our suggestion that the alternative methods of energy production and demand reduction must be explored at a strategic level as a matter of urgency.

The no-go alternative

We believe that the dismissal of the 'no go' alternative is unjustified at this early stage of the EIA process. According to the DSR "*…the no-go option was not considered during the scoping process as the no-go option would imply that the technology would be lost from the suite of actions included in the White Paper on Energy*". We suggest that the logic of this is flawed. The White Paper, a policy document, cannot dictate the decisions made in terms of other legislation (in this case NEMA and the Environmental Conservation Act (Act 73 of 1989)). Furthermore, the 'no go' in terms of this application would not necessarily mean that the technology would be lost from the suite of actions included in the White Paper on Energy. An application to implement the technology elsewhere could be successful. Implementing the no go would not necessarily spell the end of all nuclear technology in South Africa as it is specifically PBMR technology that is in question here. It is worth noting that the White Paper does not specifically prescribe the construction of a PBMR demonstration plant. We therefore suggest that the no go alternative continues to be included and considered in this impact assessment process, as is legally required.

Location alternatives

We suggest that the location alternatives were prematurely dismissed based on unclear reasoning. It is not clear how the various alternative sites were originally selected and on what information the comparative assessment was based. Was this information up to date? How were the criteria selected? Were these weighted and if so, how? Was public input sought? Furthermore, we believe that conducting a comparative assessment during Scoping is inappropriate, as Scoping should involve information gathering not assessment. The comparative assessment should therefore have been part of the Environmental Impact Report. We suggest further that alternative sites should continue to be considered and assessed as part of this EIA process, unless they are found to be completely unsuitable. The public should have an opportunity to review information on which the assessment is based and suggest additional criteria for consideration. Transparency in this regard is key.

Two major concerns with the proposed Koeberg site are: 1) The proximity to a major urban center and 2) The risk implications of locating the PBMR adjacent to an existing nuclear power station - should there be a major incident at either plant what would the knock-on effect be? These issues do not appear to have been adequately considered in the comparative assessment.

Technology Alternatives:

What, if any, technology alternatives are available that will fall within the limited scope of the stated purpose of the project? This needs to be discussed and explored further.

We remind you that DEAT's Criteria for Determining Alternatives in EIA (2004) states that "*Failure to consider alternatives adequately from the outset is symptomatic of a biased process….*"

Issues

The relationship between this EIA decision making process and the National Nuclear Regulator (NNR) is confusing. WESSA is concerned that project-specific radiological issues are relegated to the NNR. We believe that the public must have an opportunity to review and comment on all relevant information that informs the decision made by DEAT. Naturally radiological issues should be considered in such a decision. Issues considered by the NNR should therefore inform the EIA process.

WESSA is concerned with the exclusion of issues as described in Table 6 (page 70) which lists significant issues that, according to the DSR fall outside the scope of the EIA for the PBMR DPP. Is the proposed PBMR financially viable as an electricity generating option? What is the environmental impact of uranium mining? What are the implications of the absence of approved procedures/regulations to deal with spent nuclear fuel and how does this relate to the precautionary principle? Should public funds be used to test this technology? Is there a market for future PBMRs? These are all highly pertinent questions, directly related to the need and desirability of the proposed development. We believe that these issues should be explored in this EIA process and that to dismiss them is unjustified.

WESSA is further concerned that other important issue directly relevant to the proposed development will not, according to the DSR, be considered in this EIA process. For example, transportation of nuclear fuel will apparently not be dealt with, as this will be considered in another EIA. WESSA does not support the piece-meal consideration and authorization of activities directly related to a proposed development. How will these separate EIA processes inform each other? Similarly, we believe that the ability to manage radioactive waste in the long term must be addressed. We are therefore concerned that issues surrounding the storage, management and disposal of the high level waste in the long term will also not be explored in this EIA process - the DSR states that these issues will be considered by the Department of Minerals and Energy (DME). We suggest that this is inappropriate to place this responsibility on solely on the DME and that issues concerned with the operation and entire lifecycle of the PBMR DPP are key to the EIA process. We urge that a holistic view of the proposed development and its potential impacts be taken.

Lastly, we suggest that safety issues be carefully assessed in this EIA process, including risks from unpredictable catastrophic events and sabotage (recent events at Koeberg indicate that the latter is possible, if not likely).

Thank you for taking the time to consider our concerns. We look forward to participating in the process further.

Yours sincerely

Samantha Ralston

Environmentalist

WESSA Western Cape Region

8.11 APPENDIX 11: AFRIKAANSE HANDELISINSTITUUT SUBMISSION

1 Desember 2005

Mnr Ian MacFadyen

Mawantsan

Geagte Ian

AHI Standpunt oor die indiensstelling van die korrelbed modulêre kernreaktor vir die opwekking van elektrisiteit

Die Energie werksgroep van die AHI se Kamer vir Handel en Nywerheid het gedurende 2003 `n vergadering met ESKOM gehad oor bogemelde, na aanleiding, van die omstrendenheid oor die voorgestelde produksie en indienstelling van hierdie reaktor, vir die doel om elektrisiteit op te wek terwyl dit nie meer ekonomies is om nuwe steenkool aangedrewe kragsentrales te bou of bestaandes op te gradeer nie.

ESKOM het toe al gemeen dat die tyd aangebreek het om na alternatiewe energie bronne oor te skakel. Die mees logiese daarvan is die aanwending van kernkrag om Suid Afrika se energie behoeftes aan te vul. ESKOM het die doel en werking van die korrelbed modulêre kernreaktor breedvoerig en tegnies aan die werksgroep verduidelik. Na afloop van die vergadering en verdere besprekings het die werkgroep `n kort memorandum opgestel wat aan AHI lede gesirkuleer is en ook in die AHI nuusbrief geplaas is.

Die Werkgroep was van mening dat:-

1. Die ontwikkeling en indienstelling van die korrelbed kernreaktor `n ekonomiese haalbare projek is en dat dit `n groot bydrae kan lewer om te voorsien aan die stygende elektriese energie behoeftes van Suid- Afrika.
2. Dat die prosesse wat deur die reaktor gebruik word om elektrisiteit op te wek uiters veilig is en dat die tegnologie wat aangewend word daarvoor baie deeglik nagevors en baie gevorderd is.
3. Dat die uraanbrandstof (korrels) wat vir die doel aangewend word veilig is, aangesien dit deur `n dik mantel van koolstofverbinding bedek word wat bestraling tot die absolute minimum, selfs onder die internasionale standaard, beperk.
4. Dat die sisteem "skoon" is, in die sin dat dit geen skadelike afval gasse of verbrande materiaal vrylaat, wat besoedeling in die atmosfeer of omgewing tot gevolg kan hê nie.
5. Dat die prosesse veilig is omdat die reaktor afgekoel word deur vloeibare helium; en sou iets tegnies verkeerd gaan, het die sisteem die vermoë om self af te skakel sonder enige nagevolge.
6. Dat dit op die langtermyn voordelig sal wees om hierdie reaktors in werking te stel aangesien `n baie klein oppervlakte terrein nodig is om hulle op te rig, wat sal beteken dat baie minder grond oppervlakte nodig is vir die oprigting daarvan; en dat dit maklik in die bestaande elektriese verspreidingsnetwerk ingeskakel kan word.
7. Dat hierdie tegnologie waardevolle internasionale valuta vir Suid Afrika kan verdien as dit erns internasionaal bemark sou word.

