OCGT Fixed Facility: Revised Risk Assessment

Mossel Bay

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OCGT Fixed Facility: Revised Risk Assessment, Mossel Bay

March 2007

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1 INTRODUCTION

Environmental Resources Management (ERM) has been commissioned to perform a risk assessment for proposed additions to the Open Cycle Gas Turbine (OCGT) peaking power plant currently under construction at Mossel Bay. The risk assessment will be used as the basis for Eskom to identify if the facility needs to comply with the requirements of the Major Hazard Installation (MHI) Regulations.

1.1 PROJECT DESCRIPTION

The proposed additional units will be located adjacent to the present OCGT power plant and associated with the three additional generating units would be:

- A diesel fuel storage facility with a total storage capacity of 5.4 million litres;
- A propane storage facility of total storage capacity 13 m^3.

2 RISK ASSESSMENT

2.1 APPROACH

For the major hazards presented by the operations at Mossel Bay (i.e. thermal radiation from diesel and propane fires), a consequence based assessment is appropriate. An internationally recognised approach is used by the UK Health and Safety Executive (HSE) and this has been employed here.

Essentially, three zones are set around such facilities; an inner zone, middle zone and outer zone. The purpose of these zones is to ensure that large numbers of people are not exposed, exposure of vulnerable people is minimised (i.e. the young, elderly and infirm), and the risk to any individual is not so high as to be considered unacceptable. In practice, the zones provide almost complete protection from lesser and more probable accidents, and 'worthwhile' protection from major but less probable accidents.

The extent of each zone is usually based upon the consequences of a credible worst-case accident (the so called *protection-based* approach). The *protection-based* zones for flammable hazards relate to a thermal load (1) as follows:

- inner zone flame extent or 1800 TDU;
- middle zone 1000 TDU; and
- outer zone (CD) 500 TDU.

2.2 ZONE EXTENTS - CALCULATION

2.2.1 Diesel Storage

As described in *Section 2.1*, the effects of the 'worst-case' scenario are considered. The worst-case scenario is a catastrophic release of the full contents of a storage vessel. In the event of such a catastrophic release, it is prudent to assume that only half of the contents would be retained in the bund. This assumption allows for the worst-case scenario where the momentum of the release damages the bund and/or washes over the top of the bund. Typically, the diameter of the resulting pool is limited to 100 m on account of presence of other plant, kerbing, drains, and other structures and features. Therefore, it is judged that the worst-case scenario for both fixed facilities is catastrophic release of the whole vessel contents, half of which is not contained within the bund and forms a pool limited to 100 m diameter. Assuming ignition of the worst-case release, the thermal radiation extents

(1) Thermal dose unit, TDU = $tq^{4/3}$ where t is time in seconds and q is thermal radiation (kW/m^2). 1800 TDU, 1000 TDU and 500 TDU approximate 21.6 kW/m^2, 13.9 kW/m^2 and 8.3 kW/m^2 for a 30 second exposure, respectively.

have been calculated using the pool fire model within the software suite BP Cirrus [1]. The results are summarised in *Table 2.1*.

Table 2.1 ***Zone Extents: Maximum Distance to Thermal Radiation Levels for Worst-Case Scenarios (Diesel Storage)***

Thermal radiation levels (kW/m^2)	Zone	Maximum distance (m) to thermal radiation level
8.3	Outer	154
13.9	Middle	128
21.6	Inner	114

The frequency of occurrence for the catastrophic release from an ambient temperature, non-pressure vessel is 5×10^{-6} per year (i.e. one in 200,000 years) [2]. However, the frequency of an ignited release is calculated by multiplying this frequency by an ignition probability. For flammable liquid releases, an ignition probability in the range 0.01-0.1 is typical [3]. In order to represent the 'worst-case' and accounting for the relatively high likelihood of the catastrophic release being in contact with an ignition source (i.e. worst-case), an ignition probability of 0.1 is judged appropriate. Therefore, the frequency of the worst-case event is calculated as 5×10^{-7} per year (i.e. one in 2,000,000 years). Mossel Bay will operate two diesel storage tanks. Hence the frequency of a worst-case event for each power station approximates 1×10^{-6} per year (i.e. one in a million years).

