Comments on the Draft EIR for Nuclear-1

Submitted 29 June 2010 without Prejudice

Introduction

This document has been prepared by the Koeberg Action Alliance (KAA) in response to the invitation for public participation and comment on the Environmental Impact Assessment for Eskom's proposed Nuclear-1 project.

KAA is a civil society grouping of South African citizens with deep reservations about the use of Nuclear Energy in South Africa. We are particularly concerned with the actual and potential risks;

to the health of citizens,
to the environment,
related to Nuclear Waste, and,
to the economy.

KAA is therefore particularly keen to see that the EIA for the Nuclear-1 project is as accurate and complete as possible. We have therefore brought together a team of experts in various fields to examine to volunteer their time to analyse some aspects of the draft report. Of particular interest was the scientific accuracy of the studies, and whether the draft report is objective, or shows bias towards the applicant. Our findings are detailed below.

Biased treatment of matters related to radioactivity

The treatment of Radioactivity in the EIR

The Environmental Impact Assessment for Eskom's proposed Nuclear-1 project is deeply flawed and biased in favour of the project. This is most clearly apparent in how matters relating to radiation have been treated. They have only been included where they appear to favour of the developer and simply excluded otherwise.

In order to avoid the situation whereby the personnel working on behalf of the DEA would be duplicating the work of those people working on behalf of the NNR, the relevant authorities decided that the DEA would not consider any issues related to radioactivity.

This was unfortunately extended to the extremely poor decision that any matter concerning nuclear radiation would be excluded from this study.

It would have been far better to simply direct that the reports from a single and complete environmental impact assessment should simply highlight the particular sections that require the special attention of the NNR.

There are two main results of this poor decision.

Firstly, much of the expensive and time consuming work by the most of the specialists will have to be repeated to meet the requirements of the NNR. New reports will have to be produced. The public must be allowed to comment once again. This leads to a danger of 'success by attrition', whereby the public and civil society become exhausted by the time required to take part in these separate processes. This results in a bias toward the applicant.

Secondly, it is impossible for the current study to be complete. The scope is flawed. It is simply not possible to draw conclusions from incomplete information.

Inevitably, because radioactivity is so obviously important in considering the potential impact of any nuclear project, certain information has been included in an attempt to make the report sensible. The authors of the report state that matters relating to radioactivity are included "for information". Yet this selective inclusion of matters relating to radioactivity has been done in a highly prejudicial manner that favours the proposed development. They have not performed their task as required which is "to provide objective information to the EIA process, regardless of their personal opinion".

There are four routes by which radioactive matter can escape from the NPS:
Discharged into the air;
Leaked into groundwater;
Cooling water released into the sea;
Radioactive waste being transported from the site.

In each of these cases a different approach has been taken.

The air quality report considers normal and expected radioactive releases but not catastrophic incidents. The quote below is from the specialist report.

"Catastrophic incidents were not part of the plan of study for the assessment since these incidents are within the jurisdiction and mandate of the NNR."

The groundwater study includes extreme cases where it is assumed that the entire site is contaminated right down to the bedrock. For example :

"In this scenario the potential contamination from the NPS is simulated with the assumption that the entire footprint is 100 % contaminated"

This extreme case is only included in the report because the analysis showed that the results would be insignificant. However the analysis is faulty and an accurate analysis of this scenario would certainly show catastrophic consequences.

This scenario of contaminated cooling water being released into the sea is addressed in the marine biology report. The chance of such an accident is considered by that particular specialist to be extremely unlikely. So because this is considered to be almost impossible it is included in the study:

"The unintentional release of radiation emissions
Technical design of the cooling system has minimised this risk, so that this potential impact is rated as having low consequence and low significance."

Other far more probable sources of radioactive contamination of the sea are simply not mentioned. Contaminated groundwater, which has not been estimated properly, will almost certainly contaminate the sea. Likewise radionuclides released into the air will fallout into the ocean, where it is difficult to monitor.

When the site is decommissioned the High level waste will be transported hundreds of kilometres to a storage site, probably Vaalputs in the Northern Cape. This is one of the most controversial aspects of the entire project. Yet, there is no analysis of the transportation of High Level waste in the decommissioning phase.

The section on transportation considers the transport of Low and Intermediate level waste to Vaalputs in the operation phase. The section on waste management briefly discusses the storage of High Level waste at the NPS and Vaalputs site. But proper analysis of the risks involving transportation of High Level waste is omitted.

The above four examples show four different approaches to assessing the impact of radioactive releases:

Apparently safe release scenarios are considered, for example in the air quality report normal and expected radioactive releases are analysed. Abnormal accident scenarios are stated to be beyond the scope of the study.

Abnormal accident scenarios that are considered to be so improbable that the resulting risk is acceptable have been dealt with, for example in the marine report.

Abnormal accident scenarios that are erroneously considered safe, but actually aren't, are included in the groundwater report.

And the highly dangerous and inevitable scenarios related to the transport of spent fuel are simply not analysed.

1 Corrective Action

The entire report including specialist reports needs to be rewritten in a fair, objective and neutral manner.

2 Corrective Action

Issues relating to radiation need to be dealt with consistently. This study will have to be reworked. Either all references to radioactivity should be removed from this document and a separate new EIA process should be established to consider only matters related to radioactivity, or the scope of this study must specifically include all aspects of the project and another full round of the EIA process must be executed.

Confusion about construction timescales

There is widespread inconsistency and confusion in the EIA regarding the expected construction time of the NPS and the duration of negative impacts that occur during the construction phase.

In the chapter 3, the project description, the construction time is estimated to be 7 years.

Although recent experience shows that some NPS's have been built in as few as five or six years, this has only occurred in countries like China and South Korea with certain advantages. They have extensive

experience in huge construction projects. They have built many NPS's previously. They have not had much need for site preparation to avoid environmental damage. They have built in sites with existing local infrastructure such as roads, railways, harbours and high capacity electrical power systems all in place before their projects started.

It is therefore quite likely that the construction phase of Nuclear-1 could be much longer than 7 years. The EIA consultants have publicly stated that 7 years is an overly optimistic estimate in their opinion, and have said 9 years is more likely. It is therefore not infeasible that a slight delay would result in the construction taking place over ten years, which would mean that all construction related impacts would have to be considered 'long-term' by the definitions used. The cost and complexity of the mitigation measures required is therefore also likely to be greater than given in this EIR.

In chapter 7, on methodology, the duration of impacts are defined as follows:
short-term (0-5 years), ie. within the construction phase of the project
medium-term (6-10 years),
long-term (>10 years)
permanent.

In many of the specialist reports negative impacts that will occur throughout the entire construction period have been classed as short-term. They must instead be classified as medium-term and possibly long-term.

