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**ESKOM ENVIRONMENTAL IMPACT ASSESSMENT (EIA:12/12/20/944) FOR A PROPOSED NUCLEAR POWER STATION AND ASSOCIATED INFRASTRUCTURE: COMMENTS ON THE REVISED PLAN OF STUDY FOR EIA**

Your correspondence to Ms. Bongi Shinga of ACER (Africa) dated 23 June 2009 and entitled "REVISED PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT FOR ESKOM'S PROPOSED NUCLEAR-1 -2 AND -3 - REVISION MAY 2009" refers.

Arcus GIBB acknowledges receipt of the above-mentioned letter. We thank you for your valuable comments and your participation in the Eskom Nuclear Power Station (NPS) Environmental Impact Assessment (EIA) process to date. Your questions and comments concerning the Nuclear-1 EIA process have been noted.

Responses to your comments / questions are as follows:

Your comment (1)

Comment on:

The plan of study for an EIA starts out from the assumption that a nuclear power station is going to be built in a pre-determined place or places and the purpose of the EIA is to identify and mitigate the negative effects. The EIA construed in this way is self-limiting and does not ask the right question. The question should be: is nuclear power the best solution for electricity generation in South Africa out of a range of viable alternatives, going into the future? It is not logical or correct to assume this question has been answered. The plan of study however explicitly precludes this question from being included in the EIA. Under 'Alternatives assessed' (5.3 page 37) the following assertion is made: "*Identified renewable forms of energy are inadequately developed to provide large scale power generation facilities that can supply a reliable base load and easily integrate into the existing power network in South Africa*". This assertion is packed with assumptions and follows a threat that in the event that a no-go alternative is adopted "*Eskom would in all likelihood apply to develop more coal fired power stations.*" Thus the EIA study takes up the Eskom proposition that the key issues are decided beyond doubt and do not need to be assessed in the environmental impact assessment, which becomes site-specific. There is an explicit threat that if the no-go option is taken, Eskom will build new coal-fired power stations. This means that without any public debate, specialist study or peer review, South Africa's energy future is being charted along the nuclear road, with all that follows from that. It could be that an environmental impact assessment is too limited in scope to address the strategic issues involved and that the appropriate type of assessment for energy and especially for nuclear power is a strategic environmental assessment. Nevertheless, the assessment must be done.

Response (1)



It is not within the Scope of this EIA to undertake an in-depth and/or strategic analysis of alternative forms of power generation for South Africa. This EIA process is specifically in application for environmental authorisation to develop nuclear power station/s (NPSs). Nevertheless, Chapter 8 of the Final Scoping Report for the Nuclear-1 EIA discusses alternative forms of power generation. Eskom is in the process of exploring a number of different ways in which to generate electricity and is investing further development of renewable technologies. Only certain electricity generation technologies are commercially available, although not necessarily financially viable in South Africa based on the availability of resources (fuel) and geographical constraints. The limited range of viable technologies is listed in Table 17 on Page 8-5. The Final Scoping Report is available on the following website: <http://projects.gibb.co.za/>.

The Nuclear-1 EIA is part of a larger strategy being implemented by the South African Government, together with Eskom, to provide sufficient base-load energy for South Africa.

The selected sites, if any, planned for Nuclear-1, -2, or -3; will depend on the DEA's decision based on the findings of the EIA process, and is not known at this time. The DEA will apply their minds to the Final EIR and either reject or approve Eskom's application to construct, operate and decommission a nuclear power station. The site/s for the nuclear power plant has thus not yet been sanctioned by the DEA.

