Greenpeace Africa submission on Nuclear-1 Revised Draft EIA Report – August 2011

1. Introduction

South Africa is the largest CO_2 emitter on the African continent, and the 12th largest emitter in the world. As such, South Africa has a moral responsibility to act swiftly and decisively on climate change. Electricity is the sector which has the best established technological opportunities to reduce emissions while providing employment and development opportunities for the country. South Africa is extremely well endowed with renewable resources, with the potential for 50% of South Africa's electricity to come from renewable energy by 2030, creating an additional 150,000 new jobs at the same time[1,2].

However, the South African government has announced a large expansion of nuclear power in South Africa. The government's choice for expansion of nuclear power in South Africa is both disappointing and risky, especially in the wake of the Fukushima nuclear disaster in Japan in March 2011, which has caused many countries to reconsider or cancel their nuclear programme. The German government has decided to phase out nuclear energy, and a recent referendum in Italy saw 95% of Italians vote against the use of nuclear. Major questions regarding nuclear safety have been raised and will need to be evaluated.

If South Africa is concerned about energy security then nuclear should be the last option. A nuclear plant takes more than a decade to build, is dependent on a non-renewable resource, creates dangerous radioactive waste, and is extremely costly. In contrast, renewable energy capacity can be built much faster, and without the safety, environmental and financial risks associated with nuclear power. South Africa should learn from past mistakes in its costly nuclear history.[3] Indeed nuclear power delivers too little, too late, and at too high a price for the environment and the people of South Africa.

The Integrated Resource Plan 2010 (IRP2010) is a plan that will determine what South Africa's electricity sector will consist of for the next 20 years, including the effort that the

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[1] Greenpeace Africa. *Advanced Energy [R]evolution. A Sustainable Energy Outlook for South Africa.* May 2011.
http://energyblueprint.info/fileadmin/media/documents/national/2011/E_R__South_Africa_May_2011-LR.pdf

[2] Rutovitz, J. 2010. *South African energy sector jobs to 2030.* Prepared for Greenpeace Africa by the Institute for Sustainable Futures, University of Technology, Sydney. In press.

[3] *The True Cost of Nuclear Power in South Africa*, D. Fig, S. Thomas et al, Greenpeace Africa, August 2011.
http://www.greenpeace.org/africa/Global/africa/publications/The%20true%20cost%20of%20Nuclear%20Power%20in%20SA-Screen.pdf

country will put into energy efficiency and the level that South Africa will depend on coal, nuclear and renewable energy sources. The choices that are made now in the electricity sector will determine what South Africa's energy future will look like and will therefore affect our standard of living, levels of job creation, our environment and our economic future as a nation.

The South African government should reconsider its support for nuclear and focus on clean and sustainable energy sources. Greenpeace Africa believes that the energy mix of the country should be focussed on implementing renewable energy on a large-scale, rather than nuclear energy.

2. Key points Greenpeace submission

Greenpeace Africa dismisses this EIA and calls for a negative Record of Decision for the following reasons:

- The DEIR does not consider worst case scenario, nor potential radiological environmental impacts.
- The independence of the National Nuclear Regulator, who is ostensibly responsible for any nuclear safety, radiation or radiological issues, is questioned.
- The specialist studies on Human Health Risks and Emergency Response must be recommissioned, as it is based on unscientific statements.
- The SAHRA has recommended that Thyspunt is not a suitable site for development, but this has been proposed as the preferred site.
- The DEIR has not adequately assessed the project alternatives and the no-go option.
- The DEIR has a gaping hole in terms of alternatives for nuclear energy for electricity production.
- A comprehensive assessment of potentially significant impacts cannot be made in the absence of the exact specifications of the intended project (i.e. reactor design choice).
- It is clear that without the choice of design no proper health risk impact assessment can be made.

- The DEIR fails to assess the impacts of a worst case scenario such as a nuclear accident.

EIA	Environmental Impact Assessment
NEMA	National Environmental Management Act
NNR	National Nuclear Regulator
NNRA	National Nuclear Regulator Act
DEIR	Draft Environmental Impact Assessment Report

3. EIA process

3.1 Legal context

- Promotion of Administrative Justice Act 3 of 2000:

S 6(2): "A court or tribunal has the power to judicially review an administrative action if ...

(b) a mandatory and material procedure or condition prescribed by an empowering provision was not complied with; ...

(e) the action was taken –

(iii) because irrelevant considerations were taken into account and relevant ones were not considered

- The Constitution of the Republic of South Africa Act 108 of 1996:

S 24: Everyone has the right –

(a) to an environment that is not harmful to their health of well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

S 195(1): Public administration must be governed by the democratic values and principles enshrined in the Constitution, including the following principles:

Efficient, economic and effective use of resources must be promoted.

- National Environmental Management Act (NEMA) and the Environmental Impact Assessment (EIA) Regulations:

Relevant provisions of these statutes will be referenced where applicable in the submission.

3.2 Exclusion of radiological impacts from EIA process

(from Chapter 1)

"The National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) (NNRA) provides for the protection of persons, property and the environment against nuclear damage and mandates the NNR to exercise regulatory control related to safety. (...) However, in terms of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) ("the Constitution") and the NEMA, the DEA has a responsibility for decision-making regarding the potential impacts of the power station on the environment, even though these impacts are likely to include those relating to certain aspects of the radiological hazards associated with the facility.

In recognition of the dual but distinct responsibility with respect to the assessment of radiation issues, a co-operative agreement (Appendix B4) concluded between the DEA and the NNR was gazetted on 18 July 2008. One of the main purposes of this agreement is to "prevent unnecessary and unavoidable duplication of effort" between the NNR and DEA. The NNR authorisation process applies specifically to issues of nuclear and radiation safety related to the siting, design, construction, operation and decommissioning of nuclear installations.

Furthermore, the Director General of the DEA issued a statement in January 2009 (Appendix B4) to further clarify the purpose of the agreement. The statement indicates that nuclear safety, radiation and radiology "are better placed within the regulatory process of the NNRA and that consideration of the same issues in an EIA process will result in unnecessary and avoidable duplication."

Thus, whilst "Site Safety Reports" prepared as part of the authorisation process for nuclear licensing have been included as appendices in this draft EIA Report (Appendices E24, E26 and E27), radiological issues will not be assessed in detail[7] in the Draft EIR and the DEA will not consider radiological impacts in decision-making.

> *Footnote [7] The Emergency Response (Appendix E26) and Site Access Control Report (Appendix E27) and Human Health Risk Assessment (Appendix E24), which have been prepared on a high level,, are appended to this EIR for information only. Further details on these reports will be prepared as part of the NNR nuclear licensing process , as their findings will be evaluated by the NNR."*

EIA Regulation 31(2)(l) states that an environmental assessment report must include "an assessment of each identified potentially significant impact, including cumulative impacts, the nature of the impact, the extent and duration of the impact, the probability of an impact occurring, the degree to which the impact can be reversed, the degree to which the impact may cause irreplaceable loss of resources, and the degree to which the impact can be mitigated."[4] "Significant impact" is defined in the Regulations as "an

[4] EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Chapter 3, s 31, subsec 2(l).

impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment."[5]

By failing to assess radiological impacts in detail and removing radiological impacts from the DEA (Department of Environmental Affairs) decision-making, the Revised DEIR fails to comply with EIA regulations. The Revised DEIR does not consider a worst-case scenario, nor potential radiological environmental impacts under normal operation or in case of incidents.

The Fukushima nuclear accident in March 2011 and its aftermath prove that the impact of a worst case scenario should be classified as "significant impact" under the EIA Regulations. The Fukushima accident has been classified as a 'level 7' major accident on the IAEA International Nuclear and Radiological Event Scale (INES).[6] Level 7 is the most serious level on INES and is used to describe an event comprised of "A major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures". Omission of a worst case scenario from the Revised DEIR is a serious flaw and breach of EIA regulations.

Also smaller nuclear incidents can result in a "significant impact", as can be concluded from the incident in the ASCO nuclear power plant in Spain in 2007.[7] Even routine operation results in a "significant impact", for example through the production of long-lived highly radioactive waste, which by its 'duration' and 'intensity' may 'have a notable effect on one or more aspects of the environment', and hence its radiological impacts to the environment should have been included in the Revised DEIR. See section 7.1 for potential environmental impacts of radioactive waste.