2.2.2 *Propane Storage*

The main hazard in relation to propane is the escape of gas, which on ignition may result in a fire. In the absence of an ignition source, the flammable vapour cloud would drift downwind until the effects of dispersion dilute the vapours below the flammable concentration. A loss of containment of propane may occur during road tanker delivery or storage on site. The worst case scenarios for propane storage are as the result of the 20 tonne road tanker BLEVE (Boiling Liquid Expanding Vapour Explosion) causing a fireball. The results are summarised in *Table 2.2* below.

Table 2.2 ***Zone Extents: Maximum Distance to Thermal Radiation Levels for Worst-Case Scenarios (Propane Road Tanker)***

Heat Flux effect	Distance from explosion (m)
8.3 kW/m^2	148
13.9 kW/m^2	108
Flame extent	54

(1) BP Cirrus Consequence Modelling Software Package. Version 7. HSE Resource, BP Sunbury, Sunbury-on-Thames, UK.

(2) The frequency values used by UK Health and Safety Executive are based upon a review of UK, Western European and North American data from the oil, gas and process industries. The data have been supplemented with worldwide sources, as appropriate.

(3) Cox, AW, Lees, FP and Ang, ML. (1990). Classification of Hazardous Locations.

The delivery of propane is carried out with a 20 tonne capacity road tanker approximately once a month. The estimated road tanker BLEVE frequency is 1.3×10^{-7} per delivery, and considering an average of 12 deliveries per year, the catastrophic BLEVE failure frequency is calculated as 1.56×10^{-6} per year.

2.3 ZONE EXTENTS - RESULTS

The zone extents are illustrated on site plans for the Mossel Bay fixed facility in *Figure 2.1*.

The zones extend beyond the proposed site boundary. Therefore, for this location and layout, based on the assessment of storage and processing of diesel, the Mossel Bay fixed facility could present a risk to persons offsite and therefore is subject to the Major Hazard Installation (MHI) Regulations.

Figure 2.1 Mossel Bay Fixed Facility Worst-Case Zones (Initial Installation)