A few examples of such impacts are listed below.

3 Corrective Action

Table 9-20: Impacts on wetlands
Access roads during construction. This is not short term.

4 Corrective Action

Table 9-21: Assessment of impacts on terrestrial vertebrate fauna. These impacts are not short term:
Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance.
Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads.
Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot.

5 Corrective Action

Table 9-28: Impacts on air quality
Construction stage Gaseous, Particulate Matter and Fallout. This is not short term.

6 Corrective Action

Table 9-43: Noise impacts. These are not short term impacts:
Noise impacts of site works and construction
Impact of transportation noise.

7 Corrective Action

Table 9-50: Impacts on agriculture
Dust deposition. This is not short term.

8 Corrective Action

Table 9-64: Social impacts. These impacts are not short term:
Increase in informal illegal dwellings
Pressure on municipal services during the operational phase

Undetermined risk of earthquakes

The Seismological Risk Assessment Specialist Report is incomplete, scientifically flawed and presents, by its own admission, data that are not in conformance with the latest internationally accepted practice. The authors of the report nevertheless proceed to use these insufficient data to conclude that "the seismic hazard does not preclude a standard export NPS (nuclear power station) at any of the proposed sites". They appear to come to a preconceived conclusion in the face of their own contradictory observations.

The report seems to have nothing to add to and in fact appears to rely on and revisit the results of a previous report – the *Specialist Study: Geology and Seismic Hazard, Council for Geoscience Report number: 2007-0277* which was part of the Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) Environmental Impact Assessment and Environmental Management Programme.

9 Corrective Action

There must be clarity about whether any new and additional work (theoretical or field-based) been carried out since the PBMR DPP report or if the current report based on the results presented in that report.

Considering the importance of a thorough seismic evaluation of any site for an installation as potentially hazardous as a nuclear power plant (in the words of the report itself: "'Local vibratory ground motion' resulting from geological-related seismic events (fault rupture), which, in terms of potential consequences, constitutes the most serious geo-scientific threat to a NPS"), this report is highly problematic and its recommendations and conclusions are, at best, questionable.

These comments focus particularly on the assessment of the Duynefontein site, but the majority are generally applicable to all three proposed sites.

Evidence for a major historic earthquake

The report acknowledges that a major earthquake has occurred in the close vicinity of the Duynefontein site in historic time:

"Reliable evidence for a large earthquake with an intensity of VIII, and ML 6.3 (Brandt *et al*., 2005) having occurred in 1809 within 25 km of Duynefontein comes from historical records of its secondary effects. [...] Dames and Moore (1976) concluded that enough circumstantial evidence exists for the presence of a NW striking fault offshore of Duynefontein but that it does not come closer than 8 km to the site. It is however possible that such a fault could pass anywhere between 7 and 10 km offshore of Duynefontein (the inferred Melkbos Ridge fault passes 7.5 from the Koeberg NPS). No new research has been performed to confirm or refute the presence of the fault or its point of closest approach to the site."

The fact that the source (fault) responsible for this historic earthquake has not been identified with certainty does in no way preclude a recurrence of a similar event in future and neither should the fact that it took place over 200 years ago inspire any confidence since such a time period is practically instantaneous in geological terms.

The important conclusion, studiously avoided by the report's authors, is that there is no reason to believe that major earthquakes will not happen in the close vicinity of the Duynefontein site again.

The earlier report for the PBMR DPP mentioned above is more explicit:

“Detailed work will have to be undertaken if a new location is chosen on this site.The questions around the 1809 to 1810 seismic events and the existence of the Milnerton fault have to be further resolved.” […]

“Whatever the cause of the earthquake, its effects imply that peak ground accelerations (for M 6 proximal events) between 0.2 and 0.3g were attained (Talwani and Gassman, 2000) 11 km south of Koeberg.” […]

“The seismic hazard model should therefore take into account the possibility that a fault capable of producing an event at least equal in size to the 1809 event of inferred M 6.3 magnitude, and with a minimum recurrence interval of about 200 years, is located about 8 km SW of Koeberg.”

Where the PBMR DPP report called for ”detailed work” that “will have to be undertaken” to resolve “the questions around the 1809 to 1810 seismic events and the existence of the Milnerton fault”, the current report acknowledges that “no new research has been performed to confirm or refute the presence of the fault or its point of closest approach to the site”.

10 Corrective Action

Extensive and detailed new work must be done to resolve this issue as recommended by the previous PBMR DPP report

Poor quantitative data

The report is remarkable for its extreme sparsity of quantitative scientific data. While qualitative and observational data is, of course very valuable, for a report of as much significance as this one, the presentation of more measurable quantitative information would have been of paramount importance.

The only quantitative measure evaluating potential seismic activity presented in the entire report is the peak ground acceleration or PGA expected at the three sites during future earthquakes. The values given are:

Thyspunt 0.16g,
Bantamsklip 0.23g, and
Duynefontein 0.30g.

The report assures us that:

“None of these exceed the PGA of 0.3g typically used in the seismic design of NPSs, although the values for the Bantamsklip and Duynefontein sites are close, or at this threshold.”

The fact that this seismic hazard assessment includes only a single quantitative measure is worrying, as from a statistical and scientific point of view, omitting a confidence indication makes this information practically worthless as it stands.

11 Corrective Action

Additional quantitative parameters of seismic risk assessment must be determined.

The report acknowledges that the PGA values quoted for the three sites were determined using outdated methodology (Parametric-Historic PSHA, or Parametric-Historic Probabilistic Seismic Hazard Analysis) which does not conform to the latest internationally accepted practice:

“Parametric-Historic methodology previously employed for SHA [seismic hazard analysis] of these sites, does not include all the aspects recommended in the latest regulatory guides for NPPs [nuclear power plants]. As a result, the ground-motion values calculated using the Parametric-Historic PSHA are not directly comparable in a meaningful manner to those calculated using a PSHA as defined in RG 1.208 and needs to be confirmed. A new and advanced Probabilistic Seismic Hazard Analysis (PSHA) will therefore be undertaken, that will follow the latest internationally accepted practice, and in particular, will conform to the requirements of a Level 3 study as defined in the SSHAC Guidelines (Budnitz et al., 1997).”

The only quantitative assessment of seismic risk included in the report is thus not in conformance with accepted international standards.

12 Corrective Action

A new and advanced Probabilistic Seismic Hazard Analysis (PSHA)” following “the latest internationally accepted practice” must be undertaken.

