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Attention: Koeberg Action Alliance (KAA)

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)

Johannesburg

14 Eglin Road
Sunninghill 2191
PO Box 2700
Sunninghill 2128

Tel: +27 11 519 4600
Fax: +27 11 807 5670
Web: www.gibb.co.za

Dear Sirs

ESKOM ENVIRONMENTAL IMPACT ASSESSMENT (EIA:12/12/20/944) FOR A PROPOSED NUCLEAR POWER STATION AND ASSOCIATED INFRASTRUCTURE: COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Your correspondence to Ms. Bongji Shinga of ACER (Africa) refers.

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

Responses to your comments / questions are as follows:

1 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.

2 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".

Response (1)

The assessment of radiological dose in the EIA report was conducted as a qualitative assessment, considering that the quantitative assessment will be performed as part of the Safety Case through the licensing process with the National Nuclear Regulator (NNR) in accordance with the National Nuclear Regulator Act (Act 47 of 1999). In terms of the National Nuclear Regulator (Act 47 of 1999), no person may site, construct, operate, decontaminate or decommission a nuclear installation, except under the authority of a nuclear installation licence. Regulation on Safety standards and regulatory practices (R388) sets out the principal radiation protection and nuclear safety requirements that must be met by an applicant of the Nuclear Installation License. This includes the dose and risk limits, dose constraints, optimisation of radiation protection and nuclear safety, good engineering practise and a Safety culture. The DEA have indicated that consideration of radiological issues as part of an EIA process will result in unnecessary and avoidable duplication of work and based on the agreement between DEAT and the NNR. Any authorisation granted for nuclear installation would accordingly be conditional on the necessary nuclear license being in place.

The NNR's licensing process does further make provision for public hearings and is subject to the provisions of the Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000), as are all authorisation processes to which the public has access. The NNR's process is therefore required to be an open and transparent process. The agreement between the DEA and the NNR indicates that the

DEA would not “make a pronouncement on the acceptability” of radiological safety issues, and that this issue falls firmly within the ambit on the NNR licensing process. However, at the DEA’s request, information relevant to radiological safety issues has been included in the Draft EIR and it is expected that DEA will consider this information prior to deciding on an authorisation.

It is not for this EIA process to question the legality of the NNR’s mandate, or to question the legality of the NNR / DEA co-operative governance agreement. The NNR’s mandate was conferred on it by an Act of Parliament. If you have an issue with the NNR’s mandate, we strongly recommend that you raise this issue with the relevant Government Departments directly.

Your comment (2)

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.

Response (2)

We note your comments that a different approach has been taken for radioactive matter that is potentially released into different media. It is appropriate that different approaches are taken, since the impacts on these media need to be assessed by the relevant subject specialists. It would, for instance, be inappropriate for an air quality specialist to assess the impacts of radioactivity on marine organisms.

- Discharges into the air
Whilst the Air Quality Assessment (Appendix E 10 of the Draft EIR) did not assess “catastrophic” incidents, it has assessed Design Basis Accidents in Section 3.3.2(c). The assessment of catastrophic events is within the ambit of the NNR licensing process however Catastrophic incidents are related to Emergency planning, one should not forget that Eskom is using the EUR requirements at this point in time and that Safety objectives of the new generation NPS envisaged for ESKOM entail enhanced safety design features when compared to most existing operating nuclear reactors in the world today. Design features are included in these reactors to practically eliminate severe accidents and to enable simplification of the emergency planning and off-site countermeasures.y

- Leakage into groundwater

It would be appreciated if you could provide motivation for the statement that “the analysis is faulty”. Without a proper motivation for this statement, it is not possible to verify your opinion in this regard.

- Radioactive waste transported from the site
Radioactive waste being transported from the site has been assessed in a Radioactive Waste Management study that forms part of the Revised Draft EIR.
- Cooling water released into the sea;
The impacts of cooling water released into the sea have been assessed in the Marine Biology Assessment, based on the experience at Koeberg Nuclear Power Station.

It would be appreciated if the author could indicate where is it stated in the report that this case is only included because the analysis showed that the results would be insignificant. Perhaps the writer could also propose an alternative approach to go about doing what he/ she considers an “accurate” analysis of this scenario.

With regards to potential radiation leakages, it must be considered that safety objectives of the new generation power station envisaged for Eskom entail enhanced safety design features when compared to most existing operating nuclear reactors in the world today. Design features are included in these reactors to practically eliminate severe accidents and to enable simplification of the emergency planning and off-site countermeasures.

Lastly catastrophic incidents are related to Emergency planning, one should not forget that Eskom is using the EUR requirements at this point in time and that Safety objectives of the new generation NPS envisaged for ESKOM entail enhanced safety design features when compared to most existing operating nuclear reactors in the world today. Design features are included in these reactors to practically eliminate severe accidents and to enable simplification of the emergency planning and off-site countermeasures.

Your comment (3)

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.

Response (3)

Radionuclide fall-out over the ocean has not been identified as a significant issue that warranted investigation at any of the proposed sites. The Marine Assessment (Appendix E 15) further reports that due to the design of the proposed Nuclear-1 plant, coupled with the experience gained at KNPS, there is no reason to anticipate that contamination by radionuclides would occur as a result of the Nuclear-1 development. The Koeberg Nuclear Power Station has been in operation for some 30 years and there are three operational well fields and a major unconfined aquifer in relatively close proximity. Two of these well fields form part of the City of Cape Town's domestic water supply network to the

Greater Cape Town Area. To date there has been no evidence that emissions from the Koeberg Nuclear Power Station have had any measurable effect on these features. Local groundwater close to the reactors shows somewhat elevated tritium levels compared to background but well below being anywhere near levels of concern for health impacts.

No specific assessment of the impacts of atmospheric radioactive fallout into the ocean has been conducted. However, radioactivity in marine organisms has been monitored at Koeberg since before the nuclear power station was constructed to determine the background levels of radioactivity. It is also conducted to determine any potential impacts from Koeberg itself from any potential pathway, including the atmosphere or directly into the sea. The amendment of the Marine Biology Report (Appendix E15 of the Revised Draft EIR) states that due to radionuclides having been recorded in very few individual organisms at Koeberg Nuclear Power Station, the low concentrations at which they have been recorded at, **and the fact that compounds at equivalent levels of radioactivity have previously been recorded in these species under natural conditions**, these findings are not considered indicative of any significant impact on marine organisms resulting from the power station's operation.

