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1 SCOPE

This Monitoring Program (MP) describes the environmental monitoring activities undertaken by BHP Billiton Olympic Dam Corporation Pty Ltd (ODC) in relation to airborne emissions from Olympic Dam. Emissions monitoring is undertaken by ODC for the purpose of quantifying changes to air quality as a result of operations, assessing the performance of the control measures used to limit these impacts, and to meet relevant legal and other requirements. This MP sets out the measures ODC uses to monitor environmental aspects such as gaseous, aerosol and particulate emissions (both radioactive and other), which, through their interaction with the environment, have the potential to result in an environmental impact.

This MP addresses a number of distinct elements of airborne emission monitoring. For each element, the MP sets out some background information, the purpose of the monitoring and the deliverables which are produced as a result of the monitoring. The MP also includes a description of the methods for measuring achievement of compliance criteria and the movement of trends towards leading indicators (where applicable).

The copper bearing ore body processed at Olympic Dam contains uranium and, as a consequence, radioactive emissions occur as a result of the extraction process.

This MP outlines the airborne emissions monitoring requirements for the existing Olympic Dam operations including the development of an open pit mining operation. Ecological impacts arising from changes to air quality are monitored through the Flora and Fauna MPs. Impacts to human and non-human biota arising from radiation emissions are monitored through the Environmental Radiation MP.

1.1 Responsible ODC personnel

The Olympic Dam Asset President is responsible for ensuring that all legal and other requirements described in this MP are met.

ODC employs a Statutory Radiation Safety Officer acceptable to the Radiation Protection Division of the Environment Protection Authority (EPA), to establish, maintain and fulfil the requirements of this MP, thereby fulfilling its obligation with respect to clause 2.10.1(d) of the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005) (MC 2.10.1d, MC 2.10.1f). ODC also employs other staff with the necessary experience and qualifications to fulfil the requirements of this MP.

1.2 Review and modification

This MP is reviewed annually. Major changes or amendments following the annual review are documented in Appendix E (see section 9) of this MP.

1.3 Context

This MP meets part of the requirement for an Air Quality Management and Monitoring Program (AQMMP) required under condition 48 of the Major Development Approval Conditions (State 48, 48c)
2 DETAILED PROCEDURE

2.1 Smelter 2 emissions

2.1.1 Background

Smelter 2 is one of the major sources of airborne emissions at Olympic Dam and comprises a Concentrate Feed Preparation Plant, Flash Furnace, Electric Slag Reduction Furnace, two Anode Furnaces and an Acid Plant.

Copper concentrate is filtered and dried in the Feed Preparation Plant before being fed into the reaction shaft of the Flash Furnace. The concentrate is dried using two steam coil Myrens dryers, which each have an associated baghouse to remove particulates before being vented to a common stack.

Off-gas from the Flash Furnace is directed to the Electrostatic Precipitator, which removes particulate matter for recycling to the furnace before being directed to the Acid Plant. Here, the sulphur dioxide (SO$_2$) is converted and absorbed to produce sulphuric acid for use in the metallurgical plant.

Unconverted SO$_2$ is directed to the Acid Plant Tails Gas Stack and discharged to the atmosphere.

Electric Furnace off-gas is directed to a quench tower and venturi scrubber gas cleaning system before release to the atmosphere via the Main Smelter Stack.

Anode Furnace off-gas is treated in gas cleaning systems similar to that of the Electric Furnace with the exception of sulphur dioxide-rich oxidation gases being directed to the Acid Plant for conversion to sulphuric acid.

All furnaces have gas cleaning system bypass stacks in addition to the Main Smelter Stack and the Acid Plant Tails Gas Stack, for use in abnormal or emergency situations. In addition, the Acid Plant also has a bypass stack for use in abnormal or emergency situations associated with the Acid Plant or during planned maintenance activities.

2.1.2 Purpose

- Provide information that can be used to manage particulate and gaseous emissions from Smelter 2, to levels less than the prescribed limits.

2.1.3 Deliverable(s)

- Calibration records for SO$_2$ analysers on the Main Smelter Stack and Acid Plant Tails Gas Stack.
- Records of particulate and SO$_2$ emissions from Smelter 2 to assess compliance with the emission limits of EPA Licence 1301 and the Environment Protection (Air Quality) Policy 1994, as shown in Table 2.1.
- Records to assess compliance with the monitoring and reporting requirements of EPA Licence 1301 and the Environment Protection (Air Quality) Policy 1994 (see Table 3.1).
- Data to confirm that greater than 99 per cent of all SO$_2$ generated during the smelting process is captured.

