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OLYMPIC DAM

Annual Radiation Protection Report

July 2012 to June 2013



BHP Billiton Olympic Dam Corporation Pty Ltd

Registered Office: Rialto Towers Level 29, 525 Collins Street, Melbourne, Victoria 3000, Australia

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July 2012 to June 2013

DISTRIBUTION

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1 Introduction

This document is the annual report on radiation protection for BHP Billiton Olympic Dam Incorporation 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 2012 to 30 June 2013 are presented. Individual personal doses and dose components for the period 1 July 2012 to 30 June 2013 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 new data and dose management system, which is used to assess and record individual radiation exposures. The site security database (CARDAX) is also used to determine the monthly average hours for individuals working underground. 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.

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.

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 these 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 continuous 24-hour sampling.

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 2012/2013 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 $1.41 \text{ mSv}\cdot\text{m}^3/\text{mJ}\cdot\text{hr}$ (5 mSv/WLM).

3 Employee Doses

An in-house review of Olympic Dam’s radiation dose assessments noted that estimated occupational doses have been fairly consistent over the last couple of years, well below the internal dose constraint of 10 mSv/y. Furthermore, the review concluded that the radiation monitoring program has been more than adequate in capturing in depth the many different 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 1221 full-time Mine workers’ doses were calculated for the period 1st July 2012 to 30th June 2013. 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.

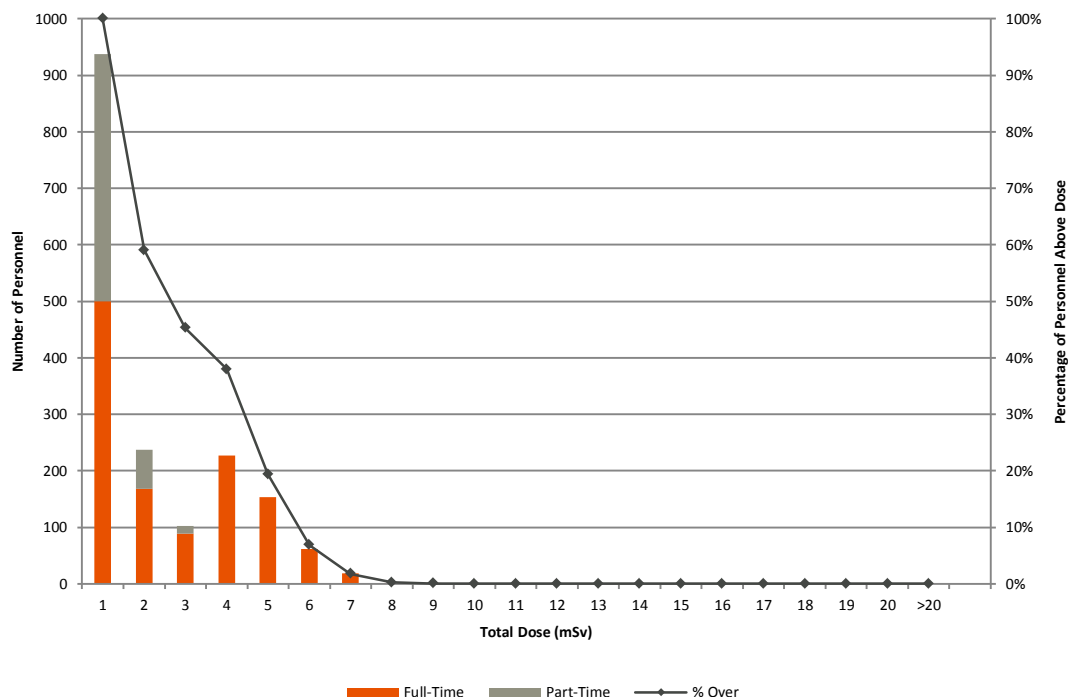


Figure 1 – Annual Dose Distribution 2012/2013 for All Mine Workers

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

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

The mean dose to all mine workers was 1.7 mSv in 2012/2013, a decrease from 2011/2012. The mean dose for full-time mine workers was 2.2 mSv in 2012/2013, a decrease from 2011/2012. The mean dose for part-time mine workers was 0.4 mSv in 2012/2013, a decrease from 2011/2012.