Die Werksgroep het derhalwe aanbeveel dat:-

1. Eskom voortgaan om `n prototipe van die reaktor op te rig by Koeberg om die werking daarvan oor `n bepaalde tyd monitor.

2. Eskom in samewerking die georganiseerde Handel en Nywerheid (Sakekamers) voortgaan om die konsep landwyd bekend te stel en ook ander belangegroepe in ag neem in hulle bemarkingsveldtog.
3. Dat Eskom in die proses van ontwikkeling van die reaktor, ten nouste sal saamwerk met die Internasionale Kern-Agentskap van die VN, ten einde te verseker dat internasionale veiligheidstandaarde noulettend nagekom word.
4. Dat Eskom alle veiligheidsaspekte sal nakom ten opsigte van die veilige berging van kernafval, wat na die proses van verbranding vrygestel word, sal ag.
5. Dat, aangesien die AHI `n nasionale sake organisasie is, en wil toesien dat tegnologiese innovasie van hierdie aard ook tot sy lede se voordeel ontwikkel en aangewend word, die AHI daarop aandring dat die klein en mediumsake sektor by die ontwikkeling van die reaktor betrek word, veral met betrekking tot

   - Konstruksie en oprigting
   - Bemarking, plaaslik en internasionaal
   - Veiligheid en toesig
   - Ingebruikstelling rakende die projek
   - Enige ander aspek, wat tot werkskepping in die sektor kan lei, sal ondersoek

6. Dat Eskom gelukwens word met die tegnologiese deurbraak wat in belang van Suid Afrika ontwikkel is.

Uit die besprekinge op die AHI-Hoofbestuur en die AHI-wandelgang sedert 2003 het ek die volle vertroue om steeds die AHI se volle steun toe te sê aan die projek om `n korrelbed kernreaktor te Koeberg te vestig vir die opwerking van 400 MW elektrisiteit. Trouens met die toenemende voorkoms van kragonderbrekings, vanweë oorbelading versoek die AHI dat spoedig met die projek voortgegaan word.

Vriendelike Groete

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8.12 APPENDIX 12: CITY OF CAPE TOWN COMMENTS

CITY OF CAPE TOWN COMMENTS ON THE DRAFT ENVIRONMENTAL SCOPING REPORT (DSR) FOR A PROPOSED 400MW(t) PEBBLE BED MODULAR REACTOR DEMONSTRATION POWER PLANT AT THE KOEBERG POWER STATION SITE IN THE WESTERN CAPE

6 March 2006

Report prepared for National Department of Environmental Affairs and Tourism and the Provincial Department of Environmental Affairs and Development Planning

Report Prepared by Mawatsan: Ref: PBMR *160106*

1. General Comments

1.1 Previous comments on the PBMR EIA by City of Cape Town

During the first PBMR EIA process *(1999* - 2003), City comment was submitted and included extensive input from relevant services including Town Planning, Economic Development, Transport and Roads, Emergency Services and City Health. Political endorsement of City comments was obtained in order to ensure that the inputs to the EIA reflected the City's interests broadly.

The City's comment at that time on both the Revised Draft Scoping Report and the draft Environmental Impact Report concluded that neither report was adequate for a decision regarding the EIA authorisation process. This conclusion was based on the omission of key issues raised by the City from the EIA.

Nevertheless, the EIA process continued and a final EIR was submitted to the Department of Environment Affairs and Tourism (DEAT) by the PBMR Consortium. The City was asked by DEAT to comment on the final EIR. The review and comment concluded that the final EIR was an inadequate basis for a decision to proceed with the PBMR at Koeberg as key environmental risks and concerns raised by the City were not assessed.

The City appealed against the approval of the EIA in 2003. However, the appeal was never considered by the Minister of Environmental Affairs as the Record of Decision was over-turned on judicial review.

Eskom have now initiated a second EIA process for a PBMR to be located at Koeberg. The proposed PBMR has potentially significant spatial, health, transport, environmental and safety implications for the City over the 40 year lifespan of the nuclear plant, plus the additional time during which high level nuclear waste is stored at Koeberg. The proposal also has significant implications for the future supply of electricity and for economic development in the region.

1.2 Key issues raised in the previous CCT appeal

Many of the concerns and issues raised by the City were not reflected in the previous EIA and subsequent ROD and conditions of approval for the PBMR. These concerns and issues formed the basis for the City's Notice of Appeal and included –

- High level nuclear waste storage at Koeberg: Financial and environmental costs
- Current and future emergency planning measures: Costs to the CCT
- Health monitoring, health risk assessment and ambient radiation monitoring
- The City of Cape Town's role as a key stakeholder
- A number of important principles and requirements of the National Environmental Management Act 107 of 1998

These issues have not been sufficiently addressed in the Draft Scoping Report (DSR). Relevant sections from the appeal document are referred to here with regard to these issues.

1.2.1 Financial and environmental costs of waste:

The full life cycle financial and environmental costs of storing the high level nuclear waste from the PBMR at Koeberg for the 40 year life span of the plant, and until a final depository for nuclear waste is licensed some time in the future must be addressed in the EIA. (Refer also to comments under section 5 NEMA principles).

1.2.2 Costs of emergency planning

The costs of current and future emergency planning and related infrastructure are direct costs due to the activity and should thus be borne by the developer, not the City of Cape Town. There is no indication in the DSR of how current and future emergency planning measures are to be addressed.

1.2.3 Health risks and radiation monitoring

Health monitoring is needed both to reassure the public and surrounding communities, and to timeously identify any health impacts that may occur. The City Of Cape Town requested (during the previous EIA comment process) that a health risk assessment be undertaken. The DSR proposes that the health issue will be addressed by means of an international literature review. This approach is questioned as there are no PBMRs of equivalent scale or technology combinations operating elsewhere in the world. Applicability of the information found via the literature review to this particular project may therefore be questionable.

The Directorate: City Health has requested that a team of respected epidemiologists undertake an "independent and unbiased study to generate sufficient epidemiological evidence".

1.2.4 The City of Cape Town's role as a key stakeholder:

The City's role in service delivery, emergency services, land use management, housing delivery and community health was emphasised in comments submitted by the City during the previous EIA process. The current 2006 EIA must include an assessment of the role of the City and its existing and future obligations in terms of relevant legislation and the effect that approval of the proposed PBMR could have on City functions and services.

1.2.5 Principles contained in the National Environmental Management Act (NEMA)

The CCT raised a number of key principles contained in NEMA that must be taken into account in the EIA. These are summarised in the next section, together with additional comments on the 2006 DSR.

1.3 Summary of comments in terms of NEMA principles

NEMA provides sustainable development principles which are to be taken into account in planning and decision-making. The comments below are presented in terms of relevant NEMA principles which should therefore be considered and addressed in the EIA for the proposed PBMR.

1.3.1 Development must be socially, environmentally and economically sustainable.

The generation and storage on site at Koeberg of high level nuclear waste which potentially poses a significant threat to human health and the environment cannot be considered sustainable. The presence of this waste effectively sterilises the site for any alternative use and the location of the existing and any future new nuclear plants has an impact on the future sustainable development of the West Coast region.

1.3.2 That waste is avoided. .and otherwise disposed of in a responsible manner.

Insufficient information is provided in the DSR on the volumes and radioactivity of waste likely to be generated. No long term repository for high level waste exists and the DSR therefore indicates that waste will be stored on the site for the lifetime of the plant (pg 30 of DSR).

