GREENHOUSE GAS MINIMISATION PLAN

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Approved: S.J. Archinal
Date: 24-03-2016

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1.0 INTRODUCTION

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfield of New South Wales (NSW) (Figure 1).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies). MCO and MCM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would continue to be carried out in accordance with NSW Project Approval (05_0117) (Moolarben Coal Project Stage 1) as modified and NSW Project Approval (08_0135) (Moolarben Coal Project Stage 2) as modified.

The current Stage 1 mining operations are undertaken in accordance with Approval Decision (EPBC 2007/3297) granted on 24 October 2007 (and varied by notice on 25 February 2009 and 11 May 2010), (EPBC 2013/6926) granted on 13 November 2014 under the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) and (EPBC 2008/4444) granted on 18 May 2015 under the EPBC Act.

The current mining operations at the Moolarben Coal Complex are conducted in accordance with the requirements of the conditions of Mining Lease (ML) 1605, ML 1606, ML 1628, ML 1691 and ML 1715 granted under the Mining Act, 1992.

Stage 1 of the Moolarben Coal Complex has commenced and at full development will comprise three open cut mines (OC1, OC2, and OC3), a longwall underground mine (UG4), and mining related infrastructure (including coal processing and transport facilities) (Figure 2).

Stage 2 of the Moolarben Coal Complex has commenced and at full development will comprise one open cut mines (OC4), two longwall underground mines (UG1 and UG2), and mining related infrastructure (including coal handling facilities and use of Stage 1 CHPP) (Figure 2).

1.1 SCOPE

This Greenhouse Gas Minimisation Plan (GGMP) has been prepared by MCO to satisfy the requirements under NSW Project Approval (08_0135) (as modified).

The GGMP describes the options for minimising greenhouse gas at the Moolarben Coal Complex underground operations.
FIGURE 2
Approved Moolarben Coal Project
(Stage 1 and Stage 2)
General Arrangement

LEGEND
- Mining Lease Boundary
- Exploration Licence Boundary
- Existing/Approved Stage 1 Project Boundary
- Open Cut Mining Area
- Out-of-pit Emplacement
- Underground Mining Area
- Existing/Approved Stage 2 Project Boundary
- Open Cut Mining Area
- Out-of-pit Emplacement
- Underground Mining Area
- Haul Road

Source: MCO, 2015
1.2 STRUCTURE OF THIS GREENHOUSE GAS MINIMISATION PLAN

The remainder of the GGMP is structured as follows:

- **Section 2:** Outlines the statutory requirements applicable to the GGMP.
- **Section 3:** Outlines the baseline data
- **Section 4:** Outlines the possible management measures
- **Section 5:** Outlines GG measurement, evaluation and research.
- **Section 6:** Provides details for the review and improvement of the environmental performance.
- **Section 7:** Describes the roles and accountabilities
- **Section 8:** Provides the references cited in the GGMP.
2.0 STATUTORY AND PROJECT APPROVAL REQUIREMENTS

MCO’s statutory obligations for the Moolarben Coal Complex are contained in:

- the conditions of the Project Approval (05_0117)
- the conditions of the Project Approval (08_0135); and
- other relevant legislation, including Environment Protection Licence, Mining Leases, Water Licences and EPBC Approvals.

Obligations relevant to this Greenhouse Gas Minimisation Plan (GGMP) are described below.

2.1 EP&A ACT PROJECT APPROVAL

Condition 10 Schedule 4 of Project Approval (08_0135) requires the preparation of a GGMP for the underground mining operations:

Prior to carrying out underground mining operations, the proponent shall submit an updated Greenhouse Gas Minimisation Plan to the Secretary. This plan must:

a) Identify options for minimising greenhouse gas emissions from underground mining operations, with a particular focus on capturing and/or using these emissions;

b) Investigate feasibility of implementing each option;

c) Propose the measures that would be implemented in the short to medium term on site; and

d) Include a research program to inform the continuous improvement of greenhouse gas minimisation measures on site.

2.2 LICENCES, PERMITS AND LEASES

In addition to the NSW Project Approvals (05_0117 and 08_0135) and Commonwealth Approvals (EPBC 2007/3297, 2013/6936 and 2008/4444), all activities at the MCO will be conducted in accordance with a number of licences, permits and leases.