The average contribution to dose from exposure to radon decay products (RDP) in the underground mine for 2012/2013 was 60%, slightly less than the 2011/2012 value of 61%. 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	1221	520	1741
Arithmetic Mean (mSv)	2.2	0.4	1.7
90th Percentile (mSv)	4.6	1.3	4.3
Min (mSv)	0.0	0.0	0.0
Max (mSv)	8.2	3.0	8.2
Mean % Dose from Dust	8%	8%	8%
Mean % Dose from RDP	60%	62%	60%
Mean % Dose from Gamma	32%	30%	32%

No mine worker received an annual dose greater than 10mSv. The highest dose was 8.2 mSv, compared to a maximum value in 2011/2012 of 6.6 mSv.

3.1.2 Review of doses by work category

Table B shows the breakdown of doses by work category for full-time workers. The total number of all full-time workers was 1221. The primary focus of our monitoring programs has remained on the critical 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 designated workers has decreased from 35% to 32% of the total dose since last year, RDP has decreased from 62% in 2011/2012 to 60% of the total dose in 2012/2013 and the dust component has remained low at 8% of the total dose.

Average annual doses for all mine work groups have varied and are well within historical variations. The Production Charging work group received the highest average dose of 4.7 mSv. The highest individual annual dose of 8.2 mSv was received by an Electrician, who worked a total of 3095 hours during the reporting period. The Full-Time Equivalent (FTE) dose for that individual over 2000 hours was calculated to be 5.2 mSv. This indicates that the increase in individual maximum dose is a result of an increase in hours worked rather than a loss of radiation protection controls.

The dose components for all 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	149	0.5	0.0	1.0	0.7
Coreprocessing	12	0.6	0.2	1.0	0.9
Development	117	4.5	0.2	7.0	5.9
Diamond Drilling	40	3.9	0.5	6.5	5.5
Electricians	109	3.3	0.1	8.2	4.9
Fitters/Maintenance	183	2.1	0.0	5.6	4.0
Mine Surface Personnel	357	0.9	0.0	4.4	1.2
Ore Handling	32	3.9	0.9	5.5	4.9
Production Charging	22	4.7	2.2	6.5	5.9
Production Drilling	31	4.2	2.1	5.5	5.2
Raise Drilling	9	4.4	1.5	6.9	6.3
Underground Services Full Time	160	2.9	0.0	5.7	4.1

Workgroups	Dust Average (mSv)	Dust % of Total Dose	RDP Average (mSv)	RDP % of Total Dose	Gamma Average (mSv)	Gamma % of Total Dose
Backfill	0.0	2%	0.2	34%	0.3	64%
Coreprocessing	0.2	27%	0.1	19%	0.3	54%
Development	0.2	5%	2.6	58%	1.7	37%
Diamond Drilling	0.1	1%	2.7	67%	1.2	32%
Electricians	0.2	5%	2.2	66%	1.0	29%
Fitters/Maintenance	0.2	7%	1.4	67%	0.5	26%
Mine Surface Personnel	0.3	34%	0.2	24%	0.4	42%
Ore Handling	0.3	8%	2.9	75%	0.6	17%
Production Charging	0.1	2%	2.9	61%	1.7	37%
Production Drilling	0.1	3%	2.5	60%	1.6	37%
Raise Drilling	0.1	3%	3.1	72%	1.1	25%
Underground Services Full Time	0.2	5%	2.2	74%	0.6	21%

