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OLYMPIC DAM

Annual Radiation Protection Report

July 2013 to June 2014

BHP Billiton Olympic Dam Corporation Pty Ltd
Registered Office: Level 16, 171 Collins Street, Melbourne, Victoria 3000, Australia

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DISTRIBUTION

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	Superintendent Ventilation
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1 Introduction

This document is the annual report on radiation protection for BHP Billiton Olympic Dam Corporation Pty Ltd.

In fulfilment of clauses 2.10.1, 3.8.1 and 3.10.1 of the Code of Practice and Safety Guide on Radiation Protection and Radioactive Waste Management in Mining and Processing 2005, employee dose assessments, dose calculation methodologies, dose parameters and dose conversion factors for the period 1 July 2013 to 30 June 2014 are presented. Individual personal doses and dose components for the period 1 July 2013 to 30 June 2014 are forwarded with this document on electronic media.

2 Employee Dose Assessment Method

2.1 Exposure Calculation Methodology

2.1.1 Exposure Calculation at the Mine

The main exposure pathways for Mine workers are inhalation of Radon Decay Products (RDP), irradiation by gamma radiation and inhalation of radioactive dust. Assessment of exposure from dust and RDP are based on employee time sheet/card information and measurements from the approved monitoring program.

Medgate™ is the data and dose management system, which is used to assess and record individual radiation exposures. The site security database (CARDAX) is used to determine the daily hours for employees working on site. The information in CARDAX is categorised into 3 major areas: surface, underground safe zone and underground blasting zone. Medgate records employee name, employee number, occupation, date, work location and hours in location information.

Locations within the Mine are grouped into areas of 'like air' known as airways. The Senior Ventilation Engineer or their nominee, who is familiar with the underground environment, maintains the locations within the airways. Airways are segregated into weekly periods and new locations are mapped into their relevant airway. This results in there being 13 weekly groupings each quarter covering the history of ventilation throughout the Mine.

The RDP concentration is then determined for each airway for each week using measurements from the approved monitoring program, which covers monitoring of most active work areas. For work airways not sampled in that week, an average is calculated. This average is calculated from all readings for that particular airway over the quarter.

RDP exposure for certain workgroups is also assessed through the use of Personal Alpha Dosimeters (PADs). PADs are typically allocated to workgroups with higher RDP exposures such as Ventilation and Raise Drilling.

Employee exposure to radioactive dust is calculated using quarterly occupation-based averages. The averages are obtained from monitoring performed under the approved monitoring program. An occupation-based dust concentration level is then allocated to each occupation.

The occupation-based dust concentration information and location-based RDP concentration information is then combined with the employee time card information to derive individual exposure data. Dust exposure is measured in units of Becquerel-hours per cubic metre (Bq.hr/m3) and RDP concentration is measured in units of micro Joule-hours per cubic metre (µJ.hr/m3). Exposure details are combined to give quarterly personal exposures.

The system is designed such that the Radiation Safety Officer is required to perform checks in each step of the process. This is in addition to a built-in auditing system within the program, as set out in section 10.2 of Olympic Dam's Radiation Management Plan.

Respiratory protection in the form of airstream helmets is available for all workers. These are worn when tasks are identified as requiring them. They are typically worn by some workgroups such as Ore Handling Beltrunners and Services Ventilation Crew. Airstream helmets are also mandatory for identified specific tasks or in certain conditions. Routine and non-routine use of airstream helmets is monitored and logged. No respiratory protection factors are used in exposure calculations, and therefore actual individual exposures will be lower than reported.

Exposure to gamma radiation is assessed using Thermo Luminescent Dosimeter (TLD) badges from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Personal Radiation Monitoring Service. TLD badges are worn for a period of three months; non-badge wearers are allocated an occupation-based average exposure.

2.1.2 Exposure calculation in the Metallurgical Plant

The main exposure pathways for Metallurgical Plant workers are inhalation of radioactive dust and fumes, and irradiation by gamma radiation. Assessment of exposure from dust and fumes is based on employee time sheet/card information and measurements from the approved monitoring program. Dust exposure in the Metallurgical Plant may involve exposure to different types of dust. These dusts will differ in particle size and radionuclide composition, which will produce different dust Dose Conversion Factors (DCFs). The table of DCFs is given in Appendix A.

Information from employee and contractor time cards or employee activity sheets is captured by the radiation management software, Medgate™, which contains daily time sheet/card information. Medgate™ contains an up-to-date list of all locations and occupations on-site. Occupations and Locations which have similar exposure characteristics are grouped into similar exposure groups (SEGs). A quarterly mean of dust activity is determined for each of the exposure groups based on the results of the monitoring program.

Dust averages are calculated for each SEG on a quarterly basis. These averages are then combined with the previously captured time and location information to produce a dust exposure for each employee.

Exposure to gamma radiation is assessed using TLD badges provided by ARPANSA. TLD badges are worn for a period of three months. They are issued to a randomly selected subset of workers from each SEG. Workers who do not receive a TLD have a dose calculated based on the average TLD dose rate for their corresponding SEG and their time sheet/card information.

Although the exposure to RDP within the Metallurgical Plant is much less than other pathways, it is assessed in the same way as for Mine workers. The same time information used for calculation of dust exposure is used for calculating RDP exposure. All surface locations/occupations are grouped into one surface airway. This surface airway has its RDP concentration calculated on the basis of a continuous 24-hour sample.

2.2 Exposure to Dose Calculations

Conversion of dust exposure to committed effective dose is achieved by the use of dose conversion factors, which are derived using the methodologies in International Commission on Radiological Protection (ICRP) Publication 68/72. The parameters physically measured to determine the factors are; particle size and radionuclide content. These measurements are undertaken in a number of areas of the Mine and Metallurgical Plant.

Analysis of the samples used to determine the radionuclide content was carried out by the Olympic Dam Analytical Laboratory. These results were used to determine dose conversion factors, which remain unchanged from last year.

Changes to existing conversion factors will only occur in the event of introduction of new processing techniques, major changes to plant or ore type or new recommendations published by the ICRP. A summary of the dose conversion factors used for 2013/2014 is given in Appendix A. Dose conversion factors have been carried over from the previous reporting year.

To calculate committed dose for airborne dust exposure, the airborne dust exposure is multiplied by the appropriate dose conversion factor. The committed doses for the different dusts are then added to give a total airborne dust dose.

Dose equivalent from RDP are calculated by multiplying the RDP exposure by the default dose conversion factor recommended by ICRP65 of 1.41 $mSv.m^3/mJ.hr$ (5 mSv/WLM).

3 Employee Doses

Occupational doses received by all Olympic Dam workers remain well below the internal dose constraint of 10 mSv/y. Furthermore, the radiation monitoring program has been reviewed and is noted to have been more than adequate in capturing all potential exposures across the operations.

In order to focus on ALARA principles, the radiation monitoring program has been optimised in accordance with the guidelines set by NIOSH (National Institute of Safety and Health). This has allowed the focus to be directed at ALARA projects. As a result of its comprehensive radiation monitoring program and increased focus on optimisation, Olympic Dam remains committed to keeping doses to as low as reasonably achievable.

3.1 Doses to Mine Workers

3.1.1 Descriptive Statistics

A total of 1803 full-time and 779 part-time Mine workers' doses were calculated for the period 1 July 2013 to 30 June 2014. This included all BHP Billiton Olympic Dam Mine workers and associated contractors. The distribution of doses for these work classifications is given in Figure 1.

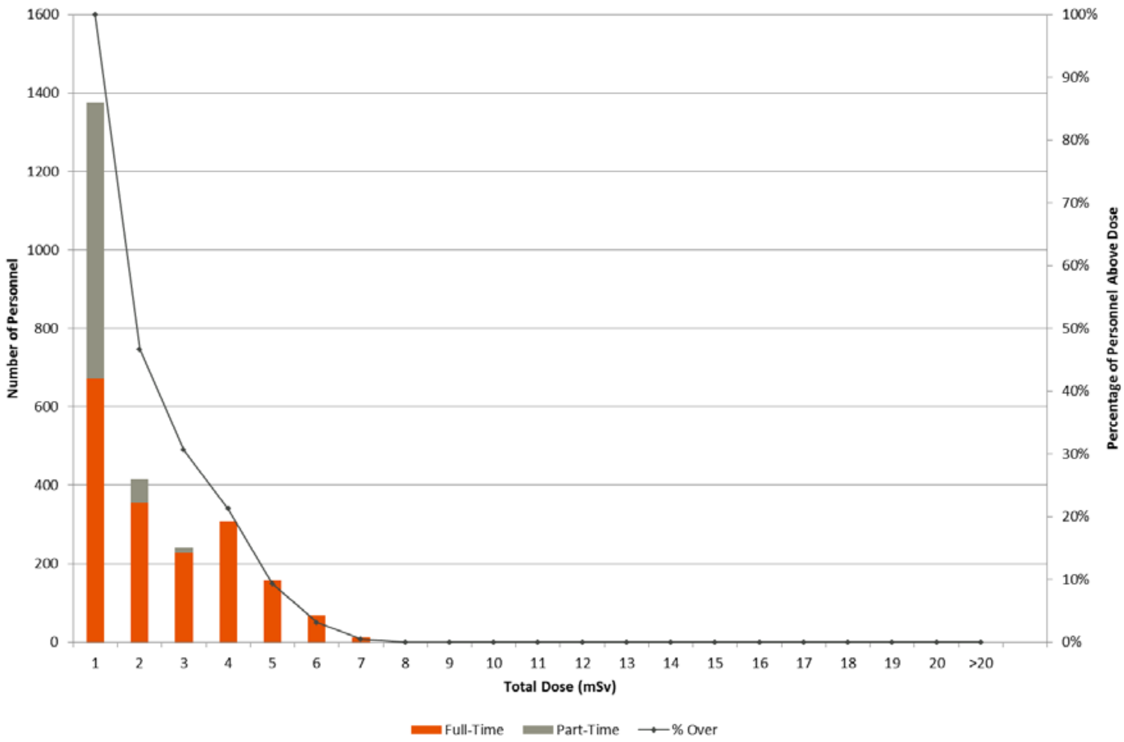

Figure 1 – Annual Dose Distribution 2013/2014 for All Mine Workers

The selection criteria for determining whether workers are categorised as 'full- time' or 'part-time' is as follows:

A 'full-time' employee is an employee whose dose has been assessed for a total of three or more quarters within the financial year. A 'part-time' employee therefore has dose assessment for less than three quarters within the financial year. This eliminates any unintentional biasing of the analysis of data due to short exposure periods.

The mean dose to all Mine workers was 1.5 mSv in 2013/2014, a decrease from 1.7 mSv in 2012/2013. The mean dose for full-time Mine workers was 2.0 mSv in 2013/2014, a decrease from 2.2 mSv in 2012/2013. The mean dose for part-time Mine workers was 0.3 mSv in 2013/2014, a decrease from 0.4 mSv in 2012/2013.

The average contribution to dose from exposure to radon decay products (RDP) in the underground mine for 2013/2014 was 57%, slightly less than the 2012/2013 value of 60%. Table A consolidates the results for the exposures at the mine.

Table A – Statistics for Mine Workers

Statistics	Full Time Workers	Part Time Workers	All Workers
Count	1803	779	2582
Arithmetic Mean (mSv)	2.0	0.3	1.5
90th Percentile (mSv)	4.2	1.0	3.9
Max (mSv)	6.4	2.6	6.4
Mean % Dose from Dust	6%	7%	6%
Mean % Dose from RDP	57%	57%	57%
Mean % Dose from Gamma	36%	36%	36%

No Mine worker received an annual dose greater than 10 mSv. The highest dose was 6.4 mSv, compared to a maximum value in 2012/2013 of 8.2 mSv.

3.1.2 Review of doses by work category

Table B shows the breakdown of doses from key work categories for full-time Mine workers. The primary focus of our monitoring programs has remained on these workgroups that are currently working in the underground mine.

Of the three major exposure pathways (gamma irradiation, inhalation of radioactive dust and inhalation of RDP), the gamma irradiation exposure levels for full-time workers has increased from 32% to 36% of the total dose since last year, RDP has decreased from 60% in 2012/2013 to 57% of the total dose in 2013/2014 and the dust component has remained low at 6% of the total dose.

Average annual doses for all mine work groups have varied but are still well within historical variations. The Development work group received the highest average dose of 4.2 mSv. The highest individual annual dose of 6.4 mSv was also received by a Development Operator, who worked a total of 2600 hours during the reporting period. The Full-Time Equivalent (FTE) dose for that individual over 2000 hours was calculated to be 5.0 mSv. This indicates that the increase in individual maximum dose is a result of extended exposure duration rather than a shortcoming of radiation protection controls.

The dose components for work categories are shown graphically in Figure 2.