2.1.4 Method

The impact of specific emissions on air quality is assessed through monitoring operational compliance, using real-time, in-stack analysers (EPA 1301.305-137) against the requirements and emission limits specified in EPA Licence 1301, EPA Exemption 3014 and the Environment Protection (Air Quality) Policy 1994.

Olympic Dam maintains systems to report bypass and exceedance emission events in accordance with statutory and other obligations. If the Anode Furnaces, Electric Furnace, Flash Furnace or Acid Plant Bypass Stacks have been operated, a report is automatically generated by the process control system detailing the date, time and duration of the event (see Appendix A, Figure 5.1 to Figure 5.3). Each operation of a bypass stack that exceeds 10 minutes duration is reported (EPA 1301.305-140).

Similarly, at the completion of every 12-hour shift (at 6am and 6pm) a report is automatically generated by the process control system detailing the 30-minute average SO$_2$ concentrations for the Main Smelter Stack and the Acid Plant Tails Gas Stack for the duration of the shift (see Appendix A, Figure 5.4 to Figure 5.5). If at any time SO$_2$ emissions from the Main Smelter Stack or Acid Plant Tails Gas Stack exceed 2,400mg/Nm$^3$ (or as amended under EPA Licence 1301; and except during conditions
specified in **EPA Exemption 3014** – see note in Appendix D), ODC is required to notify the EPA Regulation and Compliance Division of the EPA within one working day of the event (EPA 1301.37-43, 1301.305-141, 3014.500-39).

All emission events likely to result in an exceedance of the National Environment Protection (Ambient Air Quality) Measure (NEPM) limits for ground-level concentrations of SO2 are modelled using the CALPUFF Emission Dispersion Model (see section 2.4) (EPA 1301.305-138). In the event of an exceedance of the NEPM limits, ODC is required to notify EPA Regulation and Compliance within one working day of the event (EPA 1301.305-139, 1301.305-140, 1301.305-141).

All information on bypass and exceedance emission events is reported as per licence conditions (EPA 1301.305-140, 1301.305-141). All other relevant information is available to EPA Regulation and Compliance on request.

Isokinetic stack sampling of the Main Smelter Stack and Acid Plant Tails Gas Stack is performed annually by a contractor holding appropriate NATA accreditation and in accordance with relevant SA EPA (or equivalent) Test Methods (EPA 1301.305-137). Particulate emissions from the Feed Preparation Concentrate Dryers are also measured where possible on a biannual basis by isokinetic stack sampling. Other smelter stack emissions and intermediate process gases are sampled as necessary to ensure gas cleaning systems are operating optimally and in compliance with prescribed limits based on process control data obtained from the process control system. This sampling typically includes analysis for SO2, sulphur trioxide (SO3), particulates, heavy metals, radionuclides and other chemical compounds. Results from this sampling are used to update the emission profiles used in the generation of emission dispersion maps, to validate the continuous emission monitoring results and for the purpose of National Pollutant Inventory reporting.

Emission sampling results are recorded electronically and / or in hard copy (EPA 1301.305-137) and are evaluated against the limit values shown in Table 2.1.

**Table 2.1: Summary of emission limits**

<table>
<thead>
<tr>
<th>Emission</th>
<th>Criteria (mg/Nm³)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulates</td>
<td>250</td>
<td>General processes, excluding the heating of metal ores</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>Processes involving the heating of metal or metal ores, including from the Flash Furnace, Anode Furnace, Acid Plant and Electric Furnace Bypass Stacks (EPA 1301.37-43)</td>
</tr>
<tr>
<td>Antimony</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>NOx</td>
<td>350</td>
<td>Fuel burning equipment – gaseous fuels</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>Fuel burning equipment – liquid or solid fuels</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>Sulphuric acid plants</td>
</tr>
<tr>
<td>SO3</td>
<td>100</td>
<td>Including from the Flash Furnace, Anode Furnace and Electric Furnace Bypass Stacks (EPA 1301.37-43)</td>
</tr>
<tr>
<td>Total acid gases (as SO3)</td>
<td>3,000</td>
<td>Including from the Acid Plant Tail-Gas Stack and Main Smelter Stack (EPA 1301.37-43)</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hydrofluoric acid</td>
<td>50</td>
<td>Including all fluoride compounds</td>
</tr>
<tr>
<td>Chlorine</td>
<td>200</td>
<td>Including all chlorine compounds</td>
</tr>
<tr>
<td>CO</td>
<td>1,000</td>
<td></td>
</tr>
</tbody>
</table>

