BHP Billiton Olympic Dam

# LM1 ANNUAL REPORT

August 2011

BHP Billiton Olympic Dam Corporation Pty Ltd

Uranium CSG

ABN 99 007 835 761

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# OLYMPIC DAM

## LM1 ANNUAL REPORT
## August 2011

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**This Report has been reviewed by:**

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# 1 Introduction

This document is the LM1 report on radiation protection for BHP Billiton Olympic Dam. As required under the terms of the licence LM1, granted on September 28 1988 under the Radiation Protection and Control Act 1982 to mine and treat uranium bearing ores, the following information is included in this document:

- Plans of mine workings showing all existing workings and facilities for ventilation of the mine as of 30 June 2011;

- Indications of areas in which new mine development is planned and of areas from which ore extraction is planned for the period to 30 June 2012;

- Details of significant changes in processing plant layout, major equipment, or mill process during the twelve months ending 30 June 2011; and

- Estimates of quantities of radioactive wastes produced at Olympic Dam during the twelve months ending 30 June 2011.

A separate annual report containing employee dose assessments, dose calculation methodologies, dose parameters and dose conversion factors for the period 1 July 2010 to 30 June 2011 will be submitted to the Radiation Protection Branch of the SA EPA in October 2011.

# 2 Mine workings during FY11

## 2.1 Mining methods

### 2.1.1 Current Mining Method

Sub-level open stoping has been the mining method of choice at Olympic Dam since the commencement of operations in 1988. Once the stopes are mined out they are backfilled with either unconsolidated rock fill or a mixture of aggregate and binder as Cemented Aggregate Fill (CAF). The nature of the backfill material is based on future requirements of the fill mass, if the mine plan to expose walls or backs in the future then CAF will be selected to backfill the stope. Conversely, if the fill mass is not going to be exposed at a later date, then the stope will be filled using rock fill.

In cycle fibrecrete (shotcrete containing steel fibres) is a part of the mining cycle which provides a greater level of surface support for developing drives and rehabilitation sites.

### 2.1.2 Stope Size and Shape

The current stope design contains stopes of various shapes and sizes. Footprints vary from 20m by 20m to 30m by 30m. Stope height is designed as much as possible to encompass the full extent of the ore. Current stope heights generally vary from 1 to 5 lifts high (~60m to ~300m). Consequently, stope tonnages can vary from under 100,000t to in excess of 500,000t.

### 2.1.3 Extraction Sequence

The initial stope extraction sequence at Olympic Dam is defined as ‘Primary-Secondary-Tertiary’ (P/S/T). The extraction sequence was modified in 2005 to a pillarless sequence known as ‘Mining Fronts’.

The Mining Fronts extraction sequence minimises re-work caused by the need to re-access areas over time (i.e. for rehabilitation work, ventilation controls, etc.). This sequence also minimises dilution caused by CAF falling from a primary into a secondary stope and minimises ore losses caused by primary stope CAF shadowing secondary stope ore. Furthermore, the Mining Fronts sequence minimises any future impact of stress increase or decrease on the rock mass behaviour, thus maximising ore recovery. No remnant pillars need to be recovered in a Mining Front scenario and the operator retains the ability to close off areas upon completion of the stope extraction. Mining Fronts also provides the opportunity for consistent and systematic designs, increased predictability, reliability and sustainability of the mining plan, and minimise potential for ore loss.

### 2.1.4 Backfill Requirements

The permanent (existing) plant produces CAF via a pug mill and utilises neutralised tailing sands, whilst the temporary plant produces CAF via a large agitator-mixing bowl and utilises quarry fines as the sand medium. Both plants are operated by BHP Billiton and a contractor delivers the CAF to surface boreholes using semi-trailer bottom dump trucks. Binders (cement, fly ash and lime) are added to the CAF mixture according to strength requirements and are sourced externally. Crushed dolomite/limestone aggregate is sourced from an onsite quarry. Water comprises both recycled process water and local saline water.

## 2.2 Mine development and Production during FY11

The actual production, backfill and raise drilling schedules for FY11 are described in Tables 1 - 4.

### Table 1 – Actual Production Schedule FY11

| Stope | Mine Area | Jul-10 | Aug-10 | Sep-10 | Oct-10 | Nov-10 | Dec-10 | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Purple210 | DNW | | | | | | | | | | | | |
| Scarlet349 | DSE | | | | | | | | | | | | |
| Scarlet349 Rock Storage Stope | DSE | | | | | | | | | | | | |
| Cyan475 | FN | | | | | | | | | | | | |
| Jade320 | DSE | | | | | | | | | | | | |
| Green112 | DNW | | | | | | | | | | | | |
| Cyan317 | FN | | | | | | | | | | | | |
| Amber402 | FN | | | | | | | | | | | | |
| Cyan437 | FN | | | | | | | | | | | | |
| Scarlet386 Rock Storage Stope | DSE | | | | | | | | | | | | |
| Jade301 | DSE | | | | | | | | | | | | |
| Orange102 | DC | | | | | | | | | | | | |
| Purple242 Rock Storage Stope | F | | | | | | | | | | | | |
| Orange116 | DNW | | | | | | | | | | | | |
| Olive167 | C | | | | | | | | | | | | |
| Olive114 | C | | | | | | | | | | | | |
| Orange129 | DC | | | | | | | | | | | | |
| Purple218 | F | | | | | | | | | | | | |
| Cyan153 | FN | | | | | | | | | | | | |
| Scarlet143 | DSE | | | | | | | | | | | | |
| Purple265 | F | | | | | | | | | | | | |
| Green104 | DNW | | | | | | | | | | | | |
| Blue101 | DC | | | | | | | | | | | | |
| Scarlet157 | DSE | | | | | | | | | | | | |
| Cyan127 | FN | | | | | | | | | | | | |
| Purple258 | F | | | | | | | | | | | | |
| Pink116 | C | | | | | | | | | | | | |
| Olive155 | C | | | | | | | | | | | | |
| Orange111 | DNW | | | | | | | | | | | | |
| Olive374 | C | | | | | | | | | | | | |
| Purple238 | F | | | | | | | | | | | | |
| Orange107 | DNW | | | | | | | | | | | | |
| Blue142 | DC | | | | | | | | | | | | |
| Orange180 | DNW | | | | | | | | | | | | |
| Blue127 | DC | | | | | | | | | | | | |
| Blue127 Rock Storage Stope | DC | | | | | | | | | | | | |
| Blue148 | DNW | | | | | | | | | | | | |
| Cyan477 | FN | | | | | | | | | | | | |
| Cyan140 | FN | | | | | | | | | | | | |
| Purple212 | DNW | | | | | | | | | | | | |
| Amber521 | FN | | | | | | | | | | | | |
| Amber322 | FN | | | | | | | | | | | | |
| Cyan326 | FN | | | | | | | | | | | | |
| Brown224 | F | | | | | | | | | | | | |
| Purple225 | F | | | | | | | | | | | | |
| Olive107 | C | | | | | | | | | | | | |
| Pink109 | C | | | | | | | | | | | | |
| Scarlet144 | DSE | | | | | | | | | | | | |
| Orange148 | DC | | | | | | | | | | | | |
| Blue104 | DC | | | | | | | | | | | | |
| Cyan159 | FN | | | | | | | | | | | | |
| Scarlet154 | DSE | | | | | | | | | | | | |
| Scarlet128 | DSE | | | | | | | | | | | | |
| Amber448 | FN | | | | | | | | | | | | |
| Scarlet120 | DSE | | | | | | | | | | | | |
| Green114 | DNW | | | | | | | | | | | | |
| Purple246 | F | | | | | | | | | | | | |
| Jade119 | DSE | | | | | | | | | | | | |