Table B – Statistics for Full Time Mine Workers

Workgroups	No. of Workers	Mean (mSv)	Minimum (mSv)	Maximum (mSv)	90th Percentile (mSv)
Backfill	144	0.5	0.0	2.4	1.5
Coreprocessing	7	0.3	0.3	0.4	0.3
Development	108	4.2	0.0	6.4	5.9
Diamond Drilling	36	4.0	0.2	5.9	5.6
Electricians	106	2.4	0.0	6.0	4.9
Fitters/Maintenance	116	2.6	0.0	6.4	4.6
Mine Surface Personnel	321	0.8	0.0	4.5	1.5
Ore Handling	36	1.8	0.1	3.1	2.5
Production Charging	24	2.4	0.1	4.2	3.7
Production Drilling	24	3.4	1.3	4.5	4.1
Raise Drilling	21	3.5	0.1	5.2	5.0
Underground Services Full Time	58	1.5	0.1	2.9	2.4

Workgroups	Dust Average (mSv)	Dust % of Total Dose	RDP Average (mSv)	RDP % of Total Dose	Gamma Average (mSv)	Gamma % of Total Dose
Backfill	0.1	16%	0.2	41%	0.2	43%
Coreprocessing	0.2	75%	0.0	10%	0.0	14%
Development	0.2	5%	2.5	58%	1.5	36%
Diamond Drilling	0.1	2%	2.5	62%	1.4	36%
Electricians	0.1	5%	1.4	59%	0.9	35%
Fitters/Maintenance	0.3	11%	1.6	63%	0.7	25%
Mine Surface Personnel	0.1	11%	0.2	30%	0.5	59%
Ore Handling	0.2	14%	0.9	50%	0.6	36%
Production Charging	0.1	3%	1.2	47%	1.2	50%
Production Drilling	0.1	3%	1.8	52%	1.5	44%
Raise Drilling	0.3	8%	1.9	54%	1.3	38%
Underground Services Full Time	0.2	11%	0.7	48%	0.6	42%

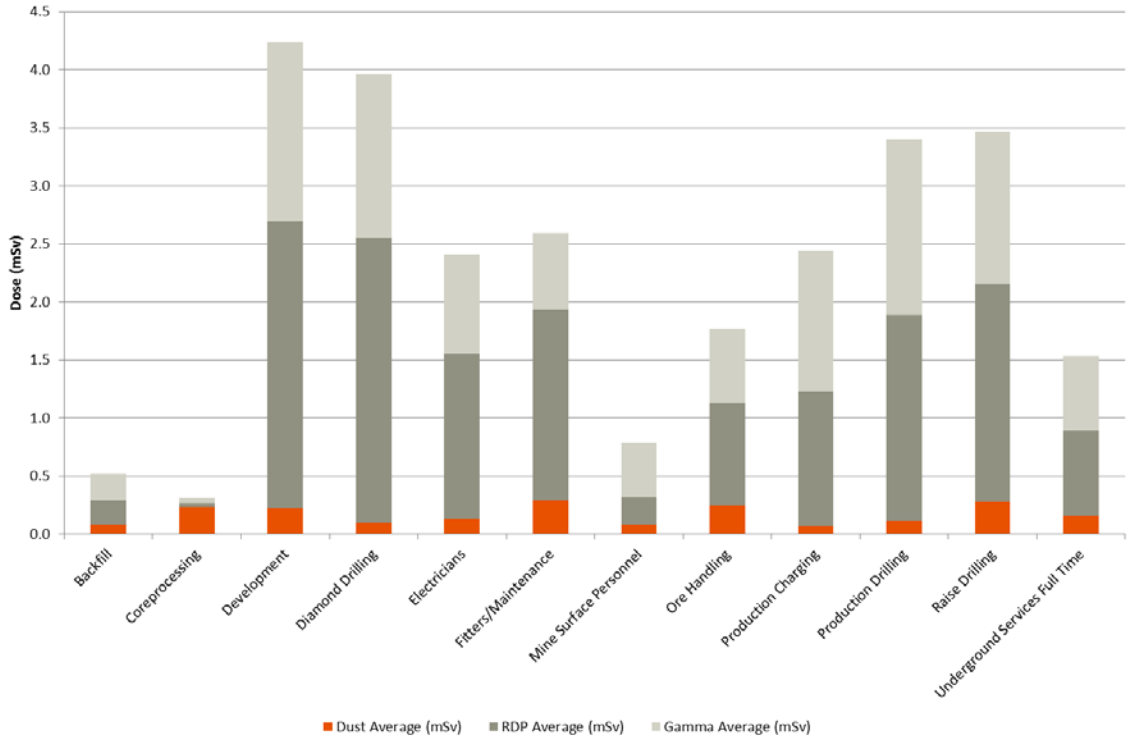

Figure 2 – Annual Dose Components by Mine Workgroup

The average and maximum effective dose for full-time Mine workers within key underground workgroups and dose component trends for selected workgroups are given from Figure 3 - Figure 26.

Backfill

The average dose to the Backfill workgroup has increased from 0.4 mSv in 2012/2013 to 0.5 mSv and the maximum dose to this workgroup has increased from 1.0 mSv to 2.4 mSv. This maximum dose was received by a worker who spent the first three quarters of this annual reporting period working in the Development workgroup and his last quarter working in Backfill, thus his dose is captured under his last exposure group, Backfill. The average dose to Backfill workers reflects the nature of the employee's work, mostly on the surface with minimal time underground.

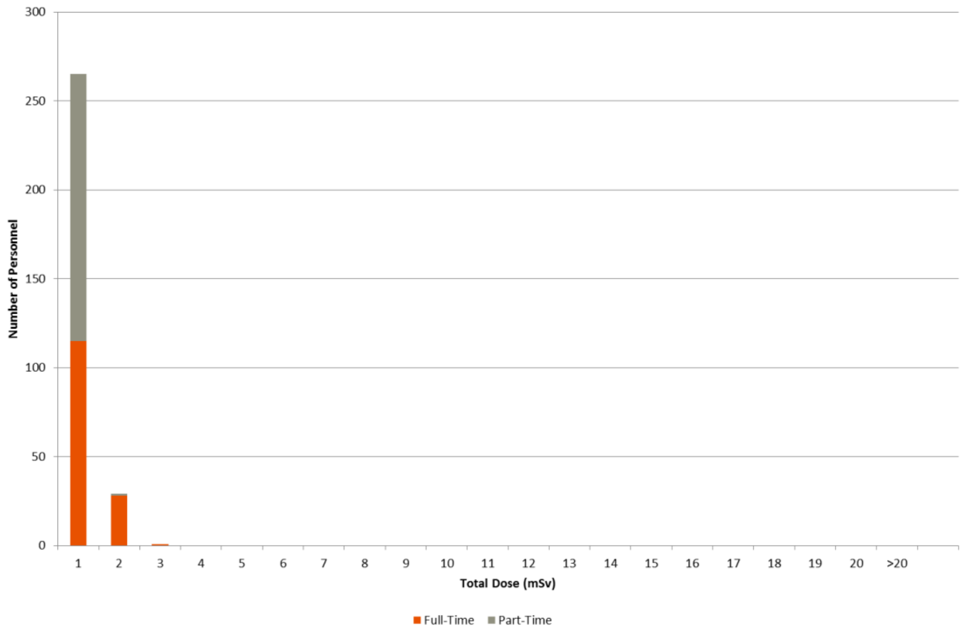

Figure 3 – Annual Dose Distribution for the Backfill Workgroup

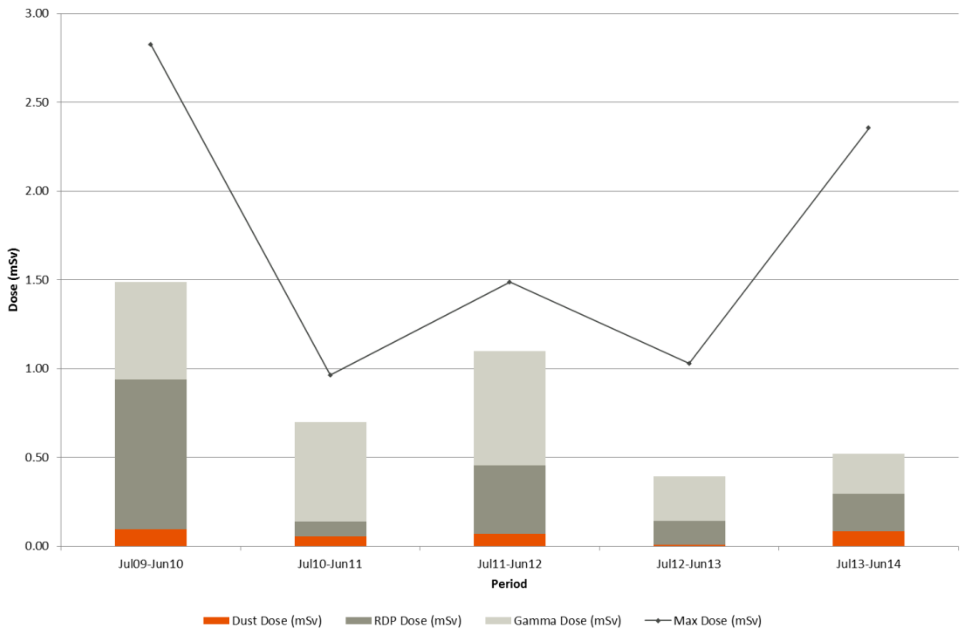

Figure 4 – Annual Dose Trends for the Backfill Workgroup

Core Processing

The average doses to Core Processing workers have remained at low levels under 1 mSv per year. The average dose for 2013/2014 was 0.3 mSv and the maximum dose was 0.4 mSv. There has been a decrease in exposure from gamma irradiation from the previous year. The average quarterly gamma dose recorded from the 16 TLDs issued within the Core Processing work group was 0.01 mSv, with six of the samples recording background measurements. Core processing technicians will continue to be issued with TLDs.

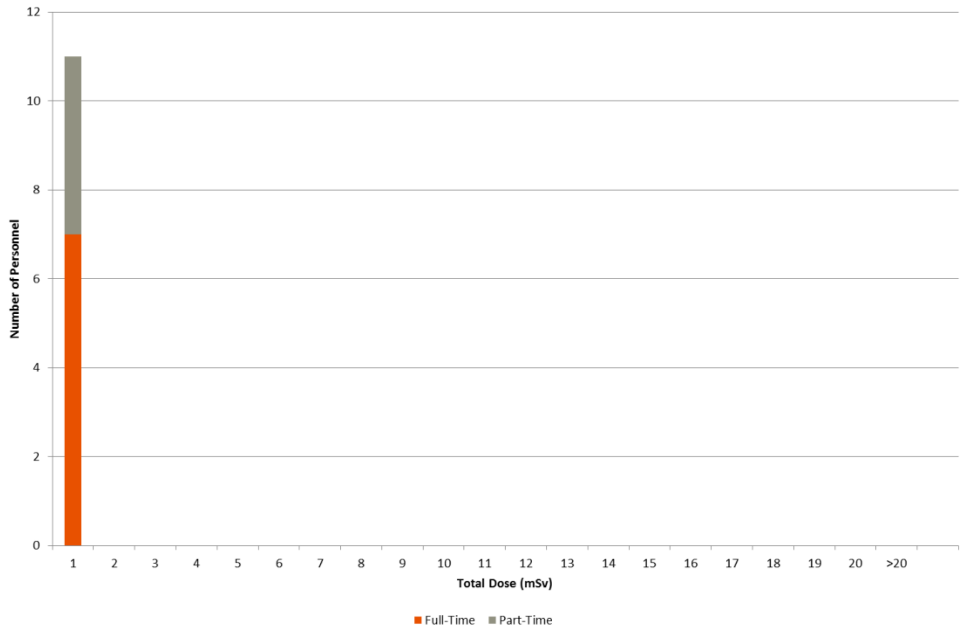

Figure 5 – Annual Dose Distribution for the Core Processing Workgroup

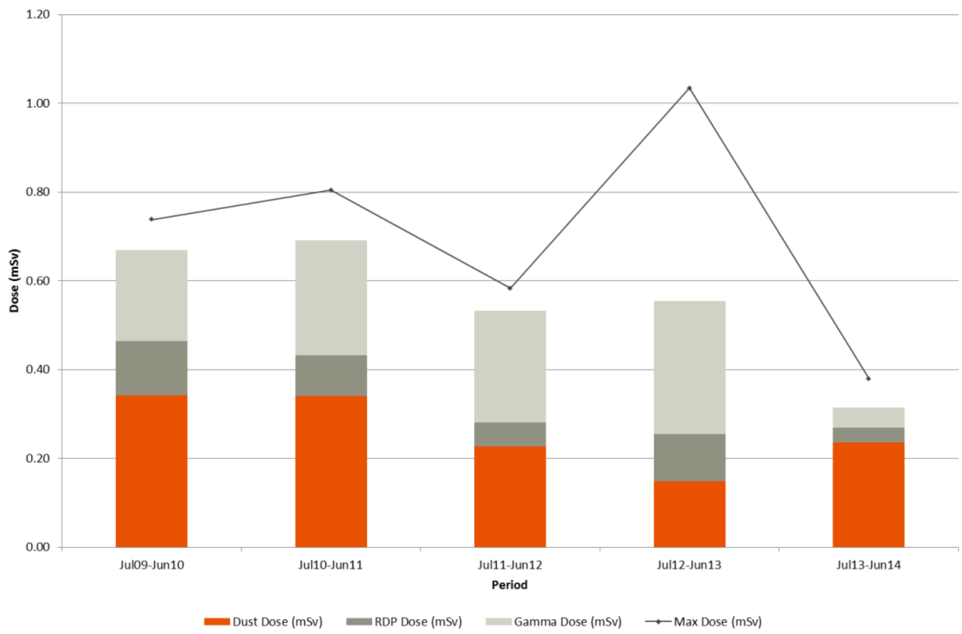

Figure 6 – Annual Dose Trends for the Core Processing Workgroup

Development

The average dose to the Development workgroup has increased from 3.4 mSv in 2012/2013 to 4.2 mSv and the maximum dose has decreased from 7.0 mSv to 6.4 mSv. This maximum dose was received by a worker who worked 2600 hours for the year. Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