Your comment (4)

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.

Response (4)

The transport of radioactive waste has been assessed by AQUIsim in their report "*The Management of Radioactive Waste*". This report will be made available for comment and review as part of Appendix E of the Revised Draft EIR.

With regards to your response that High Level Waste (HLW) will be transported to Vaalputs, that this site is not an approved site for high level waste. Although it is being considered to license it for high

level waste, no such application has yet been lodged. It is, therefore, not a certainty that HLW will be transported there.

Low and Intermediate Level Waste (HILW) is specially treated and contained before being transported to Vaalputs. The containers in which it is transported are designed to withstand the conditions of transport and disposal at Vaalputs, under strict conditions set by the National Nuclear Regulator.

Please refer to Response 2 above regarding the difference in approach of the specialist studies.

The study deals with the suitability of the sites for nuclear power stations and the studies are thus site-specific. Aspects that may influence the suitability of a site may be the meteorological conditions, proximity of sensitive receptors, seismic issues, etc.

The issue of "abnormal accident scenarios" are dealt with in design specifications of a reactor, including for example various levels of precaution (defence-in-depth), safety interlocks etc. Complex and thorough procedures of analysis of the entire safety case are followed. These considerations are not site-specific and do not belong in the assessment of the suitability of a site, which is what the EIA report is about. Similarly, transport and disposal of radioactive waste would not influence the suitability of a site for a nuclear power station.

These issues will all be addressed in the licensing process with the NNR, but not at the level where the assessment is for the suitability of a site.

Your comment (5)

Corrective Action

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

Response (5)

Your comment is noted. All specialists reports and other responses later in this document do not support major revision of report. The Environmental Assessment Practitioner and all specialists have signed declarations of interest and have formally declared their objectivity in terms of the compilation of the reports and the assessment of the significance of impacts.

Your comment (6).

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.

Response (6)

Your comment is noted but as previously stated, this issue falls within the ambit on the NNR licensing process and will be addressed in a separate application for Nuclear Licensing. The inclusion of the specialist reports that deal with radioactivity (for information) is based on the DEA / NNR co-operative agreement, as well as the guidance of the DEA. Please refer to Response 1.

Your comment (7)

3 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.

Corrective Action

Table 9-20: Impacts on wetlands

Access roads during construction. This is not short term.

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.

Corrective Action

Table 9-28: Impacts on air quality

Construction stage Gaseous, Particulate Matter and Fallout. This is not short term.

Corrective Action

Table 9-43: Noise impacts. These are not short term impacts:

- Noise impacts of site works and construction
- Impact of transportation noise.

Corrective Action

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

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

Response (7)

The assessment criteria have been revised as part of the Revised Draft EIR as follows:

- Short-term: 0 – 3 years
- Medium-term: 4 - 8 years
- Long-term: > 9 years – permanent.

Thus, in general, impacts relating to the construction phase are regarded to be medium-term impacts, as the construction phase will last up to 9 years. Where necessary, the consequence and significance of assessments of impacts have been revised accordingly.

Your comment (8)

4 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.

Response (8)

The Seismic Hazard Impact Assessment Report is clear about the fact that the results presented were compiled using a methodology that no longer conforms to international best practice. However, it should be remembered that it is because of a change in regulations which took place after the compilation of the PSHA values.

The requirement Eskom puts upon itself to undertake a new PSHA, following an approach corresponding to the latest international best practice, should therefore be seen as a proactive step in ensuring conformance with this best practice. It is also important to note that the international

regulatory benchmark used by Eskom (that of the United States Nuclear Regulatory Commission or US NRC) represents the most stringent, detailed, tried and tested set of regulations in the world and that there are several developed countries that does not yet comply to it; including countries with much larger nuclear fleets than South Africa.

A substantial change in the regulatory environment came about with the publication of Regulatory Guide (RG) 1.208 of the US NRC in 2007. However, while no longer conforming to current internationally regulatory practice, the work presented in the report has been subjected to international peer-review and was accepted by the NNR at the time that it was undertaken. It is also worth noting that while the additional reviews following the publication of RG 1.208 raised some concerns regarding the compatibility of the methodology employed with the requirements of this regulatory guide, they also highlighted the value and conformance to best practice of the large body of geo-scientific investigations undertaken to date.

The existing information can therefore be used to draw informed conclusions regarding the suitability or otherwise of the sites in question for the development of a NPS. The exact value of ground motion at the site, while a key input to the engineering design of any planned nuclear facility, does not in itself constitute a qualifier/disqualifier for a site. As noted above, the engineering design will be informed by the results of a new PSHA complying with the regulations of RG 1.208. These results are required by the engineers to define the appropriate design loads, however their exact values are not required to make the statement that such engineering-based mitigation measures exist, since this can be inferred from experience in the seismic hazard assessment and seismic design of other nuclear reactor sites in regions characterised by levels of seismicity, and thus expected levels of seismic hazard, comparable to or higher than those encountered in South Africa, such as California and Japan.

The principal disqualifier for any site would be the discovery of a potentially seismically active geological structure at the site or within its immediate vicinity (8 km radius), the reason being that there is currently no satisfactory engineering solution to mitigate the risks related to permanent displacement of the ground caused by surface rupture. An appreciable body of work and investigations carried out over several years by a team of geologists and seismologists has not yet yielded any conclusive evidence as to the presence of such a structure, which is what is reflected in the conclusion of the report. Nevertheless, the investigators acknowledge the limitations inherent to the data and methodology employed so far and the Seismic and Geological Hazard Impact Assessment reports are quite clear about the fact that not all the questions regarding the geological environment have been resolved and that there is therefore a need for additional work to reduce remaining uncertainties.