For what they are worth, the PGA values cited in the report are quoted to an accuracy of two decimal places. While the report makes a point of highlighting that the study of seismic phenomena is subject to substantial degrees of uncertainty, associated with both the apparent randomness of the physical processes involved in earthquakes and the seismic waves they generate (this is referred to as aleatory uncertainty) and the lack of sufficient data and knowledge (epistemic uncertainty), no indication of the statistical uncertainty associated with the quoted PGA values is given.

Without knowledge of the associated uncertainty, however, these values become questionable. This is particularly significant in the case for the Duynefontein site for which the quoted PGA value of 0.30g is identical to the value “typically used in the seismic design of NPSs”. The mathematical error associated with the PGA values may, for all we know, take them significantly above this “typical” threshold. Not quoting mathematical error limits with the only quantitative measure cited in the entire report is scientifically sloppy at best.

13 Corrective Action

Errors associated with the PGA values quoted in the report must be quantified and included in the report.

It should also be noted that reference to a “typical” value for “the seismic design of standard export NPSs” is not particularly enlightening, especially considering the fact that the specific design for Nuclear 1 is yet to be decided upon.

Internationally acceptable data will only be available pending further study and the report acknowledges that the PGA values quoted may increase based on this additional research:

“The findings presented here still needs to be confirmed by a more rigorous PSHA and may increase or decrease these values.”

This is particularly worrisome for all three sites, but especially for the Duynefontein site where the PGA value is already on the threshold "typically used in the seismic design of NPSs". According to the report's own observations the PGA values for all three sites may potentially rise above the 0.3g threshold once internationally acceptable methodology is used to recalculate these parameters.

Importantly the earlier PBMR DPP report mentioned above provides some additional and very significant information:

"The maximum possible earthquake for this region calculated by the Parametric-Historic Procedure (Kijko and Graham, 1998, 1999) is expected to be M 6.60±0.3 and the deterministically calculated Peak Ground Acceleration is 0.27 g ±0.14"

14 Corrective Action

The reason for the discrepancy between the PGA value of 0.27g quoted in the PBMR DPP report and the PGA value of 0.30g quoted in the current report must be explained. If the PGA value of 0.30g in the current report was determined using different methodology and/or data than the value of 0.27g from the PPMR DPP report this must be detailed and explained.

The error quoted in the PBMR DPP report is significant since it pushes the potential PGA value to a maximum of 0.41g which is substantially higher that the threshold of 0.3g "typically used in the seismic design of NPSs" according to the current report. If the error associated with the PGA value of 0.30g presented for Duynefontein in the current report is comparable, the maximum PGA value would be pushed to an even higher value of 0.44g.

Mitigation measures

According to the report, mitigation measures against the effects of earthquake activity at the proposed sites would include the fact that:

"The geotechnical and structural civil engineers shall assign the appropriate "seismic design criteria" for the design of utilities, including on-site and off-site water reservoirs."

It is, however, entirely unclear how these engineers would be able to determine what would constitute "appropriate" seismic design criteria based on data that do not conform to international standards. References to additional future studies are of little use in the context of assessing the value of the current report.

15 Corrective Action

All studies to determine seismic risk must be completed and an additional period for public comment must be allowed before this EIA can be complete.

The need for a scientific peer review

Considering the importance of a thorough assessment of seismic risk for the siting of a nuclear power plant, this report should urgently be subjected to a rigorous peer review process during which it (as well as all available raw data and detailed expositions of any methodologies employed) would be scrutinised by several independent and disinterested seismologists and geotectonicists of international reputation. As it stands the report expresses merely the opinion of its authors and it would not even be considered for publication in an internationally recognised scientific journal. Why should it be sufficient or acceptable as a basis for a

decision that may affect the lives and livelihoods of several generations and the health of large stretches of the natural environment?

16 Corrective Action

Considering all the short comings of this specialist study the existing reviewer should be replaced, or at least assisted with additional appropriately qualified and impartial seismic specialists.

Unscientific conclusion

Considering the information and observations presented in the report itself, the key conclusion drawn by its authors comes as a major surprise. It would appear that they arrive at a predetermined conclusion regardless if it contradicts some of their own observations noted in the report and some of which I have discussed above.

The key conclusion of the report is as follows:

"Based on current knowledge, the three localities under review are considered suitable locations for standard export NPS's following the extensive Nuclear Siting Investigation Programme (NSIP). To date no geological evidence has been found that would halt the development of a NPS at any these sites."

Even on superficial inspection, however, this conclusion is disingenuous and scientifically flawed. An honest assessment of the actual available data presented in the report is more accurately contained in the following paragraph:

"the available data indicate that the Thyspunt site has the lowest seismic risk of the three proposed NPS sites, and from a seismic point of view, Thyspunt is the preferred site of the three proposed NPS sites. Furthermore, in the light of the uncertainty as to whether the revised PSHA will result in significantly different PGA values, Thyspunt is the site with the biggest seismic margin to accommodate changes to this value."

The report uses outdated methods to calculate a single quantitative measure to assess the seismic risk associated with each of the three proposed sites. The best that can be done using this flawed scientific data is to rank the three sites in an at best semi-quantitative manner – thus the identification of Thyspunt as the preferred site. These data cannot, however, be used to assess the actual seismic risk at the sites on the basis of internationally acceptable scientific methods (even at Thyspunt, the flawed data cannot be used to discount the possibility of possible significant seismic risk). The key conclusion cited above is therefore all but meaningless until such time as data that are consistent with international scientific norms are available.

17 Corrective Action

Quite contrary to the official conclusion, the precautionary principle – a principle that must be applied when assessing technology as sensitive and potentially dangerous as nuclear energy – suggests that on the basis of the information presented in the report, the Duynefontein site should not be considered as a suitable site for a nuclear power plant until scientific evidence suggesting otherwise can be presented.

Antartica and tsunamis

Climate change is likely to result in some melting of the Antarctica ice cap. This could cause seismic activity, and so there is a risk of a tsunami striking the southern shores of South Africa.

18 Corrective Action

A study must be made of the possibility, scale and impact of tsunamis.

Faulty groundwater modelling

There are a numerous flaws in the EIA for Eskom's proposed Nuclear-1 project concerning the groundwater modelling in geo-hydrology study.

Inadequate numerical modelling expertise

Peter Rosewarne is listed as the specialist for this study. Although his CV claims expertise in "Numerical Modelling", this is not consistent with his formal education and published work. Familiarity with the user interface of a specific computer program is not the same thing as expertise in the underlying algorithms. In order to obtain reliable results it is imperative to have a proper understanding of what the computer software actually does, particularly in the case of complex mathematical subjects like the non-linear numerical modelling of contaminants in groundwater flow. Expertise in this field is usually associated with at least a post-graduate qualification in applied mathematics with a speciality subject in numerical solutions of partial differential equations.