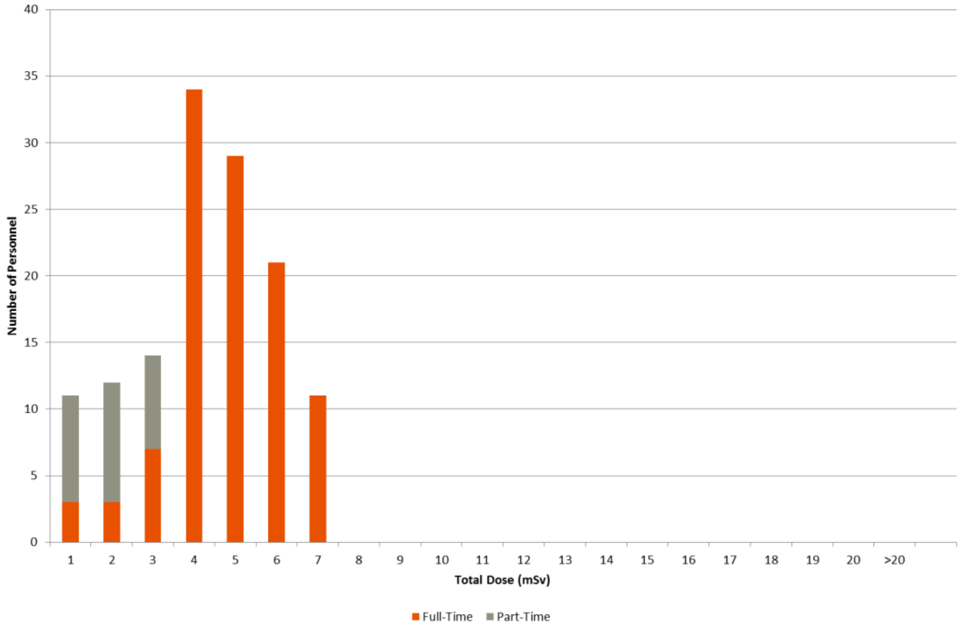

Figure 7 – Annual Dose Distribution for the Development Workgroup

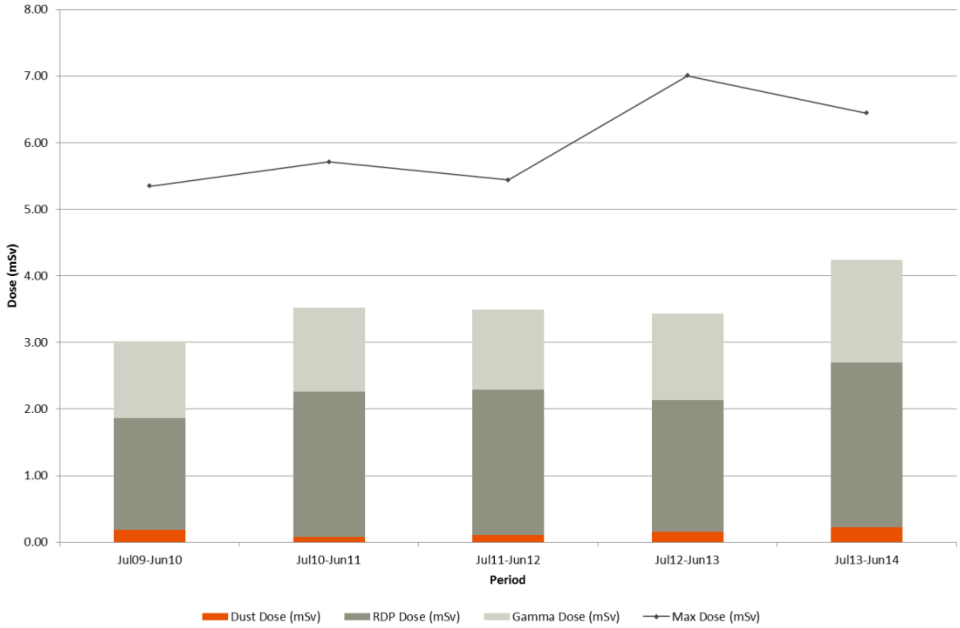

Figure 8 – Annual Dose Trends for the Development Workgroup

Diamond Drilling

The average dose to the Diamond Driller workgroup increased from 3.0 mSv to 4.0 mSv and maximum dose to the Diamond Drilling workgroup has decreased from 6.5 mSv to 5.9 mSv. Typically full-time Diamond Drillers work in excess of 2500 hours a year with the maximum hours worked by a Diamond Drillers for this year in excess of 3000 hours. Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

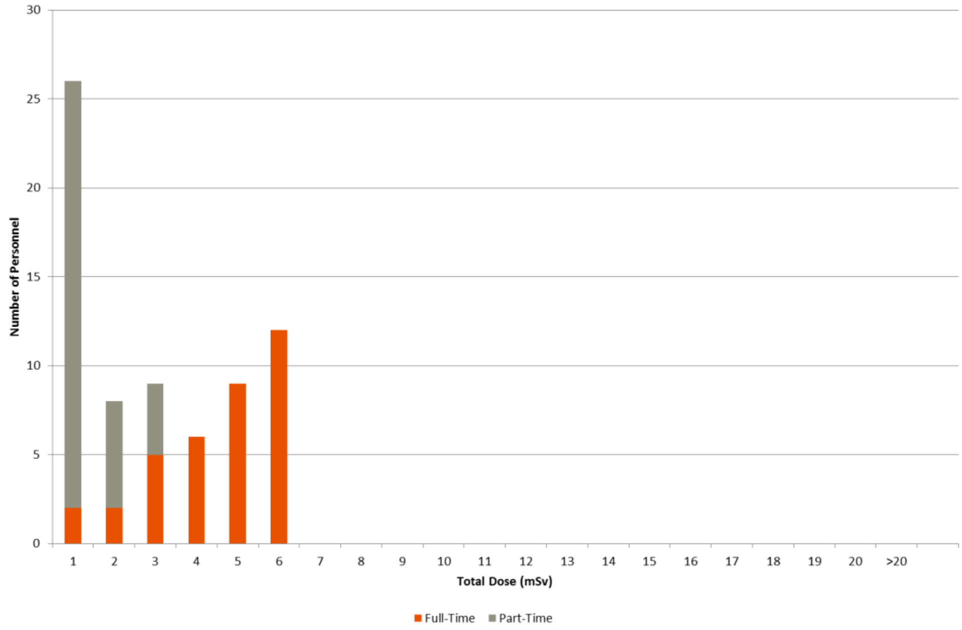

Figure 9 – Annual Dose Distribution for the Diamond Drilling Workgroup

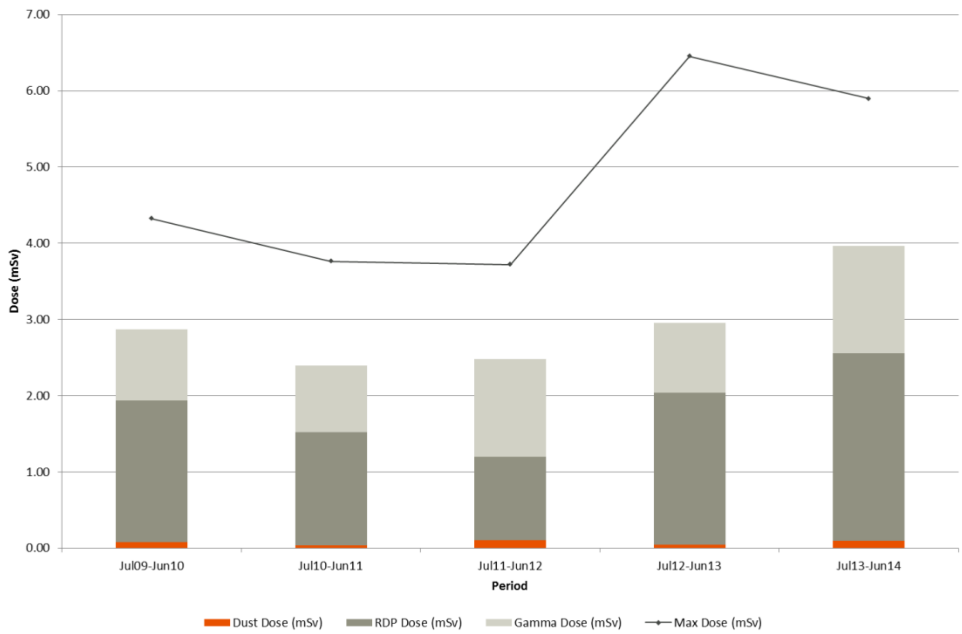

Figure 10 – Annual Dose Trends for the Diamond Drilling Workgroup

Electricians

The average dose to Electricians has decreased from 2.6 mSv in 2012/2013 to 2.4 mSv. The maximum dose to this workgroup has also decreased from 8.2 mSv in 2012/2013 to 6.0 mSv. Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

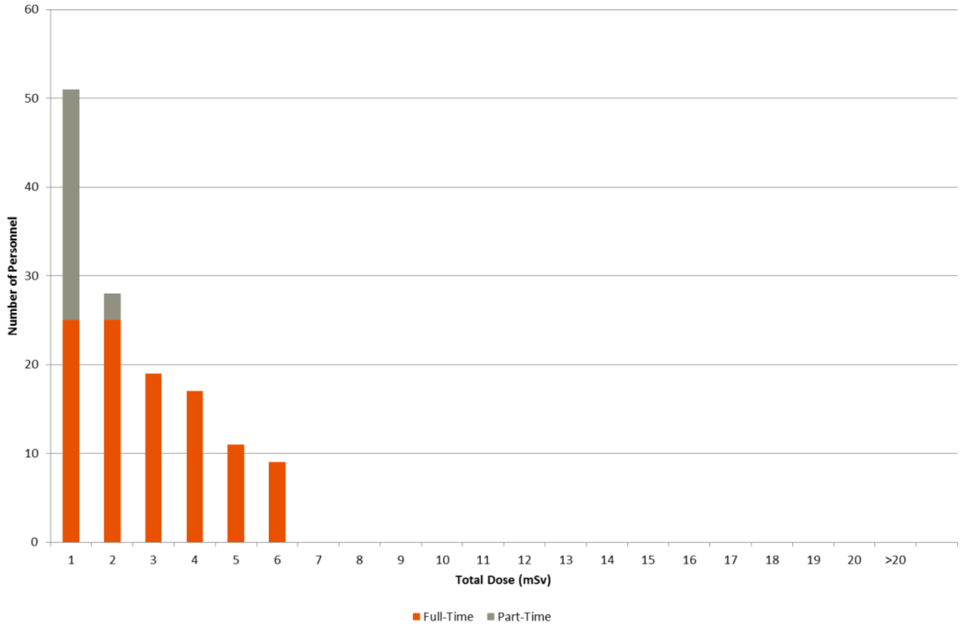

Figure 11 – Annual Dose Distribution for the Electrician Workgroup

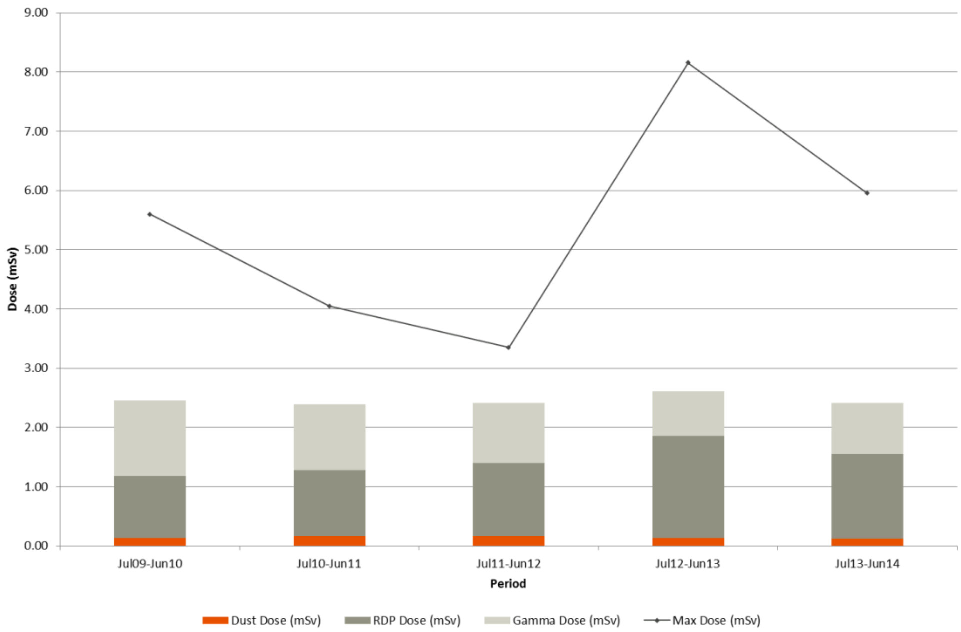

Figure 12 – Annual Dose Trends for the Electrician Workgroup

Fitters/Maintenance

The average dose to the Fitters/Maintenance workgroup has increased from 1.7 mSv to 2.6 mSv whilst the maximum dose has increased from 5.6 mSv to 6.4 mSv. This maximum dose was received by a worker with 2600 hours worked for the year. These doses are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

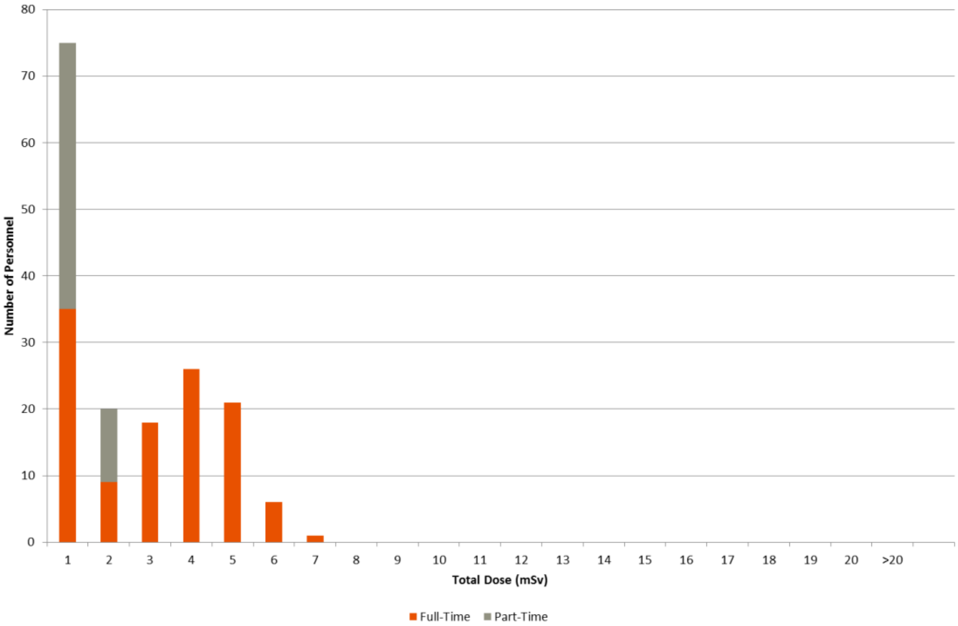

Figure 13 – Annual Dose Distribution for the Fitter Workgroup

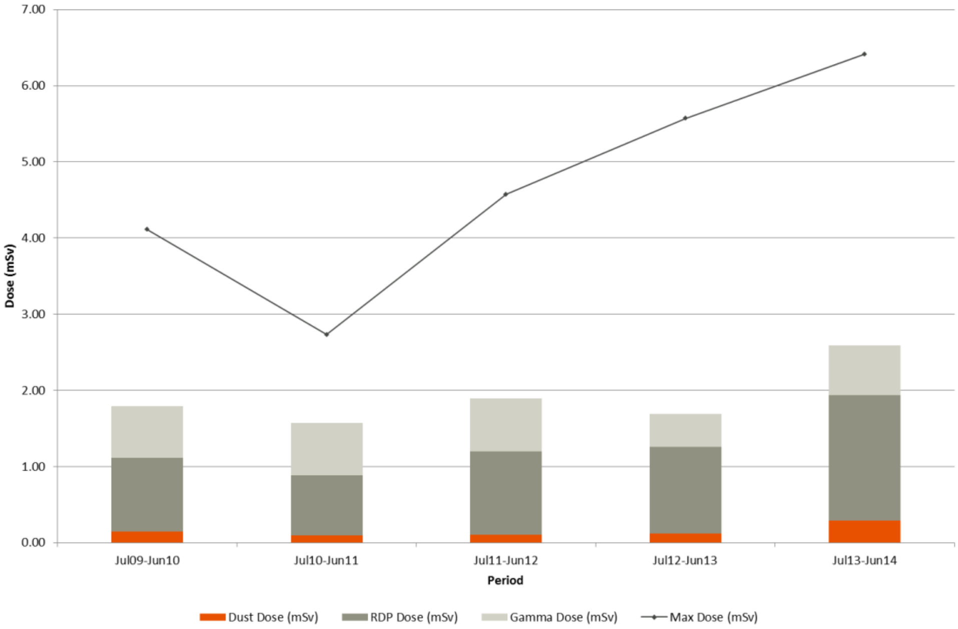

Figure 14 – Annual Dose Trends for the Fitter Workgroup

Mine Surface Personnel

The average dose has increased from 0.6 mSv in 2012/2013 to 0.8 mSv with the maximum dose also increasing from 4.4 mSv to 4.5 mSv. The average dose remains in line with the previous year taking into account the 2012 redefinition of the workgroup in Medgate™.