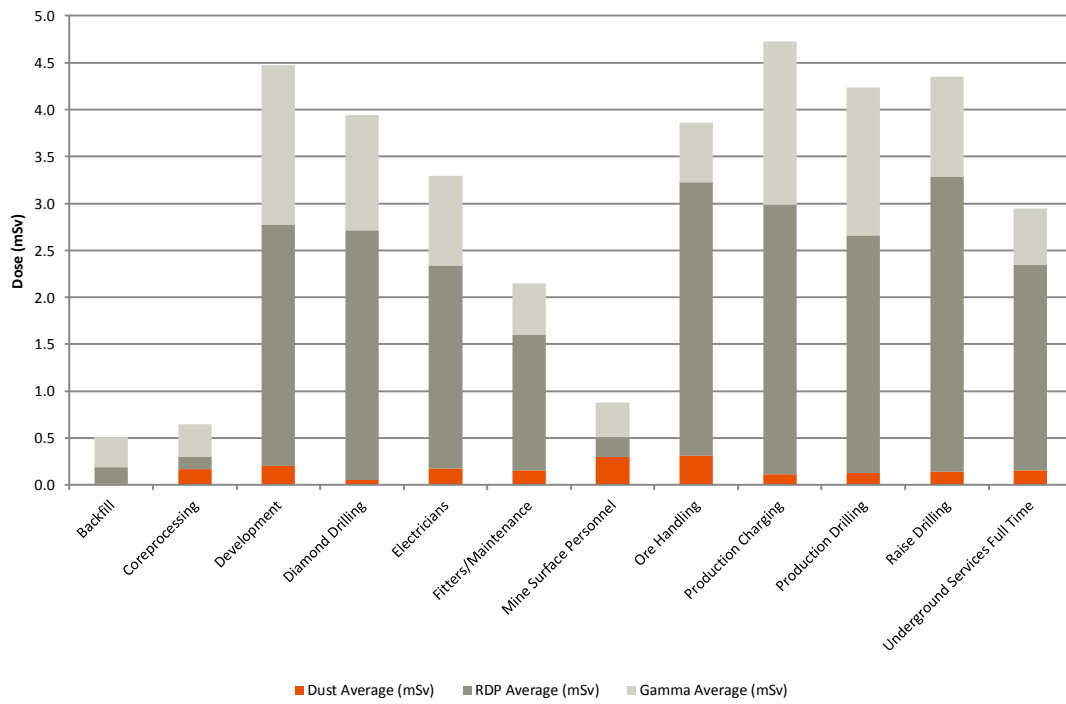


Figure 2 – Annual Dose Components by Mine Workgroup

The average and maximum effective dose for the critical Mine 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 decreased from 1.1 mSv to 0.6 mSv and the maximum dose to this workgroup has decreased from 1.5 mSv to 1.0 mSv. This reflects the nature of Backfill employee’s work, mostly on the surface with minimal time underground and the variations are in line with normal fluctuations.