(State 17ki, 17kii, 17kiv, 17kv) (EPA 1301.37-43)
2.2 Calciner emissions

2.2.1 Background

The precipitation area of the Hydromet includes two Calciners (A and B), each with its own off-gas cleaning system and gas discharge stack. Ammonium diuranate enters the calciners after the completion of the solvent extraction and precipitation stages of the uranium recovery process. The ammonium diuranate is calcined to uranium oxide concentrate, which is subsequently packed and prepared for shipping. The off-gas from the individual Calciners passes through venturi scrubbers, droplet separators and mist eliminators to remove particulates before release to the atmosphere (MC 2.8.2(e)).

2.2.2 Purpose

- Provide information that can be used to manage particulate emissions from the calciner, to levels less than the prescribed limits.

2.2.3 Deliverable(s)

- Records of particulate emissions from Calciner A and B to assess compliance with the relevant particulate emission limit specified in Environment Protection (Air Quality) Policy 1994 (see Table 2.1).

2.2.4 Method

The impact of specific emissions on air quality is assessed through monitoring the compliance of processes against emission limits specified in the Environment Protection (Air Quality) Policy 1994. Particulate emissions from Calciners A and B are measured quarterly by isokinetic sampling, where possible, depending on process reliability and plant availability. Sampling is undertaken by a NATA-accredited contractor in accordance with SA EPA Test Methods (or equivalent) for the measurement of particulate concentrations. Any measurement above the limit specified in the Environment Protection (Air Quality) Policy 1994 (currently 250 mg/Nm³) is investigated and reported to EPA Regulation and Compliance within one working day. The isokinetic stack-sampling filters used to capture particulates are also analysed annually for $^{238}$U activity. Results from this, together with data obtained from the process control system, are used to estimate total uranium discharged from the stacks, which is subsequently reported in the LM1 Radiation Annual Report.

(State 17ki, 17kii, 17kv, 17kv)

2.3 Slimes Treatment Plant emissions

2.3.1 Background

The Slimes Treatment Plant, also referred to as the Gold Room, treats slimes generated during the electro-refining of copper anodes to produce ingots of gold and silver. This occurs inside a secure building with fume and emission extraction provided by one of three systems; either the roaster scrubber system, the nitrogen oxides (NOx) scrubber system or general building ventilation. The roaster scrubber principally treats off-gas from the various roaster and gold and silver furnaces via a high-pressure impaction scrubbing system with subsequent emission to atmosphere. The NOx gas cleaning system treats fume from the electroplating and acidic processes with sodium sulphide (Na$_2$S), followed by scrubbing and emission to the atmosphere. The general building ventilation uses positive pressure created through constant air-conditioning to remove fumes via louvres.

2.3.2 Purpose

- Provide information that can be used to manage particulate and gaseous emissions from the Slimes Treatment Plant to levels less than the prescribed limits.

2.3.3 Deliverable(s)

- Records of particulate and hydrogen sulphide emissions from the Slimes Treatment Plant to assess compliance with the emission limits specified in the Environment Protection (Air Quality) Policy 1994 (see Table 2.1).

2.3.4 Method

The impact of specific emissions on air quality is assessed through monitoring the compliance of processes with the emission limits specified in the Environment Protection (Air Quality) Policy 1994.
Particulate and hydrogen sulphide emissions from the Slimes Treatment Plant are measured biannually and annually respectively by isokinetic sampling, where possible, depending on process reliability and plant availability. Any measurement above 100 mg/Nm³ for particulates from the roaster scrubber or above 5 mg/Nm³ for hydrogen sulphide from the NOx scrubber is investigated and reported to EPA Regulation and Compliance within one working day.

Emissions from the NOx Scrubber Stack are sampled annually for the concentration of NOx and other substances for the purpose of National Pollutant Inventory reporting and for assessing trends.