The report was reviewed by Dr Christine Colvin. She also appears to be unsuitably qualified to be considered an expert in numerical analysis.

In the report it states that:

"The numerical modelling specialist report was compiled by the Institute for Groundwater Studies at the University of the Orange Free State (Dennis 2009) and is summarized here."

The report referred to in the above quote must be made available. The details of the who performed this part of the study along with their CV's and statements of independence should also be made available.

Nuclear contamination irrelevant and incorrect

For each of the three sites the report describes two scenarios of nuclear contamination of groundwater: A regional model is created to simulate radioactive matter being released into the air and hence being deposited over a wide area. A local model is created to simulate the direct contamination of the groundwater below the NPS site.

As all matters related to radiation are excluded from the scope of the study at this stage, these sections should simply be removed from this report. Besides, they are so flawed that they really serve no purpose.

In addition to all of the problems associated with the other models that will be outlined in the next few paragraphs, there is insufficient detail about the contamination scenarios. There is no specification of the particular radio-isotopes being released, or of their half-lives, or of the quantity, or of the time periods and release rates, or in the case of the regional model the distribution.

Spacial discretisation is crude and unverified

The local model uses three layers in the z direction, each layer is a two dimensional finite difference grid of 50m by 50m cells. Each cell effectively represents a single constant flux value. This is quite coarse.

Was any spacial discretisation convergence check performed? In other words, how different are the results if 40m, 60m or 100m grid spacing is used? What if more layers are used? In this way one can check if the discretisation is sufficiently fine.

Flow in fractures ignored

Because of the crudeness of the spacial discretisation flow in individual fractures is not covered by this modelling. Yet flow in fractures is much faster than in the surrounding aquifer. The report notes that:

"Average sustainable borehole yields range from 0.5 to 2 L/s, but yields of
>5 L/s have been obtained from discrete fractures;"

Clearly the model cannot be considered accurate if fractures are ignored.

A far better approach would be to use geophysical surveys to locate fractures and then use finite elements methods rather than finite difference methods to do the modelling.

Unverified assumptions

Groundwater recharge values and porosity values are quite roughly estimated and then incorporated into the model.

A parametric study should be performed to test the sensitivity of the model to these estimates. In other words for a small percentage change in every input parameter, the corresponding change in results should be determined. In this way the sensitivity of the model to combinations of inputs errors can be determined across the full range of possible input errors.

Uncertainty in transmissivity

There is an enormous range of measured transmissivity values. For example the tables list values ranging from 5 m2/d to 180 m2/d for just one aquifer. But the model requires that only one value be used for the entire aquifer. Clearly it is not possible to have any confidence in the model if there is such a huge level of uncertainty in the transmissivity. It must be possible to get more consistent results. Alternative sampling and measuring procedures must be investigated.

Too many unknowns in the calibration

This is an example of a good technique being extended too far. Successful calibration of an unknown property by trial and error requires that:
There is a high level of confidence in every other aspect of the model.
There is a narrow range of values to the unknown parameter.
There is a large number of test points.
There should be only 1or 2 unknown values.

None of these apply here. Consequently this exercise is simply one of multidimensional curve fitting. There are several "fudge factors" that can be adjusted to get the flow field to fit to too few sample points.

In the Dynefontein example there are 14 boreholes with known values in a 238 x 300 grid. So roughly 1 point in 5000 is known.

The fudge factors used to force a field to fit this include:
Three values of transmissivity for layer 1
the width of the coastal area
the x-y position of the northeast corner
layer 2 transmissivity
layer 3 transmissivity
recharge value for vegetated dunes
recharge of value for non-vegetated dunes.
an unknown number of marginal cells that could be classified as either vegetated or non-vegetated.

This gives a ratio of so many fudge factors to such a small proportion of test values that there should be an infinite number of solutions that fit better than the 98% that is actually claimed.

Climate change scenario

This result is surprising.

If the sea level rises, the gradient will be less. Therefore the groundwater will flow more slowly from inland towards the sea. If the same volume of water flows more slowly then there must be a corresponding increase in the thickness of the saturated and flowing portion of the aquifer. So the height of the water-table above sea level will rise. So the rise in height of the groundwater level should be greater than the rise in sea level. Yet this model says it will be less.

Can this be explained?

Consequences to the study of wetlands

The results of the groundwater modelling are used in the freshwater ecology study. In particular there is some concern about what the effect of dewatering will have on wetlands. Crucial wetlands of national importance could suffer from permanent irreversible damage.

In the freshwater ecology study the importance of the groundwater model is stressed and the specialist report concludes by specifically calling for:
the finalisation of actual size and location of the proposed NPS, and,
the urgent implementation of a proposed surface / groundwater monitoring programme.

These two items alone will not be enough to add sufficient confidence to the groundwater model.

To this list should be added:

19 Corrective Action

Geophysical surveys. The team of experts needs to be extended. Geophysicists should be brought in to perform field surveys to locate fractures and more accurately determine the boundaries of the various geological layers**.**

20 Corrective Action

Better determination of aquifer properties. Transmissivity in particular must be more accurately measured, possibly using some other method.

21 Corrective Action

Better software. Despite the popularity of MODFLOW it remains a very crude tool. A far, far better solution would be to use finite element techniques. This will allow for much better representation of the physical domain and, most importantly, it would allow for the flow in fractures to be included in the models.

22 Corrective Action

Numerical expertise. The numerical modelling must be redone from scratch, and it must be performed and reviewed by appropriately skilled mathematicians.

Incomplete economic risk assessment

A number of important and plausible scenarios have either been excluded from the study or they have not been analysed with sufficient thoroughness.

The requirement for the EIA to be complete means that it is inadequate to simply claim that some event is unlikely to occur and therefore not perform any further analysis.

For example the NPS will be designed to withstand earthquakes where the probability of an earthquake of equivalent magnitude occurring is estimated by the geologists as 1x10-4 per annum. Considering that the timescale is 100 years minimum, the chances of the NPS receiving seismic shocks greater than what it has been designed to withstand is thus greater than 1%.

Earthquake damage to the NPS is thus highly plausible. Various scenarios in which the NPS is damaged by earthquakes must be detailed and all of the associated costs must be estimated. Likewise for all other postulated accidents a probability of occurrence and associated costs must be estimated.

Incidents that are far more serious (and also far less likely) than the Design Base Accidents must still be considered. This corresponds to events at levels 4, 5, 6 and 7 of International Nuclear Event Scale.

The probability of such events occurring as accidents must be estimated by considering actual historical data and not only the postulated probabilities estimated by various corporations and agencies who are promoting nuclear energy.