The European Commission explicitly requires the effects of 'which could result from accidents, abnormal vents or exposure of the Project to natural or man-made disasters' to be described and quantified.[8] By placing nuclear safety, radiation and radiology solely

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[5] EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Chapter 1.
[6] IAEA Fukushima Nuclear Accident Update (12 April 2011, 04:45 UTC);
http://www.iaea.org/newscenter/news/2011/fukushima120411.html
[7] After initial downplaying of the incident, it has been reclassified as an 'INES 2' incident on the IAEA International Nuclear and Radiological Event Scale, as a significant amount of radioactivity was released into the environment as hot particles. The ASCO incident is described in a letter from Greenpeace Spain to Mr. Andris Pielbags, EU Energy Commissioner. 22 April 2008.
www.**greenpeace**.org/raw/content/.../**letter**-from-**greenpeace**-spain-t.pdf
[8] Guidance on EIA; EIS Review. Environmental Resources Management. June 2001.
http://ec.europa.eu/environment/eia/eia-guidelines/g-review-full-text.pdf

under NNR licensing, the possibilities for public consultation on these issues are significantly reduced.

In addition, one can question the independence of the National Nuclear Regulator, as it is responsible to the Minister of the Department of Energy (formerly Department of Minerals and Energy). The Minister of Energy and the Department of Energy have a clear interest in promoting the use of nuclear power, and expanding South Africa's nuclear industry. During the Minister's budget speech in May 2011, she expressed a strong commitment to incorporating nuclear energy in South Africa's energy mix,[9] and a few days later even trumpeted the development of a nuclear export market for the rest of Africa.[10] This is in breach of Article 8 of the Convention on Nuclear Safety, of which South Africa is a signatory:

> Convention on Nuclear Safety, ARTICLE 8. REGULATORY BODY
>
> Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.
>
> Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

3.3 Specialists reports

The specialist studies on the Human Health Risk Assessment, Site Control and Emergency Response have been included in the Revised DEIR 'for information only'. These studies will influence the DEA decision-making, even though DEA will officially not consider radiological impacts.

Including the specialist studies gives the impression that Human Health Risks, Site Control and Emergency Response have been properly studied. However, in particular the Human Health Risk Assessment and the Emergency Response reports are of extremely poor quality. The reports are based on general assumptions regarding reactor specifications and possible impacts, and no actual risk assessment has been done (as this is impossible without the choice of design being known).

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[9] *Nuclear still part of energy mix: Peters*, Fin24, 26 May 2011. http://www.fin24.com/Economy/Nuclear-still-part-of-energy-mix-Peters-20110526

[10] *Africa must supply its own nuclear fuel – Peters*, BusinessLIVE, 30 May 2011. http://www.businesslive.co.za/incoming/2011/05/30/africa-must-supply-its-own-nuclear-fuel---peters

The Human Health Risk Assessment report only considers Category A and B events, explicitly excluding so-called 'Beyond Design Basis Accidents' (Category C), which are supposed to be considered in the Emergency Response report.[11] However, the Emergency Response report explicitly excludes "A comprehensive safety analysis of sources of potential exposure to evaluate radiation doses that could be received by the public as well as potential effects on the environment"[12].

The Human Health Risk Assessment report assumes that the probability of occurrence of Category B events (Design Basis Accidents) is very small, but does not argue why this is the case. Such a statement is unfounded; the frequency of DBA events cannot be assessed as long as the reactor design is unknown. Still, despite these unknowns, the specialist already knows that 'it will be demonstrated in the submission to the NNR that the dose to the critical group during such event would be within the dose limit of 50 mSv and ALARA'[13], and therefore the potential impact is assessed as of low significance. Greenpeace believes it is unacceptable to include such unscientific, seemingly clairvoyant statements in specialist reports, and recommends that the specialist studies on Human Health Risk and Emergency Response be re-commissioned.

[11] Human Health Risk Impact Report, October 2010. Pg 11.
[12] Emergency Response Impact Report, March 2011. Pg 4.
[13] Human Health Risk Impact Report, October 2010. Pg 23.

3.4 The Weighting/Ranking of Impacts

In assessing the impacts of the Nuclear Power Station, Arcus GIBB used a subjective process to rank the impact categories (both environmental and technical). This involved a 'specialists' workshop that through a process of elimination determined which impact categories have more relative importance than others. Using this method, Arcus Gibb stated that key "decision factors" were then used in site selection. There is clearly a flaw in this method as the preferred site, Thyspunt has exceptional archaeological, paleontological, and wilderness value[14] and thus should not be developed. Indeed, the Heritage Impact Assessment concluded that Thyspunt has exceptional archaeological, paleontological, and wilderness value and presents excessive difficulties for mitigation[15]. The South African Heritage Resource Agency has unequivocally recommended that Thyspunt is not a suitable site for development.[16]

The Heritage Assessment repeatedly emphasizes the impossibility of constructing Nuclear-1 without extensive, irreversible impacts on heritage sites at Thyspunt.[17] Yet the EIA largely ignores this, recommending that Thyspunt be the preferred site. Despite the Heritage Assessment's unambiguous warnings that mitigation at Thyspunt is highly infeasible,[18] the Revised DEIR has included a "Heritage Mitigation Study" proposing a trial excavation in the Thyspunt site. The Heritage Assessment states that the archaeological preference is to preserve conservation *in-situ*, yet the EIA suggests a parallel system of construction of the nuclear station and excavation instead.[19]

As the projects stands currently, it may not go forward before Eskom has carried out its own proposed trial excavation to explore unknown aspects of the Thyspunt site to determine if there is an area where the development footprint will result in fewer impacts. However, the suitability of Thyspunt as a site for Nuclear-1 will not change whether something is found in the trial excavation or not because the value of Thyspunt lies in both its cultural heritage and high biodiversity – even if the NPS is built in an area of relatively fewer archaeological sites, it will still destroy the landscape and wilderness qualities of the area.[20] Thus, any approval of the project will be an unlawful

[14] Revised DEIR, APP E20, Heritage Impact Assessment 4.3
[15] Revised DEIR, APP E20, Heritage Impact Assessment 4.3; 5.1.3; 5.2.2 (c)
[16] Revised DEIR, APP E20, Heritage Mitigation Study, Introduction 1
[17] Revised DEIR, APP E20, Heritage Impact Assessment 3.1.1; 3.2.9; 3.2.10; 5.1.3
[18] Revised DEIR, APP E20, Heritage Impact Assessment 4.3; 5.1.3; 5.2.2 (c)
[19] Revised DEIR, APP E20, Heritage Impact Assessment 5.1.2; Heritage Mitigation Study 1.1.1
[20] *See* Revised DEIR, APP 20, Heritage Impact Assessment 3.2.9, 3.2.10.

administrative decision in violation of the National Heritage Resources Act s 5, NEMA s 2(4)(a)(iii).

4. Lack of appropriate alternatives

A requirement in the Environmental Impact Assessment Regulations (2010)[21] stipulates that a description of any identified alternatives to the proposed activity must be included in the EIA.[22] This includes the advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity. "Alternatives" as defined in the Regulations are a "different means of meeting the general purpose and requirements of the activity, which may include alternatives to ... the type of activity to be undertaken ... and the option of not implementing the activity."[23] NEMA section 24 also requires every application for an environmental authorisation to include an investigation of alternatives to the activity, including the option of not implementing the activity.[24]

The regulations further define 'alternatives' in relation to a proposed activity to include:

- The property on which or location where it is proposed to undertake the activity;
- The type of activity to be undertaken;
- The design or layout of the activity;
- The technology to be used in the activity;
- The operational aspects of the activity; and
- The option of not implementing the activity.