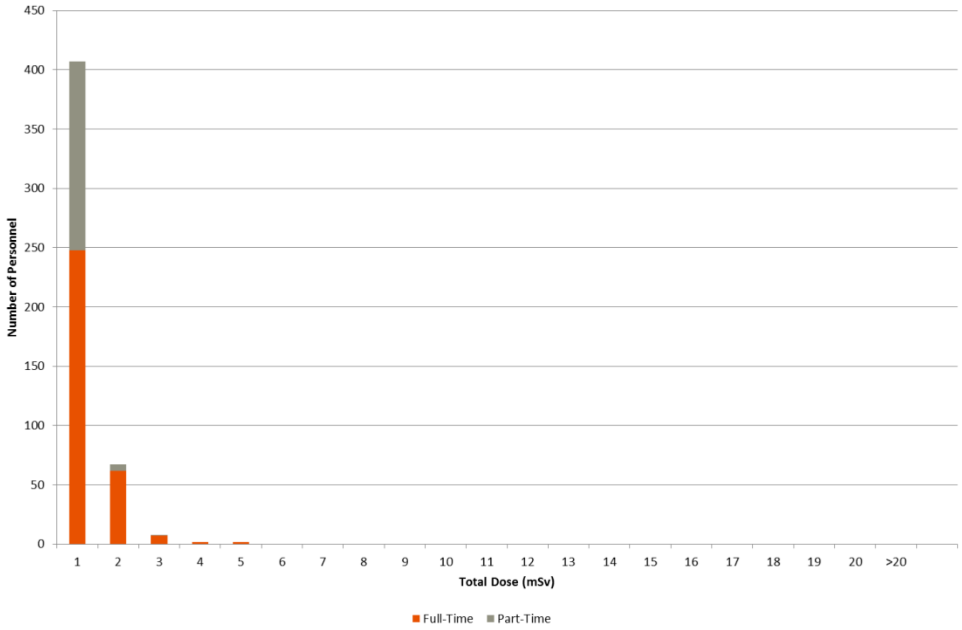

Figure 15 – Annual Dose Distribution for the Mine Surface Personnel Workgroup

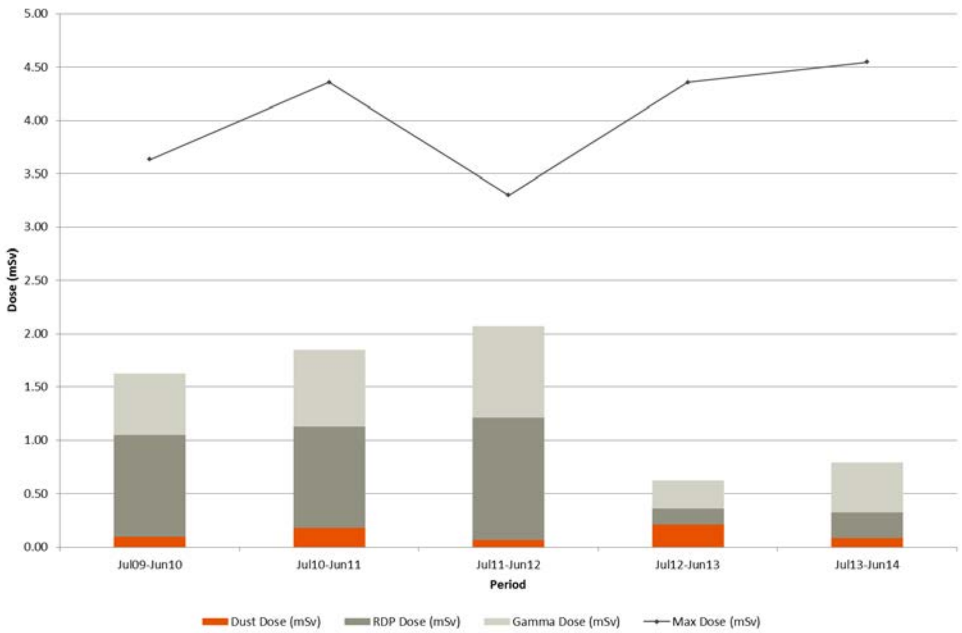

Figure 16 – Annual Dose Trends for the Mine Surface Personnel Workgroup

Ore Handling

The average dose has decreased from 2.8 mSv to 1.8 mSv with the maximum dose also decreasing from 5.5 mSv to 3.1 mSv. These assessed dose decreases are attributed to the introduction of Personal Alpha Dosimeters better capturing actual exposures for this workgroup.

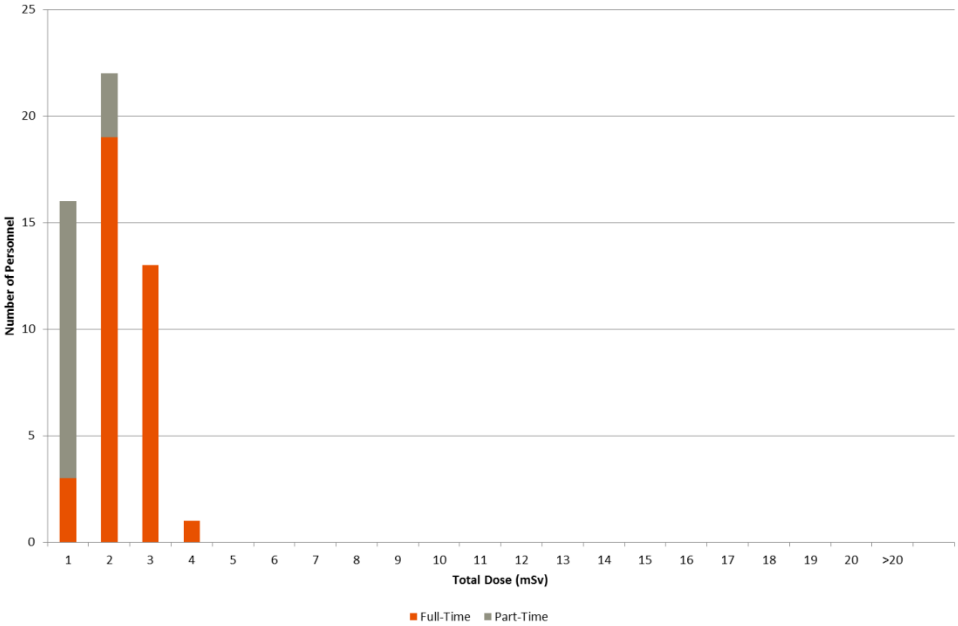

Figure 17 – Annual Dose Distribution for the Ore Handling Workgroup

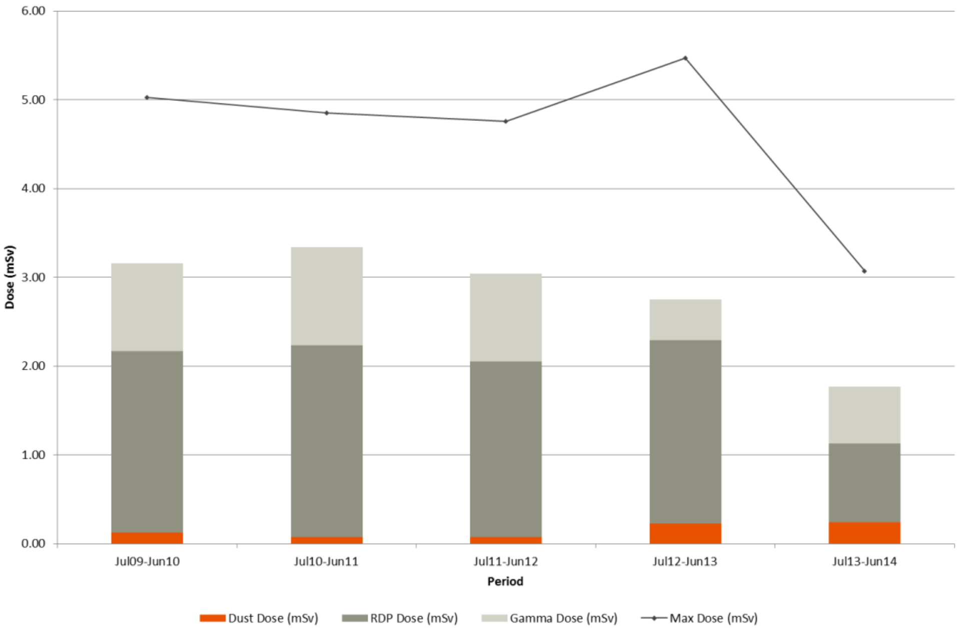

Figure 18 – Annual Dose Trends for the Ore Handling Workgroup

Production Charging

The average dose for Production Chargers has decreased from 3.8 mSv to 2.4 mSv with the maximum dose also decreasing from 6.5 mSv to 4.2 mSv. The exposures are in line with historical exposures recorded for the workgroup. These assessed dose decreases are attributed to the introduction of Personal Alpha Dosimeters better capturing actual exposures for this workgroup.

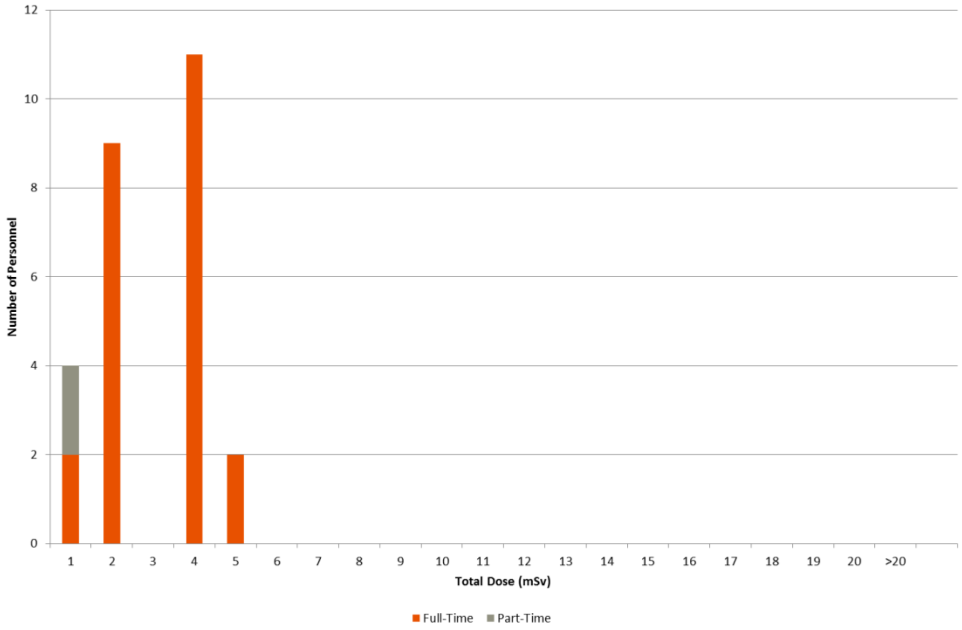

Figure 19 – Annual Dose Distribution for the Production Charger Workgroup

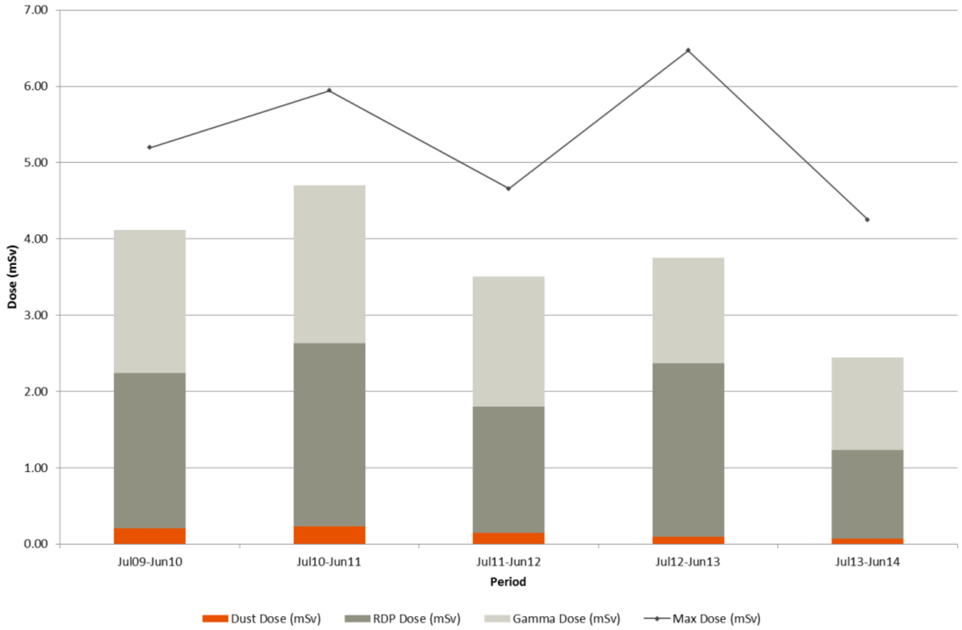

Figure 20 – Annual Dose Trends for the Production Charger Workgroup

Production Drilling

The average dose for production drillers has decreased from 3.9 mSv to 3.4 mSv and the maximum dose has also decreased from 5.5 mSv to 4.5 mSv. Personal Alpha Dosimeters were also introduced to the Production Drilling workgroup this year. Doses remain in line with historical exposures recorded for the workgroup.