Various sabotage and terrorism scenarios must also be detailed and all of the associated costs estimated.

Major construction projects typically incur significant cost overruns, especially for large and complex projects. Based on the experience of recent nuclear plants built in foreign countries it is possible to estimate the risk and magnitude of construction cost overruns. In the United States, an assessment of 75 of the country's reactors showed predicted costs to have been $45 billion but the actual costs were $145 billion. In India, the country with the most recent and current construction experience, completion costs of the last 10 reactors have averaged at least 300% over budget.

The possibility of cost overruns and construction delays must be estimated and included in the analysis.

A total cost of all of the uncertain events must be estimated. One can imagine a hypothetical insurance policy that would provide liability cover for all of these uncertain events and their associated costs. An actuary would be able to calculate what the corresponding premiums would be.

In addition to the costs associated with the above mentioned uncertain events there are other indirect but inevitable costs that have not been estimated adequately.

The costs associated with the permanent storage of High level waste is not estimated.

Nor has the cost of transporting High level waste been estimated.

The cost of road upgrades is ignored, specifically with regard to the transport of low and medium level waste to Vaalputs.

The full costs of decommissioning and cleaning up and decontaminating the site afterwards must be estimated.

The potential real estate value of the site and the lost real estate value of the surrounding area over the next century must be properly estimated.

Ultimately the information in the economic risk assessment needs to be sufficiently complete that it can conclude with upper and lower bound numerical Rand values of the total cost of power per Kilowatt hour. It is only then that the people of South Africa and their representatives can be in a position to decide on the merits of pursuing with this project. Until that level of detailed analysis has been performed this EIA is incomplete.

Apart from all of the errors and omissions, this report is extremely biased.

It's inconceivable that an NPS can have a positive effect on tourism.

The quotes from British government white papers and Engineering News (without providing full references) are amateurish, off topic and appear to have been selected because they agree with the personal bias of the economic specialist. It is very easy to search the internet to find an article supporting one side or another on any topic, especially if you include the popular press in your definition of reputable. Similarly getting the opinion of a few fishermen about the effects of nuclear discharge on fish is from scientific. Why did he not use this reference, for example?
http://www.nirs.org/reactorwatch/licensedtokill/executivesummary.htm

23 Corrective Action

The economic impact assessment must be repeated. All of the costs that will occur over the entire duration of the project must be included. In the cases of uncertain events a probability of occurrence and associated costs must be estimated. The report must be objective and neutral.

Inadequate Agriculture Specialist Report

Apparent bias
In table 7-8 of chapter 7, the label referring to the agricultural study is given as ‘Agricultural Potential’ rather than ‘Agricultural Impact’. Since ‘potential’ has a positive connotation, this indicates a positive bias in this report.

Specialist not appropriately qualified
We note that Dr Maasdorp's CV fails to list any experience or qualifications in the fields of the impacts of the impacts of radionuclides on agriculture. His expertise appears to lie in the field of economics and marketing.

Incomplete
The terms of reference have not been met w.r.t. operational phase
Quoting from the Final Plan of Study:
"4.2 ... For each of the two main project phases (construction and operation), the existing and potential future impacts and benefits (associated only with the proposed development) should be described using the criteria listed below.
4.5 ...
4. Description of the anticipated impacts using the impact assessment criteria as defined in Section 4.2 for the various phases of the project i.e. design, construction, operation;"

However, the specialist report (E21) fails to assess any impact during the operational phase in section 5.1. Table 5-1 also fails to include any impacts relating to the operational phase.

Assessment of the impacts
In section 3.3.2 (4), the author states:

"(i) Dairy Producers
In the event of a disaster all dairy cattle will have to be removed from the area immediately. If they are to continue to be milked they will then need to be fed with uncontaminated fodder for the length of their lives. Their original farms will need to be evacuated for a period exceeding their own productive lives.

(ii) Beef Farmers:
The majority of feed for beef cattle will come from grazing natural or artificial pastures, and these feed sources will be contaminated immediately in which case the cattle will need to be removed immediately from the farms and put on 'clean' grazing.

(iii) Poultry and Pig Producers:
Poultry and pigs in enclosed housing and fed "out of the bag" are the least likely of the farm animal species to be affected by radionuclides. It would appear that, in the case of a nuclear disaster, they could continue to be produced in this manner, but the farm workers would not be allowed to continue working in the area because of the likelihood of them being exposed to radiation. In this case the stock would need to be slaughtered or moved outside the danger area."

The loss of entire stock of farming animals, and the shutting down of farming operations is in our view a significant negative impact. However, this impact is not carried through to table 5-1, and is not even mentioned in 5.2 under the summary of impacts.

Impacts selectively transferred from E21 to chapter 9
In E21, there are three impacts assessed (somewhat mysteriously labelled 1, 3 and 4). Of these only 4 is marked *Positive* in *Nature,* and only this positive impact is carried over to the final table in chapter 9. Impacts 1 and 3 (which are negative impacts) are simply omitted.
In our view this demonstrates under-reporting on the negative impacts, and clearly demonstrates a bias on the part of the consultants towards the applicant.

Alteration of significance of impacts from E21 to Chapter 9
According to E21, all three sites have a medium significance for 'Change in Market Conditions' in table 5-2. However, in the final Chapter 9 table the impact significance for Duynefontein has been modified to 'low'.

24 Corrective Action

The Agriculture Specialist Report must be redone by somebody who is suitably qualified and unbiased. The report must include all phases of the project.

25 Corrective Action

This evidence of tampering with the data by the consultants while compiling impacts from the specialists report into the main documents must be investigated. We must be assured that documents will be properly checked and that this will not occur again.

Flawed marine biology assessment.

Undersea tunnels

The nuclear plants will use undersea tunnels to take in cooling water, and disperse warm water. The proposed sites are all on some of the highest energy coastlines in the world.

The design for these tunnels could be not found in the report.

In order to properly respond to any EIA, there is a requirement is to know exactly what is being proposed. The three sites covered in this EIA, Duynefontein just to the north of Koeberg nuclear power station, Bantamsklip, between Shelly Beach and Quoin point on the SW Cape Coast and Thyspunt, between Oyster Bay and Cape St Francis in the Eastern Cape are all treated in an extremely general manner, without any specifics as to the final designs, construction methods, and as far as the oceanographic and marine biology aspects are concerned, how the intakes and outfalls are to be constructed on the sea bed and many other details required in order to form properly informed opinions.

A nuclear power station is a complex piece of machinery. The infrastructure required to build these particular units proposes the use of sea water to cool the reactors. Whereas Koeberg uses a form of harbour as a basin for the intake water and a pipeline for the hot water outfall, the proposal for the Nuclear 1 design – which is not decided on as to the final type, manufacture, capacity or design – is to use undersea tunnels of up to 2km to both supply this cooling water and to remove and disperse the hot water from the plants.