This issue continues to be of concern to the City Of Cape Town as indicated in the appeal submitted to the Minister of Environmental Affairs and Tourism in August 2003. The DSR indicates that waste impacts will be addressed in the forthcoming EIA (pg 88) but the precise scope of these studies is not clear. The radioactivity and volumes of the spent fuel and other waste components is not indicated in the DSR and no clarity is given with regard to how radioactive waste will be stored or managed.

1.3.3 That a risk averse and cautious approach is applied which takes into account the limits of current knowledge about the consequences of decisions and actions.

Locating a 'demonstration' plant adjacent to a large and growing city does not appear to be a *risk averse or cautious approach*. It is questioned whether it is wise or appropriate to 'test the operability, *safety* and maintainability of the integrated plant system' in an urban environment where there are growing human populations located 2 km away from the proposed plant and there is significant urban growth northwards (pg 45 of DSR indicates that there is growth north of Milnerton and Table View). The presence of the Koeberg Nuclear Power Station already creates an opportunity cost in terms of city planning and this will be further extended by the existence of the PBMR and the presence of radioactive waste on the site for an indefinite period.

There does not appear to be any comparable nuclear plant elsewhere in the world at a similar scale and combination of technology components which would enable a reasonable assessment of potential risk and impact. Page *119* of the DSR states that the proposed PBMR design is 'unique in its different feature components'.

1.3.4 Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its lifecycle.

The potential costs of the PBMR and the lifecycle costs of storing and final disposal of nuclear waste must be assessed. Decommissioning of the PBMR and the final disposal of nuclear waste should be addressed in the EIA. The national Policy on Radioactive Waste and the agreement between DEAT and the NNR both provide a framework for the assessment of the potential impacts of the proposed PBMR throughout its lifecycle.

*1.3.5 Investigation of the potential impact, including cumulative effects of the activity and its alternatives on the environment, soclo-economic conditions and cultural heritage***.**

The DSR indicates that alternatives (site and technology) will not be assessed in the EIA. However, Eskom were requested by DEAT to scope Pelindaba as a potential site (pg 12). The DSR does not present a balanced evaluation of the two sites and instead the point of departure seems to be 'Is there a better site than Koeberg?'

Information contained in the DSR indicates that the Pelindaba site may be feasible, albeit at a higher direct (infrastructural) cost. However, factors such as the savings incurred by not having to transport fuel to the Cape (as it is manufactured at Pelindaba) do not appear to have been included. Table *I* (pg 24) fails to fully evaluate the costs and benefits of these two sites.

For example, there is no indication of the volumes of cooling water required or the feasibility of installing a dry cooling system. In an inherently water-scarce country, dry cooling systems must be regarded as increasingly important. The Directorate: Water Services of the CCT have requested that security of water supply also be considered (are there two separate supply points?). Given the scarcity of water sources, the omission of a dry cooling system as a process alternative is questioned.

The feasibility of the PBMR is proposed to be evaluated in a situation where a nuclear power plant is already located, with readily available infrastructure and expertise. No comparable site would exist for potential future PBMRs in South Africa and thus any viability studies based on the Koeberg situation would be misleading.

The DSR is not required to make detailed evaluations but the forthcoming EIA should undertake a balanced and comprehensive assessment of both sites. There is no indication that the proponents have applied to DEAT for an exemption from considering alternative sites and technologies.

It is not clear from the report how long Koeberg will continue to operate and whether the PBMR and Koeberg will be operating at the same time. If so, what are the cumulative implications in terms of safety and security and other impacts? What would be the impacts on Koeberg should there be a significant incident at the PBMR (or vice versa)?

1.3.6 Investigation of mitigation measures to keep adverse impacts at a minimum as well as the option not to implement the activity.

The 'no go' option is necessary to assist in determining whether the PBMR should be included in the suite of options for energy supply. Even though this is a 'demonstration plant', it will run for a full life cycle with the associated costs and benefits and is therefore very similar to a commercial plant. The ISEP identifies options to be investigated — not only in terms of techno-economic feasibility, but also in terms of environmental impact and social acceptability. Therefore the no go option must remain part of the EIA.

1.3.7 Public information. ..Independent review and conflict resolution in all phases of the investigation and assessment of impacts.

The City has previously requested that an independent 3rd party review of the EIA be undertaken prior to decision-making by DEAT. This request is repeated for the current EIA.

1.4 Legal Framework

The draft Scoping Report (section 6.2.2) lists the Land Use Planning Ordinance (Ordinance 15 of 1985) as relevant to the current application. However, the fact that a rezoning application to the City of Cape Town is required is not mentioned. This requirement has been raised by the City during the previous EIA process. Copied below is a section from the City's previous comment on the previous draft EIR:

"The opinion of the Urban Planning Branch of the Blaauwberg Administration is that the proposed site of the PBMR would require a rezoning application in terms of the Land Use Planning Ordinance (LUPO). This opinion was included in the City's comments during the scoping stage of the EIA but is nevertheless only mentioned indirectly in the draft EIR (under Social Impact Assessment and not in terms of the legal requirements of the proposal).

The draft EIR indicates that approval in terms of the Physical Planning Act (PPA) is needed. The reasons for both the exclusion of LUPO and the inclusion of the PPA are unclear...."

(Source: City of Cape Town comment on the draft Environmental Impact Report, dated 5 December 2002).

The City of Cape Town would be the relevant authority for an application in terms of LUPO for a PBMR demonstration plant to be located at Koeberg. In terms of the relevant legislation, the decision-making authority would be elevated to the Provincial Government of the Western Cape only if an objection or appeal is submitted by another government body.

1.5 Future electricity supply and evaluation of the alternative supply options

The DSR states that SA will need additional peak generation capacity by 2007 and additional base load capacity by 2010.

The PBMR DPP, if approved, would be operational by around 2012. However, the proposed DPP is also in response to the need to evaluate a number of power generation technologies not yet implemented in South Africa on a commercial basis in terms of technical, socio-economic and environmental aspects.

Clarification is sought on the following aspects of the proposed evaluation of the technical, socio-economic and environmental aspects:

- What other supply side generation options are being investigated for the Western Cape?
- What criteria will be used to both evaluate the PBMR DPP and to compare it to the above alternative supply options?
- Will the data and information to be used for this evaluation be open to the public and other stakeholders for review?
- How will the price of PBMR's be determined? How will this influence the average cost of the electricity to the City?
- Under what circumstances would the PBMR DPP be 'decommissioned and dismantled', as stated in the DSR?

1.6 Public involvement process

There are several concerns about the public involvement process and how it has been recorded.

- The notes of the meetings held do not include an attendance list which makes it difficult to gauge level of participation.
- At several of the meetings, questions were raised which were not answered or only partially answered. An attempt has been made to address the issues in the issues trail but information provided is still very superficial. (Example, the request for the Safety Case Report — pg 133). Each issue needs to be clearly addressed in an issues trail and not just 'noted'.
- Issues raised in the previous EIA have apparently been 'included (where appropriate) into this process' (pg 59). It is not clear on what basis issues have been incorporated or

dropped. It is recommended that a full list of issues be included in the final scoping report together with an indication of which ones will not be considered any further.