The Revised DEIR has not adequately assessed project alternatives and the no-go option. The DEIR simply lists some energy sources in a table,[25] without any

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21 National Environmental Management Act, 1998 (Act No. 107 Of 1998), Environmental Impact Assessment Regulations 2010
22 S31 (2)g
23 EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Chapter 1, s 1, subsec 1.
24 NEMA s 24(4)(b)(i).
25 Revised DEIR, Chapter 5, Project Alternatives, 5.3.1 Nuclear Generation Alternatives.

analysis of their impacts or the significance of those impacts, and cites the lack of baseload capacity as justification for not evaluating other energy sources.

Marignac (2010)[26] on a visit to South Africa stated that "*baseload centralised generation, be it coal or nuclear, belongs in the past. Combined renewables, like solar, wind and biomass, together with active demand-side management, and the flexibility provided by communications technologies, are already demonstrating their ability to provide broad, safe and reliable electricity. When taking all indirect, long term and environmental costs into account, they are the most cost-effective options. And their economies are continually improving, in contrast to the escalating costs and negative learning curves of most nuclear programmes. Moreover, they are far less risky than nuclear energy, with its inherent and unsolved problems of safety, proliferation and long-lived radioactive waste.*[27]

The Revised DEIR has a gaping hole in terms of alternatives to nuclear energy for electricity, and should include a true comparison of the various alternatives to produce electricity. There are numerous reports and research documents that illustrate this point. The Greenpeace Africa Advanced Energy [R]evolution[28] is a detailed and practical blueprint for cutting carbon emissions, replacing fossil fuels and nuclear power with renewable energy, and growing the economy. It is one of the most comprehensive plans to resolve the country's need for energy security and a sustainable energy future, ever. The Greenpeace Africa report shows that renewable energy is mature, ready for implementation, and can be deployed on a large scale.

The combination of using renewable energy and promoting energy efficiency programmes to reduce electricity usage are not investigated in the DEIR. Energy efficiency offers some of the simplest, easiest and most cost effective measures for reducing both greenhouse gas emissions and costs to end-users.

The DEIR gives a set of cost data from EPRI (Economic Policy Research Institute) but fails to calculate the production cost or to mention that EPRI report finds that wind on good sites is more affordable than nuclear. Furthermore, the DEIR compares wind to nuclear. This is a false analogy as the RE power plant cost data is out-dated and ignores the fact that to compare with nuclear plant that would go online in 2022, a

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[26] Yves Marignac is director of WISE-Paris, a France based independent consultancy office on energy policy

[27] Yves Marignac, 2010. *SA could lead energy revolution*, Business Day, 13 December 2010. http://www.businessday.co.za/articles/Content.aspx?id=129313

[28] http://www.greenpeace.org/africa/en/News/news/The-Advanced-Energy-Revolution-Report/

comparison would have to be made with wind turbines or PV panels that are ordered in 2020 or 2021, or CSP plant ordered in 2019.

With regard to the no-go option, the DEIR simply states that the no-go alternative is not a feasible or realistic alternative,[29] despite the fact that the government included a no-nuclear scenario in the IRP2 that is cost-effective and provides security of supply.[30] This assertion begs the question of how informed the Environmental Assessment Practitioners were on the project. The DEIR does not examine or support a no-go option even though there was clearly a lack of investigation into alternatives and a lack of understanding of the true impacts of the whole project without an appropriate design for the Nuclear power station.

These assertions about project alternatives and the no-go option thus violate substantive requirements to assess them under NEMA and the EIA Regulations and are also inaccurate. The finalised Integrated Resource Plan (IRP2) included no-nuclear scenarios that are cost-effective and provide security of supply.[31] Thus, the IRP2 shows that baseload is not an issue in pursuing a nuclear-free energy plan. In addition, the IRP2 stated that after taking into account the fact that new energy technology costs would decrease over time and that nuclear would be 40% more expensive that originally projected, the cost-optimal output from the model did not include nuclear at all.[32] Thus, not only is a no-nuclear scenario feasible and secure, it is actually the most cost-effective option.

The applicant has not only failed to properly assess project alternatives and a no-go option, but has inaccurately concluded that alternatives and a no-go option are simply not viable. Any decision taken on the basis of such information will be unlawful. Greenpeace Africa thus believes that on the basis of alternatives a positive Record of Decision should not be provided.

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29 Revised DEIR, Chapter 9, Impact Analysis, 9.33.12.
30 Integrated Resource Plan for Electricty 2010–2030, GNR 400 GG 34263 of 6 May 2011, at 38–45
31 Integrated Resource Plan for Electricity 2010–2030, GNR 400 GG 34263 of 6 May 2011, at p. 18, 6.9.1, 6.9.4 ("If new renewable generation capacities should fail to reach their forecast performance in terms of full-load hours, this will increase total costs. It will, however, not affect other dimensions like security of supply, since solar PV is completely backed up with conventional, dispatchable generation and wind power is backed up to a large extent."); *id.* at p. 39, B.30.
32 *See* Integrated Resource Plan for Electricity 2010–2030, GNR 400 GG 34263 of 6 May 2011, at 38–39, paras. B.23, B.25, B.27, B.30.

5. Lack of design choice

5.1 Envelope

> (from Executive Summary):
>
> Detailed descriptions of the proposed nuclear plant are not available, as a preferred supplier has not been selected.
>
> The approach used in this EIA process has been to specify enveloping environmental and other relevant requirements, to which the power station design and placement on site must comply. The enveloping criteria have been developed to ensure that they represent the most conservative parameters associated with the various plant alternatives within the PWR technologies.
>
> (from Chapter 3):
>
> It must be emphasized that Eskom has not decided on a preferred supplier for Nuclear-1 and that any suppliers and plant types named in this report are meant only for reference purposes to provide an indication of a typical power station conforming to Eskom's requirements. Thus, detailed descriptions of the proposed plant are not available. The approach in this EIA process has therefore been to assess a generic nuclear power station design for the EIA process to specify enveloping environmental and other relevant requirements to which the power station design and placement on site must comply.
>
> (from Chapter 9):
>
> At the time of compiling the EIR, Eskom and the South African Government had not yet decided on a vendor for the supply of nuclear power station equipment. Thus, an "envelope" of data was used. This envelope includes the highest possible values for various aspects for a range of different nuclear technology vendors. It is assumed that the design specifications of the proposed plant by the approved vendor will conform to the "envelope". If any of chosen vendor's power station characteristics fall outside of the specified envelope, it may have to be re-assessed from an environmental point of view (depending on the degree of variance).

According to EIA Regulation 31(2)(l), an environmental assessment report must include "an assessment of each identified potentially significant impact, including cumulative impacts, the nature of the impact, the extent and duration of the impact, the probability of an impact occurring, the degree to which the impact can be reversed, the degree to which the impact may cause irreplaceable loss of resources, and the degree to which the impact can be mitigated."

A comprehensive assessment of potentially significant impacts can however not be made in the absence of the exact specifications of the intended project. The Revised DEIR is based on a so-called 'envelope' of data, which is **assumed to** cover the chosen nuclear power station, once known. Despite this unconventional approach, the Revised DEIR fails to argue why this assumption would be valid. It is impossible to make general

assumptions about something as complex as a nuclear reactor design. According to international practice, a reactor design needs to be identified prior to a decision on the EIA. An EIA needs to be based on one or more specific reactor designs with specific parameters. For example, European regulations require the project developer to provide at least 'a description of the project comprising information on the site, design and size of the project'.[33]

Even within the category of Generation III reactors (the preferred option) the reactor designs differ significantly, with different power capacities, safety systems, fuel characteristics, cooling parameters, etc.[34] These differences, once evaluated, can result in a wide range of possible environmental impacts, which will not be covered by a generic assessment based on an 'envelope' of parameters (see paragraphs 5.2 – 5.6, 6.2, 6.3, 7.1 and 9).

5.2 Generation III

Eskom favours a nuclear power station of 'standard Generation III design'. The Revised DEIR bases proposed emergency measures as well as mitigation measures on this standard reactor design with an 'envelope' of 'the most conservative parameters associated with the various plant alternatives'.