As noted in the Seismic Hazard Impact Assessment Report, a new PSHA will be undertaken for all three sites, following a SSHAC Level 3 process. Such a PSHA was to start in 2009 and preparations for this work were already made in 2008, but unfortunately it had to be postponed due to financial constraints. The SSHAC Level 3 PSHA should take two to three years to complete and will utilise a multi-disciplinary and multi-national team of scientists. Specialists within the project team will interact with various national and international experts at project workshops, to ensure that the information included in the PSHA encompasses the centre, body and range of the views and interpretations of the informed technical community. The entire process will be reviewed by a Participatory Peer-Review Panel (PPRP) composed of internationally recognised specialists, whose collective experience and expertise covers all technical aspects of seismic hazard assessment, and specifically the execution of seismic hazard studies within a regulatory context for critical facilities such as NPPs, as well as the study of geology, seismicity and seismic hazard in South Africa and other stable continental regions. The PPRP provides independent review of process and technical assessments in the project.

In summary, while it is acknowledged that the PSHA needs to be redone using a different methodology, several years of seismological and geological investigations have not yet yielded any evidence that would irrevocably prove that Duynefontein is unsuitable for the development of a nuclear facility in accordance to current guidelines and regulations. A decision that Duynefontein should be

discarded as a potential NPS site can therefore not be made on that information alone. However, the existing information can be used to draw informed preliminary conclusions regarding the suitability of the sites in question for the development of a NPS.

Your comment (9)

Corrective Action

There must be clarity about whether any new and additional work (theoretical or field-based) had 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.

Response (9)

It is incorrect to assume that the Seismic Hazard Impact Assessment Report is based on the PBMR DPP report. Both these reports are based on the seismic hazard analysis done prior to 2004.

No new Seismological Risk Assessment was completed since 2007, although geological investigations, including marine surveys, that will be relevant to future PSHAs, continued in 2007 – 2009. Work also continued on the South African seismic catalogue. The reason for this apparent inactivity is that publication in 2007 of Regulatory Guide (RG) 1.208 of the United States Nuclear Regulatory Commission (US NRC) negated the utility of any additional Seismic Hazard Analysis (SHA) using the methodology then in place. Instead, a completely new PSHA, following a different methodology, was required. In 2008 preparations were made for a PSHA, following the SSHAC Level 3 methodology, which was to start for each of the three sites in 2009. Unfortunately the new PSHAs had to be postponed because of financial constraints.

As discussed in the response to comment 8 above, the results presented in the Seismic Hazard Impact Assessment Report summarise a large body of work carried out over several years. The determination of the ground-motion levels by the PSHA (still pending) does not in itself constitute a qualifier/disqualifier for site selection, although it is a key input for design and appropriate engineering mitigation of the risk.

Your comment (10)

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".

Response (10)

We fully agree with the statement that the current uncertainty regarding the source of the 1809 to 1811 (two larger aftershocks occurred in January and June 1811; nothing of note happened in 1810) earthquake sequence does not preclude the recurrence of a similar event in future, which is why, although more detailed work has still to be undertaken, the available information on these seismic events has nevertheless been incorporated in the PSHA.

It is standard practice when undertaking a SHA to consider both well-defined sources of seismicity (i.e. capable faults) and areas of diffuse seismicity (i.e. areas where no specific seismic source could be identified). The use of area source zones to model diffuse seismicity is particularly common in SHAs for regions of low seismicity, where correlations between geological structures and observed patterns of seismicity are difficult to establish. Hence, the fact that no source could be identified for 1809 to 1811 seismic events in Cape Town, does not mean that it was not considered in the PSHA, which integrates probabilistically over all possible earthquake scenarios (in terms of location and size) that affecting the vibratory ground motion hazard at the site.

Similarly, it is a requirement that any tectonic feature that has been active in the last ~ 50,000 years, or shows signs of repeated activity within the last ~ 500,000 years has to be considered in a SHA for critical facilities. The possibility of a recurrence of the Cape Town seismic event was therefore not avoided in the report, but was one of several seismic sources considered in the Duynefontein PSHA.

The future PSHA for Duynefontein will follow the SSHAC Level 3 methodology and will utilise a multi-disciplinary and multi-national team of scientists. During the course of this PSHA all the available data will be reviewed and it is expected that additional geological investigations, focussing on specific geological problems, will be required to decrease the uncertainties that have to be considered and incorporated into the PSHA. While it is expected that these studies will include work on the 1809 to 1811 seismic events and questions regarding the postulated Milnerton Fault, it is impossible for the

current report to predict or prescribe the nature of the studies that will have to be undertaken in future. Hence we merely note that the questions previously raised regarding these, have not yet been investigated.

Your comment (11)

Corrective Action

Extensive and detailed new work must be done to resolve this issue as recommended by the previous Pebble Bed Modular Reactor report

Response (11)

As outlined above, a new PSHA will be undertaken for Duynefontein following the SSHAC Level 3 methodology. During the course of this process all available data will be assessed by a multi-disciplinary (and multi-national) team of scientists and a review panel. Based on this review the necessity for any new field investigations to identify and characterise significant seismic sources, will be established. While the authors of this report expected that these studies will include work on the 1809 to 1811 seismic events and the postulated Milnerton Fault, it is outside the scope of the current report to predict or prescribe the nature of such studies.

Your comment (12)

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.

Corrective Action

Additional quantitative parameters of seismic risk assessment must be determined.

Response (12)

It should be highlighted that these values were reported are distinct from the values that are eventually going to be used in the engineering design of a new facility at the Duynefontein site. Furthermore, the expected value of ground-motion at a given site, while an important site characteristic and key design input, does not in itself constitute a disqualifier for a given site, since the effects of vibratory ground-motion can be mitigated by appropriate engineering design, as evidenced by the existence and

successful operation of nuclear power reactors in regions with generally higher levels of seismicity and thus higher expected seismic hazards levels, such as California and Japan.

The scarcity of quantitative scientific data is one of the main challenges for the performance of seismic hazard assessments in regions of low-seismicity, and one of the main drivers for the development of methodologies to address the treatment of uncertainties, such as those included in the SSHAC approach, which will be followed in a new PSHA undertaken for the Duynefontein site. The results from this study will form the seismic hazard baselines to be considered in the design of a new facility at the Duynefontein site. Note that a mere statement of the statistical error associated with a given model is insufficient to quantify these uncertainties, which need to include all aleatory (related to randomness) and epistemic uncertainties (related to incomplete data and knowledge).