(State 17ki, 17kii, 17kiv, 17kv)

2.4 Ambient sulphur dioxide (SO₂)

2.4.1 Background

The principal point sources of SO₂ at Olympic Dam are Smelter 2 and the Acid Plant. Small quantities of SO₂ are also emitted from diffuse sources (such as process vessels). ODC conducts an ongoing assessment of SO₂ generation, dispersion and ambient concentrations (EPA 1301.305-139, 1301.305-140, 1301.305-141).

2.4.2 Purpose

- Provide information to be used for the modelling and reporting of ambient ground-level SO₂ concentrations at Roxby Downs and Olympic Village.

2.4.3 Deliverable(s)

- Records of ground level SO₂ concentrations at Olympic Village and Roxby Downs township to assess compliance with the ground level SO₂ concentration requirements of the Ambient Air Quality NEPM (see Table 2.2).

2.4.4 Method

Modelling of the annual average SO₂ ground-level concentration, 24-hour maximum and one-hour maximum SO₂ ground-level concentrations are completed using a South Australian EPA-approved computer dispersion model (EPA 1301.305-139). Modelling is undertaken following any emission event likely to result in an exceedance of the NEPM limits and on a monthly and annual basis.

A continuous ambient SO₂ monitor is located in Roxby Downs in accordance with relevant Australian Standards (EPA 1301.305-138). The monitor provides continuous measurement of SO₂ concentrations in Roxby Downs, and allows verification of modelling results.

A modelled or measured exceedance of the NEPM must be reported to EPA Regulation and Compliance within one working day of the event. Results of the dispersion modelling are presented in the monthly Notification of Emission Events report submitted to EPA Regulation and Compliance within 10 working days of the end of the month (EPA 1301.305-139, 1301.305-140, 1301.305-141).

Table 2.2: Summary of ground-level SO₂ criteria

<table>
<thead>
<tr>
<th>Emission</th>
<th>Criteria (ppm)</th>
<th>Averaging period</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂</td>
<td>0.20</td>
<td>1-hour</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>1-day</td>
</tr>
<tr>
<td></td>
<td>0.02</td>
<td>1-year</td>
</tr>
</tbody>
</table>

(State 17ki, 17kii, 17kiv, 17kv) (EPA 1301.305-139, 1301.305-140, 1301.305-141)

2.5 Fugitive particulate deposition

2.5.1 Background

Many activities at Olympic Dam generate some level of fugitive particulate emission. Fugitive particulate emissions are emissions that are not readily captured at-source. The level of fugitive particulate emission is expected to increase as the open pit mine develops. Particulate emissions are monitored using a passive dust sampling network to determine dust deposition rates and concentrations of ²³⁵⁴U (MC 2.8.2(e)).
2.5.2 **Purpose**
- Provide information for the assessment of radiation exposure to non-human biota and reporting of dust deposition (and radionuclide concentrations within deposited dust) in the Olympic Dam region.

2.5.3 **Deliverable(s)**
- Records from passive dust deposition monitoring sites and visual inspections which characterise the annual dispersion and deposition of particulates.
- Records from passive dust deposition monitoring sites and visual inspections which characterise the annual dispersion and deposition of radionuclides contained within deposited particulates.

2.5.4 **Method**
Particulate and radionuclide deposition rate dispersion profiles are generated and analysed to determine the impact of airborne particulates on ambient air quality and for ERICA assessments (see Environmental Radiation MP).

Fourteen passive dust deposition monitoring sites are located along an axis radiating out from the operation, one of which acts as a background location (see Appendix B, Figure 6.1). Samples are collected every month and analysed for the total mass of particulates. Six-monthly composite samples are analysed for $^{238}\text{U}$ activity. From these values, dust and $^{238}\text{U}$ deposition rates are calculated and compared annually to previous monitoring results to assess trends. An annual composite sample will also be analysed for the long-lived radionuclides in the $^{238}\text{U}$ decay chain for ERICA assessments.

During annual flora monitoring, a visual inspection of limestone dust deposition is also assessed at specific monitoring sites. The coverage of limestone on the soil surface is scored based on six rankings from no dust deposition evident to between 81 and 100 per cent of the surface covered with limestone dust. These scores represent four categories of dust deposition: undetectable, detectable, high or extreme. These categories are then modelled to provide a distribution of dust deposition surrounding the operations.