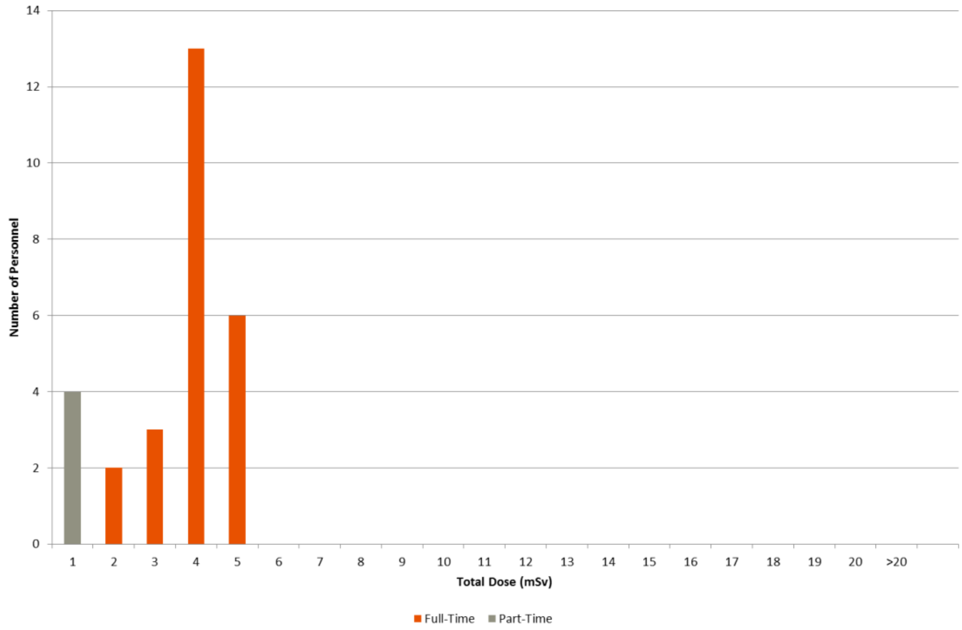

Figure 21 – Annual Dose Distribution for the Production Driller Workgroup

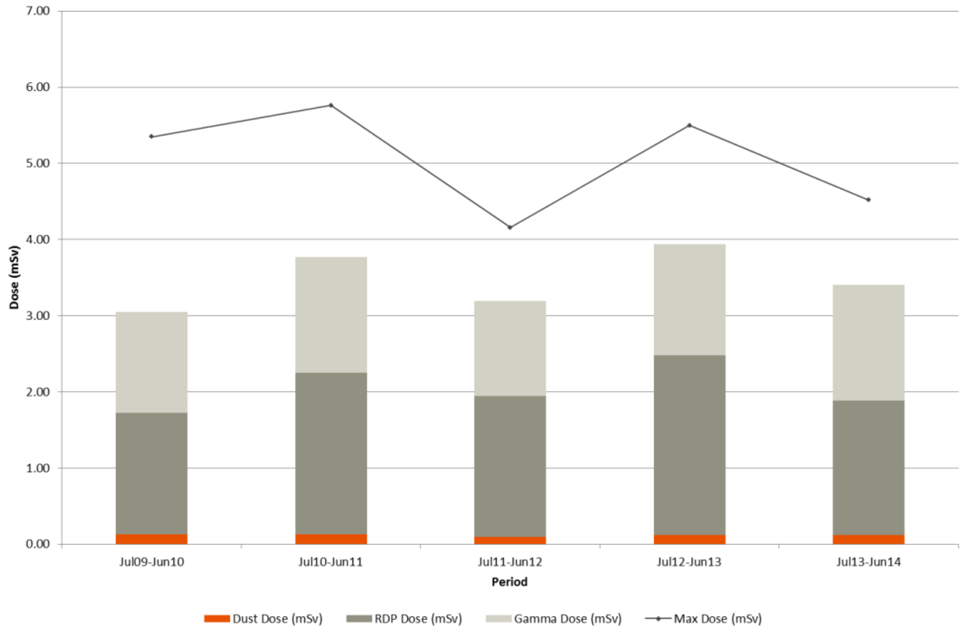

Figure 22 – Annual Dose Trends for the Production Driller Workgroup

Raise Drilling

The average dose has increased from 3.1 mSv to 3.5 mSv and the maximum dose has decreased from 6.9 mSv to 5.2 mSv. This reduction in maximum assessed dose is attributed partly to the introduction of Personal Alpha Dosimeters better estimating the dose and partly to reduction of exposure through the use of filtered air cabins for operators.

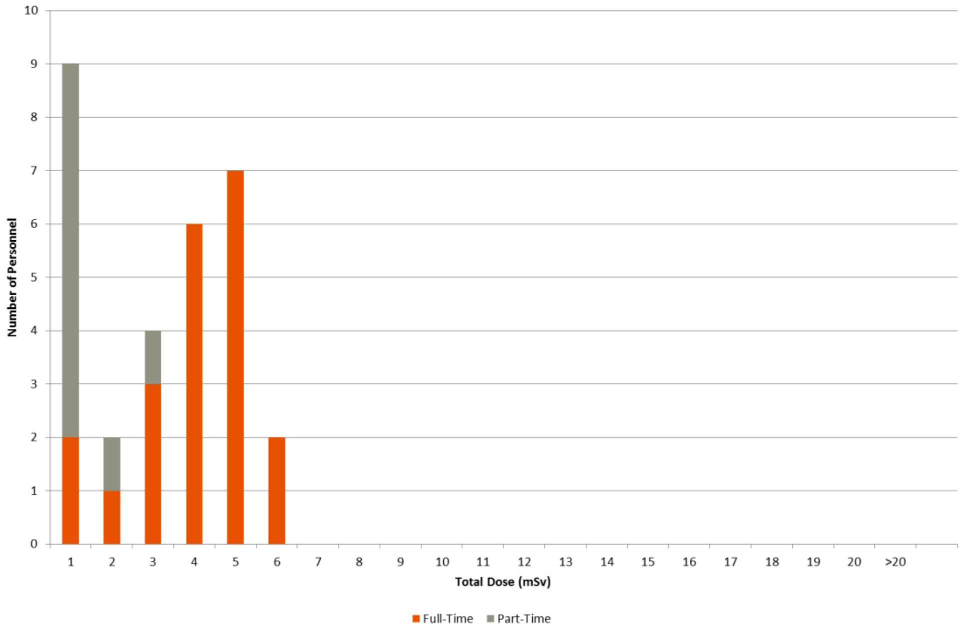

Figure 23 – Annual Dose Distribution for the Raise Drilling Workgroup

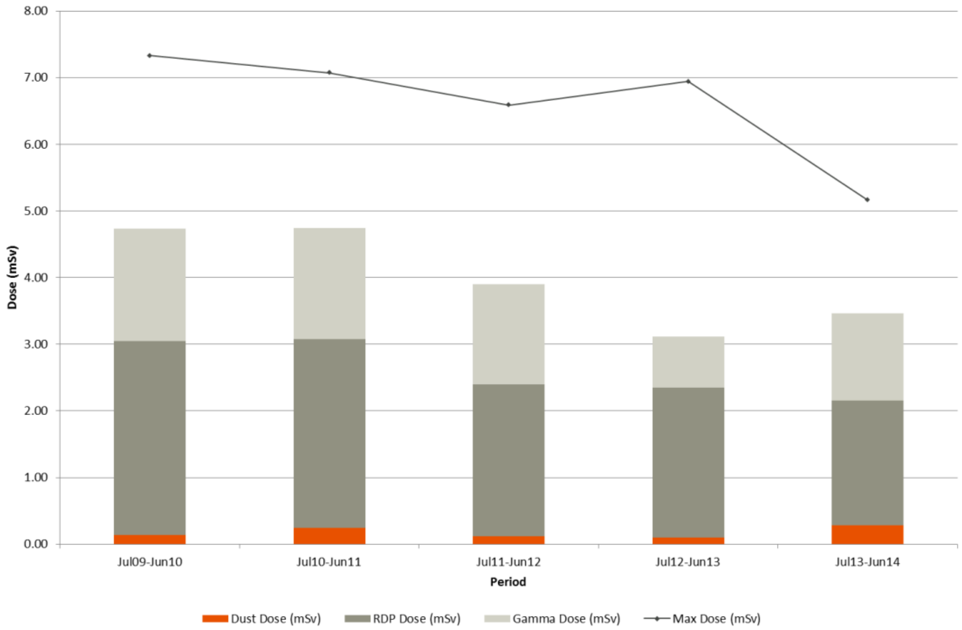

Figure 24 – Annual Dose Trends for the Raise Drilling Workgroup

Underground Services Full Time

The average dose has decreased from 2.5 mSv to 1.5 mSv and the maximum dose decreased significnatly from 5.7 mSv to 3.0 mSv. This reduction is attributed to the introduction of new timesheet information capturing more accurate underground and surface exposure times.

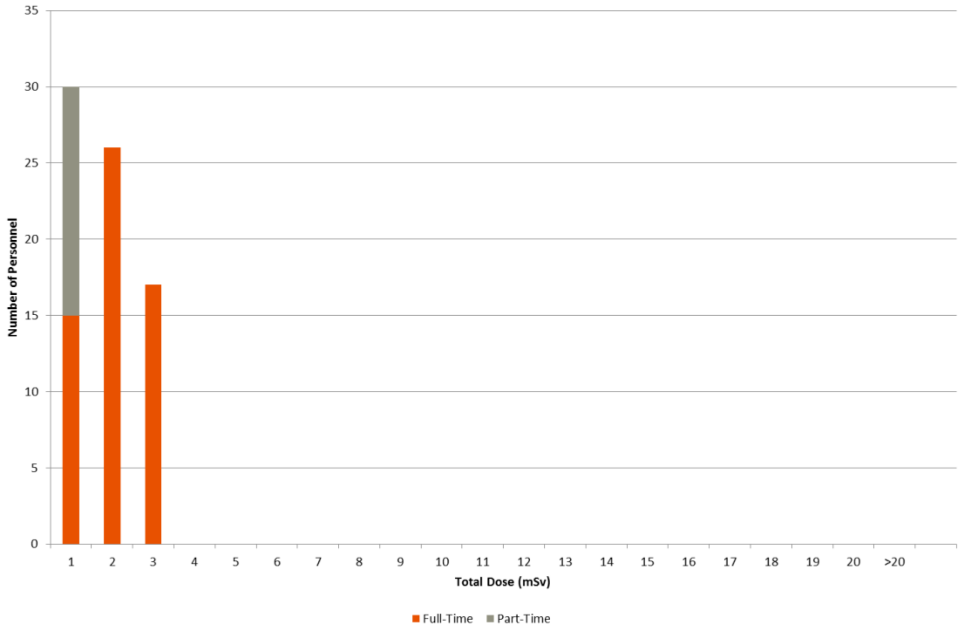

Figure 25 – Annual Dose Distribution for the Underground Services Full Time Workgroup

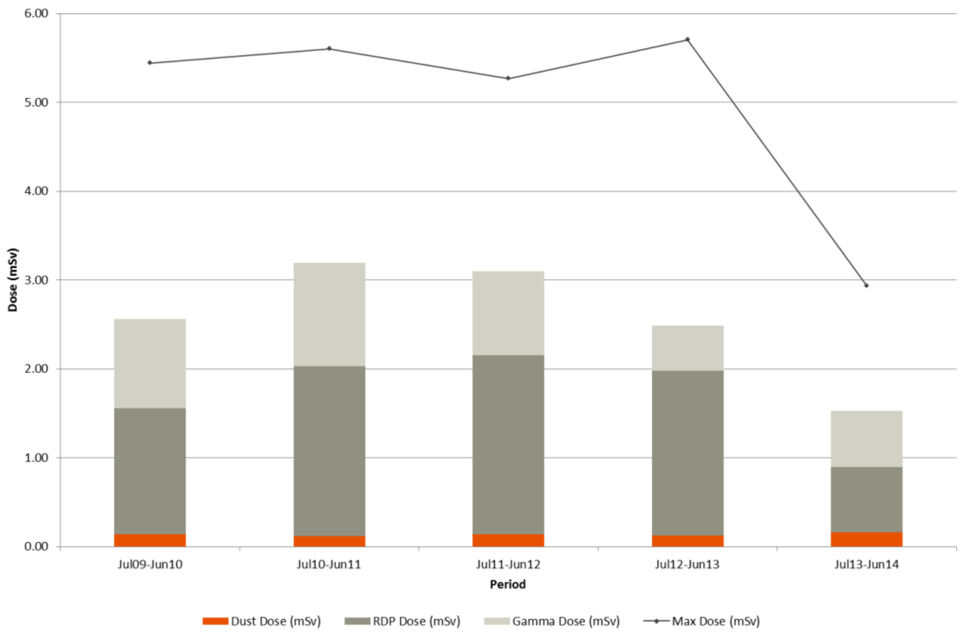

Figure 26 – Annual Dose Trends for the Underground Services Full Time Workgroup

3.1.3 Strategies for Dose Reduction

Throughout the 2014 financial year dose reduction initiatives and dose assessment improvements included:

- The approval and implementation of Personal Alpha Dosimeters (PAD) for higher-exposure underground workgroups to better assess their personal radon decay product exposure
- The final implementation of four filtered air cabins for Raise Drill operators to reduce radon decay product exposure
- Integration of detailed timesheet information capturing workers time spent in the Safe, Blast and Surface Zones, increasing accuracy in RDP dose assessment

The Mine Ventilation department has continued to focus on ensuring that exposure to radon decay products are kept low through continued extensions of the Mine ventilation systems when required.

3.1.4 Cumulative Five Year Dose

As outlined in ICRP 103, the total dose of any individual radiation worker should not exceed 100 mSv in any five year period. To this end, a five year total dose has been determined for all full-time currently designated Mine workers who were employed at Olympic Dam over the previous five years.

There were a total of 1400 designated Mine workers who worked at the Mine during the period 1 July 2009 to 30 June 2014. This number has increased from the 1064 workers reported for the period 1 July 2008 to 30 June 2013. The maximum dose for a Mine worker was 29.8 mSv for the five year period ending 30 June 2014, as compared with 32.9 mSv for the 2008/2009 to 2012/2013 five year dose period. The arithmetic mean for the group was 8.7 mSv, a decrease from 9.5 mSv for the five year dose period 2008/2009 to 2012/2013.

The distribution of doses for the cumulative five year dose is shown in Figure 27.