#### Your comment (2)

A decision about power generation and energy use is a decision affecting the whole country, the future energy path of South Africa and the resulting shape and form of our economy. An informed debate on this topic is vital. The EIA study's assertion that "renewable forms of energy are inadequately developed" is not true except in so far as Eskom has not adequately developed them. It is not true in actuality. Worldwide renewable energy technologies are developed and viable and costs of renewables are trending downwards. UCT's Energy Research Centre's renewable electricity study (2008) [1] has found that "...there are grounds to take renewable energy seriously. The modelling indicates that by itself, such a programme would have less of an impact than this year's price increase. The alternatives to electricity supply from coal in South Africa are renewable energy and nuclear. This study suggests that the renewables option is not more expensive than nuclear." In fact, together with 'partnership programmes' of research and development, infrastructure development, industrial strategy and energy efficiency measures "...the overall cost of renewables will be lower than business-as usual." The renewable electricity generation options that were evaluated in the study are wind and solar thermal and it was found that they could provide 15% of South Africa's electricity needs by 2020. Given that in 2008 Eskom distributed 220 000 GWh of electrical power, 15% of that would imply that at least 33 000 GWh is possible in South Africa from renewables by 2020. Professor Winkler, in his authoritative book "Cleaner Energy Cooler Climate" (2009) shows that there is a technically feasible contribution to be made of 86 846 GWh from renewable energy technologies.[ 2] This figures includes the savings or 'negawatts' of energy efficiency measures that displace electricity use, of solar water heating. The DME proposes a possible 7 900GWh/year in residential and commercial applications [3] which is a conservative target. One residential SWH panel with 65-70% efficiency and a timer-controller will displace 3.3MWh/year (at an installation cost of about R13 million/MW electricity displaced). Much more could be done in the field of energy efficiency and electricity-use displacement.

#### Response (2)

Your comment is noted. Please refer to Response (1) above with respect to the scope of this EIA process.

#### Your comment (3)

There is also the potential of clean energy from the run-of-river Inga III hydro electric power station with its capacity of 4 500 MW (at a construction cost of about R16 million per MW) for steadying of base-load by 2020. By having BHP Billiton move their aluminium smelter to Bas-Congo to take advantage of Inga III relieves Eskom of 1 500 MW of capacity to feed this monster at Coega when we do not even have bauxite (the base mineral of aluminium) to mine.

#### Response (3)

Your comment is noted.



#### Your comment (4)

Intermittence: It is not correct to say that renewable energy is intermittent and nuclear power is not. Renewable energy from wind is variable and from solar thermal with hot salt storage, reliable. South Africa has adequate wind resources for 30% average availability [4], which is spread across numerous locations and the solar capacity of the Northern Cape is the best in the world. Nuclear is intermittent because it can only function as a base-load, and is not variable due to safety considerations, and so it is either on or off. The factor of unplanned unavailability of Koeberg nuclear power station is 7.6% up to 2007 [5]. This is intermittence.

#### Response (4)

When comparing availability renewable resources operate in very good conditions at 20 – 50%. Coal and Nuclear have an availability of 80 – 90%. Therefore significantly more electricity would be generated from a 1 000 MW base load power station compared with a renewable technology.

#### Your comment (5)

Cost of nuclear: One 4 000 MW nuclear power station like 'Nuclear-1' has been estimated to have a capital cost of at least R120 billion [6] which works out at R30 million per MW. The capital cost is assumed because Eskom has not revealed the true cost, if it can be calculated at all. Latest estimates from the USA, where nuclear power is more commercially priced, shows realistic capital costs in the range of R41 - 57 million/ MW [7] pricing a single 4 000 MW reactor at R164 - 228 billion. With an availability factor of 70% [8] it would produce 24 528GWh in one year [9] which would be available by 2018 at the earliest (nuclear plant construction times are only vague estimates). One nuclear power station alone is not reliable due to unplanned unavailability. In the event of a shut-down, all 4 000 MW capacity is shut down. This means an equal amount of back-up is required, hence Nuclear -2. Eskom's plans are for 3, at a combined cost of at least R360 billion but possibly R500-680 billion (in today's nominal money terms) if Moody's Investor Service estimate is more realistic. This is massive expenditure of funds on a single technology that is not flexible and is not fail-safe. No private business would invest this type of money without government guarantees (including public liability guarantees) and we must beware of this.