- The DSR reports that an interested and affected party noted that the current NNR CEO used to be the Manager of Licence at the PBMR and therefore could not be both referee and player. In the response to this issue, the comment is 'noted'. If this is indeed the case, the neutrality of the NNR is to be questioned and must be addressed.
- The newly formed Regional Electricity Distributor, or RED 1, does not appear to have been involved in the scoping process.
- The web site has been dysfunctional. For example, repeated attempts to download the ISEP have been unsuccessful.

2. Specific comments

Pg 1 Introduction

The introductory sections of the report should indicate the regulatory framework for EIAs and also note that South Africa is a member of the International Atomic Energy Agency. It should also indicate to what extent the proposed project is a modification of a nuclear plant versus a brand new technology.

Pg 11 Coal

South Africa has committed to a reduction of 10% use of coal from 2012 due to climate change issues. This is not reflected in the statements with regard to energy sources.

Pg l7 Pelindaba

Pelindaba is located west of Pretoria and not east as stated in the DSR.

Pg 28 Pelindaba infrastructure

Why was supporting infrastructure for the PBMR at Pelindaba 'dismantled'? Would the site be technically feasible if such infrastructure were still in place?

Pg 30 Waste management

Clarification and further detail is needed with regard to the proposals to "accommodate all spent fuel" on site 'processing' of low and medium level waste. Would low and medium level waste also be stored on-site or would it be transported to Vaalputs for disposal?

Pg 31 Demonstration of the commercial performance

Will data on the "key commercial parameters ... such as construction costs, plant availability and efficiency, operational and maintenance costs and mid — life upgrade requirements" be available to the public? How will the cost savings of locating the plant at an existing nuclear site be calculated in order to estimate the comparable costs for a green field site remote from such infrastructure?

Pg 32 Tunnels

Why would *underground* tunnels connect the reactor building with the services and ancillary buildings?

Pg 42 Faults

There is insufficient information on the stability (or otherwise) of the three faults.

Pg 45 and 88 Urban growth

There is brief mention of growth northwards of Milnerton and Tableview. This issue needs to be comprehensively addressed in the EIA, making reference to all relevant planning documents (not only the West Coast Biosphere Policy as mentioned on pg 88).

Pg 47 Occupational categories

What is ". . .the case for 26% of the population of the WC"?

Pg 86 Thermal outflow

How reliable is the thermal ouflow figure given? Should the worst case scenario not be considered?

Pg 111 Feasibility and Business Plan availability

When will these documents become available?

Pg 112 Decommissioning

What will the costs of decommissioning and dismantling be should the project prove unsuccessful and who would bear them?

Pg 145 Meteorological analysis

The report indicates that further work is needed. Is this to be addressed in the EIA?

Pg 147 Geohydrological investigation

It is stated that further geohydrological work is required before construction. Is this information not required for the EIA and EMP?

Future desalination plants

The Directorate: Water Services has requested that future planning by Eskom should take into consideration that the City Of Cape Town may require desalination plants alongside the Cape west coast.

Fuel manufacture and transportation

It must be explained how the information from the fuel manufacture and transportation EIA will be integrated into the EIA for the PBMR.

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8.13 APPENDIX 13: SUBMISSION FROM C H GARBETT, C T GARBETT, WAT PROPS PTY, KAREE TRUST. ITUMALENG FARM CC. PROFESSIONAL AVIATION SERVICES (PTY) LTD

8.13.1 INITIAL COMMENTS

March 7th 2006

Mawatson

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Comments & Submissions in respect of the

DRAFT SCOPING REPORT for a proposed 400 MW (t) PBMR DPP

made on behalf of the following I&AP's

R C H Garbett

C T Garbett

Wat Props Pty

Karee Trust

Itumaleng Farm cc

Professional Aviation Services (Pty) Ltd

We regret that Mawatsan imposed a deadline that places us and the various entities we represent at a distinct disadvantage as we were advised that we would have 30 days to comment from the date of receipt of the draft scoping report, which was 30 days from 14th February 2006. We appreciate the additional day granted.

We request that the applicant is approached to extend the period for comment and reserve our rights in this regard.

1. The scoping report should include a means of communicating the costs, risks and possible benefits clearly, fairly and objectively with **all communities** in South Africa in each of the official language groups (not only in English & Afrikaans) and in a manner that is clear and understandable for the average citizen with a basic level of education and average IQ.

While some I & AP's may not understand highly technical information, they should be given an equal opportunity, which is their constitutional right, to be briefed on all material aspects of the proposed PBMR, inter alia the matters specified below, which should be presented in an honest, straightforward, readily understandable format.

South African communities, whom would benefit from the 14 thousand million rand of public funds that may be wasted should the PBMR experiment, should be consulted and opinions canvassed.

1.1. Information regarding the grave dangers that are present in any untested nuclear experiment and the subsequent operation of the PBMR in the event that the PBMR experiment does not fail, including such threats as sabotage and theft of radioactive materials for use as dirty bombs or any other terrorist activities.

1.2 The escalating costs which are difficult to accurately predict (as has been amply demonstrated by the applicant who estimated in 1998 a cost of R847 million, which had grown by 1358% to 11.5 thousand million in 2002 and currently stands at around R16 thousand million rand) a current budget overrun of 1889%. Details of the consequential economic risks that are inherent in the PBMR which includes the risk that the PBMR experiment may be decommissioned and abandoned as it may not be suitable for commercial purposes. These economic risks (excluding any potential accidental damage) are currently estimated at a loss to the taxpayer of R16 thousand million rand, excluding the costs of dealing with the resultant high level waste for hundreds of thousands of years as a legacy by Eskom to future generations.

1.3 The applicant should give a detailed explanation of the rationale for ignoring the recommendations of the well respected auditing firm PriceWaterhouseCoopers (PWC) following a due diligence survey in which they concluded that "the high probability of loss fell outside an the benchmark parameters for projects of this nature." The international market potential crucial to the financial viability was regarded by PWC as uncertain and PWC RECOMMENDED THAT ESKOM WITHDRAW FROM THE PBMR project.

1.4 Eskom's CEO has stated that they will accept liability for any accidental and operational problems caused by the PBMR. Eskom needs to quantify this risk that has been assumed, especially as it is a risk that is excluded from every standard property and aviation insurance policy. Whichever way the liability ultimately falls, South African public will bear the loss, either via state owned Eskom or PBMR government majority owned or directly by government.

1.5 Explanation of how viability was assessed when the only firm order on the horizon is from Eskom itself and that is not at the cost of production of the PBMR but at the cost of the next best alternative, meaning that the Eskom orders will be subsidised by the taxpayer.

1.6 The impact on Eskom prices to consumers should the cost of using PBMR technology if it falls between failure & success i.e. that it works but not as well as PBMR hope and production costs of energy are higher than alternatives.

1.7. That there is clear transparency surrounding the various PBMR supplier companies – orders placed against delivery, cancellation fees, shareholders

1.8 The cost and future availability of imported enriched uranium make it difficult to predict the future costs of operating the PBMR. It is clear that costs of power fuelled by enriched uranium will grow progressively more expensive and renewable such as wind, solar, small hydro, hydro, geothermal which will cost zero to fuel and will only bear a relatively minor cost of maintenance.

A direct comparison of routine maintenance and operational fuel costs of PBMR vs. alternative energy sources should be undertaken.

2. The specialist studies that have been made in respect of the EIA for the 302 MW(t) PBMR DPP are not acceptable for this new application except in circumstances that are absolute insofar as no other result could reasonable be concluded and that the parameters of the specialist studies remain unchanged.

