Bohlweki Environmental (Pty) Ltd

SCREENING STUDY FOR THE PROPOSED COMBINED CYCLE GAS TURBINE (CCGT) POWER PLANT IN THE AMERSFOORT AREA, MPUMALANGA

A PROJECT FOR ESKOM HOLDINGS LIMITED

3 DECEMBER 2007

E01.JNB.000128
Document 1

info@bohlweki.co.za
www.bohlweki.co.za

JOHANNESBURG
PO. Box 867
Gallo Manor, 2052
Tel: +27 11 798 6001
Fax: +27 11 798 6010

DURBAN
PO. Box 55
Pinetown, 3600
Tel: +27 31 701 7048
Fax: +27 31 701 8754

GEORGE
PO. Box 5092
George East, 6539
Tel: +27 44 884 1732
Fax: +27 44 844 1732

DOCUMENT DESCRIPTION

Client:	Eskom Holdings Limited
Report name:	Screening Study for the proposed Combined Cycle Gas Turbine (CCGT) power plant in the Amersfoort Area, Mpumalanga
Report type:	Pre-Screening Study
Project name:	Environmental Impact Assessment for the proposed Combined Cycle Gas Turbine (CCGT) power plant in the Amersfoort Area, Mpumalanga
Bohlweki Project number:	E01.JNB.000128
Document number:	Document 1
Authority Reference:	N/A
Version:	Final

Compiled by:

Author (s)	Date / location	Signature
Prashika Reddy	03/12/2007, Johannesburg	

Reviewer		
Ashlea Strong	03/12/2007, Johannesburg	

Approval

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Eskom Holdings Limited (Eskom) is mandated by the South African Government to ensure the provision of reliable and affordable power to South Africa. Eskom currently generates approximately 95% of the electricity used in South Africa. Electricity cannot be stored and must be used as it is generated. Therefore, electricity must be generated in accordance with supply-demand requirements. Eskom's core business is in the generation, transmission (transport), trading and retail of electricity. In terms of the Energy Policy of South Africa "energy is the life-blood of development". Therefore, the reliable provision of electricity by Eskom is critical for industrial development and related employment and sustainable development in South Africa.

1.1. The Need and Justification of the Proposed Project

The Department of Minerals and Energy has established a National Energy Policy and 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.

Based on the above planning processes, and in order to meet the projected 4% annual growth in demand for electricity, various projects are underway and are at various stages of implementation. These include base load technologies such as coal fired plants, combined cycle gas turbines and conventional nuclear as well as peaking technologies such as pumped storage schemes and open cycle gas turbines.

There are currently 38 projects in Eskom's "project funnel", which demonstrate the range of supply options being considered by Eskom to meet the increasing demand for electricity in the country. These projects are at different stages of development, ranging from research projects to new-build projects.

Eskom is committed to investigating and evaluating the options for the diversification of the energy mix over time (including renewable resources) and as part of an ongoing effort to evaluate the viability/feasibility of all supply-side options, a number of power generation technologies, not yet implemented in South Africa on a commercial basis, are being evaluated in terms of technical, socio-economic and environmental aspects. One such type of technology is Underground Coal Gasification (UCG), which has been successfully proven to be commercially viable, and Eskom plans to implement it as a fully commercially operating operation. In this project, it is proposed that a UCG-CCGT complex is operated, as explained below.

UCG is a gasification process carried out on “unminable” coal seams. These are coal seams that cannot be mined by using the conventional coal mining methods e.g. open cast or underground mining. UCG involves injecting steam and air (or oxygen) into a cavity created in an underground coal seam, to form a synthetic natural gas. The UCG plant on the farm Roodekopjes, Mpumalanga, has proven to be technically feasible for operation beyond the pilot plant level. Fuel from the UCG plant will be used as fuel for combined cycle gas turbine (CCGT) technology and potential co-firing with coal in the Majuba power station, thus the development of a UCG-CCGT power complex.

A **combined cycle** is characteristic of a power producing engine or plant that employs more than one thermodynamic cycle. Heat engines are only able to use a portion of the energy their fuel generates (usually less than 50%). The remaining heat from combustion is generally wasted. Combining two or more "cycles" such as the Brayton Cycle and Rankine Cycle results in improved overall efficiency.

In a **combined cycle** power plant (CCPP), or combined cycle gas turbine (CCGT) plant, a gas turbine generator generates electricity and the waste heat is used to make steam to generate additional electricity via a steam turbine; this last step enhances the efficiency of electricity generation. Most new gas power plants in North America and Europe are of this type. In a thermal power plant, high-temperature heat as input to the power plant, usually from burning of fuel, is converted to electricity as one of the outputs and low-temperature heat as another output. As a rule, in order to achieve high efficiency, the temperature difference between the input and output heat levels should be as high as possible (Carnot efficiency). This is achieved by combining the Rankine (steam) and Brayton (gas) thermodynamic cycles. Such an arrangement used for marine propulsion is called *Combined Gas (turbine) And Steam (turbine) (COGAS)*. The power plant combined cycle has a boiler called a Heat Recovery Steam Generator (HRSG) which produces steam using the exhaust gas at approximately 600 °C from an open cycle gas turbine. The steam is then used to drive the steam turbine which is also linked to the generator.