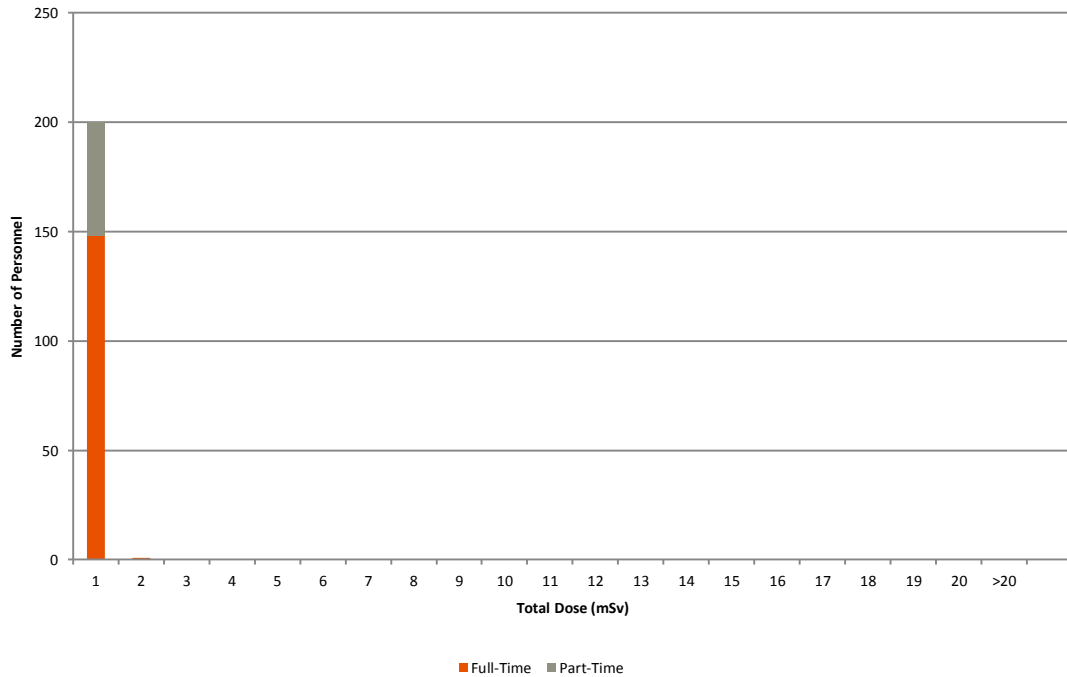


Figure 3 – Annual Dose Distribution for the Backfill Workgroup

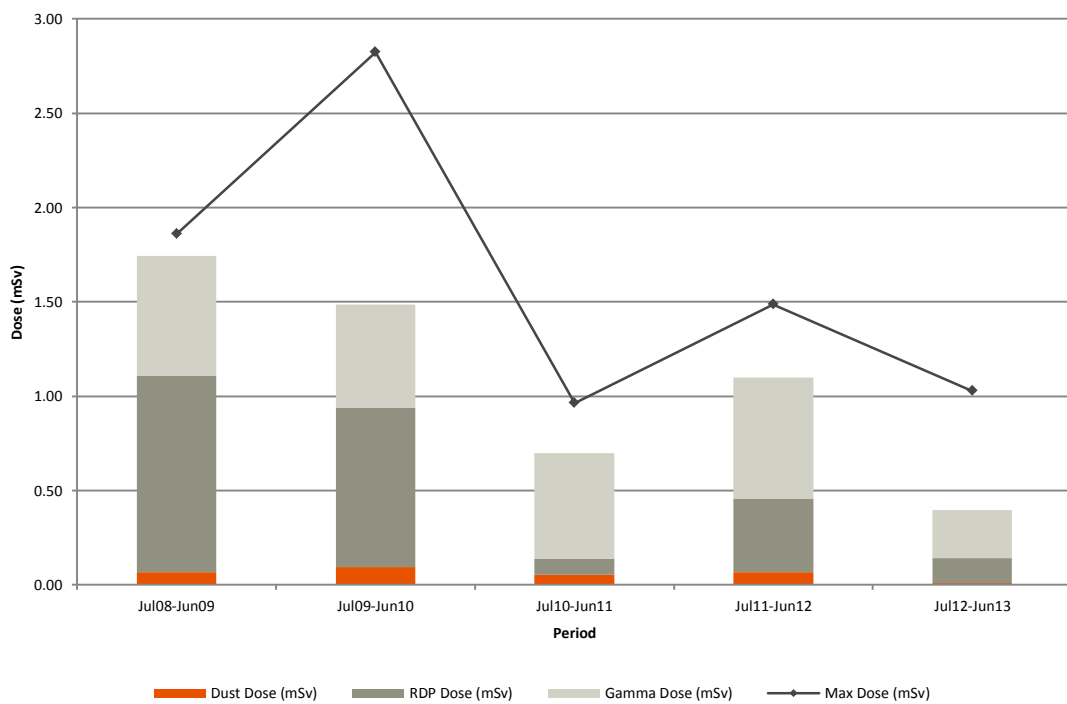


Figure 4 – Annual Dose Trends for the Backfill Workgroup

Core Processing

The average doses to Core Processing workers have remained at low levels under 1 mSv per year. The average dose for 2012/2013 was 0.8 mSv and the maximum dose was 1.0 mSv. Dust exposure to this workgroup has been assessed for occupational hygiene purposes and the installation of a new local exhaust ventilation system has been installed.