## Table 2 – Actual Backfill Schedule FY11

| Stope | Fill Type | Jul-10 | Aug-10 | Sep-10 | Oct-10 | Nov-10 | Dec-10 | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scarlet174 | CAF | | | | | | | | | | | | |
| Purple223 | URF | | | | | | | | | | | | |
| Orange113 | URF | | | | | | | | | | | | |
| Orange113 | CAF | | | | | | | | | | | | |
| Olive001 | CAF | | | | | | | | | | | | |
| Purple236 | CAF | | | | | | | | | | | | |
| Blue385 | CAF | | | | | | | | | | | | |
| Scarlet124 | CAF | | | | | | | | | | | | |
| Scarlet152 | URF | | | | | | | | | | | | |
| Blue109 | CAF | | | | | | | | | | | | |
| Purple232 | CAF | | | | | | | | | | | | |
| Cyan318 | CAF | | | | | | | | | | | | |
| Jade122 | CAF | | | | | | | | | | | | |
| Purple210 | URF | | | | | | | | | | | | |
| Brown204 | CAF | | | | | | | | | | | | |
| Jade320 | CAF | | | | | | | | | | | | |
| Purple269 | SRF | | | | | | | | | | | | |
| Cyan475 | URF | | | | | | | | | | | | |
| Purple223 | CAF | | | | | | | | | | | | |
| Green112 | CAF | | | | | | | | | | | | |
| Scarlet349 | URF | | | | | | | | | | | | |
| Scarlet349 | CAF | | | | | | | | | | | | |
| Jade305 | CAF | | | | | | | | | | | | |
| Purple210 | CAF | | | | | | | | | | | | |
| Amber402 | CAF | | | | | | | | | | | | |
| Cyan437 | CAF | | | | | | | | | | | | |
| Scarlet386 | URF | | | | | | | | | | | | |
| Scarlet386 | CAF | | | | | | | | | | | | |
| Purple242 | CAF | | | | | | | | | | | | |
| Orange102 | CAF | | | | | | | | | | | | |
| Jade301 | URF | | | | | | | | | | | | |
| Cyan475 | CAF | | | | | | | | | | | | |
| Scarlet124 | SRF | | | | | | | | | | | | |
| Olive114 | CAF | | | | | | | | | | | | |
| Olive167 | CAF | | | | | | | | | | | | |
| Orange129 | CAF | | | | | | | | | | | | |
| Orange116 | CAF | | | | | | | | | | | | |
| Purple218 | CAF | | | | | | | | | | | | |
| Scarlet143 | CAF | | | | | | | | | | | | |
| Orange102 | SRF | | | | | | | | | | | | |
| Cyan317 | SRF | | | | | | | | | | | | |
| Olive374 | CAF | | | | | | | | | | | | |
| Purple218 | URF | | | | | | | | | | | | |
| Purple238 | URF | | | | | | | | | | | | |
| Scarlet143 | URF | | | | | | | | | | | | |
| Cyan153 | CAF | | | | | | | | | | | | |
| Orange180 | URF | | | | | | | | | | | | |
| Orange180 | CAF | | | | | | | | | | | | |
| Jade301 | SRF | | | | | | | | | | | | |
| Brown041 | CAF | | | | | | | | | | | | |
| Cyan477 | URF | | | | | | | | | | | | |
| Green104 | CAF | | | | | | | | | | | | |
| Jade301 | CAF | | | | | | | | | | | | |
| Purple265 | CAF | | | | | | | | | | | | |
| Cyan140 | CAF | | | | | | | | | | | | |
| Cyan326 | CAF | | | | | | | | | | | | |
| Orange107 | URF | | | | | | | | | | | | |
| Orange107 | CAF | | | | | | | | | | | | |
| Purple212 | CAF | | | | | | | | | | | | |
| Olive107 | CAF | | | | | | | | | | | | |
| Amber521 | CAF | | | | | | | | | | | | |
| Blue127 | URF | | | | | | | | | | | | |
| Blue127 | CAF | | | | | | | | | | | | |
| Scarlet157 | CAF | | | | | | | | | | | | |

## Table 3 – Actual Raise Drilling Schedule FY11

| Description | Jul-10 | Aug-10 | Sep-10 | Oct-10 | Nov-10 | Dec-10 | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 Purple 202 Slot Raise | ■ | | | | | | | | | | | |
| 36 Orange 111 Backfill Raise | ■ | | | | | | | | | | | |
| 26 Olive 155 Backfill Raise | ■ | | | | | | | | | | | |
| 39 Blue 127 B/Fill Raise | ■ | | | | | | | | | | | |
| 27 Amber 521 Slot Raise | ■ | | | | | | | | | | | |
| 41 Cyan 475 Backfill Raise | ■ | ■ | | | | | | | | | | |
| 40 Blue 148 Slot Raise | ■ | ■ | | | | | | | | | | |
| 30 Orange 180 Backfill Raise | | ■ | ■ | | | | | | | | | |
| 27 Cyan 159 Slot Raise | | ■ | | | | | | | | | | |
| 37 Purple 453 Slot Raise | | ■ | ■ | | | | | | | | | |
| 41 Purple 225 Slot Raise | | ■ | ■ | | | | | | | | | |
| 45 Scarlet 144 Slot Raise | | | ■ | ■ | | | | | | | | |
| 30 ORANGE 107 Backfill Raise | | | ■ | ■ | ■ | | | | | | | |
| 45 Scarlet 139 Slot Raise | | | ■ | ■ | | | | | | | | |
| 36 Brown 224 Slot Raise | | | ■ | ■ | | | | | | | | |
| 45 Scarlet 386 CAF Transfer | | | | ■ | | | | | | | | |
| 39 Scarlet 144 Slot Raise | | | ■ | ■ | | | | | | | | |
| 36 Blue 104 Slot Raise | | | | ■ | ■ | | ■ | | | | | |
| 42 Orange 102 Backfill Transfer #2 | | | | ■ | ■ | | | | | | | |
| 40 Blue 148 Backfill Transfer Raise | | | | | ■ | ■ | | | | | | |
| 39NB51 Vent Raise | | | | | | ■ | ■ | | | | | |
| 26 Olive 107 Slot Raise | | | | | | ■ | | | | | | |
| 36 Purple 252 Slot Raise | | | | | | ■ | ■ | | | | | |
| 39 Scarlet 120 Slot Raise | | | | | | ■ | ■ | | | | | |
| 31 Scarlet 128 Slot Raise | | | | | | | ■ | ■ | | | | |
| 39 Orange 148 Slot Raise | | | | | | | ■ | ■ | | | | |
| 26 Scarlet 120 Slot Raise | | | | | | | ■ | ■ | | | | |
| 27 Purple 246 Slot Raise | | | | | | | | ■ | ■ | | | |
| 51 Orange 103 Slot Raise | | | | | | | | ■ | ■ | | | |
| 34 Green 114 Slot Raise | | | | | | | | ■ | ■ | | | |
| 46 Purple 252 Slot Raise | | | | | | | | | ■ | | | |
| 45 Jade 116 Slot Raise | | | | | | | | | ■ | ■ | | |
| 45 Jade 116 Vent Raise (RB20) | | | | | | | | | ■ | ■ | ■ | |
| 37 Jade 119 Slot Raise | | | | | | | | | ■ | ■ | | |
| 46LF68 Vent Raise | | | | | | | | | ■ | ■ | ■ | |
| 32 Purple 252 Transfer Raise | | | | | | | | | | ■ | ■ | |
| 30 Blue 104 Backfill Raise | | | | | | | | | | | ■ | |
| 27 Cyan 106 Slot Raise | | | | | | | | | | | ■ | |
| 39 Scarlet 152 Fill LHR | | | | | | | | | | | ■ | |
| 45 Scarlet 151 Fill Raise | | | | | | | | | | | ■ | ■ |
| 34 Cyan 17 VENT RET- Pilot | | | | | | | | | | | ■ | ■ |
| 34 Cyan 359 Slot Raise | | | | | | | | | | | ■ | ■ |
| 51 Blue 110 Slot Raise | | | | | | | | | | | ■ | ■ |
| 39 Blue 110 Backfill UGR | | | | | | | | | | | | ■ |
| 35 Orange 109 UGR Fill Raise | | | | | | | | | | | | ■ |
| 46 Orange 103 Slot Raise | | | | | | | | | | | | ■ |
| 45 Scarlet 159 Slot Raise | | | | | | | | | | | | ■ |

