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Submission by email on 23 May 2011
Email: mike.thurgood@imagnet.co.za

Dear Mr Longden-Thurgood

ESKOM REVISED 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

GIBB acknowledges receipt of the submission received from Mr R. Mike Longden-Thurgood discussing the above report.

We thank you for your valuable comments and your participation in the Eskom Nuclear Power Station (NPS) Revised Environmental Impact Assessment (EIA) process to date. Your questions and comments concerning the Nuclear-1 have been noted.

YOUR COMMENT 1

1. Appendix E4 Seismic Risk Assessment.

Last paragraph on document p.19, quoting: "Based on current knowledge, the three localities under review [*i.e. Duynefontein, Bantamsklip and Thyspunt*] are considered suitable locations for Nuclear Power Stations following the extensive *NSIP*. To date no geological evidence has been found that would halt the development of a Nuclear Power Station at any of these sites. However, a definitive statement regarding the hazard from surface fault rupture cannot be made until the foundations are excavated at the site [*sic*]".

Two questions arise:

- i) With evidence gleaned from excavations at the three sites on surface fault rupture, what specific indications would be likely to determine that a site was not suitable for a nuclear power station?
- ii) Posing a hypothetical situation, if such an adverse indicator was to be found at Duynefontein, how would it be envisaged that it could be appropriately interpreted, retrospectively, in terms of the seismic safety of the existing Koeberg nuclear power station?

RESPONSE 1

- i) Please note that the seismic assessment (Appendix E4) conducted concluded that all three sites were seismically suitable to construct a nuclear power station. Furthermore, please note that a detailed site safety case will have to be presented to the NNR as part of the nuclear licence application.
- ii) The seismic hazard at the Koeberg NPS is reviewed as new information comes to light and the Site Safety Report updated accordingly. The integrity of the nuclear safety related Structures, Systems and Components (SSC) are then checked accordingly. The safety of the KNPS has recently been checked following the events at the Fukushima nuclear power plant. These checks included beyond design basis seismic ground motion and flooding as the initiating events. The evaluation by the NNR on the safety assessment done by Eskom concluded that KNPS is able to withstand these events.

COMMENT FROM INDEPENDENT NUCLEAR SPECIALIST:

The response is saying that the site specific seismic hazard for the sites has yet to be determined and this will inform the seismic risk and the subsequent external events element of the facility safety case - however as yet this has not been done for the proposed sites. For KNPS the case is made that it has recently been subject to a beyond design basis stress test and no concerns were identified.

YOUR COMMENT 2

1. Appendix E4 Seismic Risk Assessment.

b) Section (d) *Duration* at the top of page 21, quoting: "*The duration of any impact [sic] the vibratory ground motion resulting from tectonic fault movement, will vary depending on a host of secondary environmental impacts, which falls outside the scope of this study. - - - - if it is considered that vibratory ground motion has the potential to cause damage to the Nuclear Power Station facility, the impact duration should be considered to be high. However, the impact and hence duration of impact will be decreased significantly by the appropriate engineering mitigation*".

On what basis would a professional structural civil engineer agree with the comment in the last sentence of this quote? Although the assurance sounds good at its face value, it needs to be substantiated by adding a comment from a professional structural civil engineer in order to authenticate the minimal impact significance indicated in this sentence.

A similar comment can be applied to the last sentence of Section (e) *Intensity / Severity*

RESPONSE 2

It was not the intention in this paragraph to refer to specific engineering mitigation steps. Instead it merely tries to establish the principle that any risk that the seismic hazard poses to a nuclear facility, and by implication also the environment, can be mitigated (at least to some degree) by following the appropriate engineering mitigation steps.

From a professional structural engineering perspective the seismic hazard at the site would be determined at the underside of the structural foundation. The design basis seismic motion is defined in terms of ground motion response spectra in the horizontal and vertical directions at 5% damping. Acceleration time histories would also be developed in accordance with current international standards. These typically use recorded earthquake data which suit the earthquake events anticipated at the site of interest. A suite of design basis acceleration time histories will be developed to compliment the ground motion response spectra. The NPP is designed to resist the design basis seismic motions and at the same time it must be demonstrated that the seismic margin between essentially elastic response (design basis) and the first onset of inelastic structural behaviour (beyond design basis) is in line with current international licensing requirements.