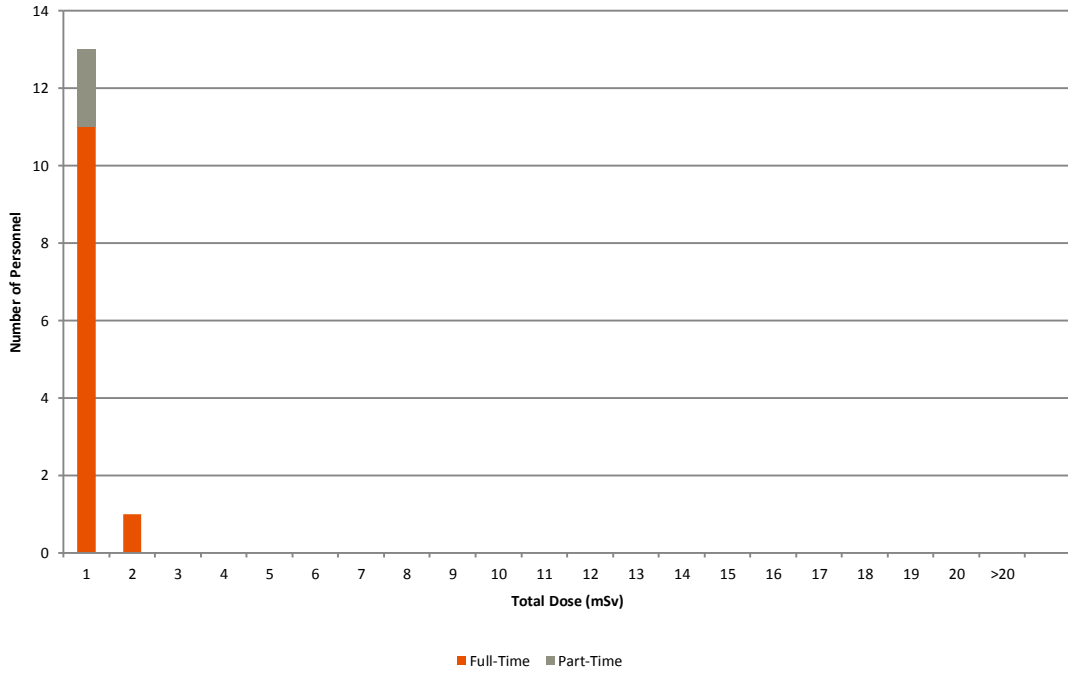


Figure 5 – Annual Dose Distribution for the Core Processing Workgroup

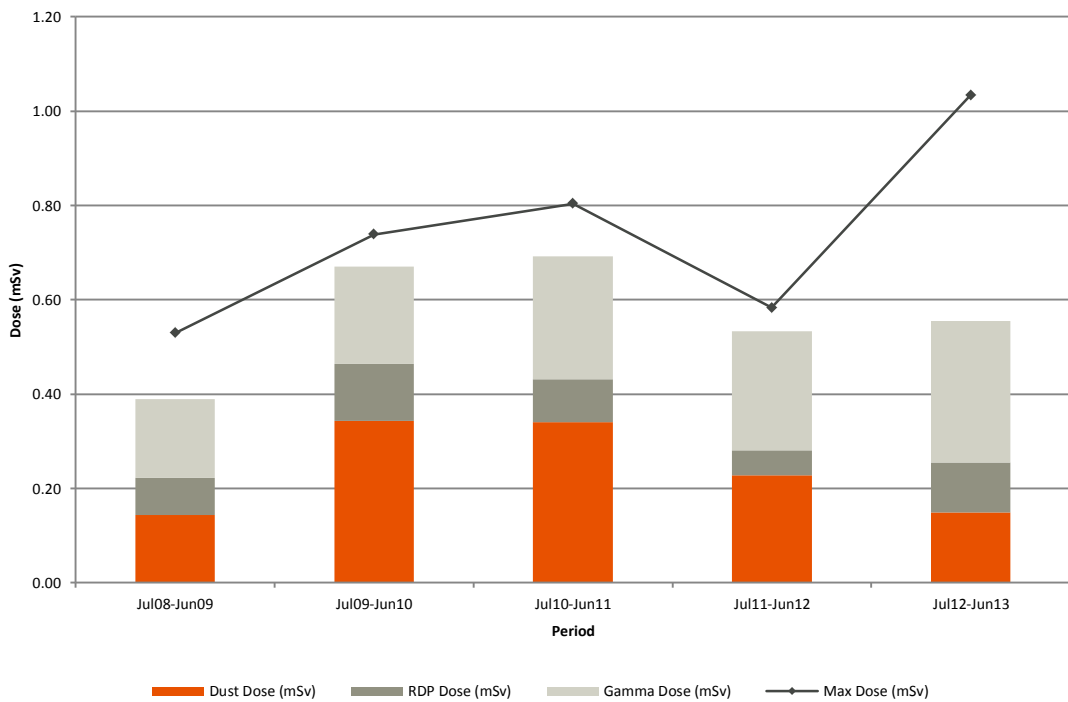


Figure 6 – Annual Dose Trends for the Core Farm Workgroup

Development

The average dose to the Development workgroup has increased to 4.7 mSv and the maximum dose has increased from 5.4 mSv to 7.0 mSv. This is attributed to the number of hours worked by the blasting miner in question (2861 hours). Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