However, there is no such thing as a 'standard Generation III design'.[35] Some designs rely on active safety systems, while others incorporate passive safety systems. Each design has a different power output, varying between 1000 – 1700 MW. Fuel burnup in different designs varies from 50 – 70 MWd/kg. Reactor core dimensions differ, which will influence potential accident scenarios. New materials are being used, that have not been sufficiently evaluated under the extreme conditions in a nuclear reactor. New safety features are sometimes incorporated, but their performance cannot be accurately simulated.[36]

Most of the Generation III designs only exist on paper, and no construction or operational experience is available. Generation III plants that are currently under

[33] Article 5.2. Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, 85/337/EEC. Reference: Official Journal NO. L 175 , 05/07/1985 P. 0040 – 0048. http://ec.europa.eu/environment/eia/full-legal-text/85337.htm

[34] See e.g. *New Reactor Designs*, US Energy Information Administration, 2006 www.usnuclearenergy.org/pdf_library/new_**reactor_designs**.pdf

[35] *Best Estimate Tools and Challenges of the New Reactor Designs,* Tomislav Bajs, April 2011. www.pnra.org/...5/Bajs_BE%20Tools%20for%20New**ReactorDesigns**.pdf

[36] *Review of Generation III Reactors,* Dr. Helmut Hirsch, April 2009. www.calla.cz/data/energetika/seminare/jrr/hirsch.pdf

construction have been plagued with regulatory issues raised in design approval processes,[37] construction problems, construction delays and cost overruns.[38] Therefore it is essential that any evaluation of potential impacts of these new designs is based on exact specifications identifying all relevant parameters, rather than a generic description.

5.3 Fuel

The Revised DEIR fails to provide essential specifications of the reactor fuel to be incorporated in the reactor core. Even though an enrichment factor of 4.95% is given, no limitations regarding the fuel burn-up are provided. It is also not specified how long fuel elements will stay in the reactor. The source term and temperatures of the fuel at the time of removal from the reactor is unknown due to lack of design choice. The exact volume of the fuel elements is not included in the envelope. The Revised DEIR also does not specify whether so-called Mixed Oxide fuel (uranium oxide mixed with plutonium oxide) will be used in the reactor, while this would have significant implications for potential radiological releases and impacts, as well as for the long term storage of the waste.[39]

All the fuel parameters are essential in assessing the potential environmental impacts of this project. In case of a nuclear incident or accident, the fuel parameters determine the source term and hence the risks of releases of e.g. volatile fractions, temperatures at which certain elements can be released, melting temperature of the fuel, etc. To evaluate potential impacts of long term storage of spent nuclear fuel, the fuel parameters are essential in assessing fractions that can most easily escape (Early Release Fraction),[40] see chapter 7.1.

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[37] *Westinghouse pauses at end of UK reactor generic design approval process,* NEI Magazine, 15 July 2011. http://www.neimagazine.com/story.asp?sectioncode=132&storyCode=2060158
http://www.hse.gov.uk/newreactors/2011-gda-issues-ap1000.htm
http://www.hse.gov.uk/newreactors/2011-gda-issues-epr.htm

[38] *EDF Delays New Reactor at Flamanville to 2016 after Fukushima Stress Tests,* Tara Patel, Bloomberg, 20 July 2011. http://www.bloomberg.com/news/2011-07-20/edf-delays-flamanville-to-2016-on-fukushima-deadly-accidents.html ; *New Problems in Olkiluoto*, Jehki Härkönen, Greenpeace Finland, 21 July 2011. http://www.greenpeace.org/international/en/publications/New-Problems-in-Olkiluoto/

[39] *Public Health Risks of Substituting Mixed-Oxide For Uranium Fuel in Pressurized-Water Reactors,* E.S. Lyman, Science & Global Security, 2000, Volume 9, pp.1–47. www.nci.org/PDF/lyman-**mox**-sgs.pdf

[40] *The Hazards of Generation III Reactor Fuel Wastes*, M. Resnikoff, J. Travers, E. Alexandrova, May 2010. http://www.greenpeace.org/canada/en/campaigns/end-the-nuclear-threat/Resources/Reports/The-Hazards-of-Generation-III-Reactor-Fuel-Wastes/ ; and
http://www.greenpeace.org/international/en/press/releases/new-nuclear-reactor-s-waste-is/

5.3 Radiological impacts on health and environment

Even though a specialist study is included in the Revised DEIR, looking at the Human Health Risk Impacts, this study is very superficial and does not make a quantitative risk assessment, because the reactor technology has not been selected. No source term can be determined, as 'radionuclides and discharge quantities may differ between various technologies'[41] and hence different reactor technologies come with different source terms. A quantitative health risk impact assessment will therefore only be done once Eskom submits its license application to the NNR.

The Human Health Risk Impact report looks at one possible source term 'encompassing all reactor designs and technologies under consideration as an upper limit of radiological discharges'. This however ignores potential radionuclide compositions, as different source terms will have different ratios of e.g. volatile and non-volatile components, long-lived and short-lived components. This simply cannot be simulated with one set of source term data.

The Human Health Risk Impact report is based on the assumption that a license to the site will only be issued by the NNR if full compliance with regulatory requirements is demonstrated. This is in contradiction with the ALARA principle, which states that every reasonable effort should be done to keep exposures to radiation As Low As Reasonably Achievable.

The Human Health Risk Impact report states that the 'envelope' approach is in line with standard international practice, following the approach for Early Site Permit (ESP) applications to the US Nuclear Regulatory Commission. However, ESPs are submitted at a very early stage in the planning process, and prior to Environmental Impact Assessments. The practice with ESPs is in no way applicable or comparable to the practice with Environmental Impact Assessments; under the US National Environmental Policy Act, nuclear power plant developers will separately have to submit an Environmental Impact Statement, specifying reactor design and parameters.[42]

In the Human Health Risk Impact report, there is no assessment at all whether the possible impacts stay within the dose limits set by the NNR, nor does the Revised DEIR propose any mitigation measures to ensure rigorous application of the ALARA principle as required by the NNRA. It is clear that without a choice of design, no proper health risk impact assessment can be made.

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[41] Human Health Risk Impact Report, October 2010. Pg 14.
[42] http://www.epa.gov/compliance/resources/policies/nepa/#nuclear-power-plants

By excluding radiological impacts from the EIA process, and not having made the design choice prior to the Revised DEIR, health and environmental risk impacts can simply not be assessed, and it is impossible for the Environmental Authority to make a proper decision regarding the true environmental impacts of this proposed project.

5.5 Site layouts/sizes

> From Executive Summary:
>
> It is estimated that the total footprint required for Nuclear-1 (4 000 MW) is 200 to 280 hectares.
>
> Finalisation of the site layouts, should the power station be authorised, will require detailed investigations, in conjunction with the relevant qualified and experienced specialists, once the preferred site and power plant type is confirmed.
>
> Based on the sizes of the areas that are environmentally suitable for a nuclear power station on the alternative sites (between 172 ha and 293 ha), and the proposed size of the Nuclear-1 footprint (200 to 280 ha), it will not be possible to construct additional power stations, beyond Nuclear-1, at any one of the alternative sites.

The site layout of the power station footprint is highly dependent on the type of reactor that is going to be built. The Revised DEIR states that detailed investigations will be required for finalisation of the site layout once the reactor type is confirmed. Hence, without the choice of design, a proper assessment of the impacts of the station footprint cannot be made. It is unacceptable and unlawful that these impacts will only be evaluated outside the EIA process and will not be open to public consultation.

The area sizes suitable for a nuclear power station on the three proposed sites are between 172 and 293 ha (DEIR Executive Summary), while the proposed size of Nuclear-1 is between 250 and 280 ha (DEIR Chapter 3) or between 200 and 280 ha (DEIR Executive Summary). Hence even the smallest proposed size would not fit on the suitable area of the smallest of the proposed sites.

6. Emergency preparedness

6.1 Worst case scenario

The Revised DEIR fails to assess the impacts of a worst case scenario, such as a nuclear accident, claiming this would fall under the NNR licensing process. However,

NNR authorisation establishes safety standards under normal operating conditions;[43] it does not meet the requirements of NEMA 24(4)(a) to measure environmental impacts.