3. All previous comments and issues raised by I&AP's should be taken into account in this scoping report.

4. The NO-GO option. The proponent's argument is irrational as there is no point in spending14 billion (of taxpayer's funds) on a demonstration plant that is not commercially viable.

Similarly, to wait until it is known if the PBMR DPP is viable or not, before making detailed comparisons with other technologies make no sense whatsoever.

This should more appropriately be called the NO-SENCE option.

5 Insurance. Standard property and aviation insurance policies exclude any claims for damage or destruction of property as a result of any nuclear accident. The South African public would therefore shoulder the financial burden of any accidental damage as this risk will be underwritten by the government. Insofar as the government may not be able to pay for such a risk the burden will fall on the property owners that fall within the potential danger zones. In terms of the climatic conditions the areas that could be affected would be extensive and financially of such a level that could undermine the entire economy. The proximity of the World Heritage Sites to Cape Town and Pelindaba which are both at risk should be considered and weighed carefully before embarking on this experimental. The loss of either is a risk that should not be undertaken on such a dubious experiment without absolute proof that there is no safety risk. The applicant has acknowledged that safety is not yet proven which should be sufficient reason to abandon the PBMR.

Eskom should also re affirm its undertaking that it will, as it has stated, shoulder the financial risks of the PBMR.

The worst case scenario cost should be calculated and factored into the risks of PBMR development.

6. Risk to human life and safety.

Provisions need to be in place for a worst case scenario in addition to the inherent risks to those working on site and in all other affected areas. Costs of security to be included in economic aspects of the DSR

7. A clear picture of "cradle to grave" environmental impacts of the PBMR including the building and development impacts, the fuel plant impacts, the ongoing uranium mining impacts, the enrichment impacts, the transport impacts, should be undertaken with a comparison to other technologies, with a 20, 30 40 year projected running costs versus alternatives.

8. It is common cause that the following are just some of the unknown aspects in respect of the PBMR DPP and answers will only be known after spending 14 billion rand and 2-7 years after the PBMR DPP is complete and operational

8.1 Safety

8.2 Viability

8.3 Power generating ability and sustainability

8.4 Ability top retain helium within the pressure boundary

8.5 Operational costs

8.6 Construction costs

8.7 Cost of power to consumers

8.8 Operational costs

8.9 Maintenance costs and maintainability

8.10 Construction costs

8.11 Plant availability and efficiency

8.12 Performance under different conditions of key mechanical components.

8.13 Reliability of power generation.

8.14. Commercial viability

The applicant should inform the public how in the light of the above the decision to proceed meets ethical criteria for the use of public funds and the potential risk to health safety and environment.

9. Emission of gaseous chemical compounds during fuel manufacture needs to be assessed on both workers and the environment. Full details of the Noxious & Offensive gas application content for permit should be provided.

10. Details of the content of all applications for permits required by the PBMR should be disclosed

11. Issues described in the DCR as "significant issues falling outside the scope of the EIA for the PBMR DPP. These issues are all relevant and we object to the applicant not dealing adequately or at all with any of these issues.

12. Details of international purchases (Past, present & future) should be detailed. Reasons why purchases and orders were placed prior to the EIA completion should be detailed.

13. Details of greenhouse gas emissions and radioactive gas emissions should be detailed. Why does ESKOM misrepresent the PBMR as a clean power to the general public.

14. Full disclosure of potential hazards to "receiving populations" should be detailed and explained fully to those "receiving populations"

15. PBMR is a private company albeit the SA government (and the public they represent) is its majority shareholder.

The applicant should justify in detail why further public funds be expended at the public expense for DME to deal with the following high level radioactive waste, NNR to assess decontamination process and finally the costs of dealing with long term waste for hundreds of thousands of years at the expense of the taxpayer and the public and not the PBMR company. (while to some extent this may be academic there is one outside shareholder being subsidised at the SA public's expense)

16. The radiological / radiation issues and the NNR evaluation must be available to I&AP's during the EIA phase.

It is not acceptable that the NNR evaluation is made a condition of the ROD. I&AP's will be unable to comment on these issues.

17. The radiological / radiation issues must be addressed in the EIA. The consultation between the NNR & DEAT must be open to public review & comment to ensure objectivity and public participation.

18. In view of the lack of participation of the majority of SA citizens we reject the claim in the DSR that no further study is required

19. On what basis is it deemed that the level of information and assessment that will be consulted in the final EIR should be determined by the agreement between DEAT and the NNR.

We do not accept the proposed lack of public participation in the aforementioned agreement and call for transparency.

20. We reject the exemption applied for in respect of disregarding alternative energy sources and alternative sites

21. The public should be aware of and given full details of the German PBMR accident that was the reason that Germany abandoned PBMR and is now phasing out nuclear technology.

Fuel manufacture defects present serious technical difficulties and unacceptable risks to the public and safety in general.

22. The public should be advised that the PBMR is a non commercial and only exists because government has subsidised the development to date and is willing to do so into the future irrespective of the apparent lack of viability

23. Full details of total waste by weight and volume over 40 year design life to be generated should be detailed in the EIA.

24. A document previously submitted marked annexure A – PBMR Demonstration Unit and Fuel Manufacture and Annexure D – copy of an e-mail from Wat Props to Afrosearch and Annexure E 2 pages These documents were prepared for the previous PBMR EIA however all relevant matters raised should be included in the scoping report.

25. We support and endorse all the submissions contained in the 22 page document made on behalf of Earthlife Africa (Cape Town) marked Annexure B and forms part of these submissions.

26. The attached document entitled "The economic risk to electricity consumers of the Pebble Bed Modular Reactor" is attached and forms part of these submissions in so far as the comments and recommendations are pertinent to be included in the scoping report for the PBMR. The document is marked "Annexure C."

27. Insofar as any other previous documentation in respect of either model of the PBMR DPP, which has been submitted by any of the entities that are a party to this submission, to one or more of the following entities; DEAT, DME, Eskom, the NNR, the applicants consultants, and such documents contain references to the previous PBMR EIA and or scoping report, all such comments and submissions should be included into this submission.

PLEASE NOTE: GIVEN A MORE REASONABLE TIME TO RESPOND WE WOULD BE IN A POSITION TO EXTRACT RELEVANT INFORMATION AND AVOID DUPLICATION AND TO MAKE ADDITIONAL IMPUTS – HOWEVER AT THIS STAGE WE HAVE TO MEET THE HIGHLY RESTRICTIVE DEADLINE IMPOSED AND THEREFORE REQUEST THAT YOU DILIGENTLY SEARCH THE FILES OF THOSE ENTITIES REFERED TO IN 27 ABOVE TO ENSURE ALL ASPECTS OF PREVIOUS SUBMISSIONS ARE INCLUDED.

8.13.2 ADDITIONAL COMMENTS

Please add the following comments to the PBMR EIR/DFR

1. China is currently using Tibet as a dumping ground for their radioactive waste & nuclear testing.

Can Eskom confirm that if this action by China continues, they will not market or support the transfer of PBMR technology to China, or any other nation committing similar atrocities, or, is this practice in accordance with our Governments Corporate Governance principles?