COMMENT FROM INDEPENDENT NUCLEAR SPECIALIST:

I am not able to comment on the specific engineering mitigation measures that could be engineered - however the response correctly states the methodology that would typically be followed to demonstrate the robustness of the design including in the beyond design basis region to examine the potential for so called "cliff edge" phenomena- this would be expected to be part of the external events assessment component of the plant safety case.

YOUR COMMENT 3

c) In each of Sections 4.1.1, 4.1.2 and 4.1.3 is an identically worded sub-Section b), quote: "*(b) Extent - The vibratory earthquake ground motion will be felt over a large area, but the most severe direct negative impact will be restricted to the footprint areas. However, it may also have a negative impact on supporting infrastructure within the site area (ie within an 8 km radius). Hence a medium rating is given to this risk factor*".

It is not clear what is meant by the phrase "*- the most severe direct negative impact will be restricted to the footprint areas*". Is this intended to indicate that only the ~8 km radius area would be expected to have any structures in it other than those associated with the nuclear power plants? What is the justification for this assumption? The phrase is almost tantamount to saying that earthquake epicentres are most likely to be associated exclusively within the 8 km radius area, which I am sure is not how it is intended to be interpreted. Nor is it in any way a practical situation.

Ground vibratory intensities associated with earthquakes can presumably vary very considerably over relatively short distances, receding as the distance from the epicentre increases. (Take as an example the May 14 low intensity ground vibrations felt from George to Plettenberg Bay, but apparently not further away).

I propose that some rewording of the above quote would be helpful in order to eliminate the present ambiguity in meaning.

RESPONSE 3

It is correct to say this sub-section does not set-out to predict where earthquake and earthquake damage will occur. The focus of the work presented here is to determine the impact a nuclear facility

may have on the environment, because of the occurrence of an earthquake, and not on the direct impact of an earthquake on the environment. In such a scenario any potential secondary environmental impact will most likely be centred on the facility and normally diminish the further away you are from the site.

However, we acknowledge that the sub-sections are confusing in its current format and propose that they be reworded as follows:

"Vibratory earthquake ground motion may be felt over a large area, but the only impact assessed in this report focused on the footprint areas. There may also be a negative impact on the supporting infrastructure and environment within the site surroundings and local region. Hence a medium rating is given to this risk factor".

COMMENT FROM INDEPENDENT NUCLEAR SPECIALIST:

It must also be stated that the qualitative analysis presented in no way predicates the necessary site safety report, external events assessment, safety assessment and quantitative radiological impact assessment and associated design compliance demonstration that will form a necessary part of the safety case for the facility and successful demonstration of this is required as part of the NNRs licencing process.

YOUR COMMENT 4

2. Appendix E3 Geological Hazard Assessment

The technical term "capable" needs to be added to the Glossary of Terms with respect to faults.

RESPONSE 4

Thank you for your comment. Your suggestion is noted.

A capable fault is defined as a geological feature which, because of its present tectonic setting, can undergo movement from time to time in the immediate geologic future. A fault, which has moved during the recent geologic past (Quaternary) and, thus, may move again would be defined as a capable fault.

In terms of the US NRC licensing guidelines, a geological fault is judged capable of producing macro-earthquakes if it exhibits one or more of the following characteristics:

- (1) Evidence of seismo-tectonic movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years.
- (2) Macro-seismic activity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the [fault](#).
- (3) A structural relationship to a predefined capable fault such that movement on one [fault](#) could be reasonably expected to cause movement on the other.
- (4) Established patterns of micro-seismicity that define a fault, with historic macro-seismicity that can reasonably be associated with that fault.

YOUR COMMENT 5

2. Appendix E3 Geological Hazard Assessment

Quoting from the 2nd paragraph on document page 8: "*At present there are no specific South African regulations for seismic and geographical issues related to the licensing of nuclear power plant sites, and thus Eskom decided to follow the US Regulations for Seismic Hazard Analysis (SHA) and associated geological work*".