The outcome of the SSHAC Level 3 PSHA will be a set of hazard curves for PGA and spectral response ordinates at selected structural periods; these curves relate the values of the ground-motion parameter to the expected annual frequency of exceedance. Aleatory uncertainties are incorporated through explicit integration over the probability distributions of key input parameters such as earthquake magnitude, location, and ground-motion amplitude; these uncertainties are reflected in the shape of the hazard curves. Epistemic uncertainties are addressed through the consideration and ranking of alternative models and interpretations selected to represent the centre, body and range of the informed technical community, and reflected in the distribution of the fractiles of the hazard curve distribution. In other words, for a given ground-motion parameter (e.g. PGA), the PSHA will provide a set of hazard curves representing the full range of values implied by the underlying analysis; the level of confidence associated with the results is reflected in the choice of the hazard curve (mean, median or some other fractile) selected to represent the inputs for design.

Your comment (13)

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.

Corrective Action

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

Response (13)

We agree with the proposed corrective action. Since Eskom has stated that it will follow the US NRC regulatory guidance, it has placed a requirement on itself to conduct a new PSHA for Duynefontein (and the other nuclear sites) following the SSHAC Level 3 methodology. Note that one of the features of the SSHAC methodology is to ensure the longevity of the results by taking into account the composite view of the informed technical community. Such a study is expected to take between two and three years to complete.

Your comment (14)

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.

Corrective Action

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

Response (14)

The issues raised in this comment have already been addressed in the response to comment (12). The results of the SSHAC Level 3 PSHA to be undertaken at the Duynefontein site will include a full quantification of the aleatory and epistemic uncertainties associated with the inputs.

Your comment (15)

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”

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 than 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.

Response (15)

Several variables need be considered when determining seismic hazard for a specific site. For example these include the tectonic environment, the seismic sources that should be considered, their recurrence of seismic activity, the maximum credible size of any future events and the ground motion prediction equations (GMPE) used to calculate the level of ground motion at any specific site.

The PSHA done for Duynefontein, using the parametric-historic approach and more recent GMPEs yielded PGA values of 0.27 g, similar to that reported for the then planned Pebble Med Modular Reactor. A PGA of 0.3 g was originally established for Duynefontein, based on the design value determined for Koeberg by Dames and Moore (1974, 1976, 1980, 1981). Since the SHA for Duynefontein was regarded as reconfirmation work and the PGA value of 0.27 g only confirms that the design parameters of the Koeberg plant was still valid, the 0.3 g PGA was maintained as a baseline value.

The baseline values that will be used in the engineering design will be the results of the SSHAC Level 3 study, which will incorporate full consideration of all uncertainties associated with the inputs, as mentioned in responses to other comments (12 to 14). These values will supersede the values cited in the comment above.

Your comment (16)

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.

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.

Response (16)

It would be incorrect to assume that the PGA values cited in the Seismic Hazard Impact Assessment Report represent the information that will eventually be utilised by engineers, as the publication of RG 1.208 meant that the engineers will be informed by a new PSHA. The introduction of new regulations means that the SHA has to be repeated according to the SSHAC Level 3 process, and the results of this will be used to inform engineering design. Preparation for this work has commenced.

As noted above, the engineering design will be informed by the results of a new PSHA complying with the regulations of RG 1.208. These results are required by the engineers to define the appropriate design loads, however their exact values are not required to make the statement that such engineering-based mitigation measures exist, since this can be inferred from experience in the seismic hazard assessment and seismic design of other nuclear reactor sites in regions characterised by levels of seismicity, and thus expected levels of seismic hazard, comparable to or higher than those encountered in South Africa.

Your comment (17)

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?

Corrective Action

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

Response (17)

The report represents a summary of a much larger body of work carried out over several years by a team of geologists and seismologists. During that time the geological and seismological data utilised in the SHA was subject to external peer review. The PSHA methodology was published in peer-reviewed, international, scientific journals and furthermore subjected to review by internationally recognised scientists. In the case of Duynefontein this work confirmed that the design parameters of the Koeberg plant were still valid and hence a 0.3 g PGA was maintained as a baseline value.

The current report clearly states that the SHA work has not yet been finalized, since a change in regulations requires a new investigation to be undertaken, following an entirely new approach. Nevertheless, all completed work presented therein had been subjected to international peer review, and accepted by the NNR.

Note that the new PSHA to be undertaken at the Duynefontein site will follow a SSHAC Level 3 process, which in particular implies that the information included in the PSHA encompasses the centre, body and range of the views and interpretations of the informed technical community. This is ensured by interaction of experts representing alternative models at project workshops, as well as monitoring through a Participatory Peer-Review Panel (PPRP) composed of internationally recognised specialists, whose collective experience and expertise covers all technical aspects of seismic hazard assessment, and specifically the execution of seismic hazard studies within a regulatory context for critical facilities such as nuclear power stations, as well as the study of geology, seismicity and seismic hazard in South Africa and other stable continental regions. The PPRP provides independent review of process and technical assessments in the project. This is achieved through participation at the formal Project Workshops and the issue of timely reports on each of these, as well as providing reviews of the draft and final PSHA reports.

Your comment (18)

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.

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.

Response (18)

The fact that the SHA for the three proposed nuclear sites will have to be repeated following an entirely new methodology (SSHAC Level 3), is mentioned several times in the Seismic Hazard Impact Assessment Report and it should be abundantly clear that this report does not present the final PSHA results for Duynefontein, Bantamsklip and Thyspunt. The report is also quite clear about the fact that the methodology employed no longer conforms to international best practice due to a change in the regulatory environment that occurred after the work had been completed. It is similarly clear in stating that steps are being taken to remediate this issue, which only concerns the methodology used in the SHA, but not the validity of the large body of geo-scientific data and information gathered over the years.

It should also be noted that the international regulatory benchmark referred to in the report represents the most conservative and detailed set of regulations in the world and there are several developed countries that do not yet comply to it; including countries with much larger nuclear power plant fleets than South Africa. Nevertheless, Eskom has committed itself, and alerted the NNR to the fact that it will implement a PSHA for each site following the SSHAC Level 3 methodology and only time and financial constraints prohibited it from completing such a study.

