1. INTRODUCTION

Electricity cannot be stored and must be used as it is generated. Therefore, electricity must be generated in accordance with supply-demand requirements. The main object of Eskom Holdings Limited (Eskom) is to provide energy and related services, including the generation, transmission, distribution and supply of electricity. Eskom currently generates approximately 95% of the electricity used in South Africa. The reliable provision of electricity by Eskom is thus critical for industrial development and related employment and sustainable development in South Africa.

1.1. The Need and Justification for the Proposed Project

1.1.1 Policy Considerations and Strategic Planning

The South African Energy Policy, published in December 1998 by the Department of Minerals and Energy (DME) identifies five key objectives, namely:

- Increasing access to affordable energy services;
- Improving energy sector governance;
- Stimulating economic development;
- Managing energy-related environmental impacts; and
- Securing supply through diversity.

In order to meet these objectives and the developmental and socio-economic objectives in South Africa, the country needs to optimally use the available energy resources. The South African Government, through the Department of Minerals and Energy (DME), the National Electricity Regulator (NER) and Eskom are required to address what can be done to meet these electricity needs both in the short- and long-term.

The Department of Minerals and Energy performs Integrated Energy Planning (IEP) to identify future energy demand and supply requirements. The National Energy Regulator of South Africa (NERSA) performs National Integrated Resource Planning (NIRP) to identify the future electricity demand and supply requirements. Similarly, Eskom continually assesses the projected electricity demand and supply through a process called the Integrated Strategic Electricity Plan (ISEP). Through these assessment and planning processes, the most likely future electricity demand based on long-term Southern African economic scenarios is forecasted, and provides the framework for Eskom and South Africa to investigate a wide range of supply and demand-side technologies and options. Eskom's ISEP provides strategic projections of supply-side and demand-side options to be implemented in order to meet these long-term load forecasts. It provides the framework for Eskom to investigate a wide range of new supply-side and demand-side technologies, with a view to optimising investments and returns. The most attractive supply-side option identified remains the Return-to-Service of the three mothballed Simunye Power Stations, i.e. Camden, Komati and Grootvlei. These stations are currently being returned to service. A variety of supply side options are being investigated including conventional pulverised fuel power plants, pumped storage schemes, gas-fired power plants, nuclear plants (PBMR), greenfield fluidised bed combustion technologies, renewable energy technologies (mainly wind and solar projects), and import options within the Southern African Power Pool (SAPP). As older Eskom power plant will reach the end of their design life by 2025, the use of all available technologies will need to be exploited in order to supply the country's growing electricity demand.

1.1.2 Growth in electricity demand and reduction in surplus capacity

The demand for electricity in South Africa has grown, on average, at more than 4% over the past few years, with a concomitant reduction in the surplus generating capacity. The DME, NERSA and Eskom planning processes all indicate that South Africa will require an additional 5 000 MW of electricity within the next 5 years, with this consisting of both base load electricity generating capacity[1] and peaking electricity generating capacity[2]. The processes also indicate that new base load capacity will be required by approximately 2010. In 2004, the South African Cabinet took the decision that Eskom will build approximately 70% of the new capacity required in South Africa. The balance is expected to come from Independent Power Producers (IPPs).

For base load capacity, the selection of the preferred alternative from those being investigated is required as a matter of urgency to enable the first unit of the chosen plant to be commissioned in 2010.

1.2. Alternatives

1.2.1 Primary energy resource alternative

The outcomes of the IEP, NIRP and ISEP planning processes described above identified that South Africa will be dependant on coal as a primary energy source for electricity generation for many years into the future. With the current production levels, coal reserves are estimated at 200 years (Chamber of Mines, 2002; cited in Eskom Research Report, 2002). The NER drew the following

[1] "Base load electricity generating capacity" refers to power station technology designed specifically to generate electricity continuously for all hours of the day and night.
[2] "Peaking electricity generating capacity" refers to power station technology designed specifically to generate electricity during periods of very high demand for electricity, normally on weekday mornings around 07:00 to 09:00 and weekday evenings around 18:00 to 20:00.

conclusion in their National Integrated Resource Plan (NIRP) (reference NER NIRP2 available from the NER website www.ner.org.za):

"*Options for diversification are insufficient to meet all of the forecast demand for electricity over the next 20-year planning horizon. Coal-fired options are still required for expansion during this period."*

The need to construct a new coal-fired power station in order to assist Eskom in adequately providing for the growing electricity demand was identified through Eskom's ISEP process. Through screening and feasibility studies undertaken by Eskom for various Eskom facilities, the construction of a new coal-fired power station in the Lephalale (previously Ellisras) area was identified as a feasible option.

1.2.2 Process followed to determine the preferred coal fired option location

- *Regional location*

  Potential sites were identified based on the high level criteria discussed in Chapter 2. Three locations have been identified for further investigation based on this process. The locations are Kendal North, Vaal South and Lephalale. These locations are not alternatives; if the necessary approvals are obtained all three of these location options may be implemented to meet the future base load demand.

  The Environmental Impact Assessment (EIA) for this location option was initiated in February 2005. EIA's for the other two location options were initiated at the beginning of 2006.

- *Local site alternatives*

  A strategic analysis was undertaken by Eskom in order to identify feasible alternative sites for the establishment of the proposed new power station (terrace) and associated infrastructure within the Lephalale area. This analysis considered technical, economic and environmental criteria. From a high-level screening study undertaken in 1998, it was concluded that there was the potential to establish a new power station in close proximity to the existing Matimba Power Station. In order to minimise the technical and environmental costs associated with the transportation of the fuel source to the power station, it was determined that the most feasible sites would be close to the existing Grootegeluk Mine. Criteria in terms of sterilisation of coal resources and major risks to the operations of the Mine or existing power station were also taken into consideration.