## Table 4 – Actual Raise Bore Schedule FY11

| Description | Jul-10 | Aug-10 | Sep-10 | Oct-10 | Nov-10 | Dec-10 | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RB033 RAISE - Reaming | ■ | ■ | | | | | | | | | | |
| RB032 RAISE - Reaming | | | ■ | ■ | | | | | | | | |
| RB3 Salt Reaming | | | | | ■ | ■ | | | | | | |
| RB35 RAISE - Piloting | | | | | | | | | | ■ | ■ | |
| RB35 RAISE - Reaming | | | | | | | | | | | ■ | ■ |

### 2.2.1 Mine Ventilation

The mine ventilation system is shown in the plan ODM-VNT-036-2011. Total air in circulation as of 30th July 2011 was 4200 $m^3/s$, no change from the previous year. A list of the air intake and exhaust shafts is shown in Table 5.

**Table 5 – Intake and Exhaust Shafts**

| INTAKES | EXHAUST SHAFTS |
|---|---|
| RB5 | RB1 |
| RB11 | RB2 |
| RB13 | RB3 |
| RB14 | RB4 |
| RB18 | RB6 |
| RB22 | RB7 |
| RB23 | RB8 |
| RB26 | RB9 |
| RB27 | RB10 |
| RB28 | RB12 |
| RB31 | RB13 |
| RB32 | RB15 |
| Robinson Shaft | RB16 |
| Clark Shaft | RB17 |
| Whenan Shaft | RB19 |
| Surface Decline | RB20 |
| | RB21 |
| | RB24 |
| | RB29 |
| | RB30 |
| | RB34 |

### 2.2.2 Financial Year 2011 - Changes to Primary Ventilation Circuit

RB 13 was converted to an exhaust shaft to ventilate the A-North Area. RB 34 is now complete as a 4.5 m exhaust shaft. RB31 and RB32 were constructed as intake raises to service the ‘DNW’ and ‘A’ mine areas respectively.

# 3 Planned Mine Development for FY12

Mine development will occur in those areas as outlined in the OM3 mine plan series and also shown in the overview plan ODM-ADM-250. The approximate scheduling of major Mine activities can be seen in Tables 6 - 9. Programming of the work may change with operational requirements. New stopes will be developed and brought on line as existing stopes are depleted. All stopes currently planned for FY12 are in the B, C , DC, DNW, DSE, F and FN mine areas.

### Table 6 – Production Schedule FY12

| Stope | Mine Area | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue148 | DC | | | | | | | | | | | | |
| Amber322 | FN | | | | | | | | | | | | |
| Purple225 | F | | | | | | | | | | | | |
| Scarlet154 | DSE | | | | | | | | | | | | |
| Scarlet144 | DSE | | | | | | | | | | | | |
| Scarlet128 | DSE | | | | | | | | | | | | |
| Cyan159 | FN | | | | | | | | | | | | |
| Amber448 | FN | | | | | | | | | | | | |
| Scarlet120 | DSE | | | | | | | | | | | | |
| Purple246 | F | | | | | | | | | | | | |
| Blue104 | DC | | | | | | | | | | | | |
| Jade119 | DSE | | | | | | | | | | | | |
| Orange148 | DC | | | | | | | | | | | | |
| Cyan359 | FN | | | | | | | | | | | | |
| Orange103 | DC | | | | | | | | | | | | |
| Green114 | DNW | | | | | | | | | | | | |
| Cyan106 | FN | | | | | | | | | | | | |
| Scarlet139 | DSE | | | | | | | | | | | | |
| Scarlet151 | DSE | | | | | | | | | | | | |
| Olive113 | C | | | | | | | | | | | | |
| Purple252 | F | | | | | | | | | | | | |
| Orange109 | DNW | | | | | | | | | | | | |
| Brown203 | F | | | | | | | | | | | | |
| Purple244 | F | | | | | | | | | | | | |
| Purple453 | F | | | | | | | | | | | | |
| Purple219 | F | | | | | | | | | | | | |
| Orange104 | DNW | | | | | | | | | | | | |
| Purple264 | F | | | | | | | | | | | | |
| Cyan144 | FN | | | | | | | | | | | | |
| Blue110 | DC | | | | | | | | | | | | |
| Olive169 | C | | | | | | | | | | | | |
| Orange114 | DNW | | | | | | | | | | | | |
| Cyan149 | FN | | | | | | | | | | | | |
| Olive153 | C | | | | | | | | | | | | |
| Brown219 | F | | | | | | | | | | | | |
| Jade116 | DSE | | | | | | | | | | | | |
| Blue156 | DC | | | | | | | | | | | | |
| Purple263 | F | | | | | | | | | | | | |
| Cyan156 | FN | | | | | | | | | | | | |
| Green106 | DNW | | | | | | | | | | | | |
| Yellow417 | B | | | | | | | | | | | | |
| Scarlet159 | DSE | | | | | | | | | | | | |
| Amber329 | FN | | | | | | | | | | | | |