This study is only applicable to the CCGT component of the complex.

1.2. Overview of the Proposed Project

The project involves the proposed establishment of a CCGT plant and associated infrastructure in the Mpumalanga Province. A CCGT plant uses a cycle configuration of gas turbines, heat recovery system generators (HRSG) and steam turbines to generate electricity.

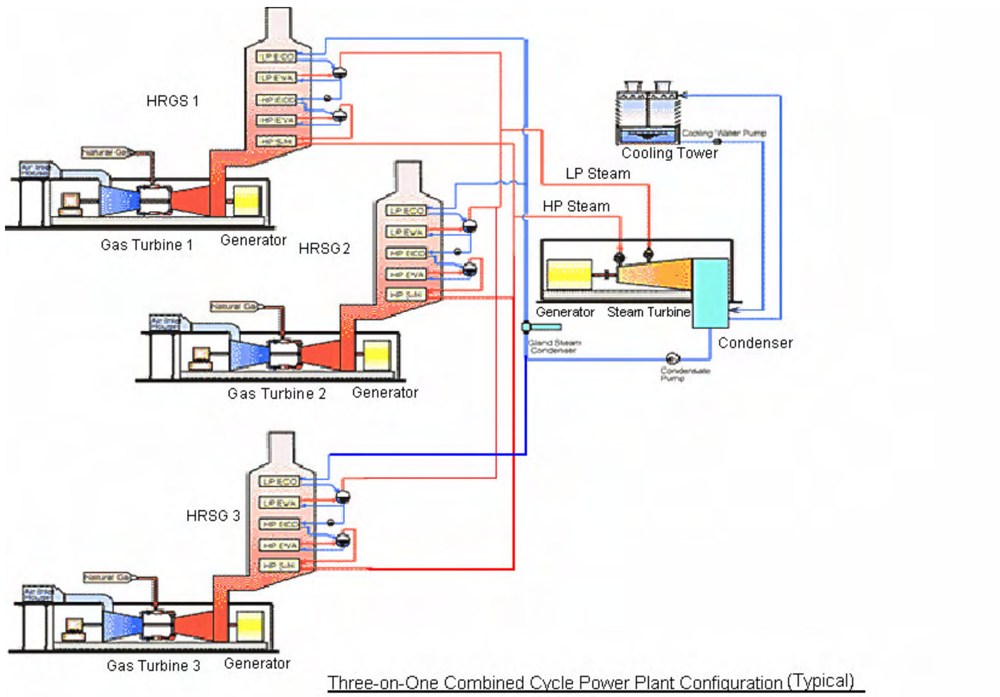

Figure 1.1 A typical 3-in-1 CCGT power plant configuration, in model form

The gas turbine is the first stage in the process of producing electricity through the CCGT plant. The gas turbine compressor draws in air from the environment via a filter. This air is compressed in the compressor, which means that it is elevated to a higher pressure, and then directed into the combustion chamber. Combustible gas is then mixed in and combustion takes place generating hot gases under high pressure. The energy that is released is converted into a mechanical rotation which powers the compressor and the generator.

When the hot gas exits the turbine as exhaust gas, it has a temperature of up to 600℃. This heat energy is transferred to the water in the heat recovery steam generator. The heat is used to generate water vapour, which powers the steam turbine. The resulting mechanical energy is transferred to the generator. In the generator mechanical energy from the steam turbine is converted into electricity. The condenser converts exhaust steam from the steam turbine back into water by means of cooling.

It is anticipated that the CCGT power plant will have approximately 2100 MW of installed capacity. The proposed project will consist of the following components:

- the CCGT power plant (comprising 6 units of approximately 350 MW each)
- a compressor plant
- a gas cleaning plant
- Ignition gas for unit start-up (using commercial propane)
- Weather and communication mast of up to 60 meters in height
- high voltage yard
- a gas pipeline from the UCG pant to the CCGT
- a water pipeline from the Rietpoort Balancing Dam
- a water treatment plant as well as ancillary works such as access roads, borrow pits and other associated infrastructure.
- Sewage treatment plant
- Borrow pits (limited to 1.5 ha each).