However, this does not mean that no informed conclusions can be drawn regarding the suitability or otherwise of the sites in question for the development of a NPS. As noted above in responses to other comments, the exact value of ground motion at the site, while a key input to the engineering design of any planned nuclear facility, does not in itself constitute a qualifier/disqualifier for a site. The existence of engineering mitigation measures against vibratory ground-motion hazard can be established from international practice and experience in this field, including in regions with higher levels of seismicity, and thus generally higher levels of seismic hazard, than South Africa. The principal disqualifier for any site would be the discovery of a potentially seismically active geological structure at the site or within its immediate vicinity (8 km radius), the reason being that there is currently no satisfactory engineering solution to mitigate the risks related to permanent displacement of the ground caused by surface rupture.

The appreciable body of work and investigations that have been carried out at the Duynefontein site since the 1970s has not yet yielded any conclusive evidence as to the presence of such a structure. This is reflected in the conclusion of the report. Nevertheless, the investigators acknowledge the limitations inherent to the data and methodology employed so far and once again the Seismic and Geological Hazard Impact Assessment reports are quite clear about the fact that not all the questions have been resolved and that there is a need for additional work before the green light can be given for the development of a NPS at any of these sites.

Your comment (19)

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.

Corrective Action

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

Response (19)

The risk of tsunamis to the proposed power station has been assessed in the Oceanographic Assessment (Appendix E16 of the Draft EIR). The finding of this study was that there is a potential for water levels to exceed the proposed elevation of the nuclear power station at all three sites should a tsunami coincide with extreme meteorological conditions (a meteo-tsunami event). The occurrence of a tsunami is, however, improbable given the low risk of seismic activity in the surrounding ocean. The impacts of these will therefore be considered and incorporate in the Site Safety Reports.

As responded in comment 12 above_the_SSHAC Level 3 PSHA to be undertaken in the future will include a full quantification of the aleatory and epistemic uncertainties associated with the inputs.

Your comment (20)

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 person(s) who performed this part of the study along with their CV's and statements of independence should also be made available.

Response (20)

The numerical modelling work was carried out by Dr Ingrid Dennis of the IGS, University of the Orange Free State. She has a BSc in mathematics and applied mathematics and Honours, MSc and PhD in geohydrology and 17 years of experience. She is widely regarded in the geohydrological community in SA as one of the country's leading modellers. Her work was reviewed by Prof Gerrit van Tonder of UOFS who has a BSc Hons in geohydrology and MSc and PhD in geohydrological statistics and data analysis. The modelling was also reviewed by Peter Rosewarne and Richard Connelly (SRK UK). CVs are attached.

Your comment (21)

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.

Response (21)

Please indicate in what way the sections referred to above are flawed. Tritium is specified in the report as the indicative radionuclide being modelled (p 39), its half life (p 19) and quantity are all stated. It is stated that this modelling is of a qualitative nature at this stage. The modelling period is 20 years for illustrative purposes.

Your comment (22)

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.

Response (22)

With what reference model is the writer comparing the EIR model to conclude that a 50 x 50 m grid is "quite coarse"? There is no point in adding more layers when there are only three main ones in the natural system. Adding more layers also adds to the complexity of the model and may lead to a model that is more detailed/complex than the input data warrant. Standard modelling procedures were used to assess the stability of the chosen grid size and time steps.

Your comment (23)

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.

Response (23)

The fractured aquifer is not the aquifer of importance on the regional scale. The most important one is the upper unconfined primary, Atlantis Aquifer. Fractures will only play a role if there is groundwater abstraction from the fractured aquifer in the vicinity of the proposed NPS.

Your comment (24)

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.

Response (24)

A sensitivity analysis was done and T was found to be the most important parameter. The values used for recharge and porosity are all within ranges of the numerous previous studies carried out by other independent researchers in the area. The Atlantis Aquifer is one of the most researched aquifers in South Africa and there are numerous reports and theses documenting the aquifer parameters.

Your comment (25)

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.

Response (25)

Transmissivity in an aquifer such as the Malmesbury Group fractured aquifer varies naturally and it is not possible or necessarily desirable to “get more consistent results”. Having T values varying between 5 and 180 m²/day is not a sign of poor or inadequate data gathering – it is a function of aquifer anisotropy and heterogeneity. For example, it is stated in the EIR that the value of 5 m²/day is related to the matrix whereas the higher values relate to fractures. If the T values had all been computed to within a narrower range of say 5-10 or 170-180 m²/day then that would have been more indicative of spurious results than the ones actually obtained in the author’s opinion.

Your comment (26)

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 1 or 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.

Response (26)

In geohydrology there are only three parameters that can be physically measured – borehole yields, groundwater electrical conductivity (and chemical content) and water levels. All other key parameters, such as transmissivity, storage and recharge, have to be estimated from some form of analytical/numerical process. Geohydrology is therefore an inexact science in which the experience and expertise of the geohydrologist plays a large part (Peter Rosewarne, the geohydrology team leader, has 34 years of experience). The only “knowns” for input parameters in any groundwater model carried out anywhere in the world can only be the above three parameters – everything else is by definition an unknown whose values are derived by lab analyses, field tests, data analysis and use of text book examples or previous work and application of experience. Transmissivity in an aquifer such as the Malmesbury Group fractured aquifer varies naturally and it is not possible to “get more consistent results”. Having T values varying between 5 and 180 m²/day is not a sign of poor or inadequate data gathering – it is a function of aquifer anisotropy and heterogeneity. For example, it is stated in the EIR that the value of 5 m²/day is related to the matrix whereas the higher values relate to fractures.

The calibration process followed is standard and documented in many guidelines, e.g. Spitz K and Moreno J (1996). *A Practical Guide to Groundwater and Solute Transport Modelling*.

Your comment (27)

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?

Response (27)

The rise in sea level was input into the digital terrain model to obtain the projected position of the new coastline. This was then input into the model as the new western boundary with an elevation of 0 m amsl and the model was re-run.

Your comment (28)

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.

Response (28)

The Groundwater Monitoring Programme commenced at the start of 2010 and will be finalised at the end of 2010. The results will be incorporated in the Revised Draft EIR and the specialist report has been updated accordingly for inclusion in the Revised Draft EIR.

The best way to improve the confidence in a groundwater model is to collect time series data. An extended groundwater/wetlands monitoring programme was thus initiated by Eskom at all three sites in February 2010, scheduled to run for at least one year. Additional boreholes/piezometers have been established and continuous data loggers installed. The monitoring database was updated on a monthly basis and further flow modelling will be done to input the new data and assess any changes to predicted impacts. This work was carried out jointly with the wetlands specialist. Monitoring is of the utmost importance to ensure that confidence in the results obtained can be improved.