The DEIR claims that the likelihood of a serious nuclear accident in a modern reactor design is very small[44]. However, the likelihood of an accident in the Fukushima nuclear power plant was estimated to be negligible. Still, a nuclear disaster occurred after the earthquake and tsunami on 11 March 2011, causing a large area around the Fukushima nuclear power station to be seriously radioactively contaminated, and hundreds of thousands of people are being exposed to significant levels of radiation. The impacts of the Fukushima accident are widespread and long-term, and have significant economic and social impacts.

Even though these kind of accidents have a low probability, their probability is not negligible and the impacts are highly significant, hence they should be taken into account in the EIA process. They cannot be simply waved away by stating:

> Since the commercial use of nuclear energy to generate electricity began, it has arguably proved to be one of the world's safest energy generation technologies, with the exception of accidents such as Chernobyl and Three Mile Island.[45]

This was clearly written prior to the Fukushima nuclear accident. The world is reassessing the nuclear risks and impacts of nuclear accidents, as the Fukushima disaster casts serious doubts on current nuclear safety levels. Therefore, all nuclear expansion plans, including this EIA process, should be put on hold awaiting the outcomes of the industry's reassessment. As a basic minimum, the Revised DEIR should be adapted to incorporate lessons learned from Fukushima.

The Revised DEIR claims that the possibility of significant accidental releases of radionuclides can be excluded. This claim is completely implausible because there are several physically plausible sequences of events which can lead to releases of radioactivity from a PWR reactor exceeding those associated with the Chernobyl

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43 *See* National Nuclear Regulator Act Regulations, No. R. 388 (2006) s 3–5; National Nuclear Regulator Act 47 of 1999, ch 1 (definition of "action").

44 Human Health Risk Impact Report, October 2010. Pg 23.

45 Revised DEIR, chapter 3, pg 35.

nuclear accident.[46] These situations can include a material failure, an operator error, an external event, a malicious act, or any combination thereof. The DEIR specification identifies the potential flood hazard on all three sites.[47]

The Revised DEIR claims:

> A key focus of accident prevention has long been the use of multiple precautionary defences against the consequences of failures. This approach of 'defence in depth' is aimed at preventing equipment failures and human errors and mitigating their consequences, should any of these happen. (...) Furthermore, should components or materials fail, or should human errors lead to consequences that may have adverse effects on human health and the environment, several layers of backup systems and other controls are automatically introduced to stop the propagation of the IE [initiating event] or to mitigate its consequences.[48]

The nuclear industry relies on so-called 'probabilistic safety assessments', giving the impression that the probability of a serious accident caused by a sequence of events is extremely low.

The Fukushima accident painfully demonstrates the shortcomings of this approach. The nuclear operator in Japan was not prepared for a tsunami height of more than ten metres. There were no emergency plans for emergency cooling systems failing in multiple reactors at the same time, or for explosions causing reactor control rooms to become inaccessible due to high radiation. There were no emergency plans dealing with the thousands of tonnes of contaminated water that are needed to continue to cool the reactors and spent nuclear fuel pools.

A tsunami is not the only thing that can cause a serious accident. Most reactors are vulnerable as the hot nuclear fuel in the reactors and waste pools need to be cooled long after shutdown, for many months. This is core to the emergency systems in all reactors: continuous cooling needs to be guaranteed in order to prevent hydrogen explosions and fuel meltdown. Unfortunately, failures do occur in cooling systems and backup cooling systems, also in the absence of natural disasters. In 2006 external loss of power almost caused a serious accident in the Forsmark nuclear power plant in Sweden, because two out of the four emergency diesel generators would not connect,

[46] John Large 2007: Assessments of the Radiological Consequences of Releases from Existing and Proposed French EPR/PWR Nuclear Power Plants. Large And Associates. For sequence of events see pg.13. http://www.largeassociates.com/3150%20Flamanville/r3150-final-1.pdf
[47] Revised DEIR, Executive Summary, pg 10.
[48] Human Health Risk Impact Report, October 2010. Pg 24.

and the others only connected after 20 minutes.[49] A former director of Forsmark commented that: "it was pure luck there wasn't a meltdown".[50]

Nuclear accidents can be caused by a wide range of causes, such as design flaws, construction flaws, ageing materials, human errors, and external events. And the worst accidents occur when there is a combination of these factors that is impossible to predict. The failing safety assessments by the nuclear industry prove that nuclear technology is inherently unsafe.

6.2 Proposed emergency zones

From Chapter 3 DEIR:

At this stage, the exact delineation of the Emergency Planning Zones (EPZs) is unknown and the sizes of the EPZ have been assumed, based on current international practice for Generation III reactors. The extent of the emergency planning zones will be set by the NNR licensing process.

(...) Given that the technology of nuclear reactors has changed significantly since the commissioning of Koeberg, it is likely that the EPZ will be reduced in comparison to Koeberg Nuclear Power Station's EPZs. The emergency planning zones for Koeberg are characterised by 5 km and 16 km radii around the power station. (...)

It is likely that the corresponding EPZs for the new nuclear power station will be reduced to 800 m and 3 km respectively. (...) The reduced EPZs are based on European Utility Requirements (EUR) standards, which prescribe that modern nuclear power plants should have no or only minimal need for emergency interventions (e.g. evacuation) beyond 800 m from the reactor. The EUR standards also provide a set of criteria that a reactor must meet in order to demonstrate that it can be built to comply with such emergency planning requirements.

The EUR standards were initiated by a group of power utilities from six European countries in 1992. (...) The NNR has indicated to Eskom, as well as in presentations to Parliament (NNR 2010), that it is revisiting its current regulatory requirements, guidelines and processes and updating them accordingly (...). The NNR (2010) states that one major outcome of these new designs is that the emergency planning zones, specifically the Urgent Planning Zone, would in all likelihood be reduced from 16 km in the case of the Koeberg Nuclear Power Station, to a much smaller radius that could fall within the property owned by the power station operator, thereby minimising the issue of the control on urban developments that could potentially threaten the viability of nuclear sites.

From the Emergency Response Impact report:

[49] www.analys.se/lankar/Engelsk/.../Bkgr1-07%20**Forsmark**%20Eng.pdf
[50] www.no2nuclearpower.org.uk/reports/Nuclear_Safety.pdf

> This safety philosophy requires enhanced safety features of LWRs and which result in less restrictive requirements for emergency planning. Eskom has developed a document [NSIP-01344] on a framework for demonstrating that a proposed nuclear installation can be built in South Africa without the need for off-site short-term emergency interventions like sheltering, evacuation or iodine prophylaxis, in line with the European Utility Requirements [EUR] for Light Water Reactor (LWR) Nuclear Power Plants. These documents prescribe that modern nuclear power plants should have no or only minimal need for emergency interventions (e.g., evacuation) beyond 800 m from the reactor, and provide a set of criteria that a reactor must meet in order to demonstrate that it can be built without such emergency planning requirements. The EUR requirements can be summarised as follows:
>
> o Minimal emergency protection action beyond 800 m from the reactor during early releases from the reactor containment;
>
> o No delayed action such as temporary transfer of people at any time beyond approximately 3 km from the reactor;
>
> o No long term action involving permanent (longer than 1 year) resettlement of the public at any distance beyond 800 m from the reactor;
>
> o Restriction on the consumption of foodstuff and crops should be limited in terms of timescale and ground area in order to limit the economic impact.

The Revised DEIR relies on a reduction of emergency zones from 5 km and 16 km, to 800 metre and 3 km for the Exclusion Zone and Long Term Protective Action Planning Zone respectively.[51] The extent of the emergency planning zones will be set by the NNR licensing process. It was confirmed in one of the EIA hearings that the DEIR will have to be re-done if the NNR decides on emergency zones larger than 800 m and 3 km.[52]

The Revised DEIR states that the proposed emergency zones are based on current international practice. However, no government or nuclear regulator in the world has adopted emergency zones as small as the proposed 800 m and 3 km, nor is there any evidence that such a significant reduction in emergency zones would be justified. On the contrary, the Fukushima accident has shown that the current practice of emergency zones would not cover the extent of the areas where special measures were implemented in the aftermath of the accident.

Following the Fukushima accident in Japan a 30 km zone has been evacuated, but also villages up to 45 km from the site were found to be highly contaminated, resulting in late

[51] Revised DEIR, Chapter 3, pg. 1.