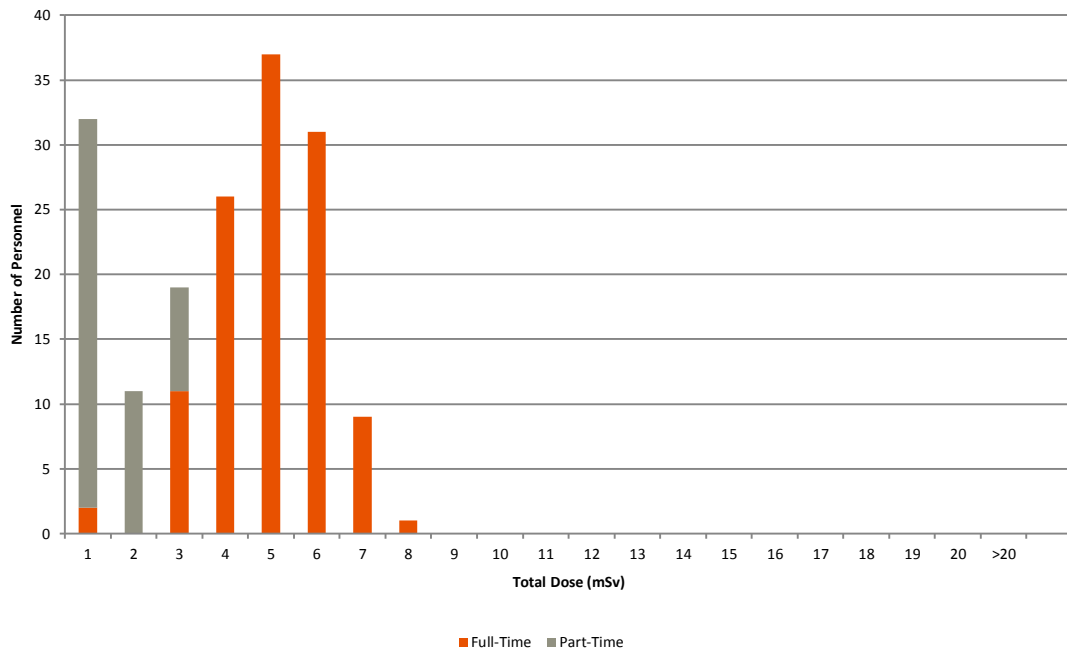


Figure 7 – Annual Dose Distribution for the Development Workgroup

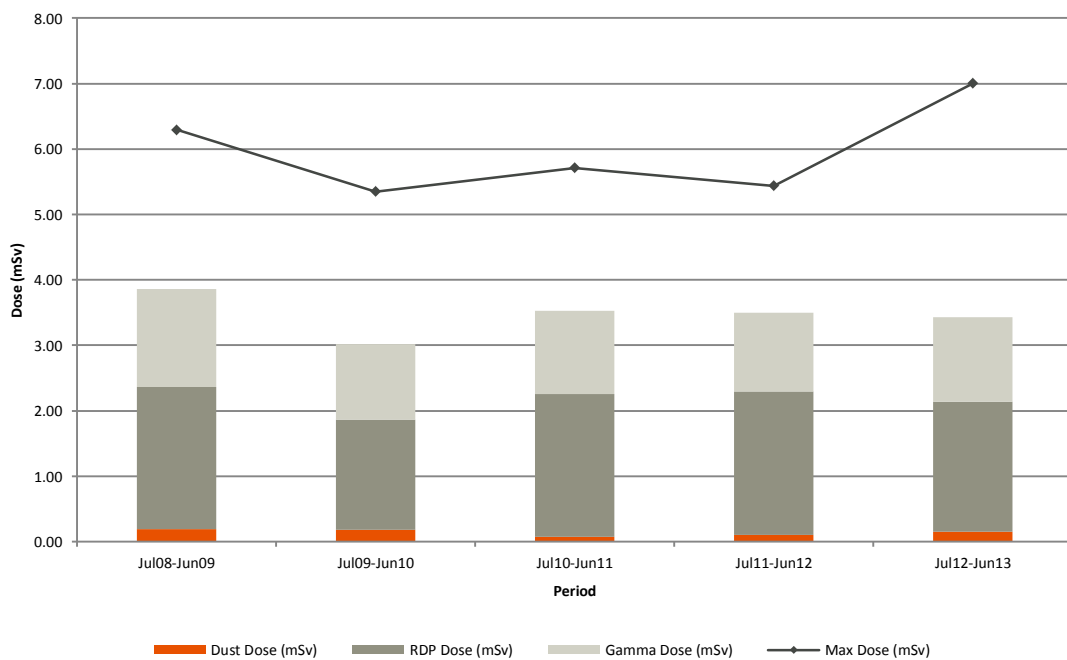


Figure 8 – Annual Dose Trends for the Development Workgroup

Diamond Drilling

The average dose to the Diamond Driller workgroup increased from 2.5 mSv to 4.1 mSv and maximum dose to the Diamond Drilling workgroup has increased from 3.7 mSv to 6.5 mSv. This is attributed to the number of hours worked by the diamond driller in question (2672 hours). Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