Your comment (29)

To this list should be added:

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.

Corrective Action

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

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.

Corrective Action

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

Response (29)

Corrective action 1

Geophysical surveys were performed. Geological boundaries are sufficiently well defined.

Corrective action 2

It is not possible to “measure” transmissivity and there is no way to determine whether T values derived from a study, no matter how detailed, are “accurate”, only whether they conform to widely published or accepted ranges.

Corrective action 3

MODFLOW is the most widely used numerical flow modelling package internationally for application to groundwater flow studies/problems. It has also been used by the US Geological Survey for simulations of groundwater and contaminant movement for the Nevada Test Site and Yucca Mountain nuclear waste repository. In the author’s opinion, the Malmesbury Aquifer acts as a pseudo radial flow aquifer on a regional scale and the simulations done give an adequate representation of likely flow patterns. It

should also be borne in mind that this aquifer is overlain by the more isotropic Sandveld or Atlantis Aquifer for which MODFLOW is a perfectly adequate modelling code. On a regional scale there is going to be very little difference between MODFLOW and for example FEFLOW (finite element package)

Corrective action 4

The modelling has been performed and reviewed by appropriately skilled persons with mathematical, statistical and geohydrological qualifications and experience.

Your comment (30)

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 1×10^{-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.

Response (30)

Your comments are noted. The scenarios described above in terms of the Nuclear Power Station being damaged by earthquakes, sabotage and terrorism attacks are associated with a number of unquantifiable variables, which makes it impossible to quantify the economic cost of such events. It is only possible to cost for damage caused by an event if the magnitude and nature of the damage caused by the event is known. The design of the power station will follow a conservative approach to ensure that the risk of damage is minimised, and appropriate security must be provided to ensure that the risk of sabotage is minimised.

In terms of the delays on other nuclear projects, these have been primarily based on quality and regulatory issues. As Nuclear-1 is not at the beginning of the nuclear renaissance, key lessons are currently being integrated into the planning. This should therefore minimise any perceived delays into the future. As an example, delays on the EPR project are currently reducing as Areva is getting into the build exercise at an increased pace (Olkiluoto experienced more delays, Flammanville less and Taishan is on schedule) from a period of not building. As most credible nuclear vendors are constructing elsewhere to date, Nuclear-1 will benefit from their experience.

Your comment (31)

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 are 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.

Response (31)

The costs of high level waste storage on site are built into the operational costs of the power station. Eskom sets aside a percentage of the operational income for the power station for the storage of high level waste and for decommissioning.

Decommissioning is discussed in the EIR and in section 3.3.3.4 of the Economic Impact Assessment Report. Further, decommissioning will be dealt with in the NNR process. The National Nuclear Regulator (NNR) has legislated the need for the establishment of a decommissioning plan for nuclear power stations. The decommissioning plan must be submitted before the nuclear authorisation is granted.

In terms of road upgrades, detailed information is not yet available on the capacity of the roads and bridges to carry the abnormal loads which will be involved in the transportation of imported equipment for the nuclear power station. Some of these loads might weigh up to 750 tons. Although Eskom has given the assurance that road infrastructure will be upgraded wherever required, the costs could be very high and are not considered in this analysis.

Your comment (32)

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>

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.

Response (32)

Your comment is noted. The Draft EIR report and associated specialist studies has been reviewed and revised and the necessary changes have been made, where considered necessary by the EIA team. The Revised Draft EIR will be made available for public comment and review.

Eskom's experience with Koeberg Nuclear Power Station and the construction of other power stations such as Medupi (at Lephalale in Limpopo Province) is that the occupation rates of accommodation in the surrounding areas increase dramatically. Whilst the nature of the tourism may not be the same as initially (i.e. business-related tourism opposed to nature-based tourism), this has been experienced at more than one Eskom power station site, both during construction and operation.

Your comment (33)

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.

Response (33)

Your comments are noted. The terms Agricultural Impact Assessment and Agricultural Potential Assessment is used interchangeably in EIA documents and does not represent any bias on the side of the specialist. There was no Table 7-8 or Chapter 7 in the Agricultural Impact Assessment (Appendix E21 of the Draft EIR). Section 7 of this report lists references. It is therefore unclear what table this comment refers to.

Dr Maasdorp of Imani Consulting contracted Mr. Jon Howcroft of Golder Associates as specialist for the Agriculture Impact Assessment. His CV has been added to the ESKOM and GIBB websites and is attached in Appendix E1 of the Revised Draft EIR.

Section 1.2 of the Agricultural Assessment acknowledges that one of the objectives of the study is to:

- Determine the potential impacts on agricultural production that would occur as a result of the construction and operation of a nuclear power station.

The operational impacts of a accidental reactor incident on crop production and livestock are accordingly discussed in section 3.3 and 3.4 of the report respectively. All the impacts in Table 5-1 are related to the operational phase.

Your comment (34)

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.

Response (34)

Your comments are noted however please note that the above discussions relates to Nuclear incidents. The actual risk of an accidental release of radionuclides over and above normal operations will need to be verified in the overall risk assessment report. However given that the probability of an incident happening is very low, the discussion, assessment and "carry through" of impacts must be seen in this context.

Your comment (35)

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.

Response (35)

We confirm that E21 is the Agricultural Impact Assessment. Impact 1 is labelled Dust Pollution, impact 3 as Availability/ Cost of Labour and impact 4 as Change in Market. This numbering system corresponds to discussion headings in section 3.3.2 and 3.4.2 of the report. These impacts have all been carried over to table 9.52 of Chapter 9 of the Draft EIR.

Your comment (36)

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'.

Response (36)

Your comments are noted. Presumably the comment refers to Table 5-1, as there was no Table 5-2 in the Draft EIR. This error will nevertheless be rectified.

Your comment (37)

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.

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.

Response (37)

Your comment is noted. The Draft EIR report and associated specialist studies has been reviewed and revised and the necessary changes have been made, where considered necessary. The Revised Draft EIR will be made available for public comment and review **(38)**

Your comment (38)

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.