2. Can Eskom confirm that supply to China (due to factors mentioned in point 1 above) falls within the defined exclusions at points 4.4 of the DFR *"supply PBMR systems .... in a ..socially and environmentally responsible way.....to customers only if they are politically and ethically acceptable*" and point 4.6.3 Waste management of the same report, which states "*PBMR will only supply reactors in countries that ensure that nuclear waste liability is responsibly managed*"

3. What liability might accrue to the Government of South Africa and/or Eskom and/or PBMR should the technology be sold to what may be considered at the time to be acceptable government but which looses power to a different government which implements unacceptable policies with their nuclear products? This has clearly not been considered in the reports.

4. The above point merely highlights the intrinsic dangers and irresponsibility of using and promoting Nuclear Technology which may be used for the future proliferation of nuclear weapons. There is no means of governing a countries future intention and/or ability of "*managing and dealing with nuclear waste in an acceptable manner*" nor to restrict the use of nuclear technology "*in a ..socially and environmentally responsible way*" for future generations.

The vast numbers of PBMR sales that are estimated by Eskom, demonstrates the vast regions that will be potentially affected globally, both by waste and nuclear threat.

5 What amount of capital will be invested in the PBMR Co apart from the cost of the development and intellectual rights of the PBMR experimental module?

6. The economic risk of continuing with the PBMR experiment to the South African economy is immense, whether or not it proves to be viable or not, in spite of the (false) assumption in the report that there is no cash burden on the fiscus.

6.1 There is a substantial risk that the PBMR project will fail (apparent from an independent assessment of potential commercialisation of the PBMR report) This will cost the state the loss of the PBMR development costs, particularly over the next five years, the handling and disposal of nuclear waste, the possible on going costs of PBMR support or decommissioning costs assuming the probability that PBMR Co is not around to pick up these costs, if any units are exported or sold locally.

6.2 Lost opportunity costs from other forms of energy exploitation are not considered in the report in relation to the risk capital / long term costs to fund the PBMR in the form of state subsidies of waste storage and disposal and costs/losses to Eskom in capital investments.

6.3 Should the PBMR succeed in selling the ambitious number of units, the government will have to deal with the substantial costs of the high level nuclear waste generated by the PBMR modules.

6.4 The viability of the PBMR is predicated on the conclusion of a considerable number of international sales which can not be determined or even estimated with any degree of certainty, at this stage.

The possible advantages are remote and outweighed by the hazardous, long term economic and associated environmental risks

7. The cost of assessing the location and the building a high level repository is being foisted on the state and the taxpayers. None of these costs are being borne by Eskom or the PBMR Co, now or at any future time.

<u>The viability of the PBMR therefore at all times</u>, even at the point of "commercial" assessment, <u>relies upon it remaining a state subsidised enterprise</u> and will at all times cost the taxpayer millions without considering the incalculable environmental damage for thousands of generations.

8. Eskom states in the report that " …<u>based on assumptions that capital cost reductions from design, manufacture, and construction are realised</u>" and based on the design of a larger module than the experimental PBMR, <u>it would be "possible (NB only possible) to generate power at below USD0.34/k</u>". This means that there are several hurdles to pass, before any real confidence in this project is realised, even by its proponents.

9. Supply of imported enriched uranium required for the PBMR is dwindling worldwide, there appears to have been no consideration given to the effects of significant price hikes on the future viability of the product and of the PBMR Company's ability to meet its substantial corporate responsibilities if this project is allowed to go ahead.

Please carefully reconsider this project and the full and future negative implications for South African people, our economy, our environment and the capital investment of taxpayers funds, being risked on a project that has more opportunity of failure than success, even without the enormous hidden costs that will be borne not by Eskom but by ordinary South Africans whose needs would be better and more cost effectively met by the development of renewable, safe, clean power.

Comments on Economic Feasibility of experimental PBMR / EIR

1. The economic feasibility of the PBMR experiment does not consider the cost to the state and/or Eskom if the PBMR experiment is a complete or even a partial failure. The taxpayer and the State have the right to be given this information prior to any decision.

2. The state will have the additional burden of costs of decommissioning, costs of dealing with nuclear waste generated, funding liabilities resulting from any PBMR nuclear accidents particularly onerous with such novel and unproven technology as is employed by the PBMR,

3. The State will have to deals with the costs to the economy arising from the negative balance of payments that will arise from the PBMR failure. Still further there are the lost opportunity costs from not investing in the strongest growth market worldwide, renewable power, that will impact on job creation and economic growth without any of the hazards that nuclear poses.

4. The impact of the exchange rate movements appear not to have been assessed.

5. There is insufficient information given in the economic feasibility to assess the PBMR viability and information given is sketchy and lacks credibility.

6. The economic feasibility of the PBMR experiment must be considered on a stand alone basis. If the feasibility is based on the premise that there will be "n" PBMR'S locally and "n" exported then the Environmental Impact assessment must be considered on the same basis. There every chance that an EIA based on the anticipated PBMR sales, will not pass an EIA and/or will not be financially or technically viable, therefore the assumption that the costs of the demonstrator will be recouped is misleading.

7. The feasibility does not treat this PBMR unit as a separate issue consequently the future PBMR potential can not be assessed with any degree of accuracy until the baseline costs of the PBMR have been established and the numerous novel and untested design features have been established as successful or failures in each instance. Finally construction characteristics and durations need to be established.

8. Based on the above point 7, what value can be placed on the reports export assessments on the PBMR, except radical optimism on the part of its proponents?

9. Is the PBMR Co intended to limit the liability risk of the owners?

10. There is no repository for the high level waste that the PBMR will generate. We should not generate high level waste until we are assured that South Africa has a suitable repository as no suitable sight may exist.

11. Although currently there may be no legislation that makes a producer of nuclear technology responsible for the waste products of exported units, the following would impact on the PBMR viability and long term implications for our country. The following are just some impacts that can be anticipated, alternatively already exist:-

11.1 The legal situation may well change retrospectively as has happened in many instances globally during recent years, and undoubtedly legislation and/or political pressures which force manufacturers to assume "cradle to grave responsibilities" will, quite correctly, increase into the future. Either the PBMR/ESKOM, or the State of South Africa will be held culpable and/or financially responsible.

11.2 South Africa may well be penalised for selling nuclear technology in future decades by consumers worldwide who would boycott our export products because we have taken short terms gains at the expense of long term environmental degradation and risk to lives & health.

12 It has been widely publicised that the development of the export market for the PBMR will include China, which is viewed as an important market for this product. Whether or not the anticipated sales could be realised it is indeed disturbing, in the light of existing events, namely.

12.1 China is currently guilty of gross mistreatment of the nation of Tibet by abusing the Tibetan people and their land, which is used by china as nuclear dumping ground for radioactive waste.

12.2 That Eskom would even consider selling and/or collaborating with China on any nuclear products while China is illegally occupying Tibet and is in gross violation of human rights, is reprehensible and in contradiction of ESKOMS stated corporate governance position in the survey.

13. The sale of nuclear technology is viewed by the majority of citizens globally as morally reprehensible, particularly as it is planned by ESKOM to sell PBMR nuclear technology to economically strapped third world countries that may be unwilling and/or unable to deal with radioactive waste in an acceptable manner.

14. Sales predicated on destinations such as China and Third World countries do not fall within the letter or spirit of even the most basic Corporate Governance principles, to which ESKOM publicly claims to subscribe.

15. The economic feasibility figures should be revised or ESKOM should provide a factual statement on their true position on such vital issues as which countries will be targeted as potential customers of this dangerous technology.

16. The report on the economic viability of the PBMR was inadequate and left insufficient time to adequately assess the document. Please consider increased time to comment.