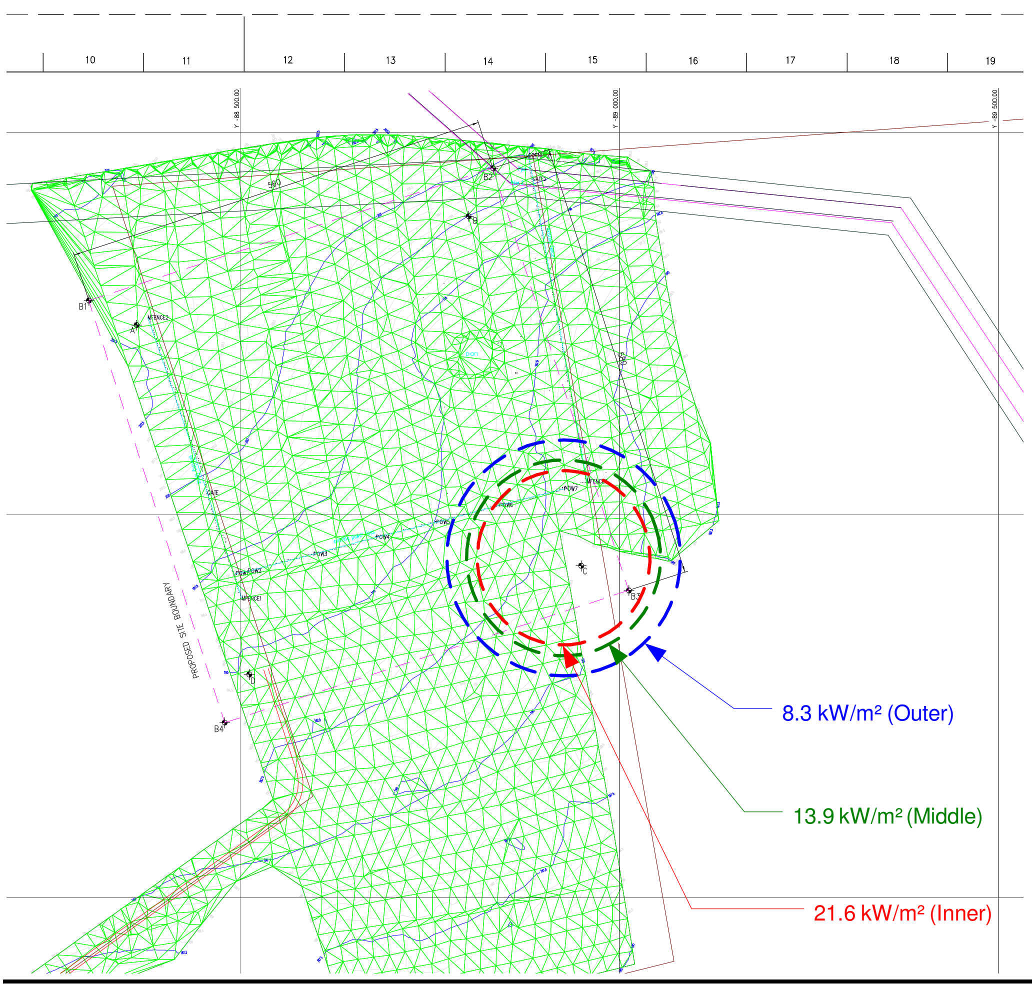


Figure 2.2 Mossel Bay Fixed Facility Worst Case Zones (Proposed Additional Tanks)