The impact of the March 11 magnitude 9 earthquake north of Tokyo, Japan, and the effect of the resulting very high tsunami on the Fukushima Daiichi nuclear power station has reverberated around the world where nuclear power stations are concerned, especially those that have been constructed on seaboards (i.e. coastal regions). Although the additional design features which will need to be looked at as a result of this earthquake and tsunami are not a part of this EIA process *per se*, none-the-less the matter of safeguarding against the destruction of all electrical supplies by very high waves and tsunamis initiated by earthquakes will need to be dealt with. (See comments below on the oceanography report).

This EIA process can, therefore, be used to let our government know of our concerns on there being no regulations or recommendations with respect to seismic, oceanographic and tsunami events.

RESPONSE 5

Thank you for your comment.

As you correctly pointed out, the safety assessment of these events is not part of the EIA process but is regulated by the NNR (National Nuclear Regulator of SA) within the current regulatory regimes in the RSA. This will be addressed as such through the NNR process. However, nonetheless, the (NNR) requires in their licensing requirements documents that external hazards including seismic and tsunami up to a probability of exceedance of $1E-6$ per annum be considered in the design of a NPP. This licensing requirement is applied by Eskom. The EIA is stating that there are no detailed processes in South Africa which must be followed for the assessment of such extreme events and hence, US NRC regulations and methodologies are used as these are generally accepted in most countries around the world having nuclear power generation capabilities.

COMMENT FROM INDEPENDENT NUCLEAR SPECIALIST:

Whilst the proposed facility is not yet the subject of a specific licence application and the exact safety case requirements that may be set by the NNR are not yet determined the NNR does currently require assessment of external events as stated and as such any assessment methodology can only at this stage be based upon international best practice and as stated in general the NRC requirements are widely used in this regard elsewhere - as such our nuclear safety process is not prescriptive and requires the applicant to demonstrate the safety of the proposed facility - part of the safety case will inevitably entail and adequate demonstration of the robustness of the methodology in the context of international best practice.

YOUR COMMENT 6

3 Appendix E5 Geotechnical Suitability Assessment

The word *unconformable* needs to be added to the Glossary of Terms

In geology “unconformable” normally refers to a contact between two adjacent deposits that represents a hiatus (which can be either a period of non-deposition or erosion). In this case the units do not represent continuous deposition and normally have very different ages

RESPONSE 6

Thank you for your comment. Your suggestion is noted.

YOUR COMMENT 7

3 Appendix E5 Geotechnical Suitability Assessment

There is an inconsistency in the caption to Table 2.2, the sentence "**Error! Reference source not found**" not being relatable to anything.

RESPONSE 7

Thank you for your comment. This error will be rectified.

YOUR COMMENT 8

3 Appendix E5 Geotechnical Suitability Assessment

The last paragraph on document p.13 and to the top of the next page discusses the Goudini and Skurweberg formations, with different founding conditions, which I assume relates to the different load carrying capability of these two formations. In view of the importance of this differential effect, I would suggest that the second sentence at the top of document p.14 be reworded to: "**From a geotechnical engineering perspective any spanning integral construction and engineering works must be avoided**". i.e. one has to be absolutely definite about it whereas the present wording would indicate that some relaxation could be permitted. I don't personally believe that it could be permitted.

RESPONSE 8

Thank you for your comment. Your suggestion is noted.

This restriction however, only applies to nuclear safety related structures which are founded on bedrock. Many of the auxiliary buildings will be founded on the terraces some 15m above bedrock and the foundations of these buildings will not be restricted as stated above.

Furthermore, the contact between these 2 geological formations must be physically located and the strike and dip of the contact zone measured.

YOUR COMMENT 9

4 Appendix E4 Oceanographic Impact Assessment

Although tsunamis are oceanographic phenomena, they are caused by seismic events. Prior to the near disaster at Fukushima-Daiichi on March 11, 2011 (when a huge tsunami eliminated all power supplies to the nuclear plants, leading to a series of hydrogen explosions and fuel meltdowns as core cooling in reactors 1, 2, 3 and no.4 spent fuel pool failed, accompanied by subsequent leakages of radioactivity into the sea), I wouldn't have given a second thought to the comments about tsunamis as they have been dealt with in this report. But, in hindsight, it is my considered opinion that the section dealing with tsunamis has to be redrafted in considerably more detail, which will necessarily include advice and comments from the seismology specialist.