As there are no design parameters, there is a complete lack of detail in how the pipeline/ tunnels for the intake and exhausts are to be constructed, how they will be secured to the sea bed, or any other such detail. Bantamsklip is mostly reef, with very little sand cover to bury any proposed tunnel/ pipeline and appears to be completely non-viable. The sewage outfall pipeline off Green Point is built in similar, but far lower energy conditions, and failed soon after being built. Consequently it is impossible to come to any sort of informed conclusion as to the impacts, safety, security of the construction of these feats of engineering.

There has never been any similar scale of undersea construction undertaken in South Africa. We must remember that all three of these sites are on some of the highest energy coastlines in the world, which face the full power of the high latitude anticyclones of southern ocean, which are amongst the most powerful storms on earth, far more powerful than tropical hurricanes. The energy from these storms makes the likelihood of securely constructing these proposed tunnels/ pipelines extremely challenging, which may be why the consultants have failed to provide any detail on the construction of this aspect of the plants.

The costs associated with the construction of these feats of engineering will be extremely high and are extremely likely to incur high cost overruns due to technical challenges related to construction. The future maintenance of these pipelines could also prove an extensive future cost and may result in high likelihood of plant shut-downs due to damage to the tunnels.

26 Corrective Action

Details of the proposed undersea tunnels must be presented and the full impact of these tunnels must be included in this EIA. Alternatives must be presented and assessed.

Additional risks

The risk of global warming is extrapolated from the UN International Panel on Climate Change (IPCC), which is, generally speaking, a conservative document. Consequently the risks and impacts related to climate change in the EIA tend to be conservatively stated and worst case scenarios, such as runaway climate change related to feedback mechanisms coming into play, are not meaningfully covered or dealt with.

There are also serious biological risks. Bantamsklip is located in the middle of one of the last remaining strongholds of Abalone/ Perlemoen (*Haliotis midae)* on our coastline. It is also surrounded by a significant proportion of kelp beds which could be impacted by the heated water plume from the power station. Thyspunt may hold threats to the local chokka squid industry and fishers are justifiably concerned by this threat, which may be measurable from a radiological perspective but which will more likely be impacted by risk related to perceptions about the quality of this product.

There are several other serious shortcomings in the EIA related to the aspects of the marine biology of this project. These include stability of the ocean bottom around each of these sites, which is not dealt with sufficiently. The risk and threats from the proposed dumping of vast amounts of spoil from the land based construction of the sites at sea adjacent to these proposed sites is not adequately dealt with, again especially in light of the fact that the final design of the nuclear reactors is not yet agreed upon.

27 Corrective Action

A more complete analysis of the impacts of this project on the maritime environment must be performed.

Sabotage and terrorism trivialised

In the EIA report potential terrorist acts are considered to be only "perceived risks" and not "real risks".

Yet on 11 April this year 47 world leaders including President Zuma attested that they believe that terrorist gaining access to nuclear material is "the single biggest threat" that the world faces right now. It is therefore a definite certainty that terrorists are planning (and indeed have regularly attempted) to launch military style raids on places where nuclear material is stored. They might be motivated to steal materials to create "dirty

bombs", or to gain access to material that can be further enriched to create atomic bombs or to directly sabotage the NPS and cause massive harm to the surrounding population.

South African sites are potential targets. There can be no doubt about that. In front of a live global TV audience and while sitting next to President Zuma, President Obama specifically mentioned Johannesburg as a potential target.

It is almost inevitable that over the next century there will be attempts to raid this facility. Wilful sabotage by suicidal terrorists is likely to result in damage to multiple systems simultaneously, where the same combination of failures is hugely improbable if caused by accident alone.

28 Corrective Action

Various sabotage and terrorism scenarios must be detailed and all of the associated impacts must be analysed, with reference to the proximity of densely populated areas and the projected growth of the metropolitan area.

Dodging the health regulations

The main content of the specialist report on potential impacts on human health is a description of a process that will be followed at some future date when radiological issues will be analysed for approval by the NNR. Although no actual calculations are performed, the report assumes that the results will show that the NPS does not present any risks to the public. On page 20 the report states:

"For purposes of the EIA, it is assumed that quantified radiological doses through all pathways and routes of exposure at any of the sites with a proposed new NPS will be within the NNR dose limits and dose constraints for public exposure."

To be so confident of this conclusion the authors must have no intention of analysing catastrophic incidents. This is contrary to legal requirements. In the report there is an attempt to misdirect the public about what the legal requirements actually are.

From Page 2 onwards there is long section on the legal requirements in terms of the Draft Regulations on Siting of New Nuclear Installations, 2009. Several paragraphs of the government gazette of 3 July 2009 are quoted verbatim.

But one of the paragraphs is amended, and is presented as follows:

"Analysis of the impact on the public due to normal operations, anticipated operational occurrences and design-basis accidents of the nuclear installation(s) to demonstrate compliance with regulatory dose limits."

The underlined words have been added. The actual content of the regulations that describe abnormal incidents is much more inclusive. It reads as follows:

(4) the identification and specification of characteristics of the site in terms of external events of natural origin or human induced occurring in the region of the particular site. The characteristics shall be monitored and the current and future uncertainties discussed. The design of the nuclear installation must take into consideration the identified and analysed external risk events that potentially can lead to radiation exposure.

The regulations require that "risk events" whether "natural origin or human induced" must be identified and analysed and this is NOT limited to design based accidents.

Clearly the regulations require that the study must include detailed analysis of postulated incidents caused by earthquakes, terrorism, severe accidents, sabotage and operator error.

The same regulations expand on what is required in the analysis, and specify that

"… the Site Safety Report must contain …source term analysis that is representative of the overall potential hazards posed to the public and the environment."

Furthermore "source term" is defined as follows:

"Source term" means the amount and isotopic composition of material released or postulated to be released from a nuclear installation or action as well as the release characteristics and associated data required for the impact analysis."

The regulations are therefore quite clear. Various postulated scenarios leading to catastrophic events must also be analysed, even if these events are associated with low probabilities of occurrence. The actual quantities and isotopes released in such events must be detailed. Numerical values must be calculated to completely describe the spacial and temporal distribution and spread for all types of radionuclides as they move through contamination pathways. This means that the groundwater modelling and the air dispersion modelling must be extended to include the actual concentrations and radio isotopes associated with a full range of postulated release incidents. Thereafter various concentration factors and dose media transfer factors must be applied to calculate estimated exposure levels.