#### Response (5)

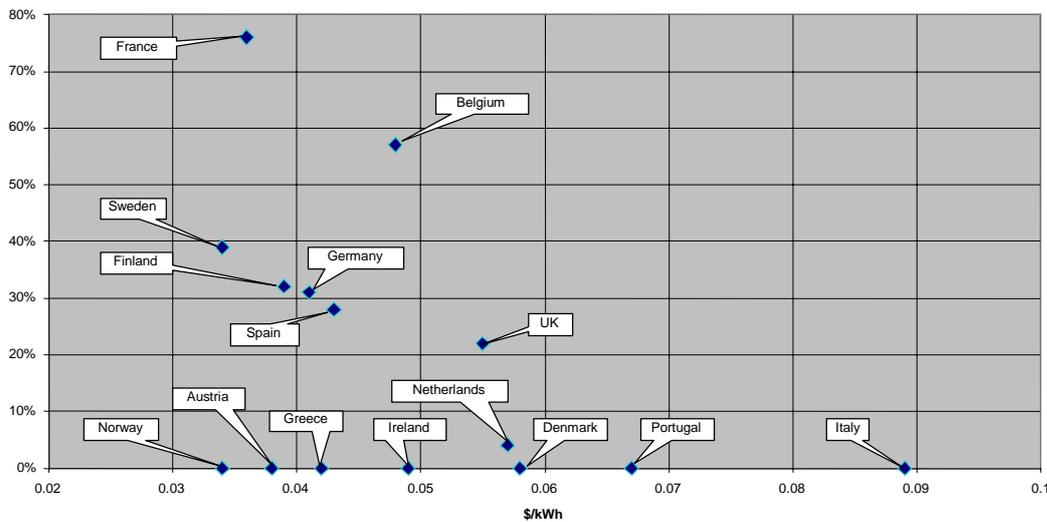
In terms of detailed comments it is of note that there is no nuclear reactor in the world of 4 000 MW as a single unit. As is explained in the application, the nuclear power stations would be made up of a number of reactors (from 2-4), with a total output of up to 4 000 MW, in the same way that Koeberg has two reactors of 900 MW each to produce an output of 1 800 MW from the station. Inside a single area of the country there is a need to have enough independent plants that a single shutdown will not threaten supply. This is why Eskom plans to build a number of nuclear reactors in the Western and Eastern Cape.

While there is much discussion on the economics of Nuclear energy, it is of note that in virtually all the countries where it has been deployed it has been seen to have long term commercial value. In Europe, for example, there have been no nuclear reactors shut down for economic reasons and countries with large nuclear component in their energy mix (France, Finland, Spain, Germany and Sweden for example) tend to have lower electricity tariffs than countries with little or no nuclear plant (Denmark, Italy Ireland and Portugal). In the case of Eskom's existing nuclear power station (Koeberg) it has demonstrated over the last 25 years to be a cost effective solution to meet the electricity needs of the Western Cape. Government has, in order to continue the introduction of nuclear generating capacity in South Africa, established a task team, led by the Department of Energy, that will work with Eskom, to develop and implement a framework for procuring a nuclear technology partner to support both the build and associated industrialisation process

Eskom will not construct and operate a nuclear power station whose design and safety does not meet the internationally recognised standards. Similarly, the NNR will not grant a nuclear installation licence if it is not satisfied that the safety standards will be met.



Electricity Prices vs. Nuclear Share  
(European Union in 2000)



#### Your comment (6)

Back-up: Koeberg nuclear power station with a total capacity of 1 800MW requires a dedicated 195MW back-up at Atlantis, in the event of an emergency shut-down, to operate essential and critical systems [10]. This is 10.8% of the total capacity so presumably a 4 000MW nuclear plant requires a 430MW dedicated back-up quick-start capacity that can not be used for any other purpose. This cost must be factored in too. Each nuclear power station therefore requires an equal amount of back-up from somewhere for unplanned unavailability plus a 10% dedicated back-up for emergency power: a total of 120% back-up availability in the case of 2 nuclear power stations. That is if they don't not both have to be shut down at the same time for same reasons.