Christine T. Garbett Robert C. H. Garbett

8.13.3 FURTHER COMMENTS

Sooner or later a fool will prove greater even than the proof in a fool proof system" Dr Edward Teller

a) The West German government closed down their experimental PBMR (THTR-300) (which was also offered as accident proof) because they found the design unsafe. Why the same or similar technology is considered safe for the South African Public? (The PBMR is based on the same West German design that in May 86 (9days after Chernobyl) resulted in accidental radiation releases as far as 2 kms following the accident.)

b) What amount has the minister set as security by NECSA for potential liability claims in respect of the PBMR and the associated nuclear fuel manufacture process?

c) Why have most residents not received or been briefed on current and future emergency plans at NECSA?

d) Other problems in West Germany include radiation induced "Bolt head" failures in the reactors gas channels. What steps have been taken by NECSA to prevent similar failures?

e) The amount of "high level waste by weight" is higher than other types of nuclear reactors. This means that there will be a much higher impact in terms of numbers of vehicles on the roads with the inherent risks of accidents and sabotage. Comments?

f) What amount has been set aside for the cost of storage and disposal of the 2.5 million fuel elements that will be created during the 40 year cycle of the PBMR?

g) For what future period beyond the 40 year life will these costs be projected into the current costs?

h) We understand that there will be no containment building for the PBMR? If not what will provide the community with a last line of defense in the event of a radiological release following an accident?

i) Without a containment building the reactors wide open to a terrorist attack. Comment?

j) How many defects have been found in the manufacturing process of the graphite covered uranium fuel balls? AND Is it possible that theses defects could lead to ignition of the graphite?

k) What is the industry norm in respect of the production of perfect v/s imperfect fuel pebbles (production 370 000 per reactor/ one released every 30 seconds)

l) What are the estimated cumulative radioactive emissions from Pelindaba from all existing sources and the MAXIMUM estimates from the PBMR processes?

m) The nuclear industry is subsidised internationally to the tune of billions of dollars a year (excluding much of its financial responsibilities for the present and future disposal of toxic nuclear waste, the cost in human lives and suffering from nuclear disasters?)

n) Why should this scenario be any different in South Africa and why should the South African taxpayer subsidise an industry that is fraught with dangers that could be better spent in clean renewable energy that will be safe, create more jobs and give our economy medium and long term advantages.

o) What is the "emergency zone" for the PBMR? As the most likely accident will result in burning graphite, radioactivity will be released via smoke and flames - the smoke could drift over several kilometres - have all these effected communities been warned of the potential disaster and where would these people be housed in the event of evacuation.

8.13.4 APPEAL AGAINST THE 302 MW(T) PBMR EIA

Annexure A

1 The process of authorisation was seriously flawed. This appeal document does not cover all issues surrounding the proposed experimental PBMR that are questionable but merely highlights certain issues and is not intended to limit this appeal to the matters raised herein.

1.1 The Minister issued the ROD without giving proper consideration to several crucial issues that impact adversely on every person and investor in South Africa.

1.2 The EIR did not adequately address several vital issues in respect of the contemplated PBMR experiment.

1.3 The report on the economic viability of the PBMR was inadequate and left insufficient time to adequately assess the document.

1.4 Public participation in the EIA was extremely limited and in particular biased against those members of the public who did not have access to a computer and/or were illiterate and /or lacked the education to easily understand the serious adverse implications of the PBMR to their lives or their rights.

1.5 Low level radiation effects on health were not investigated.

1.6 The applicant has stated that "The South African design (configuration) while untested, will look into proving both the safety and the techno-economics of the overall concept". To conduct a nuclear experiment, which on the applicants own version is not known to be safe, within a few thousand metres of Cape Town, is irresponsible in the extreme. If Eskom wish to pursue the PBMR experiment we believe that it is the constitutional right of all interested and affected parties that Eskom should evacuate the entire effected areas surrounding both Koeburg and Pelindaba that may potentially be affected on a worst case scenario basis, with appropriate financial compensation for those affected parties, and further to put up financial guarantees for the property that may be affected on a worst case scenario basis, prior to commissioning the PBMR experiment.

1.7 Security, adverse short and long term financial and practical implications in respect of dealing with high level waste, were either not addressed adequately or at all in the EIR. There is no licensed long term high level radioactive waste repository anywhere in the world. The cost to date of the Yucca Mountain repository in the USA is in the region of 56 billion Rand. There is no repository for the high level waste that the PBMR will generate. The applicant should not generate high level waste until we are assured that South Africa has a suitable repository as no suitable sight may exist. The cost of a South African repository would be paid from public funds which is unacceptable.

1.8 Any accidental, terrorist or criminal damage arising from the PBMR or the materials used or the radioactive waste, that potentially could run into billions of rand, costs of long term storage of high level radioactive waste, risks of future litigation emerging from countries that the PBMR environmental damage caused by the PBMR and the hazardous radioactive waste that is produced, will be borne by the taxpaying public who has not been widely consulted and is largely unaware of the risks. Liabilities arising from a PBMR nuclear accidents are particularly difficult to quantify with such novel and unproven technologies as are employed by the PBMR.

1.9 The EIR did not consider that Lanseria Airport hangars billions of rand of aircraft. It falls well within the area surrounding Pelindaba that would be affected in the event of the graphite nuclear fuel casing being ignited as a result of an accidental or deliberate act. Aviation and household insurance policies exclude nuclear damage. There has been no consultation regarding the liability of the State as the PBMR Company will clearly not have the funding to meet such liabilities. There has been no consultation in this regard with property owners in the potentially effected areas.

1.10 The costs of PBMR nuclear power neither adequately address the costs of damage to the environment in the event of an accident or act of sabotage, nor the escalating costs of de-commissioning and future liabilities.

1.11 Economic feasibility of the PBMR experiment must be considered on a stand alone basis. If the feasibility is based on the premise that there will be “n” PBMR’S locally and “n” exported then the Environmental Impact assessment must be considered on the same basis. There every chance that an EIA based on the anticipated PBMR sales, will not pass an EIA and/or will not be financially or technically viable. Therefore the premise that the costs of the demonstrator will be recouped is misleading and false and should be considered a loss for the purposes of this experiment.

1.12 The economic feasibility did not treat this PBMR unit as a separate issue consequently the future PBMR potential can not be assessed with any degree of accuracy until the baseline costs of the PBMR have been established and the numerous novel and untested design features have been established as successful or failures in each instance. Finally construction characteristics and durations need to be established.

1.13 Based on the above no value could be given to the export assessments of the PBMR without which the project is optimistically worthless.

1.14 The economic viability did not provide sufficient information to adequately assess the PBMR viability, information given was sketchy, impacts of exchange rate fluctuations did not appear to have been assessed. Generally the report lacked credibility.

2. Unacceptable environmental impacts were not taken into account by DEAT in authorising the PBMR application.

2.1 All HTR's built to date have used HEU, more than 90% U235, which is a serious proliferation risk. NECSA plans to use 7-8% enriched uranium, which is a very different type of fuel and never previously used. The effects of this has still to be determined, what risks does this pose for workers and the general public during the experimental phase has not been covered in the EIA/EIR

2.2 The manufacture of graphite fuel has serious technical problems in that almost every single graphite fuel sphere manufactured will be partially defective. This poses serious hazards both at Pelindaba during the manufacture and at Koeburg during the operation. These risks are not acceptable to the general public and even the applicant is on record as stating that the safety of the PBMR is unproven.