29 Corrective Action

Misrepresenting the requirements is fraud and evidence of bias. The consultants (Japie van Blerk and Willie van Niekerk) must be replaced.

30 Corrective Action

The report indicates an intention to provide less than what the regulations require. There must be an undertaking that the analysis will include due consideration of a full and representative range of postulated "risk events", including low probability catastrophic incidents, whether of "natural origin or human induced"

31 Corrective Action

In order to perform the required calculations on potential impacts on human health, more input data will be required from other specialist studies, including the groundwater contamination, air dispersal and marine biology studies than what is currently in the reports for these studies. These other specialist studies must be extended to included source term data for a full and representative range of postulated "risk events" and correct numerical modelling of the associated dispersal of radionuclides. We recognise that this extension to these other studies may either be part of this current EIA for the DEA or they may be done at a later date in preparation for the submission to the NNR. However we require that there is a commitment that these studies will ultimately be performed, that the reports will be published and that there will be an opportunity for the public to comment.

Wishy-washy methodology

The methodology as detailed in chapter 7 of the EIR should be made more rigorous and use quantitative definitions in the probability and confidence rating systems.

Probability rating system

There are two problems with the probability rating system.

Firstly, words should not be used differently to their normal everyday English meaning.
"Improbable" means less than 50% probability.
"Possible" means greater than zero probability.
"Probable" means greater than 50% probability.
"Definite" means 100% certainty.
In this EIA these words are all used incorrectly.

Secondly, there must be a quantitative boundary separating the two categories of least probability.

One suitable system is presented below as a recommended improvement to the probability rating system. Many other schemes will be equally acceptable. These particular definitions are based on formal hazard analysis methods that have been mandated for the aviation industry and are widely used in other fields:

Original term	Improbable	Where the impact is unlikely to occur
Improved term	Extremely Improbable	Qualitative meaning: So unlikely that it is not anticipated to occur during the entire operational life of an entire system or fleet. Quantitative definition: Probability of occurrence per operational hour is less than 10^-9.

Original term	Possible	Where the possibility of the impact occurring is very low
Improved term	Extremely Remote	Qualitative meaning: Not anticipated to occur to each item during its total life. May occur a few times in the life of an entire system or fleet. Quantitative definition: Probability of occurrence per operational hour is less than 10^-7 but greater than 10^-9

Original term	Probable	Where there is a good probability (< 50 % chance) that the impact will occur
Improved term	Remote	Qualitative meaning: Unlikely to occur to each item during its total life. May occur several times in the life of an entire system or fleet. Quantitative definition: Probability of occurrence per operational hour is less than 10^-5, but greater than 10^-7.

Original term	Highly probable	Where it is most likely (50-90 % chance) that the impact will occur
Improved term	Probable	

Original term	Definite	Where the impact will occur regardless of any mitigation measures (> 90 % chance of occurring)
Improved term	Almost certain	

Reference:
http://en.wikipedia.org/wiki/Hazard_analysis#Likelihood_of_occurrence

Confidence rating system

The degree of confidence is mostly expressed as high. In over 600 identified impacts, the number that are presented as low confidence is only in the thirties. Considering that most of the specialists are in fields sometimes referred to collectively as the "imprecise sciences", this high level of confidence seems most dubious.

This does not imply that the "degree of confidence" expressed in the assessed impacts is wrong, but rather that it is meaningless.

It is of no value to simply categorise the degree of confidence in predictions as low, medium or high without defining what these categories mean. The methodology section needs one additional sentence along the lines of:
"Less than 50% is low confidence and more than 95% is high confidence."

Thereafter all the specialists need to reconfirm their degree of confidence ratings.

32 Corrective Action

Quantitative definitions are required for all categories in the probability and confidence rating systems, and the specialists and reviewers will have to verify their usage of these terms.

Wishful thinking on NPS design and safety

Unknown design

This EIA cannot be adequately complete or correct if the type of the NPS is not known.

In the Economic Impacts section, for example, a "standard cost" for a nuclear reactor is given. (And this is done to eight significant figures!) But there can be no standard cost when the NPS is not specified.

Another example of how this EIA cannot be adequately complete or correct is in the Marine Biology section of the EIR. The Executive Summary states:

"The unintentional release of radiation emissions. Technical design of the cooling system has minimised this risk, so that this impact is rated as having low consequence and low significance."

Yet the design of the cooling system is not available. And even if it was, the Marine Biology specialist might well be a brilliant A grade biologist but he is not in any way qualified to assess the risks associated with the long term structural integrity of complex pressure vessels in saline environments under neutron bombardment. This is another example of biased results based on incomplete information.

A third case in which the detail of the design is must be finalised concerns the impact on wetlands. The details of the layout, location and extent of the excavations must be completed as they are critical to determine the extent of dewatering and hence on the potential risk to wetlands.

The Technology Envelope concept is explained in the Health Report (A rather bizarre place to locate this information) with an explanation that this concept is used in the USA and gives 5 examples of where Early Site Permits have been issued on this basis. However the American Early Site Permit is a preliminary stage in a long process and is not quite the same as what is required here. Final approval has not yet been given for any of these sites. In the American system, and certainly in all of the example cases, the actual data that comprises the Technology Envelope is included at the same stage of the environmental impact assessment that considers issues that are in the scope of the current study such as the thermal effect of the cooling water discharge. This analogy to the American system only reinforces the demand that full design details of all potential options must be presented before this EIA process can proceed any further. This is a difficulty in trying to evaluate many aspects of this EIR, in that without the design being available, the potential impacts can simply not be assessed.

33 Corrective Action

A choice of the actual NPS and full particulars of it's design must be fully defined before the current stage of the EIA process, including the public participation process, can be completed. If more than one design is still being considered then all candidate NPS designs must be fully specified. Crudely specifying a generic class of PWR is far too imprecise to allow the EIA process to proceed further.

Unrealistic assumptions on safety

In the air quality assessment nothing more severe than quite benign accidents with minimal radioactive releases are considered. Anything more serious is assumed to have an annual probability of occurrence of less than one in a million. Indeed if this rosy state of affairs could be proved then the Koeberg Alert Alliance would endorse and welcome the Nuclear-1 project.
Unfortunately this one in a million figure is not based on reality. It bears no resemblance to the actual history to nuclear accidents. And it is not based on any specific NPS design.