#### Response (6)

The alternative power supplies for the Koeberg plant is less 20MW for the entire site. This is met by the existing Acacia Power Station (3 x 57MW) because at the time of Koeberg's construction there was no other dependable generation in the Western Cape and only a single supply through the Hydra Substation (near De Aar) from the power stations in the north of South Africa. It was therefore considered that a single failure could lead to the loss of all offsite power to Koeberg (which has 5 onsite diesel generators to meet all safety requirements). When the new nuclear plants are commissioned (in around 2018) there will be a second parallel grid supply from the north of South Africa and Eskom has (since Koeberg was commissioned) built the Palmiet pumped storage plant (2 x 200MW) and the Ankerlig OCGT plant (9 x 150MW). Therefore the need for an alternative grid supply should be met without the need of dedicated extra plant, however if such an extra supply was required it would be in the order of 25MW for the site (dependant on the detailed design chosen).

#### Your comment (7)

Decommissioning: Decommissioning costs and impacts and the technology of long-term waste management are, according to the study, "too far into the future...and therefore cannot be assessed at present" (4.4.2. Impact identification and assessment. Page15). It is strange indeed to preclude renewable forms of energy from Eskom's planning and the EIA itself because they are assumed to be "inadequately developed" and yet absolve the EIA from assessing impacts of the decommissioning phase of nuclear power. It is to be hoped that the specialist consultants evaluate all aspects of nuclear power against the viable renewable alternatives at the outset and also do not pull a cover over future costs and impacts of decommissioning and long-term waste management. Costs in the region of R11.5million/ MW have been mentioned [11].



### Response (7)

Globally decommissioning costs are budgeted at 10 – 15 % of the overnight capital cost and is included in the business case of building a nuclear power station.

The impacts and the management of decommissioning will be determined by the selected decommissioning strategy coupled with technological and legislative advancements. Arcus GIBB will provide guidelines, principles and criteria based on international literature, specialist input and best practice. The EMP will also contain specific 'in principle' commitments which will ensure responsible decommissioning.

Further, the EIR will also elaborate on the NNR's role and requirements on decommissioning, and address the long term impacts and the long-term sterilisation of land, as requested by DEAT in their letter dated 19 November 2008.

There are a number of issues that need to be taken care of when looking at the options for electricity generation; these include cost, lead time for construction, environmental impact, and operating characteristics relative to peaking and base load power generation. The planning for the construction of new power stations must also consider the different types of power stations that are required and their cost (which impacts on the price of electricity), the time taken to construct them, the environmental considerations and their operating characteristics. The total demand for electricity in South Africa is not constant; rather it varies on a 24-hour basis, with peak demand in the early morning and in the late afternoon / early evening. To optimally meet the total demand, it is thus necessary to have both "base load" electricity generating power stations designed specifically to generate electricity continuously at all hours, as well as "peaking" electricity generating power stations designed specifically to generate electricity only during the periods of peak demand. This is achieved by harnessing different energy sources and applying different technologies.

With respect to the preclusion of renewable technologies Chapter 8 of the Final Scoping Report for the Nuclear-1 EIA discusses alternative forms of power generation. Eskom is in the process of exploring a number of different ways in which to generate electricity and is investing in further development of renewable technologies. Only certain electricity generation technologies are commercially available, although not necessarily financially viable in South Africa based on the availability of resources (fuel) and geographical constraints. The limited range of viable technologies is listed in Table 17 on Page 8-5. The Final Scoping Report is available on the following website: <http://projects.gibb.co.za/>.

Projects are already underway regarding the different energy sources. This EIA is for only one of the projects that are proposed, separate EIA's have been completed for two coal fired power stations and a third for two future power stations is in progress. An EIA for a 100 MW wind facility has been completed and another for future wind power has been initiated.

