

# An estimate of the cost of the intake tunnels for the Thyspunt nuclear reactor.

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Attached as Appendix 1 are excerpts from the document "Revised DEIR Chapter 3 Project description.pdf", page 19. Namely section 3.11.1 and section 3.11.2 dealing with both the intake tunnels and the outfall tunnels

## Introduction

An estimate of the cost of the intake tunnels will be approximate in that costs will be estimated at a concept level.

## The intake tunnels

An indication of the volume of water that would be required to report to the reactors via the intake tunnels is given by the statement in Appendix 1 namely section 13.11.2 "It is estimated that **six pipelines of** approximately 3 m diameter will be required for the outfall." This means that the sum of the cross area sections of the intake tunnels would be required to be 42m<sup>2</sup>.

As a rough check, Koeberg draws in 80 tons of water per second for cooling purpose. A tunnel or tunnels whose cross sectional sum is 42m<sup>2</sup> will require water to move at a velocity of 2 m/s thus providing 80 tons of water per second to the reactors. These numbers look reasonable.

In order to get 42m<sup>2</sup> of cross sectional tunnels there are a number of permutations some of which are shown below:

- One rectangular tunnel of dimensions of 6.5 m by 6.5 m, drill and blast, end might be too big for conventional drill and blast.
- Two rectangular tunnels of dimensions of 4.6 m by 4.6 m, drill and blast.
- One circular tunnel with a 7.5 m diameter excavated by tunnel borer.

Each one of these options would have their own costs for excavation complicated by the requirement that the tunnel/s will be required to be lined.

## Costs

### Establishing the infrastructure

In order to access the intact rock at some depth below surface an 8 m diameter shaft will be required to be sunk. This shaft will give access to the development faces as the intake tunnel/s are developed. Once the intake tunnel/s are developed the shaft will itself be part of the intake as it is here that the water (enclosed in a pipeline) will emerge on surface on its way to the reactors. There will be two cost components namely the pre-sink civils to about 30 m and the sink to an estimated depth of 80 m to intact rock.

Pre- sink civils - **R 50 million**

Sink to 80 m - **R 40** million (R0.8 million/m)

### Developing the tunnel/s

It is assumed that the tunnel/s will be developed for 1500 m to a point where the depth of the ocean is 30 m. A cost per ton of R 2000 will be used and included in this cost is the cost of the lining.

The number of cubic metres to be developed is  $1500 \text{ m} * 42 \text{ m}^2 = 63000 \text{ m}^3$

This represents  $63000 \text{ m}^3 * 2.7 = 173200 \text{ tons}$

At R 2000 a ton the tunnel/s excavation and lining costs are

$R 2000 * 173200 = R 346500000$  rounded off to **R 347** million

### Intake tower on sea bed

This tower will stand about 10 m above the sea bed. Estimated cost **R 30** million

### Geotechnical drilling

This will be required in order to geotechnically classify the rock that will be traversed and will have to be done from vessels at sea. Estimated cost **R 10** million

### Total cost of the intake tunnels and related infrastructure.

Summing the rand values in bold comes to a value of **R 477** Million

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Dr Roberts has a PhD in mining engineering from the University of the Witwatersrand, an MSc in structural geology and rock mechanics from Imperial College London. He is a certificated rock engineering practitioner and consultant on hard rock underground mines with 34 years of experience. He was a C2 NRF rated researcher with a record of 54 publications as author or co-author in technical journals. He is a Professional Natural Scientist PrSci Nat Registration number 400117/96

## Appendix 1

Excerpt from file: Revised DEIR Chapter 3 Project description.pdf, page 19

### 3.11.1 Intake tunnels

An undersea intake tunnel will **draw** cooling water from the sea into **the cooling water** intake basin adjacent to the cooling water pump houses. No detailed design for the intake tunnel(s) has been done, but the design will comply with the requirements of the relevant specialist recommendations, so as to minimise the impact on marine ecosystems and sediment movement. The following basic principles will, however, apply. The construction of the intake tunnel(s) will involve sinking of a shaft on land to a depth of **approximately 65 m** below mean sea level. At this point the tunnel will be driven seawards underneath the seabed. The tunnels will be lined with precast or *in-situ* poured concrete. At the other end of the tunnel, a tower extending approximately **5 m to 10 m** above the sea bed floor will be constructed to connect the intake **structure** and the tunnel. Fixed dredging may need to be installed at the base of this tower. The length of the tunnel from the onshore access shaft will be approximately 1 km to 2 km **and the depth of water in which the intake structure will be constructed is limited to 30 m.**

### 3.11.2 Outfall tunnels

The outfall **pipelines/tunnels** dispose the seawater used to cool the **turbo-generators and other smaller heat exchangers as well as** diluted chemical effluent into the ocean. It is estimated that **six pipelines of** approximately 3 m diameter will be required for the outfall works. The marine biologist recommends the use of multiple **discharge** points in order to facilitate dispersion of the warmed water and mixing with the relatively cooler sea water. The objective of the outfall works will be to transfer the heated water at least beyond the surf zone (estimated to be in the order of 500 m to a depth of **5 m** below mean sea level). The final depth and distance of release of the heated water will be determined by the **results** of the marine specialist study. The water released into the ocean will be 12 °C warmer than the seawater, as a result of the heat absorbed from the process. The primary objective is to ensure that the heated water **has minimal** impact on sea life. The velocity of the water in the pipes will fast enough to ensure adequate dispersion into the sea. A high velocity of the expelled water ensures an adequate rate of mixing with the sea water, which reduces thermal pollution of the benthic environment.