## Table 7 – Backfill Schedule FY12

| Stope | Fill Type | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Purple265 | CAF | ■ | | | | | | | | | | | |
| Orange111 | CAF | ■ | | | | | | | | | | | |
| Pink116 | CAF | ■ | | ■ | | | | | | | | | |
| Pink116 | URF | | ■ | ■ | | | | | | | | | |
| Scarlet157 | SRF | ■ | | | | | | | | | | | |
| Blue127 | CAF | ■ | | | | | | | | | | | |
| Cyan140 | CAF | ■ | | | | | | | | | | | |
| Green104 | CAF | ■ | ■ | ■ | | | | | | | | | |
| Purple238 | CAF | | | ■ | ■ | | | | | | | | |
| Purple238 | URF | ■ | | | | | | | | | | | |
| Purple238 | SRF | | ■ | | | | | | | | | | |
| Cyan127 | CAF | ■ | ■ | ■ | ■ | | | | | | | | |
| Olive107 | CAF | ■ | | | | | | | | | | | |
| Amber521 | CAF | | | | ■ | ■ | | | | | | | |
| Blue101 | CAF | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Blue142 | CAF | | ■ | ■ | ■ | ■ | | | | | | | |
| Pink109 | CAF | ■ | | ■ | | | | | | | | | |
| Pink109 | URF | ■ | ■ | | | | | | | | | | |
| Pink109 | SRF | | | ■ | | | | | | | | | |
| Scarlet144 | CAF | | | | | | ■ | ■ | ■ | ■ | | | |
| Scarlet144 | URF | | | | | | | ■ | ■ | | | | |
| Purple258 | CAF | | | ■ | ■ | ■ | ■ | ■ | | | | | |
| Cyan159 | CAF | | | | ■ | | | | | | | | |
| Cyan159 | URF | | ■ | ■ | | | | | | | | | |
| Cyan159 | SRF | | | | ■ | | | | | | | | |
| Blue148 | CAF | | | | | ■ | ■ | ■ | ■ | | | | |
| Blue148 | URF | | | | | | ■ | ■ | | | | | |
| Purple246 | CAF | | | | | | | | | ■ | ■ | ■ | |
| Scarlet154 | CAF | | | | | | ■ | ■ | ■ | ■ | | | |
| Scarlet154 | URF | | | | | | | ■ | | ■ | | | |
| Cyan359 | CAF | | | | | | ■ | ■ | | | | | |
| Cyan359 | URF | | | | | | ■ | ■ | | | | | |
| Brown224 | CAF | | | | | ■ | ■ | | | | | | |
| Brown224 | URF | | | | | ■ | ■ | | | | | | |
| Cyan106 | CAF | | | | | | | ■ | ■ | | | | |
| Cyan106 | SRF | | | | | | | ■ | ■ | | | | |
| Purple225 | CAF | | | ■ | ■ | ■ | ■ | | | | | | |
| Purple225 | URF | | | | ■ | | | | | | | | |
| Orange103 | CAF | | | | | | | | | ■ | | ■ | |
| Orange103 | URF | | | | | | | | | ■ | ■ | ■ | ■ |
| Scarlet128 | CAF | | | | | | | | ■ | ■ | ■ | ■ | |
| Brown203 | CAF | | | | | | | | | ■ | ■ | | |
| Scarlet151 | CAF | | | | | | | | | | ■ | ■ | ■ |
| Scarlet151 | URF | | | | | | | | | | | ■ | ■ |
| Amber448 | CAF | | | | | | | | | | ■ | ■ | ■ |
| Olive113 | CAF | | | | | | | | ■ | ■ | | | |
| Green114 | CAF | | | | | | | | | ■ | ■ | ■ | ■ |
| Orange148 | CAF | | | | | | | ■ | ■ | ■ | ■ | | |
| Orange148 | URF | | | | | | | ■ | ■ | ■ | ■ | | |
| Scarlet120 | CAF | | | | | | | | | | | | ■ |
| Amber322 | CAF | | | | | | | | | | ■ | ■ | ■ |
| Jade119 | CAF | | | | | | | | | | ■ | ■ | |
| Purple264 | CAF | | | | | | | | | | | | ■ |
| Purple264 | URF | | | | | | | | | | | | ■ |
| Brown226 | CAF | | | | | | | | | | | ■ | ■ |
| Cyan144 | CAF | | | | | | | | | | | ■ | ■ |
| Purple219 | URF | | | | | | | | | | ■ | ■ | ■ |