(State 17ki, 17kii, 17kiv, 17kv)

2.6 **Raise bore ventilation shaft emissions**

2.6.1 **Background**
The underground mine ventilation shafts pass through two aquifers (Arcoona Quartzite and Tent Hill). During normal operation, groundwater flows passively into the unlined raise bores, where it may be collected by the updraft of air and subsequently emitted at the surface as saline aerosols.

2.6.2 **Purpose**
- To provide data to allow assessment of the impact of emissions from underground mine ventilation shafts on local vegetation and Category 1b at-risk species through the monitoring and reporting of salt deposition rates.

2.6.3 **Deliverable(s)**
- Records from salt deposition monitoring jars which characterise the dispersion and deposition of saline aerosol emissions around the raise bores.
- A statement of impacts to Category 1b at-risk species.

2.6.4 **Method**
A system of 26 salt deposition monitoring jars are located in the vicinity of the northern upcast raise bores, extending three kilometres to the north (see Appendix C, Figure 7.1). Salt jars are collected monthly and analysed for sodium chloride (NaCl), from which a deposition rate is derived. Comparison with historic data enables broad trending of emission capture efficiency. A comparison is made between saline aerosol impact footprint and records of Category 1b at-risk species.

(State 17ki, 17kii, 17kiv, 17kv)
2.7 Particulate emissions from open pit and rock storage facility

2.7.1 Background

The construction and operation of an open pit mine and the construction and operation of the Rock Storage Facility (RSF) creates the potential for an increase in particulate emissions from the operation. Compliance criteria need to be met at all times at Roxby Downs to ensure impacts are low and remain well controlled.

Monitoring results are used to determine impacts and provide real-time information for management control of potential dust-emitting activities. (MC 2.8.2(e))

2.7.2 Purpose

- Provide information for the modelling and reporting of ambient ground-level particulate concentrations at Roxby Downs and Olympic Village.

2.7.3 Deliverable(s)

- Records of real-time monitoring of particulates to ensure that concentrations at Roxby Downs remain within the compliance criteria.
- Provision of real-time particulate information to inform the management of dust-producing activities in the open pit mine.

2.7.4 Method

Compliance monitoring stations are located in accordance with relevant Australian Standards (State 50c) at each of the sensitive receivers plus two background monitoring stations to enable the operationally-contributed ground-level particulate concentrations at each of the sensitive receivers to be calculated (see Figure 6.1) (State 50a, 50e). Each compliance and background monitoring station consists of:

- a real-time (eBAM) PM\textsubscript{10} particulate monitor;
- a real-time (eBAM) PM\textsubscript{2.5} particulate monitor;
- a real-time (eSampler) total suspended particulate (TSP) monitor;
- a meteorological monitor collecting wind speed and direction, temperature, pressure and humidity data, with the Roxby Downs monitor also collecting solar radiation, rainfall and evaporation data.

All monitoring stations transmit real-time TSP, PM\textsubscript{10} and PM\textsubscript{2.5} particulate information and meteorological information to a central location (State 50b, 50d). Real-time monitoring provides information that can be used to manage dust generating activities in order to remain within the compliance criteria.

Twenty-four hour average (PM\textsubscript{10} and PM\textsubscript{2.5}) and annual average (TSP, PM\textsubscript{10} and PM\textsubscript{2.5}) ground-level particulate concentrations are derived from the monitoring data and reported annually in the Environmental Management and Monitoring Report (EMMR).

(State 17ki, 17kii, 17kv, 17kv)
3 COMMITMENTS

3.1 Reporting
The results and a discussion of the findings are presented in the EMMR as outlined in the Environmental Management Manual (EMM).