[52] Final Minutes of the St Francis Bay Public Meeting, 31 May 2011. "If any of the assumptions in the consistent data set or regarding the 800 m and 3 km exclusion zones are incorrect, this EIA would have to be started again." http://projects.gibb.co.za

evacuation of specific areas.[53] Agricultural impacts are enormous, as food at distances of more than 60 km contains levels of radioactive caesium and iodine several times higher than the maximum allowable limit.[54] Recently beef from farms as far as 75 km from the site was found to contain caesium levels more than four times the set limit, caused by cows being fed contaminated straw.[55] Schoolyards also need to be cleaned up as children are being exposed to radiation levels more than 20 times the internationally set limit for members of the public.[56]

Theoretical studies confirm the potential of serious radiological impacts in case of a serious accident. A study commissioned from the prominent UK nuclear expert John Large by Greenpeace, estimated that a severe accident in the French PWR design EPR (European Pressurised Reactor) in France would cause 40-400 early deaths, 6,000-30,000 latent deaths from cancer and necessitate the evacuation of a land area of 5,000-20,000 square kilometres.[57]

It is clear from the Revised DEIR that the main motivation for reducing the emergency zones lies in economical arguments:

- "to a much smaller radius that could fall within the property owned by the power station operator, thereby minimising the issue of the control on urban developments that could potentially threaten the viability of nuclear sites."

- "This safety philosophy requires enhanced safety features of LWRs and which result in less restrictive requirements for emergency planning."

- "Restriction on the consumption of foodstuff and crops should be limited in terms of timescale and ground area in order to limit the economic impact."

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[53] *Fukushima reactions to radioactive 'hot spot' evacuation recommendation mixed,* Mainichi Daily News, 17 June 2011. http://mdn.mainichi.jp

[54] See e.g. *Radiation above standards found in Shizuoka tea,* Asahi, 11 June 2011. http://www.asahi.com/english/TKY201106100410.html ;
Greenpeace Identifies High Contamination Levels in Vegetables, Greenpeace International, 6 April 2011. http://www.greenpeace.org/africa/en/News/news/Greenpeace-Identifies-High-Contamination-Levels-in-Vegetables/

[55] *Radioactive cesium detected in straw fed to beef cattle*, Daily Yomiuri Online, 15 July 2011. http://www.yomiuri.co.jp/dy/national/T110715005727.htm

[56] *Fukushima city to remove topsoil from schoolyards,* NHK World, 10 May 2011. http://www3.nhk.or.jp/daily/english/10_24.html

[57] John Large 2007: Assessments of the Radiological Consequences of Releases from Existing and Proposed French EPR/PWR Nuclear Power Plants. Large And Associates. http://www.largeassociates.com/3150%20Flamanville/r3150-final-1.pdf

There is no theoretical or empirical evidence to support a reduction of the emergency zones. The presumption that "modern nuclear power plants should have no or only minimal need for emergency interventions (e.g. evacuation) beyond 800 m from the reactor" has not been proven. In fact, recent experience with the Fukushima nuclear power plant shows that the industry has not been able to predict or prevent a serious accident, despite its assurances that nothing could happen.

Serious flaws in Generation III reactor design have been identified, confirming the vulnerabilities that exist even in 'modern nuclear power plants'. A recent report by the Austrian nuclear expert Dr. Helmut Hirsch shows that the architects of the French EPR failed to systematically design against a sustained loss of power to cooling systems.[58] The entire design is built on the assumption that either grid power or primary diesel generators can be restored within 24 hours, while in Fukushima the blackout lasted for 11 days. If faced with a sustained loss of power, the operators of an EPR would have:

- no ability to cool water in reactor below 100^{o}C and achieve stable shutdown;
- no power to pump water into reactor coolant system. This would be critical if the reactor cooling system starts leaking or water level drops because of lack of cooling, and cooling via the steam generators fails;
- no operable boron injection system (boron is needed to keep the nuclear chain reaction from restarting);
- no power to cool spent fuel pool (in the basic design and the US EPR); and
- no hydrogen recombiners or igniters in fuel building to prevent explosions.

The proposed emergency zones are based on European Utility Requirements (EUR) standards, which were initiated by a group of European power utilities. They have not been adopted by any official authority, and hence cannot be regarded as international standards or international practice.

[58] *Selected Aspects of the EPR Design in the Light of the Fukushima Accident,* Dr. Helmut Hirsch, 3 June 2011. http://www.greenpeace.org/france/PageFiles/266521/EPR_Report_Greenpeace.fr.pdf

7. Radioactive waste

7.1 Waste

> A nuclear power station of standard Generation III design is favoured by Eskom due to the operational simplicity and rugged design, availability, reduced possibility of core melt accidents, minimal effect on the environment, optimal fuel use and minimal waste output.[59]
>
> The Vaalputs Nuclear Waste Site has the capacity to handle the additional low-level and intermediate-level radioactive waste that will be produced by Nuclear-1 and is regarded as a safe and well-managed site. High-level radioactive waste will be stored on site (as has been the practice at the KNPS) until an authorised facility for the disposal of high-level waste is available in South Africa. This holds no significant risks, provided that the spent fuel waste is contained within a protected area according to management practices approved by the NNR.[60]
>
> (...) the National Radioactive Waste Disposal Institute Act, (Act No. 53 of 2008) was promulgated in January 2009 and came into effect in December 2009. The purpose of this Act is to ensure that the capability and capacity of the institutions to manage radiological w aste is addressed. This Act provides for the establishment of a National Radioactive Waste Disposal Institute in order to manage radioactive waste on a national basis (a function historically performed by Necsa). Although the Act has come into effect, it w ill still be some time before the Agency is formally constituted.[61]
>
> Internationally, this waste is currently being stored (usually above ground), awaiting the development of geological repositories. While the arrangements for storage have proved to be satisfactory and have been operated without problems, it is generally agreed that these arrangements are interim and do not represent a final solution.
>
> These requirements should be supplemented from the experiences of several national programs that are within a decade of operating a geological repository for high-level waste and spent fuel, notably Finland, Sweden and the USA.
>
> The potential environmental impacts identified and assessed include all potential radioactive wastes expected to be generated by the proposed Nuclear-1 Nuclear Power Station. The assessment results indicate that with the implementation of appropriate mitigation measures all potential impacts are low. [62]

EIA Regulation 31(2)(l) states that an environmental assessment report must include "an assessment of each identified potentially significant impact, including cumulative impacts, the nature of the impact, the extent and duration of the impact, the probability

[59] Revised DEIR, Executive Summary, pg 3.
[60] Revised DEIR, Executive Summary, pg 17.
[61] Specialist report "Management of Radioactive Waste", September 2010. Pg 25.
[62] Specialist report "Management of Radioactive Waste", September 2010. Pg 87.

of an impact occurring, the degree to which the impact can be reversed, the degree to which the impact may cause irreplaceable loss of resources, and the degree to which the impact can be mitigated."[63] "Significant impact" is defined in the Regulations as "an impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment."[64]

Radioactive waste is certainly a "significant impact" under a common sense reading of the definition, and it has been identified as such by numerous public participants,[65] the DEA,[66] and the applicant itself.[67] The Revised DEIR fails to adequately assess the impacts of radioactive waste generated in the proposed nuclear power plant. The DEIR does not adequately analyse the nature, extent, duration, and probability of waste impacts and the degree to which they may cause irreversible damage.

The DEIR refers to the National Radioactive Waste Disposal Institute Act (NRWDIA) for the long term storage of radioactive waste. This is completely insufficient and in breach with EIA requirements. The EIA Regulations clearly list the "construction of facilities or infrastructure for (...) the storage and disposal of nuclear fuels" as an activity requiring an EIA[68] and thus also within the ambit of NEMA. The NRWDIA does not present a strategy on how to deal with highly radioactive waste on the long term.[69] The Act merely lists a range of options, each of them requiring further research and development before a decision on waste disposal can be made. Not including concrete plans for the storage and disposal of highly radioactive waste is a serious flaw in this Revised DEIR. The fact that there is no established way to manage a given environmental impact cannot be a justification for its exclusion.