Key licences, permits and leases pertaining to greenhouse gas at the Moolarben Coal Complex include:


- Mining Operations Plan (required as a condition of the Mining Lease) approved by the Division of Resources and Energy.
3.0 BASELINE DATA

Stage 1 and Stage 2 EAs (including PPRs) assessed the potential for fugitive methane emissions from the underground operations on the basis of measured gas content from drill hole coal samples taken from underground coal resource areas or where unavailable using the governments standard methane emission factors for shallow underground mines.

Gas desorption tests have been carried out in several boreholes within UG1 with gas content analysis indicating low levels of seam gas emissions of less than 0.008 t CO₂-e per ROM t. Emissions composition is predominantly CO₂ with minor traces of CH₄ under normal operating conditions with the majority of gas released following fine crushing. This indicated seam gas levels in UG1 are anticipated to be low, consistent with the experience at the neighbouring Ulan mine.

Annual forecast emissions for the Moolarben Coal Complex for the approved project are presented in Table 1 (PAE Holmes, 2011).

<table>
<thead>
<tr>
<th>Source</th>
<th>Emissions (Annual Mean)</th>
</tr>
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<tbody>
<tr>
<td>Fugitive Emissions from Underground Mining</td>
<td>32,000 t CO₂-e/4.0Mtpa ROM</td>
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</table>
4.0 POTENTIAL MANAGEMENT MEASURES

The following section identifies and assesses the feasibility of greenhouse gas management controls for underground operations.

Options for Greenhouse gas capture and re-use include:
- Flaring (Open and closed);
- Power generation; and,
- Gas Drainage.
- Thermal flow reversal reactors (TFRR);
- Regenerative Afterburners; and
- Hybrid Coal Gas Turbines.

4.1 GREENHOUSE GAS CAPTURE AND REUSE FEASIBILITY

As described in Section 3.0, Moolarben’s gas analysis of coal seams indicates low levels of seam gas emissions and a composition that is predominantly CO2 under normal operating conditions.

The beneficial capture and reuse of fugitive methane emissions can be undertaken through the adoption of management controls such as flaring, methane capture and energy production. These are not considered feasible or reasonable for the Moolarben Coal Complex due to the low methane concentration generated from the coal seam.

The low methane concentrations mean that Moolarben Coal Complex underground workings do not require pre-drainage to manage methane levels, with the main ventilation system capable of meeting safe ventilation requirements of the underground mine. Without a pre-drainage system supplying high concentrations of methane it is not technically feasible to capture methane for flaring or beneficial reuse (i.e. energy production).

There are technologies available to potentially beneficially reuse VAM, such as a TFRR which oxidises low methane concentrations in the air flow exhausted from the underground ventilation system to produce heat, however, these systems require ventilated methane concentrations of 0.2% to 1.2% to operate. Moolarben’s methane concentration in the ventilation stream is predicted to be below this range, consistent with the experiences at the adjacent Ulan Coal Mine, meaning these technologies are not feasible. The need for solid fuel in conjunction with the low gas concentrations mean hybrid coal gas options are also not feasible.

Management controls to address fugitive greenhouse gas emissions from underground mining operations will continue to be evaluated by Yancoal and Moolarben as part of the NGERS program.

4.2 PRIORITISING GREENHOUSE GAS MANAGEMENT CONTROLS

Through the implementation of the GGMP Moolarben will identify, plan, monitor, review and evaluate selected greenhouse gas emission reduction opportunities. To prioritise the implementation of greenhouse gas management controls, Moolarben will use technical review and cost benefit analysis to evaluate and prioritise any selected operational controls. Focus on the validation of gas contents is the current priority.
5.0 MEASUREMENT AND EVALUATION

5.1 GREENHOUSE GAS MONITORING PROGRAM

Moolarben will monitor greenhouse gas emissions by direct and indirect monitoring. The greenhouse gas monitoring program will involve direct measurement of fugitive emissions from the underground mine.

A mine gas monitoring station will be located within the OC1 area at the UG1 temporary return air portal whilst the temporary fan is in operation and at the Remote Services Infrastructure Area upcast shaft fan once constructed.

5.2 CONTINUOUS IMPROVEMENT AND RESEARCH

Moolarben will review industry developments in fugitive underground gas emission management technologies and identify opportunities where relevant for continuous improvement at the Moolarben underground mines. The requirement and/or implementation of such improvements will be informed by monitored gas levels from the underground mining operations.