2.3 Costs to cover the long term storage of radioactive waste and contaminated materials can not be calculated, let alone be provided for by the applicant. The public have the right to refuse to fund storage of radioactive and toxic waste produced by the PBMR experiment. At least during the known period of radioactive contamination (250 000 years), storage costs of the waste produced by the PBMR must be provided for by the applicant.

2.4 Alternatives were not adequately or independently assessed in respect of the benefits of utilising the entire estimated PBMR budget, plus the sale of the current technology claimed to be the most advanced in the world, compared to a similar investment in renewable power, including scale of employment potential, savings in taxpayers funds from reduced toxic pollution management costs weighted with potential liability damage, negative impacts on tourism. Further there are the lost opportunity costs from not investing in the strongest growth market in energy worldwide, namely renewable power, that will impact on job creation and economic growth without any of the hazards that nuclear poses.

2.5 PBMR Company is unable, both technologically and financially, to comply with the King Commission requirements on "cradle to grave responsibilities", a prerequisite of good corporate governance. The radioactive waste will remain hazardous for hundreds of thousands of years, there is no method available for its safe disposal and the cost of merely caretaking the problem for such a period is literally incalculable. The applicant proposes to pass the problem to this and all future generations.

2.6 The economic risk of continuing with the PBMR experiment to the South African economy is immense, whether or not it proves to be viable or not, in spite of the (false) assumption in the report that there is no cash burden on the fiscus. There is a substantial risk that the PBMR project will fail (apparent from an independent assessment of potential commercialisation of the PBMR report) This will cost the state the loss of future PBMR development costs, particularly over the next five years, handling and disposal of nuclear waste, decommissioning costs based on the probability that the applicant is not financially capable of sustaining these costs.

2.7 The manufacturers of the gas turbine have not provided the guarantees that it is reported that the applicant was requesting. This may have unknown safety implications for the PBMR operation and was not investigated.

2.8 Points 4.4 of the DFR stated that they undertook to ***"supply PBMR systems .... in a ..socially and environmentally responsible way.....to customers only if they are politically and ethically acceptable"*** *and at* point 4.6.3 Waste management of the same report, undertook that ***"PBMR will only supply reactors in countries that ensure that nuclear waste liability is responsibly managed"*** *The aforegoing* merely highlights the intrinsic dangers and irresponsibility of using and promoting Nuclear Technology which may be used for the future proliferation of nuclear weapons. There is no means of governing a countries future intention and/or ability of "*managing and dealing with nuclear waste in an acceptable manner*" nor to restrict the use of nuclear technology "*in a ..socially and environmentally responsible way*" for this, let alone for future generations. The aforegoing merely highlights the intrinsic dangers and irresponsibility of using and promoting Nuclear Technology which may be used for the future proliferation of nuclear weapons.

There is no means of governing a countries future intention and/or ability of "*managing and dealing with nuclear waste in an acceptable manner*" nor to restrict the use of nuclear technology *"in a ..socially and environmentally responsible way"* for future generations.

2.9 Liability might accrue to the Government of South Africa and/or Eskom and/or PBMR should the technology be sold to what may be considered at the time to be acceptable government but which looses power to a different government which implements unacceptable policies with their nuclear products? This aspect has clearly not been considered in the reports. The vast numbers of PBMR sales that are projected by Eskom, demonstrates the vast regions that will be potentially affected globally, both by waste and nuclear threat.

2.10 Target markets for the PBMR appear to be those countries that can either ill afford to deal responsibly with nuclear waste or have a record of abuse. For example, China has for some time used Tibet as a dumping ground for their radioactive waste and nuclear testing. If this action by China continues the South African public needs assurances that the PBMR company will not market or support the transfer of PBMR technology to China, or any other nation committing similar atrocities, or, if not, our Governments should state that this practice in accordance with acceptable governance principles?

2.11 PBMR Nuclear power is incorrectly referred to as being a clean power as this ignores the "cradle to grave" principle. The Nuclear Industry does not even have the technology to deal with the resultant pollution safely. The processes used in developing nuclear power from the mining of Uranium to the development of the nuclear plants can not render PBMR technology or any other Nuclear Power "clean". This terminology is not only inaccurate but also deliberately misleading to the public, particularly when it is used on the basis that Nuclear positively combats Global Warming.

2.12 The cost of assessing the location and the building a high level repository is being foisted on the State and its taxpayers. None of these costs are being borne by the applicant, now or at any future time. Therefore the viability of the PBMR relies upon it remaining a state subsidised enterprise which is unacceptable.

8.14 APPENDIX 14 INDIVIDUAL SUBMISSIONS

8.14.1 OPPOSITION TO THE PROPOSED PBMR DPP.

The following submissions were received stating their opposition to the proposed PBMR DPP.

a) Itumaleng Farm cc

I the undersigned

Christine T Garbett on behalf of

Itumaleng Farm cc

Hereby support the submission made by Earthlife Africa on the DRAFT SCOPING REPORT for the 400 MW Pebble Bed Modular Reactor

10th March 2006

b) Wat Props Pty Ltd

I the undersigned

Christine T Garbett on behalf of

Wat Props Pty Ltd

Hereby support the submission made by Earthlife Africa on the DRAFT SCOPING REPORT for the 400 MW Pebble Bed Modular Reactor

10th March 2006

c) The Karee Trust

I the undersigned

Christine T Garbett on behalf of

The Karee Trust

Hereby support the submission made by Earthlife Africa on the DRAFT SCOPING REPORT for the 400 MW Pebble Bed Modular Reactor

10th March 2006

d) Professional Aviation Services (Pty) Ltd

I the undersigned

Christine T Garbett on behalf of

Professional Aviation Services (Pty) Ltd

Hereby support the submission made by Earthlife Africa on the DRAFT SCOPING REPORT for the 400 MW Pebble Bed Modular Reactor

10th March 2006

e) Christine T Garbett, Robert C H Garbett

We the undersigned

Christine T Garbett

Robert C H Garbett

Hereby support the submission made by Earthlife Africa on the DRAFT SCOPING REPORT for the 400 MW Pebble Bed Modular Reactor

10th March 2006

f) Sally Andrew, Bowen Boshier

From: Bowen and Sally [sally@mail.ngo.za]

Sent: Saturday, March 11, 2006 12:43 PM

To: Mehreen Khan Mawatsan

Subject: Re: Communication to IAPs regarding availability of Scoping Report (Jan 2006)

Please note the following for your records:
We reject the pebble bed on economic, environmental and social grounds. We believe energy should be renewable, non-toxic and in the hands of the people.
We support the submission made by Earth Life Africa.
Sally Andrew, Bowen Boshier.

8.14.2 SUPPORT FOR THE PROPOSED PBMR DPP.

a) Vilieria Community Association and the Ward committee of ward 53

From: AHJ Verrips [hr@iiskzn.co.za]
Sent: 03 March 2006 11:09
To: pbmr@mawatsan.co.za
Subject: PEBBLEBED POWER

The Vilieria Community Association and the Ward committee of ward 53 has no problems with the PBMI PROJECT and hopes that it will go ahead and be on line as soon as possible.

Thank you for keeping me updated.

Villieria greetings,

Aart Verrips

8.15 APPENDIX 15: NATIONAL INTEGRATED RESOURCE PLAN (NIRP)