## Table 8 – Underground Raise Drill Schedule FY12

| Description | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 Scarlet 159 Slot Raise - Pilot | ■ | | | | | | | | | | | |
| 45 Scarlet 159 Slot Raise - Ream | ■ | | | | | | | | | | | |
| 35 Orange 109 UGR Fill Raise - Pilot | ■ | | | | | | | | | | | |
| 35 Orange 109 UGR Fill Raise - Ream | ■ | ■ | | | | | | | | | | |
| 26 Blue 110 Backfill UGR - Pilot | ■ | ■ | | | | | | | | | | |
| 39 Blue 110 Backfill UGR - Ream | ■ | | | | | | | | | | | |
| 34 Cyan 127 Transfer - Pilot | ■ | | | | | | | | | | | |
| 34 Cyan 127 Transfer - Ream | ■ | ■ | | | | | | | | | | |
| 46 Orange 103 Slot Raise - Ream | ■ | | | | | | | | | | | |
| 45 Scarlet 151 Slot Raise - Pilot | ■ | | | | | | | | | | | |
| 45 Scarlet 151 Slot Raise - Ream | ■ | | | | | | | | | | | |
| 52 Purple 219 Slot Raise - Pilot | | ■ | | | | | | | | | | |
| 52 Purple 219 Slot Raise - Ream | | ■ | | | | | | | | | | |
| 41 Purple 244 Slot Raise - Pilot | | ■ | ■ | | | | | | | | | |
| 42 Orange 114 Slot Raise - Pilot | | ■ | | | | | | | | | | |
| 42 Orange 114 Slot Raise - Ream | | ■ | ■ | | | | | | | | | |
| 26 Blue 110 Backfill UGR - Ream | | ■ | | | | | | | | | | |
| 39 Green 106 Slot Raise - Pilot | | ■ | | | | | | | | | | |
| 39 Green 106 Slot Raise - Ream | | ■ | ■ | | | | | | | | | |
| 29 Blue 142 Backfill UGR - Pilot | | ■ | | | | | | | | | | |
| 29 Blue 142 Backfill UGR - Ream | | ■ | | | | | | | | | | |
| 26 Jade 119 Transfer Raise- Pilot | | | ■ | | | | | | | | | |
| 26 Jade 119 Transfer Raise- Ream | | | ■ | | | | | | | | | |
| 45 Olive 169 Slot Raise - Pilot | | | ■ | | | | | | | | | |
| 45 Olive 169 Slot Raise - Ream | | | ■ | ■ | | | | | | | | |
| 27 Green 106 Slot Raise - Pilot | | | ■ | | | | | | | | | |
| 27 Green 106 Slot Raise - Ream | | | ■ | ■ | | | | | | | | |
| 26 Olive 113 Slot Raise - Pilot | | | ■ | | | | | | | | | |
| 26 Olive 113 Slot Raise - Ream | | | ■ | | | | | | | | | |
| 41 Purple 244 Slot Raise - Ream | | | ■ | | | | | | | | | |
| RB8 EXT Raise - Pilot | | | | ■ | | | | | | | | |
| RB8 EXT Raise - Ream | | | | ■ | | | | | | | | |
| 46 Orange 109 Slot Raise - Pilot | | | | ■ | | | | | | | | |
| 46 Orange 109 Slot Raise - Ream | | | | ■ | ■ | | | | | | | |
| 46 Purple 219 Backfill Raise - Pilot | | | | ■ | | | | | | | | |
| 46 Purple 219 Backfill Raise - Ream | | | | ■ | | | | | | | | |
| 39 Olive 169 Slot Raise - Pilot | | | | ■ | | | | | | | | |
| 39 Olive 169 Slot Raise - Ream | | | | ■ | | | | | | | | |
| 27 Amber 329 Slot Raise - Pilot | | | | ■ | | | | | | | | |
| 27 Amber 329 Slot Raise - Ream | | | | ■ | | | | | | | | |
| 37 Brown 203 Slot Pilot | | | | ■ | | | | | | | | |
| 37 Brown 203 Slot Raise | | | | ■ | ■ | | | | | | | |
| 36 Orange 104 Slot Raise - Pilot | | | | ■ | ■ | | | | | | | |
| 36 Orange 104 Slot Raise - Ream | | | | | ■ | | | | | | | |
| 30 Orange 104 Slot Raise - Pilot | | | | | ■ | | | | | | | |
| 30 Orange 104 Slot Raise - Ream | | | | | ■ | ■ | | | | | | |
| 27 Cyan 144 Slot Raise - Pilot | | | | | ■ | | | | | | | |
| 27 Cyan 144 Slot Raise - Ream | | | | | ■ | ■ | | | | | | |
| 30 Orange 148 Backfill Raise- Pilot | | | | | ■ | | | | | | | |
| 30 Orange 148 Backfill Raise - Ream | | | | | ■ | ■ | | | | | | |
| 46 Purple 264 Slot Raise - Pilot | | | | | ■ | | | | | | | |
| 46 Purple 264 Slot Raise - Ream | | | | | ■ | | | | | | | |
| 52 Cyan 149 Slot Raise - Pilot | | | | | | ■ | | | | | | |
| 52 Cyan 149 Slot Raise - Ream | | | | | | ■ | | | | | | |
| 26 Olive 153 Slot Raise - Pilot | | | | | | ■ | | | | | | |
| 26 Olive 153 Slot Raise - Ream | | | | | | ■ | ■ | | | | | |
| 41 Purple 264 Backfill Raise - Pilot | | | | | | ■ | | | | | | |
| 41 Purple 264 Backfill Raise - Ream | | | | | | ■ | | | | | | |
| 26 Purple 202 Slot Raise - Pilot | | | | | | ■ | | | | | | |
| 26 Purple 202 Slot Raise - Ream | | | | | | ■ | ■ | | | | | |
| 46 Orange 104 Slot Raise - Pilot | | | | | | ■ | | | | | | |
| 46 Orange 104 Slot Raise - Ream | | | | | | ■ | | | | | | |
| 35 Brown 219 Slot Raise - Pilot | | | | | | | ■ | | | | | |
| 35 Brown 219 Slot Raise - Ream | | | | | | | ■ | | | | | |
| 36 Orange 103 Backfill Transfer Hole - Pilot | | | | | | | ■ | | | | | |
| 36 Orange 103 Backfill Transfer Hole - Ream | | | | | | | ■ | ■ | | | | |
| 26 Blue 156 Vent Raise - Pilot | | | | | | | ■ | | | | | |
| 26 Blue 156 Vent Raise - Ream | | | | | | | ■ | | | | | |
| 26 Olive 135 Slot Raise - Pilot | | | | | | | ■ | | | | | |
| 26 Olive 135 Slot Raise - Ream | | | | | | | ■ | ■ | | | | |
| 39 OLIVE 102 Slot Raise - Pilot | | | | | | | ■ | | | | | |
| 39 OLIVE 102 Slot Raise - Ream | | | | | | | ■ | ■ | | | | |
| 42 Orange 552 Slot Raise- Pilot | | | | | | | | ■ | | | | |

## Table 9 – Raise Bore Schedule FY12

| Description | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RB35 RAISE - Reaming | ■ | | | | | | | | | | | |
| RB39 RAISE - Piloting | | | | | | | ■ | ■ | ■ | ■ | | |
| RB39 RAISE - Reaming | | | | | | | | | | ■ | ■ | ■ |

## 3.1 Planned Changes to Primary Ventilation Circuit during FY12

- RB35 exhaust raise to be commissioned to service A north Violet area
- RB39 exhaust raise to be constructed to service the Lime area
- Fan upgrades are planned for RB2 and RB8, to be completed by end of December 2011
- RB33 exhaust raise to be commissioned September 2011 servicing FN area and rail level
- Possibility of construction of RB38 intake raise to service Limes

## 3.2 Changes to Equipment or Process in Mine Production

### 3.2.1 Changes to Mine Equipment

Equipment purchased during the course of the 20010/2011 year:

- For BHP Billiton Limited the following equipment was purchased and decommissioned during the reporting period:
  - Trucks UT041, UT042 and UT043 were commissioned
  - Trucks UT025, UT026 and UT027 were decommissioned
  - Loaders UL049, UL050, UL051 and UL052 were commissioned
  - Loaders UL034, UL035, UL036 and UL038 were decommissioned
  - Tool Carriers UF041, UF042, UF043, UF044 and UF045 were commissioned
  - Tool Carriers UF019, UF021, UF024, UF026 and UF027 were decommissioned.
  - Drill UJ034, UJ035, UJ036 and UJ037 was commissioned
  - Drill UJ022, UJ023, UJ024 and UJ025 was decommissioned
- For Macmahon Underground Pty Ltd, the following equipment changes occurred:
  - Jumbo DR0027 – UJ27 was decommissioned
  - Sandvik Jumbo DR44 (3 month trial rig) has been removed from site
  - Light Vehicle LV0017 was decommissioned
  - Light Vehicle LV0218-Coaster Bus was decommissioned
  - Loader LO7001-UL36 was decommissioned
  - Dump Truck TD0043-DT43-TORO was decommissioned
  - Shotcrete Rig (Jacon) TR1919 was commissioned.
- For Boart Longyear Pty Ltd, there were no equipment changes.
- For Macmahons Raise Drilling Pty Ltd, the following equipment changes occurred:
  - Light Vehicle LV0694 and LV0695 was commissioned
  - Light Vehicle LV15 and LV17 was decommissioned
  - Integrated Transporter IT81 was commissioned

- Surface Raise Rig #81R, on site temporarily for RB34.

- For Heading Contractors Pty Ltd, the following equipment changes occurred:
  - Bobcat Skidsteer S205/1 and S70/1 was commissioned
  - Excavator X05 was commissioned.
- For Exact Mining Pty Ltd, the following equipment changes occurred for the CAF plant, quarry and batch plant:
  - Dozer SME1710 commissioned
  - Dump truck SME1765, SME1798 commissioned
  - Drill rig SME1764 commissioned
  - Excavator SME1584, SME1766 commissioned
  - Elevated work platform SME1695 commissioned
  - Light vehicle PC393, PC399, PC400 commissioned
  - Front end loader SME1604, SME1706, SME1825 commissioned
  - Front end loader SME393, SME394, SME438 decommissioned
  - Dozer SME436 commissioned
  - Drill rig SME891 commissioned
  - Stacker ST015 commissioned
  - Excavator SME399, SME407, SME620, SME909 decommissioned
  - Grader SME393 decommissioned
  - Loader SME375, SME394, SME438 decommissioned

Changes were made to the model of surface contamination monitor used at Olympic Dam. The fleet of Ludlum 16 with Ludlum 43-44 alpha only surface contamination monitors were replaced with Ludlum 2360 units paired with a 43-93 alpha beta probe. The addition of beta detection greatly enhances the ability to detect contamination due to the greater distance beta radiation travels and also hidden contamination due to the probes cross sensitivity to gamma radiation.