Although all the respective alternative technologies are discussed in the Scoping report and will, where relevant be discussed in the Final EIR the debate regarding the correct energy mix for South Africa forms part of the National Electricity Resource Planning process. Such a process is open to public participation and PWG is encouraged to engage government through such a forum.

The disposal of non radioactive waste will be discussed in the Environmental Impact Report as well as the Environmental Management Plan (EMP). With respect to the various streams of radioactive waste, the management of radioactive waste falls under the jurisdiction of the Minister of Energy in terms of the Nuclear Energy Act, and is also subject to a licensing process from the NNR.

### Your comment (8)

Greenhouse gases: Nuclear power while having lower greenhouse emissions than coal is not better than renewables. Nuclear power emits in the region of 66kg CO<sub>2</sub>e/MWh in its lifecycle [12] which is below that of



coal (1000kg CO<sub>2</sub>e/MWh) [13] but 5 times above that of wind (12-14kg CO<sub>2</sub>e/MWh) [14]. Nuclear power also emits radionuclides in the normal course of operation and in its lifecycle while renewable energy technologies do not.

#### Response (8)

*Dones et al, 2003: Comparison and overview* highlights that over the full life cycle – from mining of the uranium, iron ore and other minerals, manufacture of the components and construction of the power station, operation and maintenance of the power station through to decommissioning of the station and the management and disposal of waste – nuclear power emits less than 11 grams of carbon equivalent per kilowatthour (gC /kWh) (ref: Greenhouse gas emissions from energy systems:). This is the same order of magnitude as wind and solar power including construction and component manufacturing, and two orders of magnitude below (i.e. one hundredth of) the average for coal, oil, and natural gas.”

Furthermore as indicated in responses above there are a number of issues that need to be taken care of when looking at the options for electricity generation; these include cost, lead time for construction, environmental impact, and operating characteristics relative to peaking and base load power generation

In addition to the above, your view that the EIA should consider the entire life cycle of impacts from mining to decommissioning is noted however the EIA process is specifically focused on the actual development (construction, operation and decommission) of the NPS as per the NEMA regulations. The environmental impacts associated with other components of the life cycle such as the mining of uranium do not form part of the scope of this EIA process and will have to be addressed as part of the EIA undertaken within the ambit the respective legislation such as the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) and the NEMA, as part of the application for associated activities.

Activities relating to the life cycle of nuclear power were discussed as part of the Scoping Report.

The Air Quality and Climatology Specialist Study will assess the following during the Impact Assessment Phase of the EIA:

- *The radionuclide content of ventings and purgings; decay periods involved; whether or not they could be cumulative; types of radiation predicted; and potential impact on surrounding communities under the strong prevailing wind conditions found in the area; and*
- *Potential radionuclide emissions during malfunction or accident, to determine probable time frames and significance of risk. The design-based accident scenarios will be established in consultation with Eskom (in consultation with potential vendors) and the NNR requirements.*

#### Your comment (9)

Environment: The specialist consultants are asked to provide a description of the affected environment. From an economic perspective, the affected environment is the entire future shape of South African economy and the type of work and of industry that will prevail. To do justice to this, none of the impacts mentioned in the EIA study's terms of reference for the economic assessment (4.5.13 Economic. Pg. 25) can be assessed without an assessment of the alternatives. Eskom is not only proposing 3 x 4 000 MW nuclear power plants but also any number of Pebble Bed Modular Reactors as well.

#### Response (9)

Please refer to response (1). It is not clear what 'alternatives' are referred to but if it is alternative forms of generation these have been discussed in the Scoping Report and will be discussed in the economic specialist study.