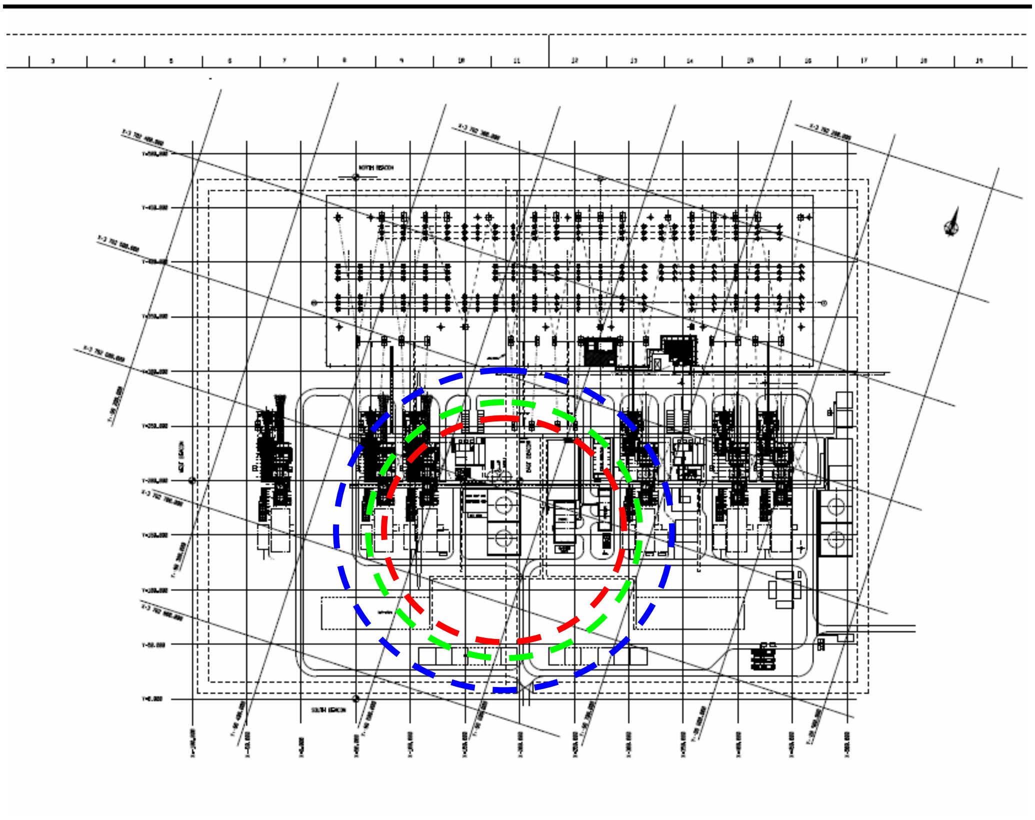
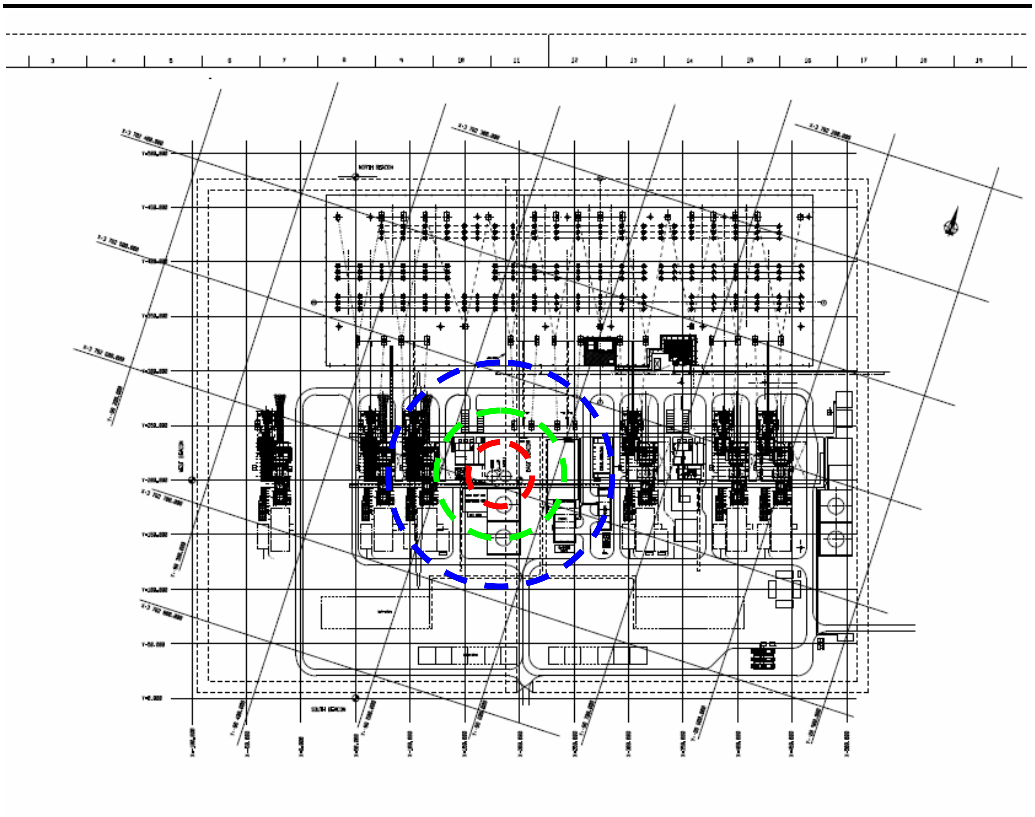


Figure 2.3 Mossel Bay Fixed-Facility Worst Case Zones (Propane Tanks)



3 CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS

Given the location and layout considered, based on the assessment of storage and processing of kerosene from current activities, the proposed storage of diesel and propane, the Mossel Bay fixed facility could potentially present a risk to persons offsite.

It should be noted that current surrounding land is undeveloped, with no sensitive land-uses (i.e. residential houses, schools, etc) identified within the risk zones calculated. Therefore, ERM does not recommend any further assessment of risk at this time.

3.2 RECOMMENDATIONS

- Eskom should register the fixed facility as a Major Hazard Installation given the potential for offsite risk in the event of a kerosene fire, as per the previous assessment;
- Given the low sensitivity of surrounding land-uses, no mitigation measures are recommended;
- Local authorities should consider the risks outlined in this report, in any future land-use planning adjacent to the site.

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