### 3.2.2 Changes to Mine Procedures

There have been no changes to mine operating procedures with a bearing on environmental and radiation management in the FY11 period.

Site radiation clearance procedures were modified to include the use of the new Ludlum 2360 surface contamination monitors. All personnel authorised to perform radiation clearances were also retrained in the use of the Ludlum 2360.

### 3.2.3 Changes to Mine Processes

#### Mining Method

There have been no changes to the mining method in the FY11 period.

#### Stope size/shape

There have been no changes to the stope size/shapes in the FY11 period.

## Extraction sequence

There have been no changes to the extraction sequence in the FY11 period.

## Backfill Requirements

Backfill production last year was 2.249 $Mm^3$. The current schedule for FY11 is 2.182 $Mm^3$. This will be achieved by fully utilising the permanent CAF plant and using the temporary CAF plant only as required.

Studies continue to examine varying CAF mix designs to achieve different strengths, as required by mine design.

# 4 Changes to Equipment or Process in the Process Plant

## 4.1 Changes to Process Plant Equipment

Changes that have a bearing on environmental and radiation management in the plant are as below:

### Concentrator

Though there were no major changes to the Concentrator plant, the noted changes or replacements were as follows:

- Relocation of the Concentrator/Hydromet production offices to an area adjacent to the P1 change rooms. The removal of these offices from the controlled area reduces the size of the workforce required to wear controlled area clothing resulting in water savings and greenhouse gas emission reductions from fewer people needing to shower and have clothes laundered and reduces the number of people in the controlled area from a risk perspective.
- The Amdel multi stream analyser (MSA) was Decommissioned and dismantled following its replacement with an Outotec x-ray fluorescence analyser. The MSA radiation source was removed by the process plant Senior Radiation Safety Officer and secured in the site isotope store
- Major maintenance of ANI, Fuller and Svedala Mills
- Concentrate Leach Tank 3 serviced.

### Hydromet

Though there were no major changes to the Hydromet and Solvent Extraction (SX) plant the noted changes or replacements were as follows:

Hydromet Plant:

- Continued work on the tailings disposal upgrade (TDU), this also included the purchase of 3 additional density gauges which will be installed in FY12.
- Tails Leach Tank 2 cleaned and agitator replacement
- Tails Leach Tank 3 agitator and gearbox changed
- CCD 4 major overhaul completed
- CCD 1, 2 and 3 inspected and repairs carried out
- Clarifier 2 overflow tank relined.

SX Plant:

- Copper SX A Train cleaned out in July 10
- Copper SX B Train cleaned out in April 11
- Uranium SX loaded solvent line was cleaned out in February 2011 to improve flow (line pigged)
- Pulse Column 4 overhauled

- 30% of the pregnant leach solution (PLS) pipeline replaced in Copper SX A and B trains.
- Loaded organic pre-scrub tank cleaned out October 2010
- Commencement of project to replace the SX crud centrifuge.
- Commencement of project to relocate ammonia storage compound to the north of the SX plant.

## Smelter

The smelter has continued to closely monitor polonium 210 (Po-210) within the process to ensure airborne radionuclide concentrations are maintained below the derived air concentration (DAC). Critical streams are assayed for Po-210 on a daily basis. The contractor smelter project radiation technician position has been converted to 2 full time BHP Billiton Occupational Hygiene Technician employees further highlighting the importance the business places on controlling exposures. Routine monitoring of airborne activity exposures to the workforce and fume emission sources has remained in place. The additional Occupational Hygiene Technician resource also allows for more in depth study of fume emissions to further reduce exposures.

Supplies of Flash Furnace slag for use as revert were depleted during the year. In its place, high copper content Electric Furnace and Anode Furnace slag are being utilised.

Attempts were made to improve the reliability of the dry stream analyser (DSA) located on the Flash Furnace concentrate feeder. Due to the age of the system and constant problems with its feed system it has been decided to decommission the instrument in the next financial year. The radiation source will be removed prior to commencement of decommissioning.

Larox filter 1 was overhauled.

## Refinery ER/EW/Gold area

No changes occurred to the Refinery process flows during July 2010 to June 2011.

## Analytical Laboratory

No changes of note occurred to the Analytical Laboratory during July 2010 to June 2011.

## Tailings Storage Facility

The following were items of note for the Tailings Storage Facility

- Continued construction of TSF Cell 5, commissioning planned for FY12
- EP1 recommissioned in July 2010 following a 2 metre wall raise
- Constructed a buttress on TSF cell 1 south wall
- Construction of tailings disposal upgrades consisting of additional tailings pipelines and upgrades to the pipe traces.
- Stability assessment undertaken to investigate a potential height increase from 30 m to 34 m on TSF cells 1-3
- EP2 returned to service November 2010 at completion of work on the wave barriers

- EP3A removed from service due to a high level of precipitated solids. EP3B was also removed from service in May 2011 due to liner damage.

The process plant also had its Ludlum 16 contamination meters replaced with the Ludlum 2360 – Ludlum 43-93 alpha beta contamination meter.

## 4.2 Changes to Process Plant Procedures

There were no changes to process plant operating procedures with a bearing on environmental and radiation management in the FY11 period.

Site radiation clearance procedures were modified to include the use of the new Ludlum 2360 surface contamination monitors. All personnel authorised to perform radiation clearances were also retrained in the use of the Ludlum 2360.

# 5 Estimated Quantities of Radioactive Wastes

During the production of copper cathode and uranium oxide concentrate from ore mined on site, waste streams containing radioactive materials are generated. These are discussed further in the following sections.

## 5.1 Solid Wastes

Solid wastes from the processing of ore reach the Tailings Storage Facility (TSF) in the form of tailings slurry, deposited via spigots along the edges of any of four TSF Cells. The solids consolidate over time and the majority of the liquor either evaporates on the tailings cell or captured then transferred to a system of evaporation ponds, or is neutralised by the limestone underneath the TSF, before entering the groundwater, where it is reclaimed via a number of bores.

For the period 1 July 2010 to 30 June 2011, the mass of solid tailings produced was approximately 9,249,925 tonnes. The TSF water balance indicates that a volume of approximately 99,708,212m$^3$ of liquor was delivered to the TSF, of which approximately 2,923,000m$^3$ was decanted to the evaporation ponds with the remainder remaining in the tailings cells or evaporating. The data for the previous five years is shown below in Figure 1. The increase in FY11 was due to return to normal production as FY10 was impacted by the Clark Shaft incident.