Response (38)

Designs of the undersea tunnels are conceptual and no detailed design drawings of these tunnels are available. The conceptual designs of the tunnels and the construction methods are discussed in the Marine and Oceanography reports (respectively Appendices E15 and E16 of the Draft EIR). Further

Detail on the proposed construction methods for the pipelines are contained in Section 3.1.3 of the Oceanographic report. The sizes, depths and lengths of the proposed pipelines are indicated under "Intake / Outfall Structure" section on pages 7 to 8 of the Consistent Dataset (Appendix C of the Revised Draft EIR).

The level of information regarding the pipelines is sufficient for an analysis of their potential impacts for this EIA. However, as with other details regarding the location of infrastructure for the proposed power station, further input will be required from the relevant environmental specialists once detailed design is done, in order to minimise the environmental impacts.

Your comment (39)

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.

Response (39)

Please refer to response no. 38 above.

Your comment (40)

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, and 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.

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.

Response (40)

Descriptions of the intake and outfall structures are contained in the Consistent Dataset (Appendix C of the Draft EIR). In this document, the following characteristics are indicated:

Intake tunnels:

- Distance from shore: 1 to 2 km
- Number of tunnels: 1 to 2
- Diameter of tunnels: 5 to 10 m
- Depth of tunnels: Approximately 30 m

Outfall tunnels:

- Number of tunnels: 3 to 4
- Diameter of tunnels: Approximately 3 m
- Depth of tunnels: Approximately 5m

Your comments on the technically challenging nature of the construction of marine tunnels is noted and not disputed. It is in Eskom's interest to ensure that the design and construction of these structures is able to withstand the prevailing conditions, as failure of these systems would result in the plant not being able to generate electricity, as well as potentially large financial losses and environmental impact.

Your comment (41)*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.

Corrective Action

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

Response (41)

The risks of climate change are dealt with in terms of the findings of the International Panel of Climate Change, which is a body comprised a large number of highly respected scientists from across the globe. As such, the findings of the IPCC are widely respected and considered to be the world authority on climate change. There is no proven reason to adopt an approach different to that of the IPCC to the issue of climate change.

The issue of the release of warmed cooling water from the power station is assessed at length in the Marine Biology Assessment (Appendix E15 of the Draft EIR), particularly for Bantamsklip, because of the importance of the abalone populations at this site. This organism is particularly sensitive to an increase in temperature. At Bantamsklip, the impacts of warmed cooling water on the abalone populations was found to have an impact of potentially high significance, in recognition of the scarcity of this organism. The importance of the chokka squid and the potential impact on the fishing industry is also clearly indicated in this report, as well as in the Economic Impact Assessment (Appendix E17 of the Draft EIR).

The impacts of the offshore dumping of spoil are dealt with in detail in the Oceanographic Assessment (Appendix E16 of the Draft EIR) and in the Marine Biology Assessment. This is based on detailed and extensive numerical modelling of the distribution of the spoil, based on the prevailing ocean currents at all three sites. Without a motivation for your opinion that this aspect is not adequately dealt with, we cannot fully respond to this comment.

Your comment (42)

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.

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.

Response (42)

Your comments are noted. The National Intelligence Agency will perform a detailed threat analysis for the proposed power station prior to construction and will put in place an appropriate security exclusion zone and requirements for security at the power station, based on the findings of its analysis. The Site

Control EIR deals with the impacts of site control measures on the environment, not the likelihood of sabotage or terrorist attacks and accordingly makes no comment on these aspects.

Your comment (43)

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.

Corrective Action

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

Response (43)

The amended paragraph referred to provides a more complete description of operational states, which include normal operation and anticipated operational occurrences (AOOs). There should not be any uncertainty about the scope of this report. It has not been the intention to re-write entire sections of NNR requirements documents. The report has not changed the context of any of the principles in the siting requirements document of the NNR.

The report clearly states in Section 4.1.2 (Initiating events) that:

“This study considers discharges from Category A (normal operation and AOO) and Category B (design-basis accidents) events only. Design-basis accidents (DBAs) usually have a low probability of occurrence during the operational lifetime of an NPS, viz, less than one in one hundred years, but more than one in one million years.

“Releases associated with beyond-design-basis-accidents (Category C) do not form part of this assessment but are considered as part of the emergency response environmental impact assessment in the EIA (Khoathane 2009).”

It is unclear why the reviewer copied the definition of source terms. Section 4.3 deals with source terms and quotes terminology from Regulation R. 388. As stated in the report, the concept of source terms is not uniquely applicable to radionuclides. Any emissions into air and releases in liquid effluent can be characterised by concentrations of substances in source terms.

The study of “(V)arious postulated scenarios leading to catastrophic events....” does not form part of this report, as stated in the above paragraphs. The study was also not intended to consider external events and events described as “abnormal”. One must keep in mind that the study deals with an assessment of the suitability of a site to accommodate a nuclear power station, not the assessment of the inherent safety of a nuclear reactor. These issues are dealt with comprehensively elsewhere in documents that will be considered by the NNR, but not under the site assessment process.

The report is based on a qualitative interpretation of regulatory requirements of the NNR. As outlined in the report, the nuclear installation shall comply with dose limits and dose constraints and exposure shall be as low as reasonably achievable (ALARA). For exposures below the annual dose limit of 1 mSv, as required by the ALARA principle, the upper limit of cancer risk would be in the de minimis lifetime risk range. This conservative approach confirms that cancer risks to members of the community would be trivial under the application of the rigorous regulatory control of the NNR. These statements satisfy the requirements of a qualitative interpretation of regulatory requirements of the NNR.

Your comment (44)

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"

Response (44)

These arguments will be contained in the Safety Case. This will be submitted to the National Nuclear Regulator as part of the license application to demonstrate compliance to all regulations and whatever additional aspects the NNR might require.

Your comment (45)

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 include 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.

Response (45)

This work will be done as part of the NNR licensing process (see Response 1). The NNR and DEA will, through their memorandum of agreement, devise ways in which the public can participate.

Your comment (46)

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.

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.

Response (46)

The assessment criteria were included in the Plan of Study for EIA which was approved by the Department of Environmental Affairs and adheres to acceptable international and national guidelines and practices. Impact assessment, by its very nature, is both a science and a matter of professional judgement, based on experience of similar developments and similar environments. Not all impacts can be precisely quantified. This is why experienced specialists, including those with experience of nuclear power stations particularly, have been included in the EIA specialist team.

