Review of:

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED NUCLEAR POWER STATION ('NUCLEAR-1') AND ASSOCIATED INFRASTRUCTURE
Oceanographic Impact Assessment
March 2011
Prepared by:
WSP Environment and Energy
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By

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I was given copies of the document in the title above (65 pages) but with the Appendices B-F as blank pages. After requesting Appendix B (the figures of the report), I received a further three files labeled (Rev DEIR APP E16 App C Duynefontein Coastal Eng Report; Rev DEIR APP E16 App D Duynefontein Modelling Report; and Rev DEIR APP E16 App D Duynefontein Modelling Appendices), but not Appendix B.

Bearing this in mind, I set out to review the main document by R Giljam, under the terms of reference supplied to me.

These are enumerated below for completeness:

Terms of reference for the peer review of the specialist report:

1. *Assess the document/ report in terms of its fulfillment of the Terms of Reference set;*
2. *Consider whether the report is entirely objective;*
3. *Consider whether the report is technically, scientifically and professionally credible;*
4. *Consider whether the method and the study approach is defensible;*
5. *Identify whether there are any information gaps, omissions or errors;*
6. *Consider whether the recommendations presented are sensible and present the best options;*
7. *Consider whether there are alternative viewpoints around issues presented in the report and if these are clearly stated;*
8. *Consider whether the style of the report is written so as to make it accessible to non-specialists, technical jargon is explained and impacts are described using comparative analogies where necessary; and*
9. *Report on whether normal standards of professional practice and competence have been met.*

For my TOR 1-4; and 9, I can specify that the report by R Giljam, has been very professionally handled and well presented, with most of his content arising from a credible interpretation and summary of at least the three very technical documents (also listed above), and many more that I have not been privy to. Indeed, it is a credit to the author that he has managed to faithfully summarize such a volume of highly specialized oceanographic observations, scientific and engineering analysis and numerical modeling with much specialized engineering content. This is as specified in his *Study Approach*.

Bearing in mind that the *"scoping phase of the EIA set out to examine the main potential environmental impacts of the development on the physical marine environment and additionally to consider the impact of the physical marine environment on the safety and design of the NPS*", the author then set out a number of critical oceanographic and climatic aspects, including extrapolated Global warming factors, to address this target. This approach is comprehensive, logical and entirely reasonable at this stage, even if there is some difficulty involved to accurately quantify the values (e.g. deriving the best statistically reliable extreme values of various processes over the next 80 years to the year 2100). A number of these processes will be heavily impacted by global change and our ability to adapt or mitigate aspects of it). For this aspect, the author has relied on the (4^{th} Assessment Reports) of the IPCC AR4 (2007) results. This is because his report predated the most current 5^{th} Assessment Reports; IPPC AR5 (2013). The new IPPC AR5 (2013) has much more probabilistic language, and can be consulted if and when required concerning the long-term (e.g. 80 years or more under various carbon emission scenarios) extrapolations of various parameters such as sea level rise, sea temperature rise etc.

Collecting oceanographic field data for the 10 parameters used in the report is both difficult, expensive and usually needs to be done over as long a period as possible. A number of analyses were from only 1-2 years of intensive data collection at the three sites (Duynefontein, Bantamsklip and Thyspunt). The Duynefontein site clearly has the advantage of having a long term (20 years or more) of regular monitoring (e.g. sea temperatures), whilst in its operational cycle of the Koeberg Nuclear Power Plant. The other two potential new NPS sites suffer from short term field observations, as their important field sampling period (of necessity) has been much shorter. To supplement this difficulty, the author has used all the desktop studies of the numerical modeling available (water levels, etc.) in order to objectively compare the three different sites.

Of particular note is the large difference in the sea temperature regime at the three sites. Duynefontein is in a well-known coastal upwelling zone with southeasterly winds creating a coastal strip of upwelled cold, nutrient rich water (bad for bio-fouling) in the summer, when one would normally expect high sea surface temperatures. In contrast, the Bantamsklip and Thyspunt sites are away from the main west coast upwelling centres, and have very warm maximum sea temperatures (around mid twenty degrees C) in summer, with very strong vertical stratification (order 7^0C), and a well-mixed, much cooler vertical water column in winter.

For TOR 5-7, I did not find any glaring information gaps, omissions or errors. Since the report is largely based on factual data and engineering analyses, there is not much scope for alternative viewpoints.

Two import critical factors have been highlighted in the report:

A) The direction and dispersion of the warm plume emanating from the hot water outlet of the NPS will spread in directions along the shore that are largely influenced by the local prevailing wind and wave conditions. These appear to be most favourable for mixing and dispersion at the Dunyefontein site; and least favourable at the Thyspunt site.

B) In the very long term (> 60 years), according to the best estimates for extreme high sea levels with all the relevant processes incorporated, there appears to be the potential for the these extreme high sea levels to exceed the proposed elevation of the NPS. It should be noted that this includes the *very low probability of a large tsunami* being generated off shore, either by shelf edge slumping or from traditional under sea "earthquake" forcing, and coinciding with factors to increase the sea level. The good news is that due to the intake of cooling water expected to be quite deep, the extreme low water levels do not appear to be an issue.

With regard to the report being accessible to non-specialists, it must be pointed out that generally matters regarding the major ocean physics processes of the coastal zone are not well understood by non-marine experts. From this point of view, I believe the author has done his best to make his report readable and relatively free of technical jargon. In this regard, it should also be pointed out that 10 years ago, the term "Tsunami" (meaning a "harbor wave", a term coined in Japan), was not understood by the general public. However, the 2004 Boxing Day Tsunami that travelled all the way across the Indian Ocean from Sumatra to African shores, tragically killing a quarter of a million people, allowed this concept to be understood by almost all of the general public. One can think of other similar analogies marine and atmospheric phenomena that are now better understood by the informed layman.

In conclusion, the report by Mr. Giljam can be considered to be a very comprehensive summary of previous in situ field observations and engineering modeling and analysis. As such, it should serve as a useful as a base for decisions on the EIA of the Ocean on the three potential new NPS sites.

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