3.2 Summary of commitments
(State 17ki, 17kiv)

Table 3.1: Summary of commitments

<table>
<thead>
<tr>
<th>Action</th>
<th>Parameter</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor</td>
<td>SO₂ emissions – continuous emission monitoring reports</td>
<td>Daily</td>
</tr>
<tr>
<td>Monitor</td>
<td>Particulate emissions – continuous emission monitoring reports</td>
<td>Daily</td>
</tr>
<tr>
<td>Monitor</td>
<td>Fugitive particulate emissions – dust deposition</td>
<td>Monthly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Saline aerosol emissions</td>
<td>Monthly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Calciner particulate emissions and ²³⁸U activity via isokinetic sampling</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Fugitive particulate emissions – ²³⁸U ²³⁰Th ²²⁶Ra ²¹⁰Po ²¹⁰Pb activity</td>
<td>12-monthly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Calibration records for SO₂ and particulate analysers</td>
<td>Annually</td>
</tr>
<tr>
<td>Monitor</td>
<td>Acid Plant Tails Stack and Main Smelter Stack SO₂ and particulate emissions via isokinetic sampling</td>
<td>Annually</td>
</tr>
<tr>
<td>Monitor</td>
<td>Slimes Treatment Plant particulate emissions via isokinetic sampling</td>
<td>6-monthly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Feed Preparation Concentrate Dryers particulate emissions via isokinetic sampling</td>
<td>6-monthly</td>
</tr>
<tr>
<td>Monitor</td>
<td>Slimes Treatment Plant NOₓ and hydrogen sulphide emissions via isokinetic sampling</td>
<td>Annually</td>
</tr>
<tr>
<td>Report</td>
<td>Compliance with EPA Licence 1301, EPA Exemption 3014 and ground-level SO₂ concentration requirements of the Ambient Air Quality NEPM (i.e. results of dispersion modelling and information on bypass and exceedance emission events in Notification of Emission Events report)</td>
<td>Monthly</td>
</tr>
<tr>
<td>Report</td>
<td>²³⁸U emission from Calciner stacks in the LM1 Radiation Annual Report</td>
<td>Annually</td>
</tr>
<tr>
<td>Report</td>
<td>Monitoring results in the EMMR to the Indenture Minister</td>
<td>Annually</td>
</tr>
<tr>
<td>Review</td>
<td>The Airborne Emissions MP and modify as appropriate</td>
<td>Annually</td>
</tr>
</tbody>
</table>
4 DEFINITIONS AND REFERENCES

4.1 Definitions
Throughout the EPMP some terms are taken to have specific meaning. These are indicated in bold text in the documentation and are defined in the glossary in section 5 of the EMM. Defined terms have the same meaning wherever they appear in bold text. Some other terms and acronyms are also defined in the glossary, but do not appear in bold text.

4.2 References

4.3 Bibliography
5  APPENDIX A: AUTOMATICALLY GENERATED EMISSION REPORTS

These reports are automatically generated upon operation of any of the Bypass Stacks for the attention of Environment Section personnel.

Example:

<table>
<thead>
<tr>
<th>Anode Furnace #3 Bypass Stack Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smelter</td>
</tr>
<tr>
<td>Damper to Stack Opened</td>
</tr>
<tr>
<td>Damper to Stack Closed</td>
</tr>
<tr>
<td>Bypass Duration</td>
</tr>
<tr>
<td>Time between the last oxidation or</td>
</tr>
<tr>
<td>reduction and the damper opening</td>
</tr>
</tbody>
</table>

Operation in previous 24 Hours

| Start of 24hr Period                   | 25/12/2012 10:41:54 |
| Reduction Off                          | 25/12/2012 10:42:16 |
| Reduction On                           | 25/12/2012 10:46:50 |
| Reduction Off                          | 25/12/2012 11:20:06 |
| End of 24hr Period                     | 26/12/2012 10:41:54 |

| Operating Time (Oxidation or Reduction)| 00:35 (h:m) |
| Bypass Duration during Operating Time  | 00:00 (h:m) |

Online Bypass Duration
(As a percentage of Operating Time)

0.0 %

Figure 5.1: Anode Furnace Bypass Stack operation report

<table>
<thead>
<tr>
<th>Electric Furnace Bypass Stack Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smelter</td>
</tr>
<tr>
<td>Damper to Stack Opened</td>
</tr>
<tr>
<td>Damper to Stack Closed</td>
</tr>
<tr>
<td>Bypass Duration</td>
</tr>
</tbody>
</table>

Figure 5.2: Electric Furnace Bypass Stack operation report
Acid Plant Bypass Stack Operation

Smelter

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damper to Stack Opened</td>
<td>28 Dec 2012</td>
<td>08:08</td>
</tr>
<tr>
<td>Damper to Stack Closed</td>
<td>28 Dec 2012</td>
<td>13:58</td>
</tr>
<tr>
<td>Bypass Duration</td>
<td></td>
<td>5:50 (h:m)</td>
</tr>
<tr>
<td>Time between feed off and damper opening</td>
<td></td>
<td>7:08 (h:m)</td>
</tr>
</tbody>
</table>