Your comments regarding the proposed quantitative boundary separating the two categories of least probability is noted. However, the assessment of which category of probability is applicable is still dependent on the professional judgement of the particular specialist. Defining such quantified boundaries does not add to the overall accuracy of the assessment.

Your comment (47)

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.

Response (47)

The assessment of impacts is based on a comprehensive envelope of criteria. GIBB considers this envelope satisfactory in terms of the detail provided for use in the assessment of significance.

Considering the principle of a technology envelope, it is not necessary to know the exact type of reactor. Also see Response 48.

Your comment (48)

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.

Corrective Action

A choice of the actual NPS and full particulars of its 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.

Response (48)

Your comments are noted.

The Health Report describes the concept of a Technology Envelope (TE) and refers to examples where this concept was used. The report is based on a qualitative interpretation of concepts and regulations. Quantitative assessment will be presented in the SSR.

The recommended corrective action is based on a misunderstanding of the principles of a TE. The actual choice of technology does not matter, as long as any technology that may be selected would fall within this TE, the total dose to the critical group(s), as defined in the report, will be at the level of *de minimus* risk.

Reference to the TE in the Health Report is appropriate, because it relates to a TE in terms of radiological dose limits.

With regards the ability of the marine specialist to predict the impacts of the cooling system: this specialist team from the University of Cape Town has been involved in the monitoring of the marine impacts of the cooling water system ever since the Koeberg Nuclear Power Station was commissioned. The same team also commenced background radiation studies on the marine environment before Koeberg was constructed. The assessment of marine impacts associated with the cooling water system is, therefore, based on experience in a similar environment, and with the same (Pressurised Water Reactor) technology. The marine specialists have not assessed the structural integrity risks of the cooling system, as this is not their field of expertise. They have, however, based on their experience of the Koeberg system, assessed the radioactivity of what is released into the ocean, and the effect of this radioactivity on the marine environment. Their conclusions, based on more than 20 years of monitoring, is that the levels of radioactivity found in sensitive organisms at

Koeberg is hardly discernable from natural background radiation levels, and that it has no significant impact on these organisms.

A detailed geo-hydrological monitoring programme of Thyspunt has been conducted through 2010 and the results thereof are included in the revised Wetlands Report (Appendix E 12 of the revised Draft EIR). This indicates that the impacts on wetlands of groundwater drawdown within the excavation can be mitigated by the use of a cut-off wall. Geo-hydrological studies have also been undertaken at Bantamsklip and Duynefontein. This study indicated the extent of predicted groundwater drawdown at all sites.

Your comment (49)

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 of 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 its 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.

Corrective Action

Catastrophic incidents cannot be considered to be too improbably to occur. When the EIA is extended to include 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.

Response (49)

The emergency preparedness report and issued related to catastrophic events falls within the ambit of the NNR licensing process and the public will be granted insight into further details about emergency planning through the public hearing process that forms part of this process.

Your comment (50)

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.

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.

Response (50)

Your comments are noted. The impact of the proposed Nuclear Power Station on the Biophysical Environment has been assessed a number of specialists appointed in terms of the Nuclear-1 project who are recognised leaders in their field and well respected in terms of their academic track records. In addition, the specialist reports have been peer reviewed for technical quality and accuracy. Although the specialists have identified numerous sensitive features on all sites, all specialists agree that none of the sites pose any fatal flaws in terms of the construction of a Nuclear Power Station. Lastly, all specialists have reviewed the Draft EIR to ensure it provides an accurate representation of their results and recommendations.

Your comment (51)

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://www.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).

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.

Response (51)

Your comment is noted. The purpose of this EIA process, being a project-specific process to for a nuclear power station, is not to assess the electricity generation alternatives. It is the function of the Integrated Resource Plan to weight the options in this regard and to define an appropriate mix of renewable and non-renewable energy resources for South Africa. Renewable generation alternatives such as wind and solar need to be included in South Africa's strategy to meet its future energy demands. However, wind power is not an alternative to base-load power such as nuclear and needs to be pursued in parallel to nuclear power. Concentrated solar power has the potential to become a base load option when storage is included. This technology however is still in demonstration phase and to date these potential high load factors have not been achieved. It has been made clear in the EIR that nuclear generation is not proposed as an alternative to renewable technologies, and that a number of relevant technologies need to be pursued in parallel.

A high level assessment of the implications of a wind farm as an alternative to a 4 000 MW nuclear power station has been included in Chapter 5 of the Revised Draft EIR. This analysis indicates an area of between 273 000 ha and 345 600 ha will be required for 13 333 MW of installed capacity (depending on the rotor diameter). Due to the fact that wind is not available at all times, a capacity factor of 30% is assumed and the effective power produced will be 4 000 MW.

Due to the variable availability of wind, it is not a simple solution to replace base load power generation such as nuclear with wind generation. In the case of wind turbines the output is a direct function of the local wind speed, and cannot be dispatched on request. This results in a requirement to have alternative means to supply the demand when there is too little or too much wind.

A recent example of this was in September 2010 in Spain where the national wind turbines dropped to below 3 000 MW on Thursday from 4 600 MW on Wednesday, compared with peaks of more than 10 000 MW on Tuesday. This swing of 8 000 MW was equal to 20% of the national demand and is very difficult to sensibly manage without investing in base load options such as coal and nuclear and installing additional wind turbines for contingencies.

In light of this the option to use wind power to provide stable, dependable base load supply to the grid is extremely challenging. Wind power therefore does need to be supplemented by more reliable base load generation.

Your comment (52)

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.
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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)

Response (52)

Your comment is noted. The Draft EIR report and associated specialist studies has been reviewed and revised and the necessary changes have been made, where considered necessary by the EIA team. The Revised Draft EIR will be made available for public comment and review.

Should you have any queries with respect to the above please do not hesitate to contact Arcus GIBB.

Yours faithfully

For Arcus GIBB (Pty) Ltd

A handwritten signature in black ink that reads "Jm Ball". The signature is written in a cursive, flowing style.

Jaana-Maria Ball
Nuclear-1 EIA Manager