The 'several national programmes that are within a decade of operating a geological repository' referred to in the specialist report, are haunted by serious open questions that will need to be answered prior to any of the proposed options becoming operational.[70]

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[63] EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Chapter 3, s 31, subsec 2(l).
[64] EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Chapter 1.
[65] Revised DEIR App D8 Combined IRR Volumes Final at 157–186.
[66] Letter from Ms. Joanne Yawitch, Deputy Director General of Environmental Quality and Protection, DEA, to Mr. Tim Liversage, Arcus Gibb (Nov. 19, 2008) (laying out conditions under which the scoping report was to be accepted, which included assessment of nuclear waste).
67 Revised DEIR, Chapter 9, Impact Analysis 9.29 and APP E29.
68 EIA Regulations 2010, GNR 543 GG 33306 of 18 June 2010, Listing Notice 2, Appendix 1.
[69] National Radioactive Waste Disposal Institute Act, (Act No. 53 of 2008). December 2009.
[70] Rock Solid? A scientific review of geological disposal of high-level radioactive waste. Dr Helen Wallace (GeneWatch UK). http://www.greenpeace.org/eu-unit/Global/eu-unit/reports-briefings/2010/9/rock-solid-a-scientific-review.pdf

Furthermore, a proper assessment of the potential impacts of radioactive waste cannot be made without detailed knowledge of the reactor design. The potential impacts of the waste will vary depending on the properties and composition of the waste which will depend on the type of fuel (enrichment, MOX), the reactor core design, and the fuel burn-up. "A nuclear power station of standard Generation III design is favoured by Eskom due to -- minimal waste output" = high burn-up. The EIA must include an assessment of the specific risks with high-burn-up fuel, but should also investigate alternatives, i.e. low burn-up fuel.

In addition, the Revised DEIR does not take into account the potential impacts of long term (>70 years) storage of spent nuclear fuel in on-site fuel pools. Storage of spent nuclear fuel in pools poses significant safety risks, as was recently recognised by Jacques Besnainou from the French nuclear company AREVA in North America:

> "One of the things we're discovering in Fukushima is leaving used fuel in ... a spent fuel pool may not be a very wise decision"[71]

Spent nuclear fuel rods require continuous cooling. If the cooling system would fail, spent nuclear fuel rods can overheat, and fuel elements can be damaged, releasing radioactive gases and potentially resulting in melting of the fuel.[72] When spent nuclear fuel pools become too full, these risks increase as the total amount of waste will be hotter and more radioactive.[73]

7.2 Dry storage

> It is expected that standard wet storage will be implemented at the proposed Nuclear-1 Nuclear Power Station, supplemented with dry storage as appropriate.[74]

The Revised DEIR does not properly assess possible alternatives. In the case of evaluating the potential impacts of spent nuclear fuel storage, the DEIR should properly assess the option of storing the spent nuclear fuel in dry storage casks instead of pools. The option of dry storage is common practice in countries like Germany and the US.

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[71] *Areva sees US nuclear waste recycling planning by '15*, Reuters, 6 June 2011. http://af.reuters.com/article/energyOilNews/idAFN0626744520110606

[72] See Union of Concerned Scientists, Nuclear Power, Safer Storage of Spent Nuclear Fuel, at http://www.ucsusa.org/nuclear_power/nuclear_power_risk/safety/safer-storage-of-spent-fuel.html (last accessed 8 July 2011).

[73] Robert Alvarez, *Spent Nuclear Fuel Pools in the U.S: Reducing the Deadly Risks of Storage, Institute for Policy Studies* (May 2011), available at http://www.ipsdc.org/reports/spent_nuclear_fuel_pools_in_the_us_reducing_the_deadly_risks_of_storage [last accessed 21 July 2011].

[74] Specialist report "Management of Radioactive Waste", September 2010. Pg. 47.

Even though the option is listed in the specialist report, the impacts are not weighed against the storage of spent fuel in pools. This is a serious omission, as the dry storage option is potentially much less risky than wet storage in pools, hence minimising environmental impacts.

7.3 Decommissioning

Table 3-1: Estimated timeframes for Nuclear-1's lifecycle[75]

	Start	Complete
Preconstruction	Pending authorisation	2013
Construction	2013 - 2014	2020 - 22
Operation	2020 - 2022	50 – 60 years
Decommissioning		Undetermined

The decommissioning plan for Nuclear-1 is likely to be similar to the plan for Koeberg Nuclear Power Station.[76]

The Revised DEIR does not define a detailed decommissioning strategy for Nuclear-1, nor does it evaluate potential environmental impacts thereof. There is no mention of a decommissioning fund in Chapter 3 or the specialist Economic Report, while future cost of decommissioning could have significant social and economic impacts on future generations.

8. Water

8.1 Groundwater contamination

Potential impacts identified at all three coastal sites included flooding by groundwater, depletion of local aquifers, degradation of wetlands, contamination of groundwater, degradation of infrastructure by corrosion and contamination of the shore zone. The potential degradation of wetlands is assessed in the specialist wetland assessment.

The assessment concluded that all three sites are environmentally acceptable, with the majority of the impacts being rated as low before and after mitigation. Radioactive contamination was, however, identified as being of high significance before mitigation, reducing to medium after mitigation (use of nuclear reactor designs meeting the NNR's requirements for normal operational dose emissions and containment of accident emissions).[77]

[75] Revised DEIR, Chapter 3, Pg 9.
[76] Revised DEIR, Chapter 3, Pg 43.
[77] Revised DEIR, Executive Summary, Pg 10.

Radioactive contamination of groundwater and wetlands is identified as being of potentially high impact especially in the wetland areas of Thyspunt. However, the Human Health Risk Impact report does not assess the potential health risks caused by groundwater contamination. Also potentially damaging impacts of radioactive contamination to flora and fauna in the area have not been included in the Revised DEIR.

8.2 Cooling water

> Consideration of two cooling water disposal alternatives at Thyspunt: near-shore and off-shore. The assessment concluded that the near shore outfall is acceptable at Thyspunt from the point of view of marine organisms (e.g. chokka squid).[78]
>
> Outlet structures for cooling water and chemical effluent must be offshore. All releases need to occur at the appropriate distances as described by the relevant specialists. Provided that the specific mitigation measures identified in the marine biology report are adhered to, offshore effluent release is therefore the recommended alternative.[79]
>
> It is concluded that offshore deep outlets are required at the Bantamsklip and Duynefontein sites. This is particularly important at Bantamsklip in order to mitigate impacts on abalone. It is further concluded that a shallow (5 m deep) nearshore release point for cooling water is environmentally acceptable at Thyspunt, as it would not result in significant impacts on chokka squid.[80]

It is clear from the Marine Ecology Impact Assessment report that the off-shore release of cooling water will result in fewer environmental impacts than the near-shore option on all three locations. Despite this, the Revised DEIR allows for the less preferred near-shore release of cooling water in shallow waters (5 m deep) stating it is 'environmentally acceptable'. However, it is not Eskom or Arcus Gibb who should judge what is environmentally acceptable, that is for the DEA and the DEA alone to decide. Furthermore, a less damaging option is identified in the DEIR, while no arguments are provided as to why this option would not be favourable. We urge the DEA to ensure that, in case this project does indeed go ahead despite the numerous flaws, the least impacting option will be implemented.

[78] Revised DEIR, Executive Summary, pg 5.
[79] Revised DEIR, Executive Summary, pg 8.
[80] Revised DEIR, Chapter 10, pg 10-2.

9. Economic impacts

9.1 Economics

The impacts on the economic environment were considered in the Economic Impact Assessment report contained in Appendix E17. The economic impact assessment does not really look at the impact of the project, nor does it look at the impact of electricity prices and economic losses on the country, but rather focuses on the economic cost effectiveness of the three alternative sites (that includes the capital and operational costs of the service provide). The Economic Impacts covered in this report are thus insufficient as they do not explore the full extent of the macro-economic impacts of building a Nuclear Power Station.