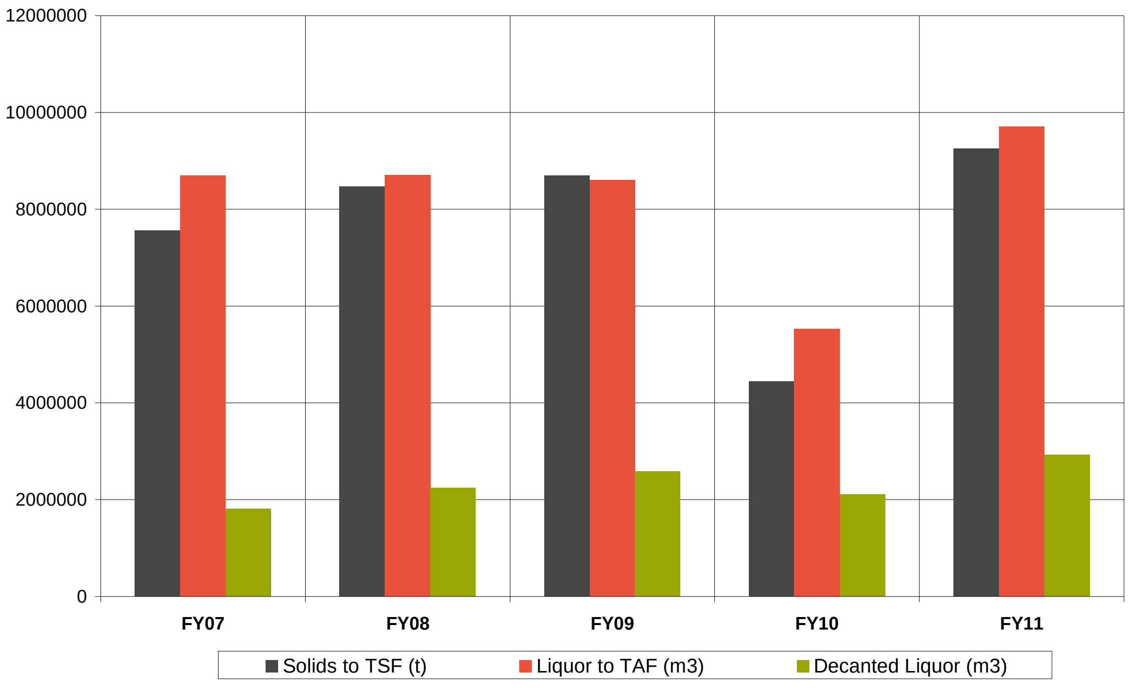


**Figure 1: Wastes to the Tailings Storage Facility (TSF)**

## 5.2 Gaseous Wastes

Fugitive radon is emitted from all areas of site; however the most significant are the mine ventilation raise bores, the ore stockpiles, milling activities, emission from the TSF and a component derived from ambient background concentrations.

Using the methodology derived from a review of radon source terms undertaken in 2002, the total site fugitive emission of RDP is approximately 230 TBq for the reporting period. This represents an increase over the previous reporting period's estimation of 219 TBq. The change is a result of increased production and is inline with the increases seen in FY07, FY08 and FY09 where there were similar levels of mine development and process plant production. The previous five year radon emission activity is trended in Figure 2.

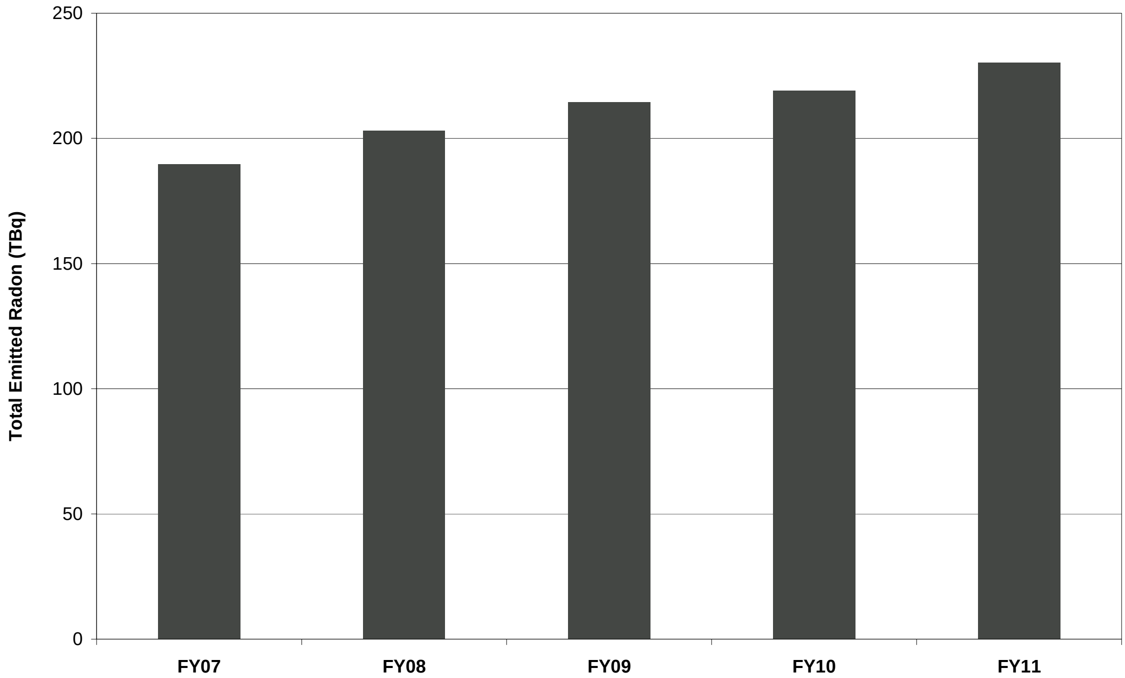


**Figure 2: Site total emitted radon**

## 5.3 Dust and Particulate Emissions

Quantities of dust and particulate are generated from point-sources during the processing of ore. The principal point-sources of dust and particulate emissions are Smelter 2 (Smelter 1 only being used for the remelting of clean refinery scrap copper), the uranium calcining facility and the Slimes Treatment Plant (STP).

Smelter 2 processes copper concentrates produced during the milling, flotation, leach and feed preparation stages of the process, and consist of a Flash Furnace (FF), an Electric Slag Reduction Furnace (EF) and two Anode Furnaces. Concentrate is fed into the FF, generating slag, blister copper and off-gas containing significant quantities of sulphur dioxide ($SO_2$) and dust. The dust is captured within the Waste Heat Boiler (WHB) and the Electrostatic Precipitator (ESP), and either recycled to the FF, or leached and pumped to the hydromet tails leach facility.

The $SO_2$ goes to the Acid Plant and is converted and absorbed to produce sulphuric acid. The EF takes FF slag and further reduces it to produce blister copper, slag and off-gas containing particulate. The particulate is captured via a quench tower and venturi scrubbing system, before off-gas is emitted to atmosphere. The two Anode Furnaces undertake the final fire-refining of the copper prior to casting copper anodes for use in the refinery. The off-gas from the Anode Furnaces is treated in a gas cleaning system similar to that of the EF. All furnaces are fitted with gas cleaning system bypass stacks for use in emergency or abnormal situations.

The precipitation area of the hydrometallurgical plant includes two calcining furnaces, used to convert ammonium diuranate (ADU) to uranium oxide ($U_3O_8$). Each calciner has a dedicated gas cleaning system to remove particulate material prior to emission to atmosphere.