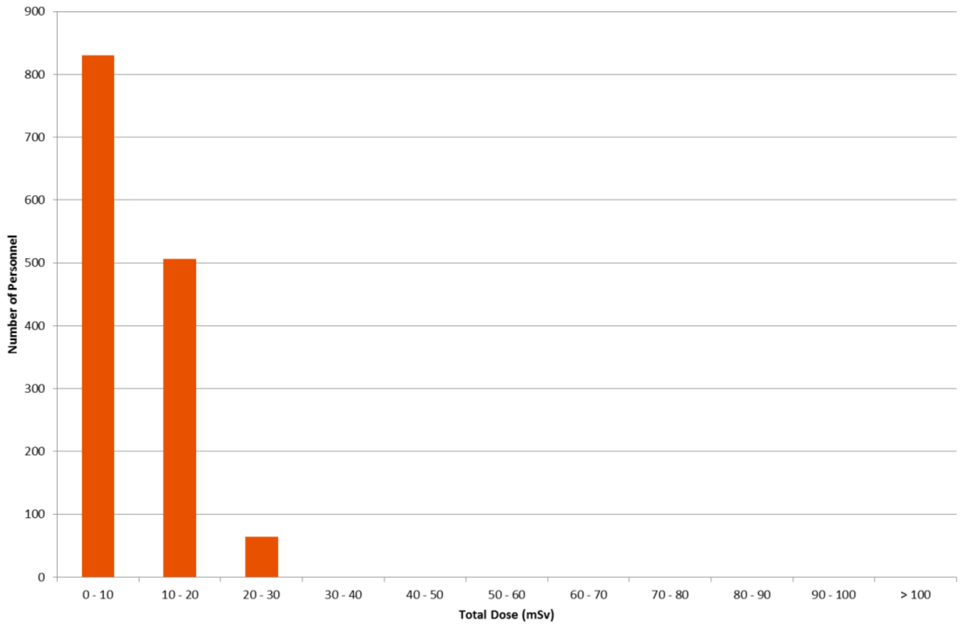

Figure 27 – Five Year Cumulative Dose Distribution Mine

A summary of the cumulative five year dose is given in Table C.

Table C – Five Year Dose Statistics

Statistics	Cumulative 5 Year Doses	Equivalent Average Yearly Dose
Count	1400	1400
Arithmetic Mean (mSv)	8.7	1.7
90th Percentile (mSv)	18.1	3.6
Max (mSv)	29.8	6.0
Mean % Dose from Dust	6%	
Mean % Dose from RDP	60%	
Mean % Dose from Gamma	34%	

3.2 Doses to Metallurgical Plant Workers

3.2.1 Descriptive Statistics

A total of 1393 full-time and 1783 part-time Metallurgical Plant workers' doses were calculated for the period 1 July 2013 to 30 June 2014. This included both BHP Billiton Olympic Dam Metallurgical Plant workers and associated contractors.

Approximately 10.2 million tonnes of material (ore and slag) was milled producing at total of 184,343 tonnes of copper cathode, 4,016 tonnes uranium oxide concentrate, 121,336 ounces gold bullion and 971,997 ounces silver bullion.

The mean dose to all Plant workers was 0.5 mSv in 2013/2014, unchanged from 2012/2013.

The mean dose for full-time Plant workers was 0.9 mSv in 2013/2014, a small increase from the 2012/2013 value of 0.8 mSv.

The mean dose for part-time Plant workers remained very low at 0.1 mSv.

For this period the distribution of doses is shown in Figure 28, and the statistics are given in Table D.

Table D – Statistics for Metallurgical Plant Workers

Statistics	Full Time Workers	Part Time Workers	All Workers
Count	1393	1783	3176
Arithmetic Mean (mSv)	0.9	0.1	0.5
90th Percentile (mSv)	1.4	0.2	1.0
Max (mSv)	6.2	2.5	6.2
Mean % Dose from Dust	73%	76%	73%
Mean % Dose from RDP	8%	5%	7%
Mean % Dose from Gamma	20%	18%	20%

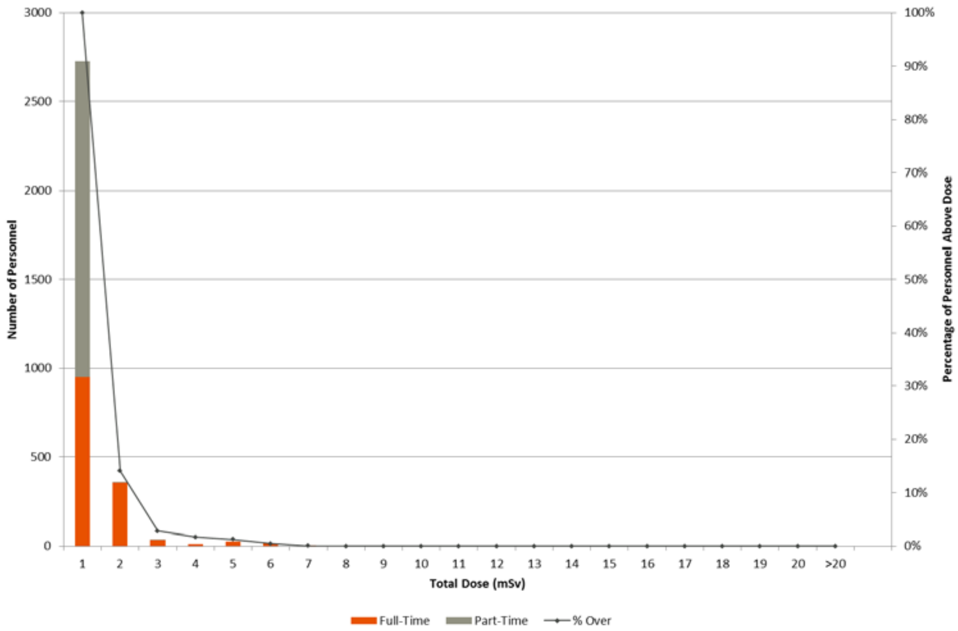

Figure 28 – Annual Dose Distribution for all Metallurgical Plant Workers

3.2.2 Review of Doses by Work Areas

The analysis of doses by work area is presented in Table E. The dose statistics for the 2013/2014 year from the Metallurgical Plant areas show all areas are in line with historical levels.

Annual dose components for each work area can be seen in Figure 29.

Table E – Statistics for Full Time Metallurgical Plant Workers

Workgroups	No. of Workers	Mean (mSv)	Minimum (mSv)	Maximum (mSv)	90th Percentile (mSv)
Concentrator	237	0.5	0.0	1.7	1.1
Hydromet	128	1.0	0.0	4.4	1.5
Plant Services	343	0.7	0.0	2.4	1.4
Refinery	172	0.6	0.0	2.1	1.0
Smelter	513	1.2	0.0	6.2	3.0

Workgroups	Dust Average (mSv)	Dust % of Total Dose	RDP Average (mSv)	RDP % of Total Dose	Gamma Average (mSv)	Gamma % of Total Dose
Concentrator	0.3	56%	0.0	8%	0.2	35%
Hydromet	0.6	66%	0.0	5%	0.3	29%
Plant Services	0.4	53%	0.1	15%	0.2	33%
Refinery	0.4	77%	0.1	11%	0.1	12%
Smelter	1.0	84%	0.1	5%	0.1	11%

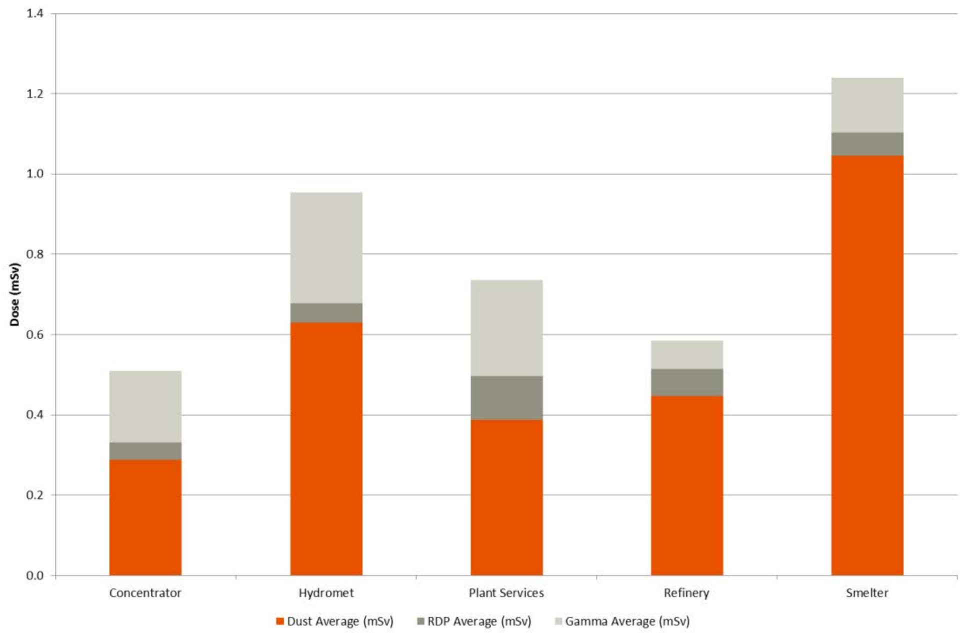

Figure 29 – Annual Dose Components by Metallurgical Plant Workgroup

Annual total dose distributions and dose trends for each work area along with dose component profiles for selected workgroups can be seen in Figure 30 to Figure 39.

Concentrator

The average dose has decreased from 0.7 mSv in 2012/2013 to 0.5 mSv in 2013/2014 while the maximum dose has increased from 1.2 mSv to 1.7 mSv. Doses remain in line with historical exposures recorded for the workgroup.

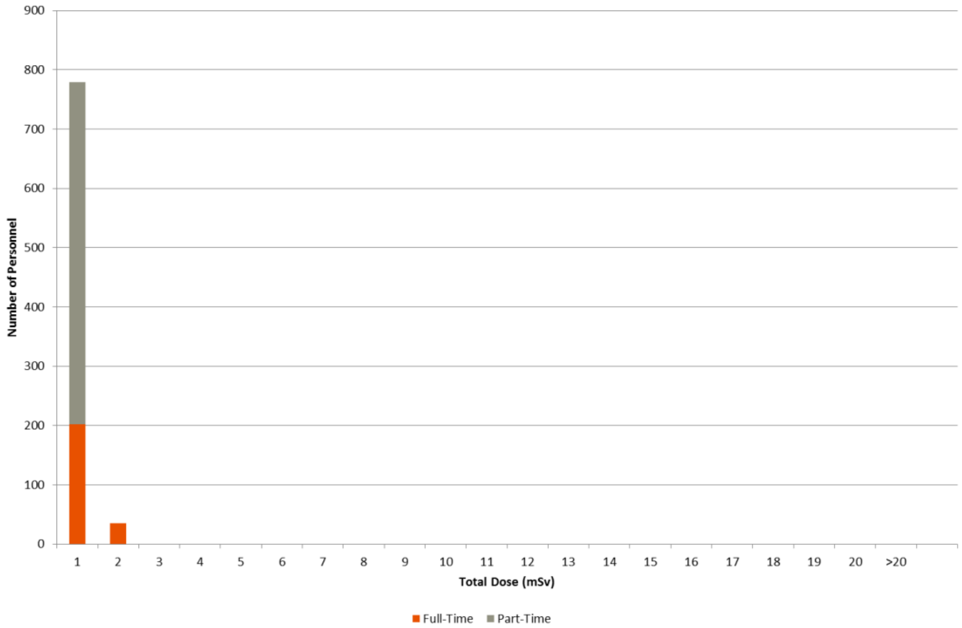

Figure 30 – Annual Dose Distribution for the Concentrator Workgroup

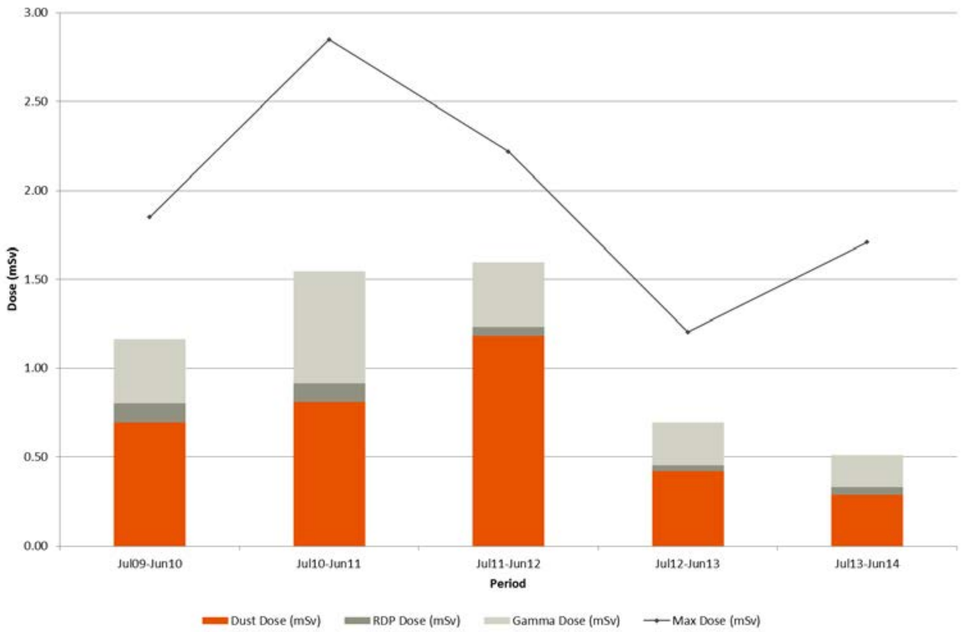

Figure 31 – Dose Trends for the Concentrator Workgroup

Hydromet

The average dose has decreased from 1.4 mSv in 2012/2013 to 1.0 mSv in 2013/2014 while the maximum dose has increased from 2.3 mSv to 4.4 mSv. This maximum dose was received by a worker who spent the first three quarters of this annual reporting period working in the Smelter workgroup and his last quarter working in the Hydromet, thus his dose is captured under his last exposure group, Hydromet.