This section only covers a superficial economic impact on the provinces in which the NPS is being placed, confuses the cost data and ignores the huge impact on the country as a whole. At a broader macroeconomic level the report assessed the impacts of the three sites on their relevant provincial economies and did not assess the impacts at a national level. This was also the case in assessing the impacts of a nuclear disaster. The report states that "the likelihood of such an event would be negligible" and only assessed the impacts on the areas close to the three sites. This is an indication of the lack of understanding of the economic impacts such a disaster will have to the country. Kazumasa Iwata, President of the Japan Center for Economic Research, has estimated the costs of the Fukushima Daiichi accident to be ¥ 5.7−20 trillion (US$ 71 – 250 billion). According to a 2006 report by the International Atomic Energy Association, though difficult to measure, the total costs of the Chernobyl disaster were in the hundreds of billions of dollars, Belarus having estimated losses of US$ 235 billion over 30 years.[81]

In terms of the cost of electricity, the Economic Impact Assessment assumes electricity sales revenue of R230/MWh vs EPRI, which are an estimated production cost of about R740/MWh (over R1,200 with the overnight cost used in economics report). There is no explanation as to how this gap will be plugged. It is important to note that Eskom is a publicly owned utility and thus Eskom's losses are losses to the taxpayer – as was the case in the PBMR.

[81] http://www.globalsubsidies.org/subsidy-watch/analysis/fukushima-disaster-puts-focus-hidden-subsidies-nuclear-power

The economic assessment also confuses cost data. The cost comparison states that a 3.3GW nuclear plant would cost R90-R110 bln while the site comparison uses R170 bln. This has the effect of making nuclear look more competitive with other options in the comparison while inflating the macroeconomic impact. The graph below illustrates

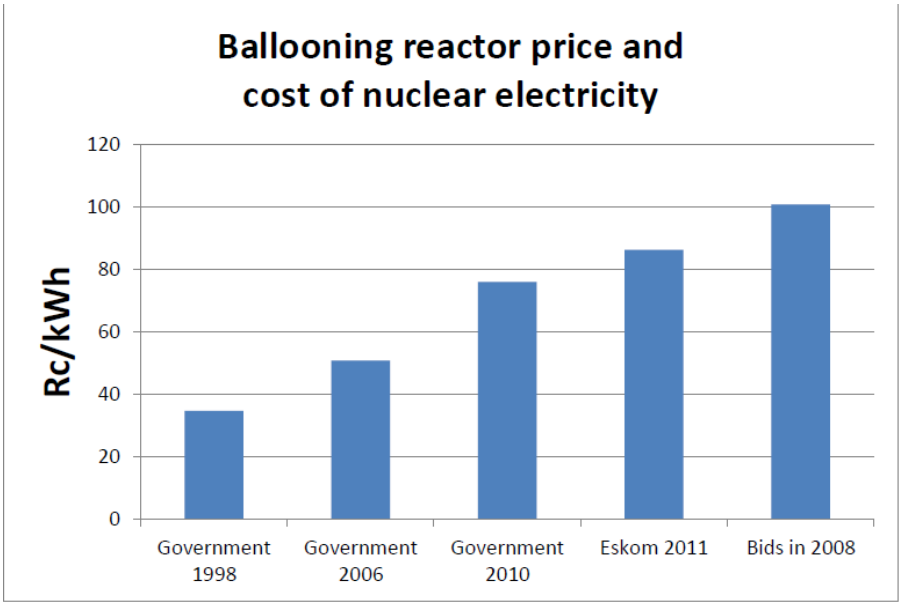

Figure 1: prepared using information from the True Cost of Nuclear [Source: Greenpeace Africa, 2011]

that the price in 2008 bids for nuclear power have an electricity cost of about 100c/kWh or more than double the current tariff.

An economic impact assessment must review the impacts of nuclear energy to the country as a whole and thus a true economic assessment must include:

a. the impact on the price of electricity of the expenditure of R120bn on a NPS and how this will affect consumers, particularly the poor;

b. the impact on household income and the taxpayer;

c. the economic impact of a catastrophic incident on adjacent communities;

d. the economic impact on all phases of the NPS's life including decommissioning which could be of the same order as commissioning;

e. an indication of the costs and benefits to assess the socio-economic impacts of the project;

f. the economic impacts of a major or serious accident; and

g. waste storage costs (current and cumulative).

In addition, the economic impacts of the construction of a nuclear reactor would vary depending on the specific design and its corresponding features[82]. In turn, the lack of a final design results in a failure to properly assess and analyse the full potential economic impacts and place sufficient relevant information before the decision maker. It is further submitted that because all potential economic impacts need to be assessed, the impacts of the cost of insurance against significant potential impacts must also be assessed and analysed in the economic report. This is especially so because the cost of insurance against such accidents may be very large and are excluded from household insurance.

Further to the above, the fact that a site has not been chosen again means that it will be impossible to assess and analyse the full potential economic impacts. This report thus lacks crucial information to make an informed decision on the economic impacts of a nuclear Power Station.

10. Social impacts

The Social Impact Assessment[83] identified and evaluated the possible impacts of Nuclear-1 during the construction and operation phase of the proposed project that included issues such as small business development, employment opportunities, noise and dust pollution, etc. The report touched on the possible social impacts that are linked to a nuclear disaster, but only as related to people's perceptions rather than the potential social impacts of a nuclear disaster.

[82] Safety features, fuel type, burn up rate, fuel storage options, waste facilities and disposal methods, emergency zones, core catcher, containment hulls, source term, cost overruns, labour, expertise and material required, etc.

[83] *Impacts on the social environment are dealt with in the Social Impact Assessment specialist report contained in Appendix E18*

10.1 National

The Social Impact Assessment (SIA) also focused on the impacts in the three proposed areas. However, the social impact of a nuclear disaster should be done at a national level. There are two very key impacts that are not covered in the SIA – the increase in electricity prices and the economic fallout from a disaster. As noted earlier [section on economic impacts], a nuclear fallout can cripple the economy of a country.

10.2 Future generations

Building a nuclear power station could take 10 years or more to completion. In general the life-cycle of nuclear plants are 40-50 years. The waste that is produced will have to be managed for hundreds of years. This is a burden that is being placed on future generations – socially, environmentally and economically. Section 24 of the South African Constitution sets the foundation for the protection of environmental rights. It stipulates "Everyone has the right to an environment that is not harmful to their health or well-being." Furthermore, it recognises the rights of future generations in the context of sustainable development by stating "and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

The SIA concludes that a "no-development" alternative would impact on the positive impact of the nuclear power station on macro-economic performance indicators. This assessment did not take into account the debt that South Africa would have to incur to build a nuclear power station in South Africa. According to a study by Citibank the costs of constructing a new nuclear power plant range between 2,500 to 3,500 euros (3,420 US dollars) per kilowatt.[84] The construction of a large reactor would cost between R40 billion to R80 billion.

In reality however, it is difficult to estimate the cost of a nuclear reactor as the full costs are only established at the end of the project at which time the amount spent is way above the estimate. A case in point would be the PBMR where the initial project estimate in 2002 was R1013m but by 2010 when the project was shut down it had cost almost R10 billion and nothing to show for it. Similar delays can be seen with the first ever EPR nuclear reactor - currently under construction by French nuclear company

[84] Nuclear Does Not Make Economic Sense Say Studies', http://ipsnews.net/news.asp?idnews=50308

Areva in Finland.[85] Areva recently doubled its claim for economic damages from the Finnish project from 1 billion to 1.9 billion euros , and Areva's total cost for the project is approaching double the contracted price of 3 billion euros .

As NEMA places such a high premium on minimisation of impacts and investigation of mitigation, a worst-case scenario analysis is clearly relevant information, as it will bring to light the full extent of potential impacts and all possible safety measures.[86] Any approval made without such information will be one in which relevant factors were not considered.

The SIA has failed to assess the socio-economic impacts of a worst-case scenario, the long term effects of waste and the socio-economic impacts of project alternatives.

[85] Greenpeace briefing, released 21 July 2011: New problems in Olkiluoto http://www.greenpeace.org/international/en/publications/New-Problems-in-Olkiluoto/

[86] See *supra* Section (b)(ii) at p. 13–15 & n. 30.