Monitoring data will be reviewed to validate pre-mining estimates and inform future underground fugitive emissions.
6.0 ANNUAL REVIEW, REPORTING AND IMPROVEMENT

6.1 ANNUAL REVIEW AND REPORTING

Moolarben are required to report greenhouse gas emissions in accordance with the National Greenhouse and Energy Reporting System (NGERS) as it triggers corporate reporting thresholds and the site triggers individual facility thresholds. The National Greenhouse and Energy Reporting Act 2007 requires individual sites to report greenhouse gas emissions, energy consumption and energy production if one of the following threshold criteria is met:

- The site generates greenhouse gases (Scope 1 and 2) in excess of 25,000 t CO2-e or more; or
- The site produces in excess of 100 TJ of energy; or
- The site consumes in excess of 100 TJ of energy.

In accordance with Condition 4, Schedule 6 of the Project Approvals (08_0135) MCO will conduct an annual review of MCO operations prior to 31 March each year.

This annual review will specifically address the following aspects of Condition 4, which directly relate to greenhouse minimisation:

- include a comprehensive review of the monitoring results over the previous calendar year, which includes a comparison of these results against the:
  - monitoring results of previous years; and
  - relevant predictions in the Environmental Assessment;
- identify any trends in the monitoring data over the life of the project; and
- identify any discrepancies between the predicted and actual impacts of MCO operations, and analyse the potential cause of any significant discrepancies.

The annual review will be made publically available on the Moolarben Coal website in accordance with Condition 11, Schedule 6 of the Project Approvals (08_0135).

6.2 GREENHOUSE GAS MINIMISATION PLAN REVIEW

In accordance with Condition 5, Schedule 6 of the Project Approvals (08_0135) this GGMP will be reviewed, and if necessary revised to the satisfaction of the Secretary, within 3 months of the submission of:

- an Annual Review in accordance with Condition 4, Schedule 6 of the Project Approvals (08_0135);
- an incident report in accordance with Condition 7, Schedule 6 of the Project Approvals (08_0135);
- an audit in accordance with Condition 9, Schedule 6 of the Project Approvals (08_0135);
- any modification to the conditions of the Project Approval (08_0135).

This GGMP will be made publically available on the Moolarben Coal website, in accordance with Condition Condition 11, Schedule 6 of the Project Approvals (08_0135).
7.0 ROLES AND ACCOUNTABILITIES

Specific roles and accountabilities in relation to this Greenhouse Gas Minimisation Plan are outlined below.

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<thead>
<tr>
<th>Role</th>
<th>Accountabilities</th>
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<tbody>
<tr>
<td>General Manager (GM)</td>
<td>• Make appropriate resources available for the implementation of this GGMP</td>
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<tr>
<td>Environment and Community Manager (ECM)</td>
<td>• Reviewing and updating the GGMP in accordance with Project Approval conditions</td>
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<td></td>
<td>• Ensure that the GG management measures are implemented in accordance with this Plan</td>
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<td>• Communicate the results of monitoring and NGERS reporting of energy usage to Moolarben personnel</td>
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<td>• Ensure all internal and external reporting (including NGERS) requirements are met.</td>
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<td>• Liaise with government and community as required</td>
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<td></td>
<td>• Ensure revised plans are uploaded to the Moolarben Coal Mine website</td>
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<tr>
<td>Environment and Community Coordinator (ECC)</td>
<td>• Manage and maintain the monitoring programs in accordance with this Plan</td>
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<td></td>
<td>• Ensure monitoring equipment is operated in accordance with relevant industry standards and protocols</td>
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<td>• Ensure that all monitoring records are effectively maintained on site in accordance with the EMS</td>
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<td>• Report environmental performance to the ECM</td>
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<tr>
<td>Underground Operations Manager</td>
<td>• Identify feasible and reasonable options for minimising greenhouse gas emissions from underground mining operations, with a particular focus on capturing and/or using these emissions;</td>
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<tr>
<td></td>
<td>• Manage and maintain the underground ventilation and gas monitoring programs in accordance with this Plan</td>
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<td></td>
<td>• Coordinate the implementation of the GG management controls and monitoring with respect to the underground ventilation system</td>
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<tr>
<td>Project Managers, Process Owners and Task Coordinators</td>
<td>• Implement feasible GG management measures for their process area or project</td>
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<td></td>
<td>• Ensure any potential or actual GG management issues are reported to the ECM</td>
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<tr>
<td></td>
<td>• Ensure the effective implementation of strategies designed to reduce GG impacts from the project</td>
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</table>
8.0 REFERENCES

PAE Holmes (2011) “Moolarben Coal Project Stage 2 Preferred Project Air Quality Impact Assessment”.