1.2.3 Technology selection process and criteria

- *Sub-critical vs Super-critical*

  The feasibility phase of the project considered both sub- and super-critical pulverised fuel technologies for implementation. Through the technical and financial evaluation processes followed during the feasibility phase, it emerged that the **super-critical option** is the preferred technology solution. The term "super-critical" refers to the critical transition point of water to steam at pressures over 22 MPa. Super-critical units typically refer to main steam conditions of 24 to 30 MPa and 538 to 600ºC, with a single reheat stage at 566 to 600ºC. The super-critical boiler is a once through design which (with sliding pressure) means that heating, evaporating, and super-heating of the incoming feed water are completed within a single pass through the evaporator tubes and therefore does not require the use of a steam drum to separate and re-circulate water during normal operation. This technology provides improved cycle efficiency and hence improved environmental performance.

  The three primary factors driving the resultant conclusion were:

  * An improvement in reliability of supercritical units to the same level as those currently achievable in sub-critical units.
  * A reduction in the capital cost difference between sub-critical and supercritical plant to the extent that they are indistinguishable on a levelised lifecycle cost basis.
  * Improved environmental performance of supercritical units due to the higher efficiencies, which became the differentiating factor in the selection of super-critical over sub-critical PF technology.

  The benefits of super-critical technology are:

  * Increased gross efficiencies. This increase in efficiency results in a reduction in coal consumption of approximately 5%.
  * A reduction in emissions in the order of 5%.
  * Super-critical plant performance in terms of availability indicators is comparable to that of current Eskom plant performance according to a VGB report "Availability of Thermal Power Plants" for the operation period from 1995-2004.

  The levelised cost difference between sub-critical and super-critical technologies is extremely small and does not support the selection of one technology over the other based on financial grounds. Improved environmental performance of super-critical units due to the higher efficiencies, becomes the differentiating factor in the selection of super-critical over sub-critical PF technology.

Further investigation was also conducted during the feasibility phase to clarify the appropriate unit size and cooling technology to be implemented. In addition an assessment on flue gas desulphurisation (FGD) technologies available was performed and recommendations were made on the preferred technology choice, should the implementation of FGD be required.

Based on the technological and financial assessments conducted during the feasibility study a detailed User Requirement Specification was produced and approved by Eskom's Generation Division.

- *Low NO_x burners*
  The proposed power station in the Lephalale area will be fitted with low turndown burners to improve the ignition and flame stability over an extended load range.

- *Cooling technology options*
  Water usage is reduced from approximately 2,0 to approximately 0,1 – 0,2 litres per kWh of electricity sent out by using either one of two different non-evaporative cooling techniques: indirect cooling with dry-cooled heat exchangers within a conventional natural draught tower, and direct dry-cooled condensing heat exchangers installed above forced draught fans, situated just outside the power station's turbine generator hall. These technologies have already been employed by Eskom at Grootvlei unit 5, Matimba, Kendal and Majuba Power Stations.

- *Size of the generating units*
  Unit sizes in Eskom show a change upwards from 600 MWe to 660 MWe from Lethabo onwards. The latest coal fired units in Eskom are Majuba units 4, 5 and 6 at 713 MWe. The following considerations were taken into account in determining the preferred unit size for the proposed power station in the Lephalale area:
  - Larger unit capacity results in lower levelised investment cost.
  - The construction lead time difference between 800 MWe and 1000 MWe units, from "Notice to Proceed" to "Commercial Operation" of the first unit is 5,5 months.
  - The performance in terms of availability indicators for different unit capacities are almost the same, however super-critical units tend to be slightly higher than sub-critical units.
  - The Matimba, Kendal and Majuba dry cooling designs are currently the largest of their type in the world. There are currently no dry cooled power stations at 800 to 1000 MWe size.

* World experience shows that most supercritical units in operation are of the 700 MWe size range and larger units operating at supercritical conditions are limited in number.

Based on the above considerations, the size of the proposed power station in the Lephalale area should be greater than or equal to the size of the latest installed units such as Majuba to ensure reasonable economies of scale, however the unit size will be limited by proven design criteria relevant to dry cooling size, where the size of the turbine utilised should at least have a proven track record under dry cooling conditions at this capacity.

1.3 Environmental Study Requirements

In terms of the Environmental Impact Assessment (EIA) Regulations published in terms of the Environment Conservation Act (No 73 of 1989), Eskom Holdings Limited requires authorisation from the National Department of Environmental Affairs and Tourism (DEAT) in consultation with the Limpopo Department of Economic Development, Environment and Tourism (L DEDET) for the undertaking of the proposed project. In order to obtain authorisation for this project, comprehensive, independent environmental studies have been undertaken in accordance with the EIA Regulations.

Eskom appointed Bohlweki Environmental (as independent consultants) to undertake environmental studies together with a team of specialists to identify and assess all potential environmental impacts associated with the proposed project.

The environmental studies followed a two-phased approach in accordance with the EIA Regulations published in terms of the Environment Conservation Act (No 73 of 1989) i.e.:

- Phase 1: Environmental Scoping Study
- Phase 2: Environmental Impact Assessment (EIA)

This Environmental Impact Report evaluates potential environmental impacts associated with all aspects of the proposed project as identified in the Environmental Scoping Study. In terms of the EIA Regulations, *feasible* alternatives were evaluated within the Scoping Study (refer to Chapter 4 for a summary of this site selection process). The Environmental Scoping study recommended the farms Naauwontkomen 509 LQ and Eenzaamheid 687 LQ as the feasible preferred sites for the development, and identified further studies that would be required within the EIA phase of the project. These studies are detailed in Chapters 6 to 15).