#### Your comment (10)

The following, not included in the EIA study, needs to be addressed:



- 10-1: The make and type of nuclear plants proposed
- 10-2: The cost
- 10-3: Decommissioning and waste management impacts can not be excluded from assessment, as proposed in the present study, nor the costs.
- 10-4: In the case of Duynefontein, the sterilisation of surrounding land for urban development and the opportunity cost of that.
- 10-5: A comparative evaluation with renewable energy alternatives and alternative efficiency strategies.
- 10-6: The opportunity cost of investing R320 - 680 billion into nuclear power plants and the resulting opportunity cost of associated nuclear-related industry, mining and servicing, security and public liability insurance and waivers and potential nuclear proliferation.

#### Response (10)

10-1: As stated in Chapter 8 of the Final Scoping Report (FSR), two power plant type alternatives belonging to the Pressurised Water Reactor (PWR) technology family were under consideration by Eskom for the proposed NPS. The existing NPS, Koeberg, uses PWR technology and it is therefore a proven, reliable and tested form of power generation. Eskom is therefore familiar with the technology from health and safety as well as operational perspectives based on its experience with Koeberg. Government has set up a task team to develop the nuclear programme further. This will include the final choice of plant type within the PWR technology family. For the purposes of the EIA enveloping values will be utilized to ensure that all potential impacts are identified and evaluated.

For further information, please refer to Chapter 8 of the Final Scoping Report. The Final Scoping Report is available on the following website: <http://projects.gibb.co.za/>.

10-2: The economic assessment will incorporate the costs associated with the NPS. The Terms of Reference for the Economic Study include assessing the “*Cost implications of the proposed NPS in relation to other electricity generation activities as indicated in the Long-term Mitigation Scenario document.*”

It should however be noted that with regards to the issues on cost this is addressed through Public Financial Management Act (PFMA), the National Integrated Resource Planning Process and the NERSA licensing process. Environmental approval is only one of many approvals required before a project can proceed. The NERSA process provides for public input.

10-3: The impacts and the management thereof will be determined by the selected decommissioning strategy coupled with technological and legislative advancements. Arcus GIBB will provide guidelines, principles and criteria based on international literature, specialist input and best practice. The EMP will also contain specific ‘in principle’ commitments which will ensure responsible decommissioning.

The EIR will elaborate on the NNR’s role and requirements on decommissioning, and address the long term impacts and the long-term sterilisation of land, as requested by DEAT in their letter dated 19 November 2008.

As indicated above, the disposal of non radioactive waste will be discussed in the Environmental Impact Report as well as the Environmental Management Plan (EMP). With respect to the various streams of radioactive waste, it must be noted that handling of radioactive waste falls under the jurisdiction of the Minister of Minerals and Energy in terms of the Nuclear Energy Act, and is also subject to a licensing process from the NNR. In light of this, the EIR will include a preliminary discussion of radioactive waste, as well as the amount of waste (both radioactive and non-radioactive) that will be expected from the proposed NPS. Waste disposal and transportation will be further addressed in the EIR (as requested in DEAT letter date 19 November 2008).

10-4: The potential sterilization of land and the costs associated with such will be assessed by the respective social and economic specialists



10-5: Please refer to response (7)

10-6: Your comment is noted and will be relayed to the Economic Specialist

Your comment (11)

The specialist consultants must not be influenced by Eskom's threat to 'develop more coal-fired power stations' in the event of a no-go option. Eskom has the alternative of buying electricity from independent power producers at NERSA rates and investing their capital in maintaining and up-grading their existing distribution network and investing in smart-grid technology to balance supply and demand and energy efficiency strategies. It is intolerable that South Africa could be taken down the nuclear road without a strategic assessment of the implications for all of us.

Response (11)

The evaluation and decision making for the energy mix in South Africa is determined through a strategic analysis which the NERSA and Department of Energy are accountable for. This process is open for public comment.

Your comment (12)

NOTES:

All costs in this study are given in 2008 nominal Rands.