Operation of "Flash Furnace Feed On" in previous 24 Hours

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of 24hr Period</td>
<td>27 Dec 2012</td>
<td>13:58</td>
</tr>
<tr>
<td>Feed Off</td>
<td>28 Dec 2012</td>
<td>01:00</td>
</tr>
<tr>
<td>End of 24hr Period</td>
<td>28 Dec 2012</td>
<td>13:58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Time</td>
<td></td>
<td>11:02 (h:m)</td>
</tr>
<tr>
<td>Bypass Duration during Operating Time</td>
<td></td>
<td>00:00 (h:m)</td>
</tr>
<tr>
<td>Online Bypass Duration</td>
<td></td>
<td>0.0 %</td>
</tr>
</tbody>
</table>

(As a percentage of Operating Time)

Figure 5.3: Acid Plant Bypass Stack operation report
These reports are automatically generated at the conclusion of any shift for the attention of Environment Section personnel.

Example:

**Main Stack SO₂ Exceedance Report**

**Smelter**

<table>
<thead>
<tr>
<th>Shift Start</th>
<th>28 Dec 2012 06:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift Finish</td>
<td>28 Dec 2012 18:00</td>
</tr>
</tbody>
</table>

**SO₂ Emissions 30min Average**

![Graph showing SO₂ emissions over time]

2400 mg/Nm³ Transitions this shift (Actual Measured)

<table>
<thead>
<tr>
<th>Start of Shift</th>
<th>28 Dec 2012 06:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of Shift</td>
<td>28 Dec 2012 18:00</td>
</tr>
</tbody>
</table>

2400 mg/Nm³ Transitions this shift (30 Min Rolling Average)

Total Exceedance Duration 0:00 (hrs)

Exceedance Duration 0.0 %

(As a percentage of Shift Period)

**Figure 5.4: Main Smelter Stack SO₂ emission exceedance report**
Final Absorption SO2 Exceedance Report

Smelter

Shift Start 28 Dec 2012 06:00
Shift Finish 28 Dec 2012 18:00

SO2 Emissions 30min Average

$40 ppm Transients this shift (Actual Measured)

Start of Shift 28 Dec 2012 06:00
End of Shift 28 Dec 2012 18:00

Total Exceedance Duration 0:00 (h:mm)

Exceedance Duration 0.0 %
(As a percentage of Shift Period)

Figure 5.5: Acid Plant Tail Gas Stack SO₂ emission exceedance report
6  APPENDIX B: DUST MONITORING SITES

Figure 6.1: Location of dust monitoring sites
7 APPENDIX C: SALINE AEROSOL MONITORING SITES

Figure 7.1: Location of saline aerosol monitoring sites
APPENDIX D: METHOD – SMELTER EMISSIONS

The impact of specific emissions on the quality of the local atmosphere is assessed through monitoring the compliance of processes with the requirements and emission limits specified in EPA Licence 1301, EPA Exemption 3014 and the Environment Protection (Air Quality) Policy 1994.

SO\textsubscript{2} emissions from both the Acid Plant Tails Gas Stack and the Main Smelter Stack are monitored using continuous emission monitoring analysers. The analysers are maintained and calibrated in accordance with site procedures and practices, with appropriate records retained.

ODC maintains systems to report bypass and exceedance emission events in accordance with statutory and other obligations. If the Anode Furnaces, Electric Furnace, Flash Furnace or Acid Plant Bypass Stacks have been operated, a report is automatically generated by the process control system detailing the date, time and duration of the event (see Appendix A, Figure 5.1 to Figure 5.3). Each operation of a bypass stacks that exceeds 10 minutes duration is reported (EPA 1301.305-140). The report contains the date, start and end time and duration of the event. Smelter and Environment personnel use this information to investigate the root causes and corrective actions of the bypass or exceedance emission event.

At the completion of every 12-hour shift (from 6 am to 6 pm and 6 pm to 6 am), a report is automatically generated by the process control system detailing the 30-minute average SO\textsubscript{2} concentrations for that shift for the Main Smelter Stack and the Acid Plant Tails Gas Stack (see Appendix A, Figure 5.4 and Figure 5.5). Designated Smelter and Environment personnel assess this data against ODC’s legal and other obligations to determine whether compliance criteria have been exceeded. If an exceedance has occurred, the event is investigated for root causes and potential corrective actions.