The STP (or Gold Room) treats the slimes generated during the electro-refining process to recover gold and silver. The facility consists of a Roaster Scrubber, designed to treat various furnace off-gas streams, and a NOx Scrubber designed to treat emissions from the aciding process.

Using process control system data in coordination with isokinetic sampling, the total site particulate emission is estimated at 153,787 kg for the period 1 July 2010 to 30 June 2011. There is an increase from last year's figure due the reduced output of the plant in FY10 during the Clark Shaft recovery but was however below that of FY09 which had similar production rates to FY11. The main difference between FY11 and FY09 was that the Electric Furnace and Anode Furnaces spent less time in bypass during FY11 which reduced the total particulate emission.

The previous five year point source particulate emission data is trended in Figure 3.

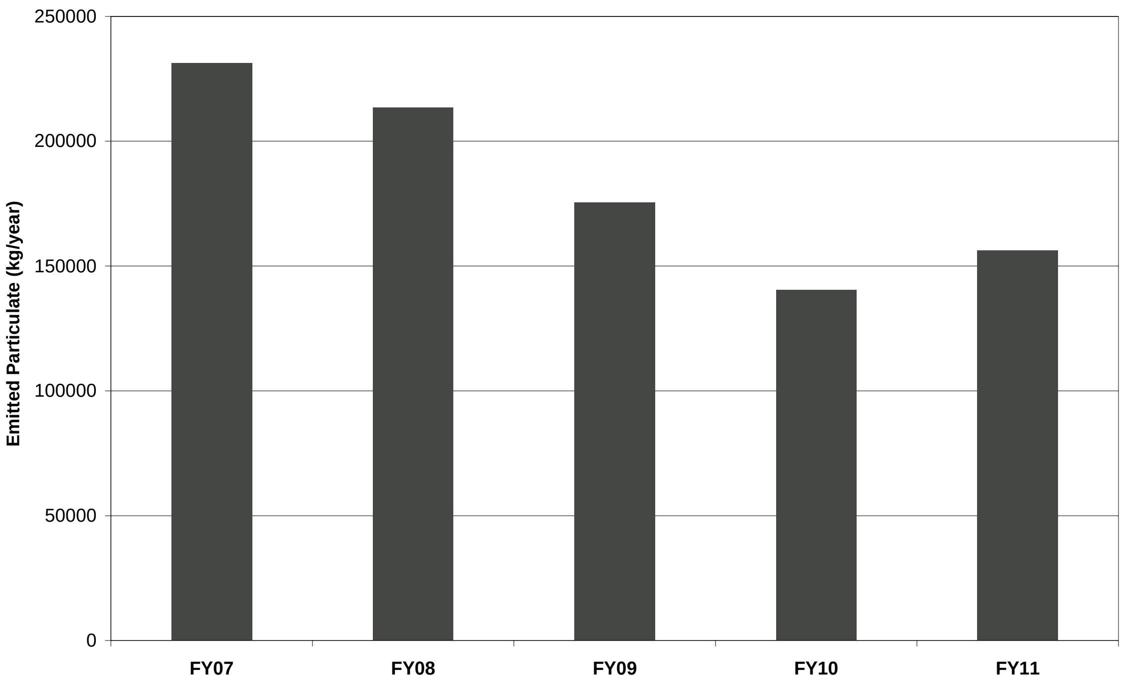


**Figure 3: Total emitted point source particulate**

Uranium oxide emissions from the calciners are shown in Figure 4. The uranium oxide emissions were determined from radionuclide analysis of samples collected during FY11 stack testing (with exception of those collected in June 2011 as these have yet to be analysed at time of reporting).

Total particulate emission from both calciner stacks in FY11 was 3,944kg, a decrease from previous year result of 6,035kg. The decrease in total particulate emission was due to lower average particulate concentrations and extended calciner downtime.

The uranium oxide component of calciner stack was calculated to be 97kg for FY11. This result is higher than in recent years (noting that radionuclide data was unavailable for the FY10 results and FY09 radionuclide data was used). The result however was in the ranges previously reported between 2002 and 2006.

The majority of uranium oxide emissions were from Calciner A. Stack sampling results throughout the year reveal that the main contribution was from the Calciner A venturi scrubber, however its particulate performance was well below the 250 mg/Nm$^{3}$* stack emission concentration therefore not requiring any immediate investigation. The radionuclide analysis results were not available until the end of the financial year and in review of these results, performance of the calciner A scrubber and bag house will be reviewed in FY12. At no time however have emissions been above the limit of 250mg/Nm$^{3}$.

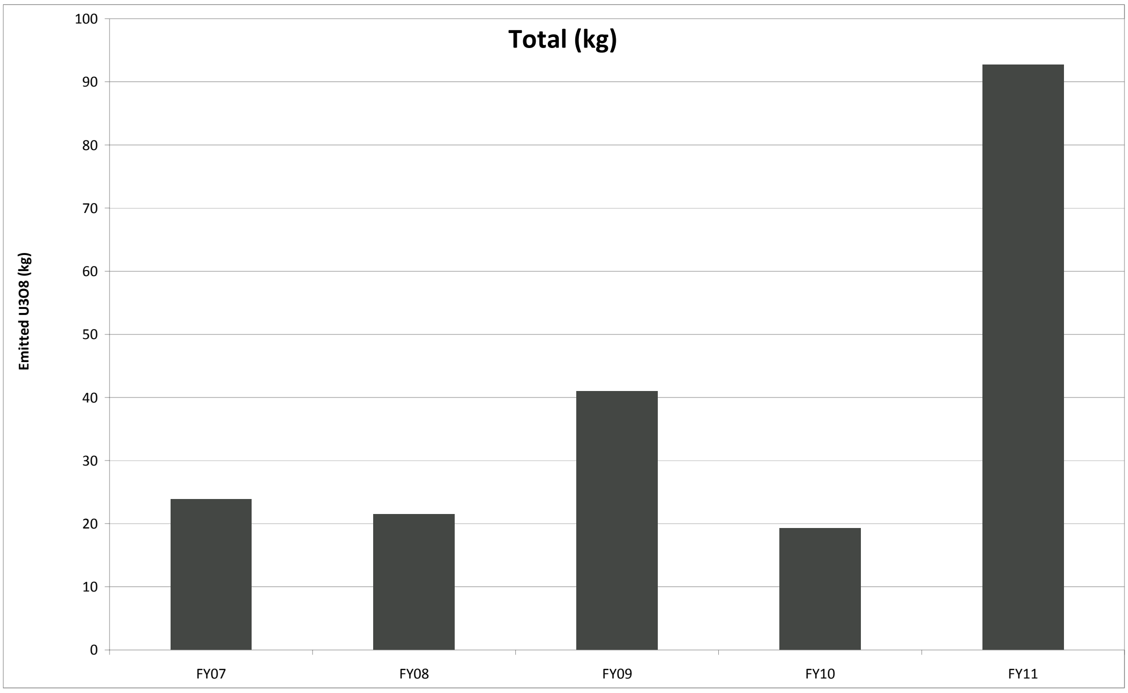


**Figure 4: Total emitted uranium oxide (U3O8) from the Calciner facilities**

* Nm$^{3}$ is the gas volume adjusted to standard temperature (273.15K) and pressure (101.3 kPa)