2. APPROACH TO SITE SELECTION

2.1. Introduction

A site selection process was initiated in the pre-screening study to identify potential ideal/preferred areas within the study area. The study area was demarcated using a 10 km radius around the UCG plant, off-coal resources. A sensitivity mapping exercise was undertaken for the study area in order to establish the best possible sites to evaluate during the scoping phase of the project. The purpose of such an exercise was to identify suitable areas within the study area that could accommodate the CCGT plant and associated infrastructure and to pro-actively identify sensitive areas that should ideally be avoided.

2.2. Sensitivity Mapping

The qualitative sensitivity mapping exercise divided the study area into three categories *viz.* ideal, acceptable and sensitive. A site sensitivity map for the study area, indicating sensitive areas, acceptable areas (areas with medium or average sensitivity) and ideal areas (least sensitive areas), was requested from each of the following specialist fields:

Biophysical

- Groundwater
- Surface Water
- Ecology

Social

- Air
- Noise
- Social
- Heritage
- Visual
- Risk
- Traffic

Table 2.1 provides a description of the various categories used in the sensitivity mapping.

Table 2.1 Description of the various categories used in the sensitivity mapping

Study Component	Category	Description
Hydrogeology	Sensitive	Shallow coal, average borehole yields > 0.8 l/s, average groundwater levels < 10 m.
	Acceptable	Deep coal, average borehole yields 0.3 to 0.8 l/s, average groundwater levels 10 -20 m.
	Ideal	Average borehole yields <0.3 l/s, average groundwater levels > 20 m.
Hydrology	Sensitive	Within 100 m of water bodies and on slopes steeper than 5%.
	Acceptable	Over 100 m from water bodies and on slopes of less than 5%.
	Ideal	Over 200 m from water bodies on slopes of less than 2%.
Ecology	Sensitive	Wetlands, rivers, streams, marshes, rocky outcrops, pristine grassland, Red Data habitat.
	Acceptable	Agricultural lands, degraded grassland.
	Ideal	Transformed habitat, areas of extensive degradation, existing infrastructure.
Air Quality	Sensitive	Zone containing potentially expanding and permanent residential settlements.
	Acceptable	Zone within wind dispersion field with potentially sensitive receptors but whose land if purchased by Eskom would be relocated and would no longer be considered sensitive.
	Ideal	Zone within wind dispersion field and with no potentially sensitive receptors.
Noise	Sensitive	Zone 3: • The new facility should be closer than 4 km to urban areas (the town of Amersfoort) and any informal settlement. • Areas east of National Road N11.

Study Component	Category	Description
	Less acceptable	Zone 2: Areas where construction is possible, as the Majuba power station is already the centre of a noise degraded area, but less desirable than in Zone 1.
	Most acceptable	Zone 1: Area at or within a 10 km radius of the Majuba Power Station. Subject to consideration of isolated noise sensitive sites. Proviso that if the CCGT power plant is at or within three (3) kilometers of the Majuba Power Station, special consideration is to be given to the acceptability of the cumulative affects at affected noise sensitive sites.
Social **a. Demographic**	Sensitive	Displacement and resettlement of people are necessary. Inhabitants of houses in close proximity to the proposed CCGT do not have the choice to resettle elsewhere (distance informed by visual, noise and risk specialist study).
	Acceptable	Visual, noise, air quality and traffic impacts on affected parties are highly significant during construction, but acceptable during operation (to be informed by the relevant specialists).
	Ideal	No displacement and resettlement of people are necessary. Houses are not in close proximity to the proposed CCGT (distance informed by visual, noise and risk specialist study).
b. Economic and Land Use	Sensitive	Land use is affected in such a way that those who are dependent on the land to make a living are affected, and mitigation measures cannot neutralise the impacts. Good agricultural land is lost. Potential mining land is lost.

Study Component	Category	Description
	Acceptable	Land use is affected in such a way that those who are dependent on the land to make a living are affected, but mitigation measures can neutralise the impacts. Land that was mined and which are stable, not potentially putting people's safety at risk.
	Ideal	Land use activities can carry on, and people who are dependent on the land to make a living can carry on with their activities. Good agricultural land is not affected. Potential mining land is not affected.
c. Socio-cultural	Sensitive	Socio-cultural activities cannot carry on, and sense of place is irrevocably changed.
	Acceptable	Socio-cultural activities and sense of place are affected but can be mitigated.
	Ideal	Socio-cultural activities are not affected and the sense of place is not disturbed.
d. Institutional	Sensitive	New services and infrastructure is necessary, and not clustered in the vicinity of similar activities.
	Acceptable	Although new services and infrastructure will be necessary, the proposed project is placed in the vicinity of similar activities.
	Ideal	As far as possible, link up with existing services and infrastructure.
Heritage	Sensitive	Heritage resources with qualities so exceptional that they are of special national significance.
	Acceptable	Heritage resources which, although forming part of the national state, can be considered to have special qualities which make them significant within the context of a province or a region.