Even if it was based on a specific design the probability of an accident as estimated by the companies marketing the NPS cannot be taken on face value without being tempered by the observable history of nuclear accidents. Even the supposedly neutral American Nuclear Regulatory Commission is notoriously

inaccurate in it's estimates of the probability of nuclear accidents. For example in 1979 the NRC staff produced a document entitled, "Probabilities That The Next Major Accident Occurs Within Prescribed Intervals." It stated that it is not likely that there will be a major accident within the next 400 years. Less than three weeks later the NPS at Three Mile Island suffered a meltdown.
(Ref http://www.greenpeace.org/usa/news/the-probability-of-a-nuclear-a)

Quite apart from accidents caused by improbable simultaneous multiple system failures, there are other possible causes of catastrophic incidents, namely deliberate sabotage, terrorism and gross operator error.

34 Corrective Action

Catastrophic incidents cannot be considered to be too improbably to occur. When the EIA is extended to included all matters related to radioactivity, then catastrophic incidents must be included in ALL sections of the EIA that deal with potential impacts of the development on the biophysical, social and economic environments.

Unacceptable risks to unique ecosystems

All three of the proposed sites are in pristine locations of extremely rare and valuable ecosystems. The south-western coastline of South Africa is one of the world's most precious ecosystems with a higher concentration of rare and endangered plants than any area anywhere else in the world. And these particular three sites are extremely rich even by the standards of the fynbos biome. If in any other country in the world an area of 30 hectares with an equivalent concentration of rare and endangered plants to any one of the three proposed sites were to be discovered, then those 30 hectares would immediately be proclaimed as that countries most highly prized botanical reserve.
The EIA report understates the significance of the damage that will be done to these ecosystems. Furthermore in the conclusions and summaries of the EIA report the opinions of the specialists have been softened. It gives the impression that the loss of these ecosystems is quite acceptable. For example on page 10-4 is the most outrageous statement that "the ecosystems on this site are fairly common along this section of coastline".
In the specialists reports the level of concern is much higher. What is most clear from within the details of their reports is that these areas should be conserved and not developed at all. These reports include long lists of red data species and have quotes like the following from Prof Richard Cowling: "This must rank as amongst the most extreme concentrations of point endemism anywhere in the world".
The EIA summary report also overrates the extent to which potential mitigation efforts could reduce this damage to these ecosystems. Simply sending in a team to collect rare plants before the bulldozers are sent in to destroy an ecosystem is just not an acceptable mitigation plan.
Likewise the suggestion that the land surrounding the NPS that is owned by Eskom won't be developed but will be retained in its pristine condition is also not a valid mitigation strategy. The entire area must not be developed by anyone for any purpose. It is inconceivable that if the NPS does not get built then the DEA would allow the same land to be developed for some other purpose.
It is also particularly worrying that the specialists state that they have been given inadequate time and money to do the assessment properly.

35 Corrective Action

All three sites are too valuable to be developed. This is clearly the impression of the vast majority of natural scientists who are familiar with these areas. The EIA must be rewritten to reflect their views more accurately, and the relevant specialists must be given the time and resources required to do their jobs properly.

Inadequate consideration of alternative options

The EIA's discussion of alternatives is skimpy, biased and erroneous. Without any analysis the reports makes the following false assertion (On page 4-6):

"At present, identified renewable forms of energy, for example wind and solar, are, due to intermittent supply and lower load factors are unable to equal viable large scale power generation facilities capable of supplying a reliable base load and being easily integrated into the existing power network in South Africa."

In the economic impact assessment report the same error is repeated more plainly:

"renewable forms of energy, for example, solar, cannot supply base-load power stations"

This statement is not backed by research or references. In fact, we have found references which indicate concentrated solar power can provide base-load power:
A capacity factor of 74% is described in
http://www.nrel.gov/csp/troughnet/pdfs/2007/martin_solar_tres.pdf
In an Eskom presentation, Louis van Heerden, PhD, estimated a capacity factor of approximately 70%, see
http://ww.dme.gov.za/pdfs/energy/renewable/
According to Eskom's annual report for 2009, the average capacity factor (also known as load factor) across all power plants was 67,0%. This indicates that a concentrated solar plant would be able to exceed the current average capacity factor.

Since according to Eskom, base load generation is defined as having a 70% or greater capacity factor, it is clear that based on information from Eskom itself, the above statement about solar energy being unable to supply base load power is patently false. It appears that this statement has been uncritically accepted by the consultants, indicating either a lack of thoroughness or a disturbing bias towards the applicant.

In several countries, for example Spain, existing nuclear plants are to be phased out entirely, and they plan to make up the shortfall in power generation capacity primarily by greatly expanding renewable energy usage. If wind and solar power can play such a major role in Spain, the same can happen in South Africa.

Perhaps the biggest flaw in this EIA is that the downstream economic consequences have been so poorly analysed.

If South Africa builds an NPS then in excess of one hundred billion Rand will be spent offshore.
On the other hand if any other power source is developed to an equivalent scale then, with appropriate industrial development programmes set in place, a similar huge quantity of capital can largely be kept within this country to stimulate the local economy and create jobs. Job creation is not only the top priority of our government now, but is also stated as one of the primary reasons why supporting the development of renewable energy is a major policy of many governments around the world.

A further economic advantage of pursuing renewable energy is that much of the cost will be subsidised by carbon trading schemes, and this will result in a net flow of capital into South Africa.

The environmental consequences of alternatives to the development are also improperly analysed. The following is from page 9-274:

"It should further be noted that should Eskom not utilise the sites for nuclear development, it is likely to sell the properties, pending a decision by the Eskom Board. The sale of the properties will be to a willing buyer

at the market-related price, which would probably result in an alternative form of land use that may be more damaging than a nuclear power station. "

This is a really spurious argument. If the DEA rejects the proposed development on the grounds that the damage to the environment does not justify the benefit to the economy that will come from 4000 MW of generating capacity it is inconceivable that they will allow any other more damaging development on the same land, regardless of who owns it. This statement highlights the extraordinary level of bias of the author(s).

36 Corrective Action

Throughout this EIA the all of the existing descriptions of alternative options to how the land could be used and to how the equivalent power could be generated must be replaced with more thorough, objective and factually accurate analyses.

Conclusion

The EIR has a legal requirement to be correct, complete and unbiased. Unfortunately, our review has determined that it meets none of these requirements:

Objectivity: It is biased in favour of the development.
Correctness: We have identified many errors.
Completeness: Much information and analysis is missing.

As it stands, this EIR is fatally flawed.

In this document thirty six numbered "Corrective Actions" are identified, and we insist that all of these items must be addressed. Thereafter a new draft of the entire environmental impact report must be prepared and made available for public comment again.

Contributors to this submission include:

Robert Isted M.Sc. Eng (Cape Town)
Peter Becker B.Sc (Cape Town), B.Sc. Hons (UNISA)
Andreas Spath M.Sc. (Cape Town), PhD Geology (Cape Town)