For example, I would have expected to see comments about the basic differences between the expanding Atlantic Ocean and the contracting Pacific Ocean, where the latter has an almost continuous sub-ducting seaboard. Common seismological sub-ducting events are responsible for the greater frequency of tsunamis around the Pacific seaboard than occur around the Atlantic seaboard, which are caused by different seismological events.

If this subject isn't given considerably more in-depth consideration, now, there is a very strong possibility that the EIA process will be held up whilst the situation is being remedied. I suggest that no time should be wasted in dealing with the matter.

In view of the time that has elapsed since the Japanese tsunami on March 11th, I am very surprised that, at the very least, a rider hasn't been added to this report that attention is being urgently given to the matter of upgrading this part of the report.

RESPONSE 9

Thank you for your comment. The risks related to the possible occurrence of tsunamis have been assessed in the Hydrological Assessment (Appendix E6 of the Revised Draft EIR), the position of the 1:100 year floodline report (Appendix E9 of the Revised Draft EIR) and the Oceanography Report (Appendix E18 of the Revised Draft EIR). It is concluded that there is the 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.

As we have pointed out in response 5, as part of the NNR licensing process, Tsunami related events corresponding with submarine large magnitude earthquakes, meteo tsunamis, offshore slumps and other marine related hazards will be included in the oceanographic section of the SSR (Site Safety Report). Continual updates of these sections should be planned to incorporate new information on hazards which have the potential to generate tsunamis. Of importance is the identification of palaeo-tsunamis which have occurred along the coastline in the region around the Thyspunt site.

The SSR hydrological section will deal with onshore generated tsunamis off which there are none identified to date.

YOUR COMMENT 10

5. General observations

The international nuclear power community, and international nuclear representative organisations, are looking at what recommendations they will be formulating to be implemented to ensure the guaranteed safety of nuclear plants at all nuclear power stations around the world. As at the time of my preparing this brief report, Dr Mike Weightman of the Health & Safety Executive's *Office for Nuclear Regulation* - ONR - in Britain would appear to have been the first to prepare an *interim* report. (See UK HSE's ONR website url: <http://www.hse.gov.uk/nuclear/fukushima/interim-report.htm>).

RESPONSE 10

Your comment is noted.

YOUR COMMENT 11

5. General observations

b) Dr Weightman has made it clear in this interim report that it is the nuclear industry in Britain which is expected to take the initiative to introduce whatever additional safety measures are necessary and essential, not for the industry to wait for the ONR to pass instructions on to them.

RESPONSE 11

Your comment is noted. Eskom will, in line with standards and practises accepted by the National Nuclear Regulator and in terms of the Environmental Management Plan, adhere with and comply to internationally accepted best practise safety measures in terms on the construction and operation of Nuclear-1.

COMMENT FROM INDEPENDENT NUCLEAR SPECIALIST:

It should be noted that a fundamental principle of the nuclear and radiological safety is that over and above meeting specific limits the licence applicant demonstrate the incorporation of ALARA principles and this reinforces that existing approach.

YOUR COMMENT 12

5. General observations

c) Nuclear reactors work on strict fundamental principles of reactor physics, which are totally independent of language, religion, race and culture. Once the international nuclear community, through the major international nuclear organisations, has agreed on what measures need to be

implemented, the necessary actions must be carried out on a worldwide scale. The nuclear industry retains the primary initiative to ensure that the recommendations are implemented, with national nuclear regulatory authorities overseeing that the objectives have been properly and effectively achieved.

RESPONSE 12

Your comment is noted. Please see our response 11 above.

YOUR COMMENT 13

5. General observations

What has become very clear from the March 11 magnitude 9 earthquake in northern Japan, and the near-disaster caused at the Fukushima Daiichi nuclear power station by the loss of all power supplies through the action of the subsequent tsunami, is that an additional report needs to be added to this draft EIR dealing with tectonic events which could result in the formation of huge waves, and possibly tsunamis in the Atlantic Ocean, which could reach South African shores.

RESPONSE 13

Your comment is noted however please see our response 9 above.

We thank you for providing us the opportunity to respond to these comments. Please do not hesitate to contact us should you require any additional information regarding this proposed project.

Yours faithfully,



For and on behalf of GIBB (Pty) Ltd
The Nuclear-1 EIA Team