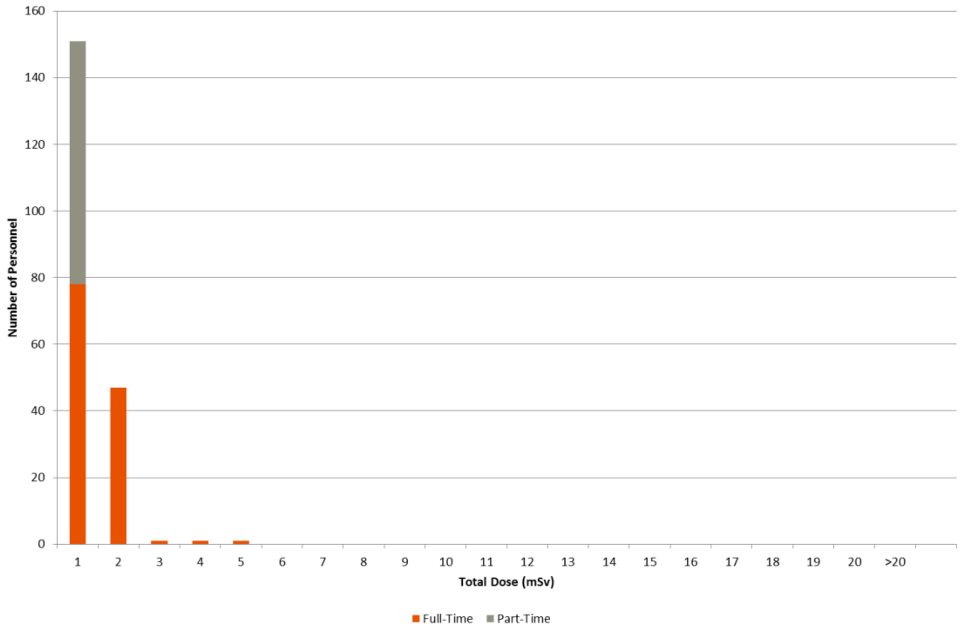

Figure 32 – Annual Dose Distribution for the Hydromet Workgroup

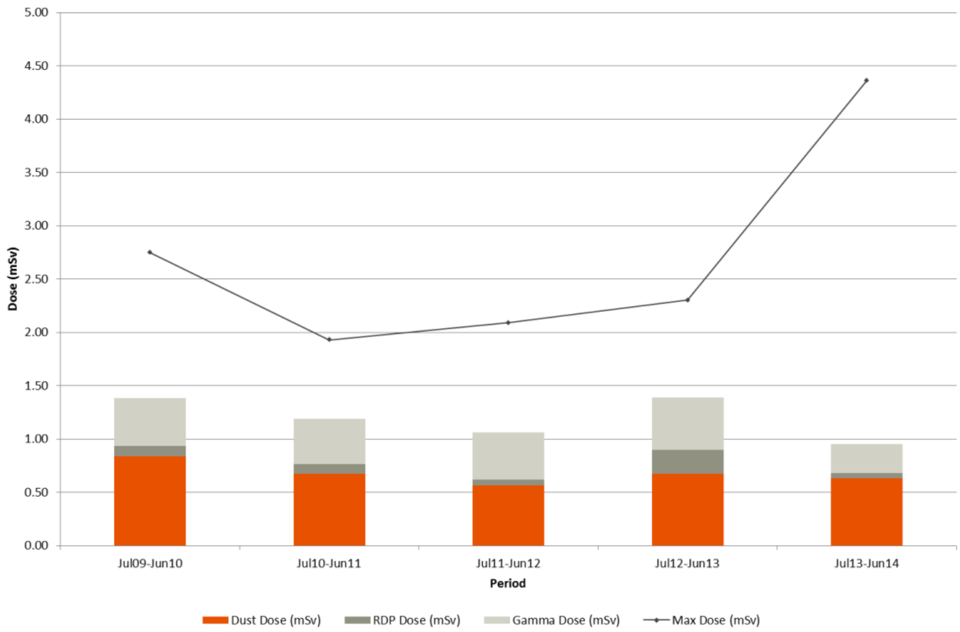

Figure 33 – Dose Trends for the Hydromet Workgroup

Smelter

Average dose in the Smelter decreased to 1.2 mSv from 2.8 mSv. The maximum dose increased from 5.4 mSv to 6.2 mSv with the 90th percentile dose increasing to 3.0 mSv. The smelter has continued to closely monitor Polonium 210 (Po-210) activity concentrations in key smelter inputs and outputs during the year to ensure it would not reach activity concentrations that would adversely impact on dust exposures. The reduction in average dose is attributed to better management of revert.

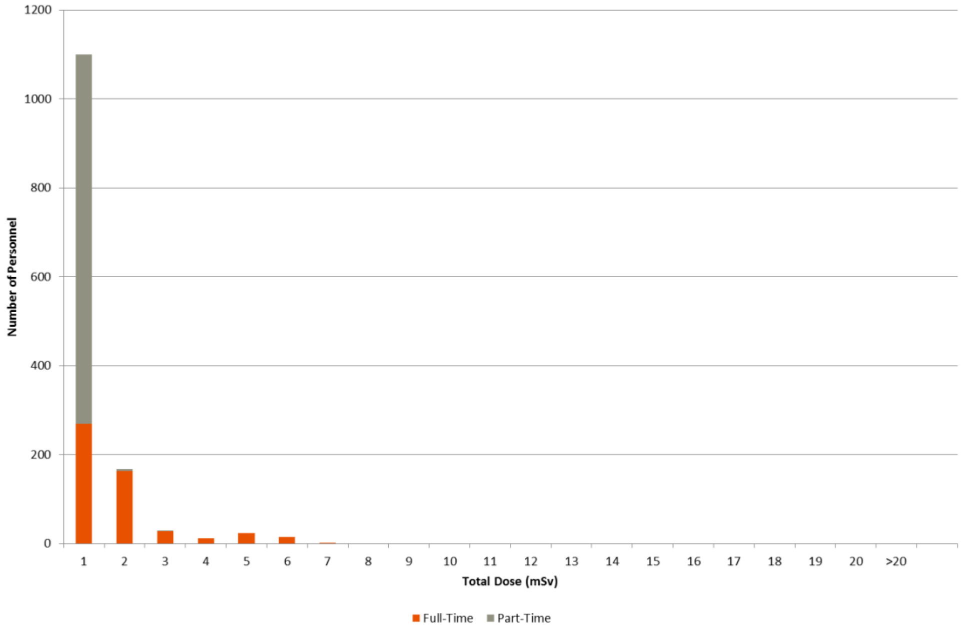

Figure 34 – Annual Dose Distribution for the Smelter Workgroup

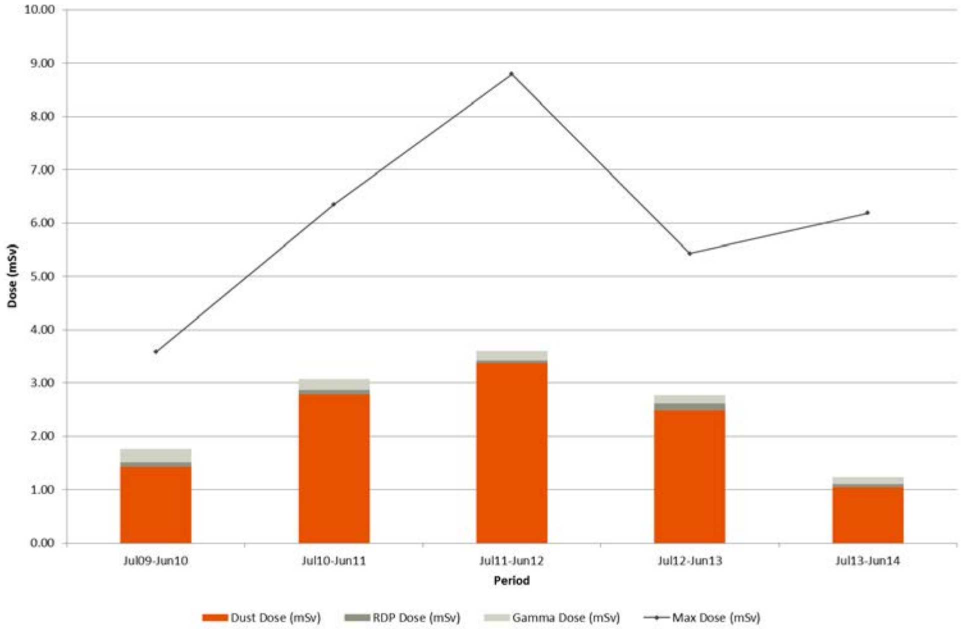

Figure 35 – Dose Trends for the Smelter Workgroup

Refinery

The Refinery workgroup recorded the lowest annual average, 0.6 mSv, of any workgroup in the Metallurgical Plant, while the maximum dose increased to 2.1 mSv. This maximum dose was received by a worker who spent half the first half of year working within underground workgroups, Fitters and Electricians.

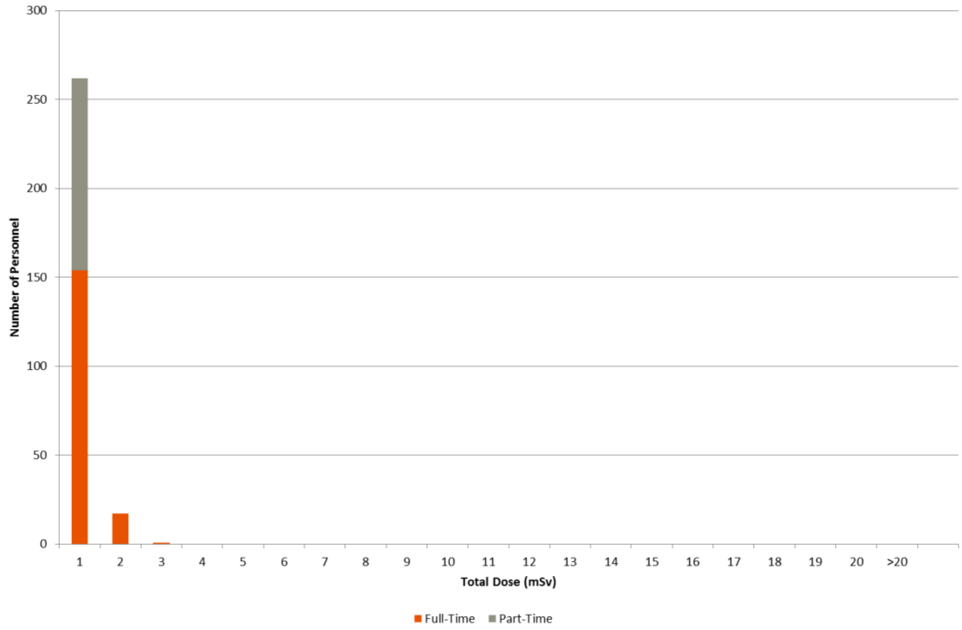

Figure 36 – Annual Dose Distribution for the Refinery Workgroup

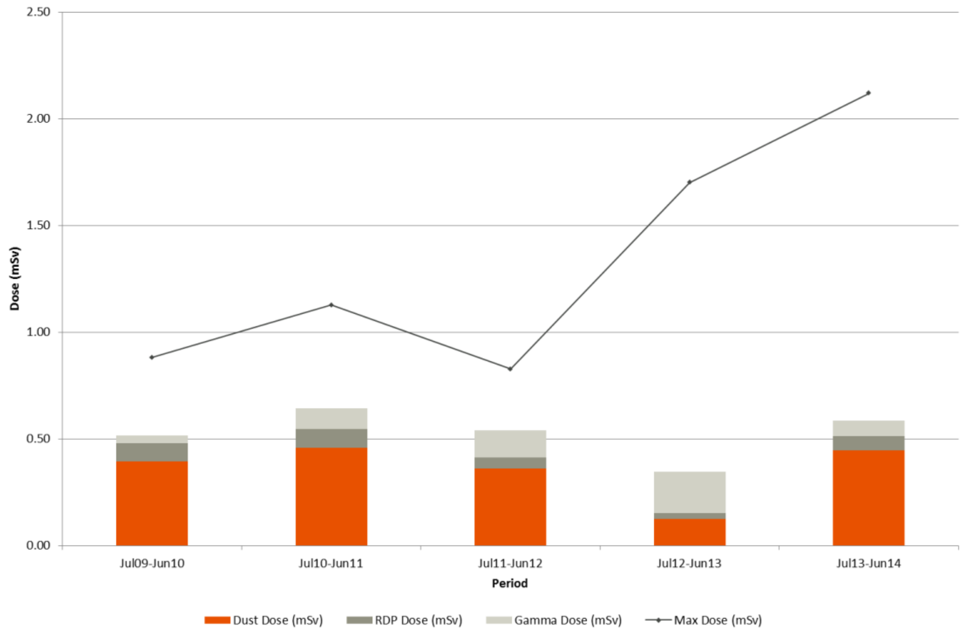

Figure 37 – Dose Trends for the Refinery Workgroup

Maintenance/Services

The average dose has decreased from 1.6 mSv in 2012/2013 to 0.7 mSv in 2013/2014 while the maximum dose has slightly increased from 2.3 mSv to 2.4 mSv. The decrease in average dose is predominantly due a reduction in RDP dose which was elevated in the previous period due to several workers moving from underground workgroups to surface based maintenance workgroups. Doses remain in line with historical exposures recorded for the workgroup.