1	UCT Energy Research Centre. Costing a 2020 Target of 15% Renewable Electricity for South Africa. October 2008
2	Cleaner Energy Cooler Climate. Developing Sustainable Energy Solutions for South Africa. Harald Winkler. HSRC Press 2009. Table 5.15 pg. 135
3	Dept of Minerals and Energy 2004. Economic and financial calculations and modelling for the renewable energy strategy formulation. Prepared for DME by Conningarth Economists for CaBEERE project, Pretoria. Accessed from Renewable Energy Briefing Paper. August 2008. Holm, Banks et al.
4	UCT Energy Research Centre. Costing a 2020 Target of 15% Renewable Electricity for South Africa. October 2008
5	IAEA Power Reactor Information System. March 2009. Retrieved from <a href="http://www.iaea.org/programmes/a2/index.html">www.iaea.org/programmes/a2/index.html</a> .
6	According to Moneyweb. <a href="http://www.moneyweb.co.za/mw/view/mw/en/page55?oid=240406&amp;sn=Detail">http://www.moneyweb.co.za/mw/view/mw/en/page55?oid=240406&amp;sn=Detail</a> .
7	Nuclear Engineering International. Escalating cost of new build: what does it mean? Steve Kidd, Director of Research, World Nuclear Association. Quotes Moody's Investor Service estimate of \$5000-\$7000/kW as "realistic". Retrieved from: <a href="http://www.neimagazine.com/story.asp?storyCode=2050690">http://www.neimagazine.com/story.asp?storyCode=2050690</a> \$5000-7000/kW (2007\$) @ exchange rate \$1:R7.29 = R36450 - 51030/kW x CPIX adjuster 167.7/150.3 = R40570-56800/kW or R41-57 million/MW in 2008 Rands
8	70% is the historic availability factor of Koeberg nuclear power station up to 2007. IAEA Power Reactor Information System. March 2009. Retrieved from <a href="http://www.iaea.org/programmes/a2/index.html">www.iaea.org/programmes/a2/index.html</a>
9	4 000MW x 365 days x 24 hours x 70% availability = 24 528 000 MWh or 24 528 GWh/year
10	Eskom. Proposed capacity expansion of the existing OCGT plant and associated transmission lines and substation at Atlantis. <a href="http://www.eskom.co.za/content/Chap2PrjDescri081206.pdf">http://www.eskom.co.za/content/Chap2PrjDescri081206.pdf</a> .
11	Parliamentary Monitoring Group. Environmental Affairs and Tourism Portfolio Committee. 19 October 2004. Nuclear Regulatory Issues. A cost of R16bn for 1800MW KNPP (2004R) translates to R11.5bn/MW in 2008R.
12	Energy Governance Program, Yew School of Public Policy National University of Singapore. Energy Policy 36 (2008). Valuing the greenhouse gas emissions from nuclear power: A critical survey. Benjamin K Sovacool. Elsevier. Retrieved from: <a href="http://www.elsevier.com/locate/enpol">www.elsevier.com/locate/enpol</a> .



13	Cleaner Energy Cooler Climate. Developing sustainable energy solutions for South Africa. Harald Winkler. HSRC Press. 2009. Tables 3.3 and 3.6
14	Declaration EPD of Electricity from Vattenfall's Wind Power in the Nordic Countries.2007. Retrieved from: <a href="http://www.environdec.com/reg/epd115e.pdf">http://www.environdec.com/reg/epd115e.pdf</a>

Response (12)

The above is noted. Thank you for the references.

In conclusion, the project team would like to assure you that Interested and Affected Parties comments are important to us and that your continued involvement in this process as an I&AP is valued. Your comments/questions will be captured in the draft EIR that will be submitted to the decision-making authority in due course.

Please do not hesitate to contact us at any stage should you require any additional information regarding this proposed project.

We thank you for providing us the opportunity to respond to these questions and look forward to your ongoing involvement in the project.

Yours sincerely  
For and on behalf of Arcus GIBB (Pty) Ltd

Jaana-Maria Ball  
EIA Project Manager