If at any time SO\textsubscript{2} emissions from the Main Smelter Stack or Acid Plant Tails Gas Stack exceed 2,400 mg/Nm\textsuperscript{3} (except during conditions specified in EPA Exemption 3014 - see note below), Olympic Dam is required to notify EPA Regulation and Compliance within one working day of the event.

All emission events likely to result in an exceedance of the National Environment Protection (Ambient Air Quality) Measure (NEPM) limits for ground-level concentrations of SO\textsubscript{2} are modelled using the CALPUFF Emission Dispersion Model. A dispersion map displaying concentration isopleths for the period following the event is generated. In the event of an exceedance of the NEPM limits, ODC is required to notify EPA Regulation and Compliance within one working day of the event.

All information on bypass and exceedance emission events is compiled monthly to form the Notification of Emission Events report. This report is submitted to EPA Regulation and Compliance within the first 10 working days of the month. All other relevant information is available to EPA Regulation and Compliance on request.

Isokinetic stack sampling is performed in accordance with condition (305-137) of EPA Licence 1301. Smelter stack emissions and intermediate process gases are sampled as necessary to ensure gas cleaning systems are operating optimally and in compliance with compliance criteria based on process control data obtained from the process control system. This sampling typically includes analysis for SO\textsubscript{2}, sulphur trioxide (SO\textsubscript{3}), particulates, heavy metals and other chemical compounds. Results from this sampling are used to update the emission profiles used in the generation of emission dispersion maps, and to validate the continuous emission monitoring results.

Sampled isokinetic data, together with data gathered from the in-stack analysers and flow meters, are used to derive a figure for total SO\textsubscript{2} recovery, expressed as a percentage. This figure is the ratio of the total SO\textsubscript{2} treated in the Acid Plant (total SO\textsubscript{2} generated from furnace operations minus SO\textsubscript{2} released from the Acid Plant Tails Gas Stack, Main Smelter Stack and bypass stacks) to the total SO\textsubscript{2} generated from furnace operations.

Note: Condition (37-43), Section 2 of EPA Licence 1301 defines the limit for total acid gas (expressed as SO\textsubscript{3} equivalent) emitted from the Main Smelter Stack and Acid Plant Tails Gas Stack as 3,000 mg/Nm\textsuperscript{3}, except during start-up, abnormal or emergency situations for the exempted periods and conditions described in EPA Exemption 3014. Both the Main Smelter Stack and Acid Plant Tails Gas Stack use continuous SO\textsubscript{2} analysers to determine compliance with this condition.

It is very difficult to correlate SO\textsubscript{2} output to SO\textsubscript{3} concentrations as SO\textsubscript{3} cannot be continuously monitored. Based on stack sampling and monitoring, ODC utilises an internal SO\textsubscript{2} limit of 2,400 mg/Nm\textsuperscript{3} for the Acid Plant Tail Gas Stack and the Main Smelter Stack. Concentrations above this limit are estimated to result in a total acid gas (expressed as SO\textsubscript{3}) concentration greater than 3,000 mg/Nm\textsuperscript{3}. 
Routine stack sampling, in accordance with condition (305-137) of **EPA Licence 1301**, has verified that measured SO$_3$ concentrations are within the limits specified in **EPA Licence 1301** and the Environment Protection (Air Quality) Policy 1994. Should future sampling indicate otherwise, notification will be provided to the EPA and predicted emission models/calculations as discussed above will be revised.
## APPENDIX E: AMENDMENTS TO MONITORING PROGRAM – AIRBORNE EMISSIONS FY13

Where applicable a summary of major changes to this MP is provided. Individual changes have not been itemised.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Change Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 2.5.2</td>
<td>Addition of reference to non-human biota</td>
<td>Clarification of monitoring and assessment purpose</td>
</tr>
<tr>
<td>Section 2.5.4</td>
<td>Addition of reference to analysis of all radionuclides in the $^{238}$U decay chain.</td>
<td>Additional analysis required to replace high volume air samplers.</td>
</tr>
<tr>
<td>Section 2.7.4</td>
<td>Removal of reference to high volume air samplers</td>
<td>Real-time monitoring of TSP using eSamplers to replace high volume air samplers.</td>
</tr>
</tbody>
</table>