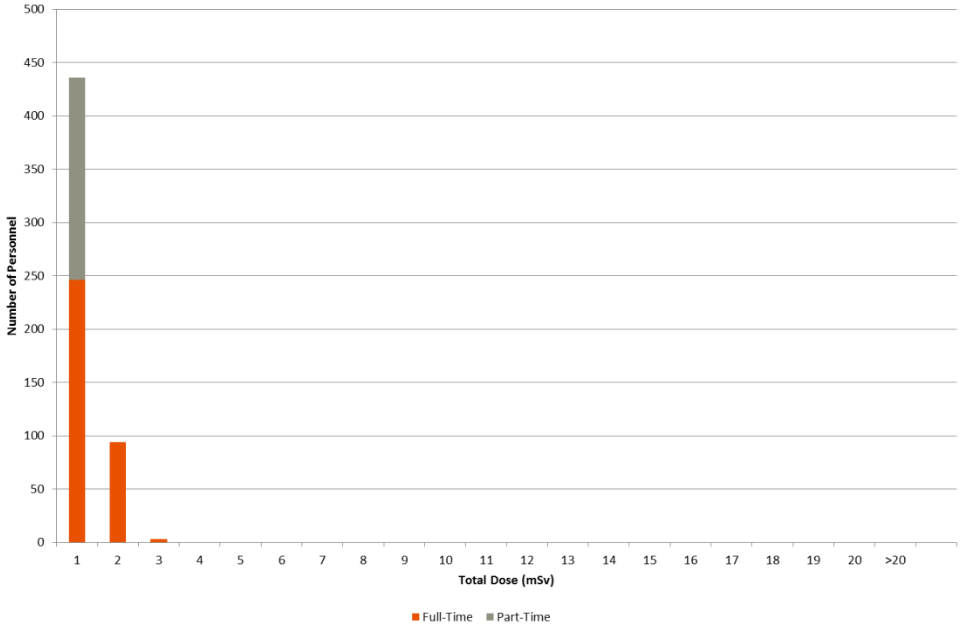

Figure 38 – Annual Dose Distribution for the Maintenance/Services Workgroup

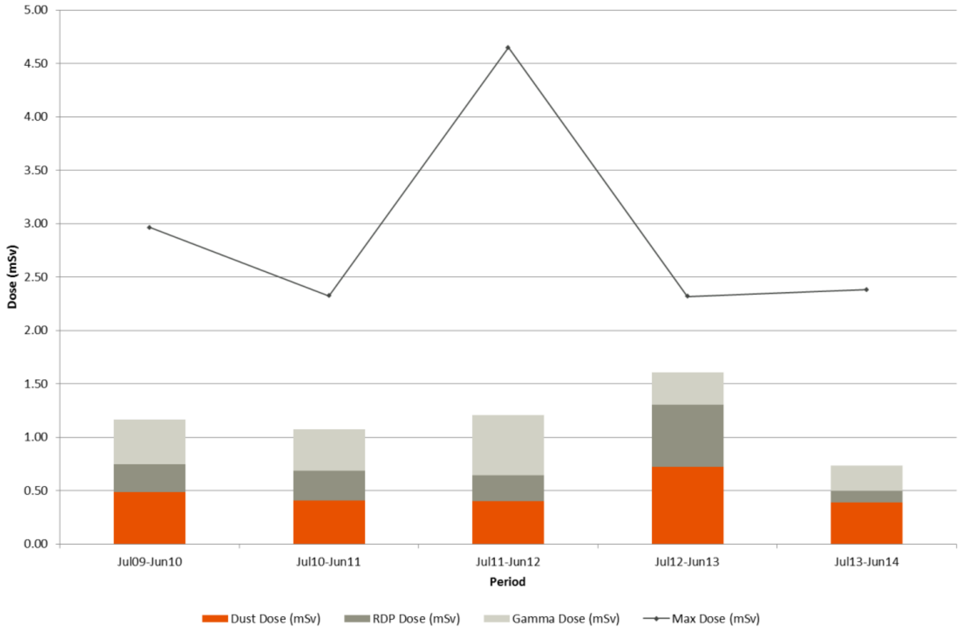

Figure 39 – Dose Trends for the Maintenance/Services Workgroup

3.2.3 Strategies for Dose Reduction

The high assay frequency of process streams such as Dust Leach, Concentrate Leach and Furnace inputs and outputs, remain unchanged as this information is a key control for maintaining Po-210 levels throughout the system.

Smelter staff and area metallurgists are well informed of the effects and impacts of process changes, in particular the importance of controlling the amount of Po-210 added to the system via charging of revert.

General improvements include the proposal of a new bypass launder from the Flash Furnace and refurbishment and extension of the existing Electric Furnace skirt, which is expected to have a significant beneficial impact on radioactive dust concentrations, this is due to be completed in 2015.

3.2.4 Cumulative Five Year Dose

As recommended in ICRP 103, the total dose of any individual radiation worker should not exceed 100 mSv in any five year period. To this end, a five year total dose has been determined for all full-time currently designated Metallurgical Plant workers who were employed at Olympic Dam for the previous five years.

There were a total of 433 designated Metallurgical Plant workers who worked at Olympic Dam during the period 1 July 2009 to 30 June 2014.

The maximum dose for the five year period was 29.1 mSv, compared to the value of 34.0 mSv calculated in 2012/2013. The arithmetic mean for the five year dose period for the Metallurgical Plant has decreased from 6.8 mSv to 5.6 mSv. The distribution of doses for the cumulative five year dose is shown in Figure 40.

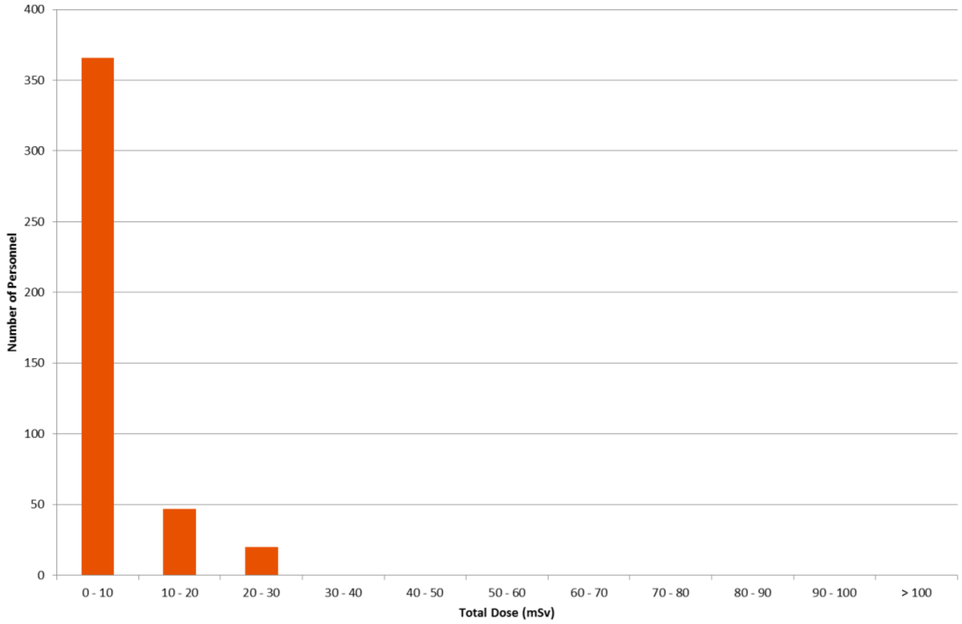

Figure 40 – 5 Year Cumulative Dose Distribution for Process Plant Workers

A summary of the cumulative five year dose is given in Table F below.

Table F – Five Year Dose Statistics

Statistics	Cumulative 5 Year Doses	Equivalent Average Yearly Dose
Count	433	433
Arithmetic Mean (mSv)	5.6	1.1
90th Percentile (mSv)	12.4	2.5
Min (mSv)	0.0	0.0
Max (mSv)	29.1	5.8
Mean % Dose from Dust	50%	
Mean % Dose from RDP	26%	
Mean % Dose from Gamma	24%	

3.3 Annual Dose Trends

The average total effective dose to all workers at the Mine and Metallurgical Plant since 2009/2010 are shown in Figure 41 and Figure 42, respectively. The annual dose for the last year has been mainly attributed to radon decay product exposure in the Mine and by radioactive dust exposure in the Metallurgical Plant.

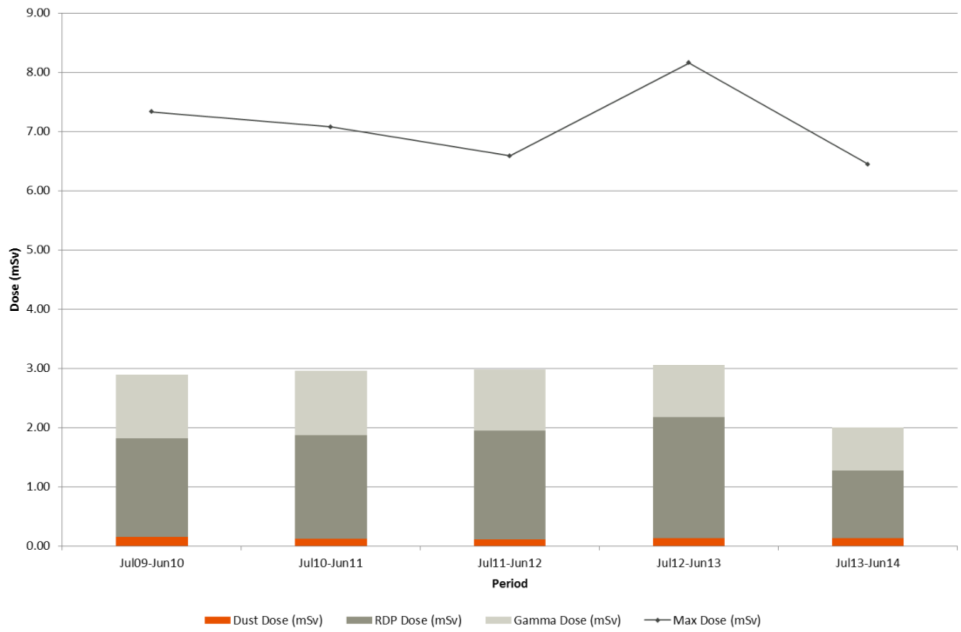

Figure 41 – Mine Annual Dose Trend

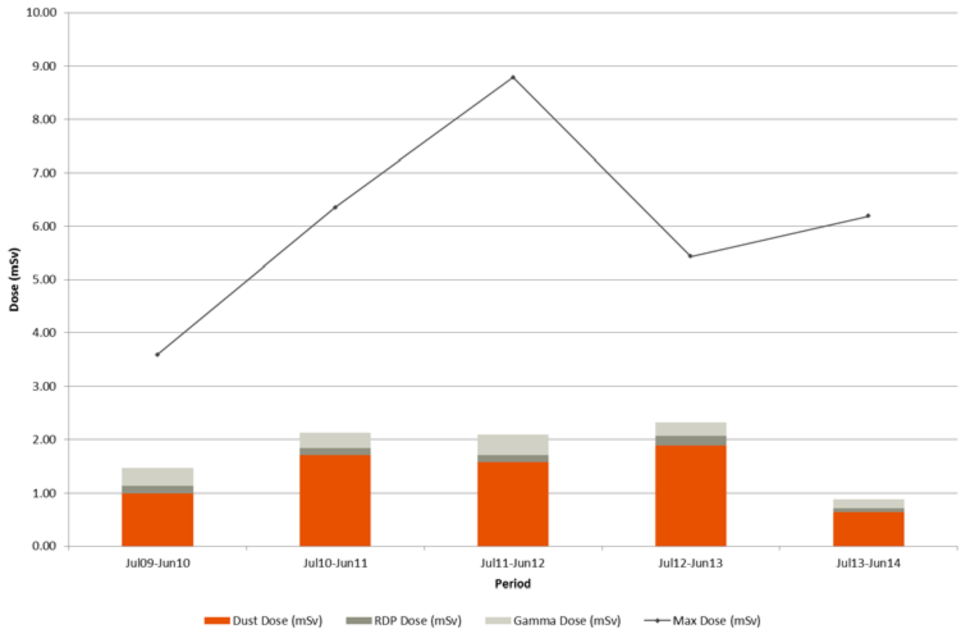

Figure 42 – Plant Annual Dose Trend

3.4 Doses to Members of the Public

The full assessment of doses to members of the public has been presented separately in the Environmental Management and Monitoring Report.

For all members of the public, the effective dose from the operation, for the period July 2013 to June 2014 was well below the statutory limit of 1 mSv per annum. Estimated maximum operational related doses are shown in Table G.

Table G – Public Doses

2013/2014 Dose to Members of the Public Living at	Dose (mSv)	Dose Limit (mSv)
Roxby Downs	0.03	1
Olympic Dam Village	0.02	1

Figure 43 presents the public dose trends for Olympic Dam Village and Roxby Downs since 2004. The 2013/2014 dose to the members of the public has continued to remain below the minimum detection limit of 0.048 mSv.

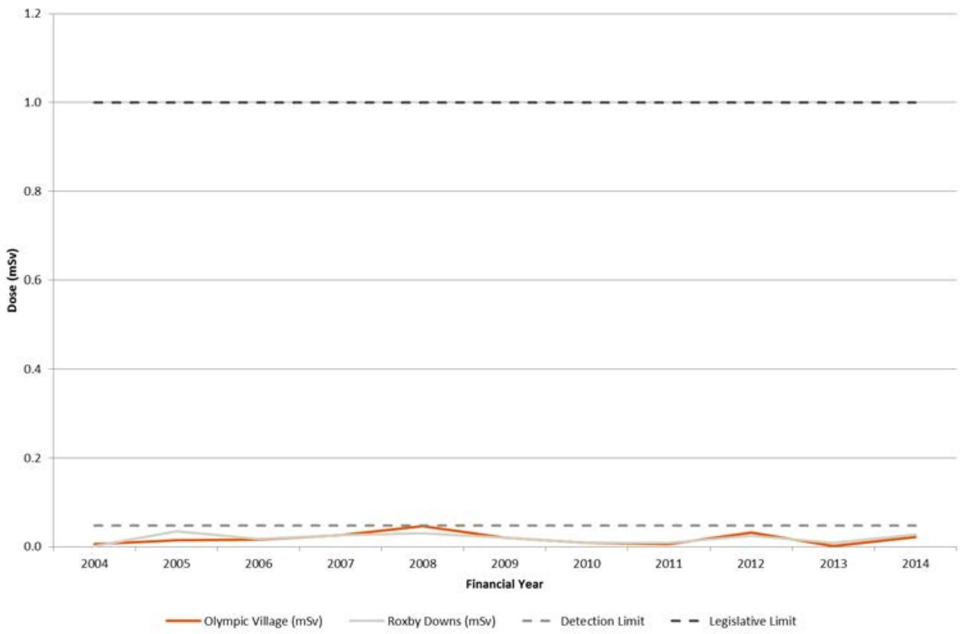

Figure 43 – Total Dose Trend for Olympic Dam Village and Roxby Downs

Appendix A

Dose Conversion Factors 2013/2014

A summary of the airborne dust dose conversion factors for specific work areas can be viewed in the following table.

Table H – Dust Dose Conversion Factors

Location	DCF ($\mu Sv.m^3/Bq.hr$)
Smelter	7.5
Refinery / STP	5.4
SX / Precipitation / Calciners	4.5
Other*	4.1

***All other areas of Mine, Concentrator, Slag Concentrator, Hydromet and Services (Laboratories and Metallurgical Workshop)**

The default RDP dose conversion factor used was 1.41 $mSv.m^3/mJ.hr$ (5 mSv/WLM).