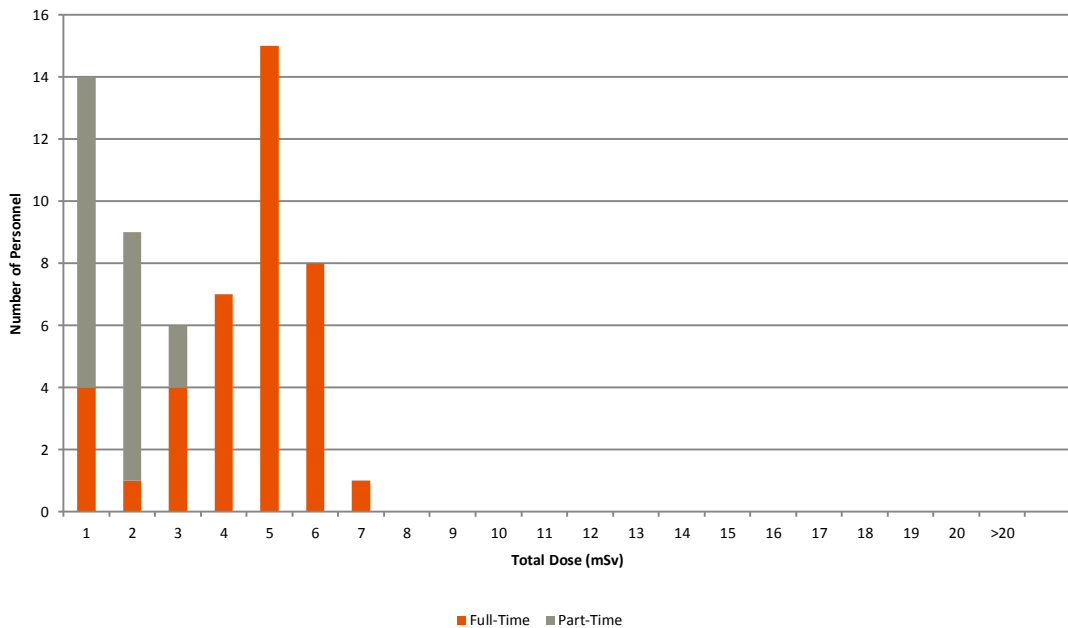


Figure 9 – Annual Dose Distribution for the Diamond Drilling Workgroup

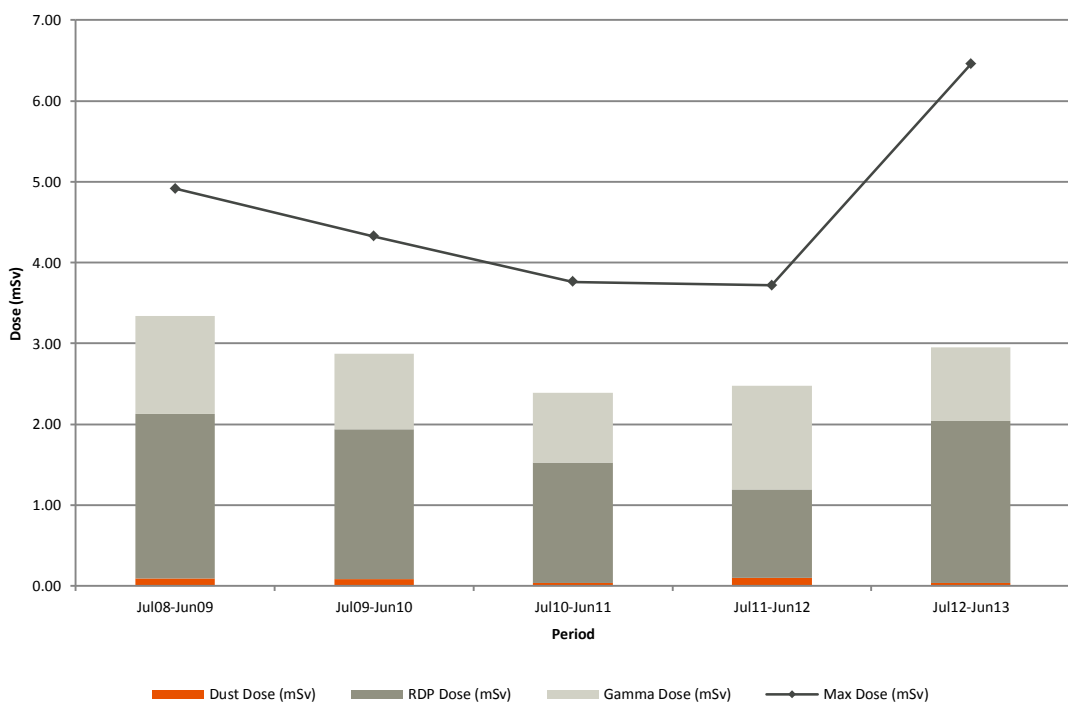


Figure 10 – Annual Dose Trends for the Diamond Drilling Workgroup

Electricians

The average dose to electricians has increased to 4.1 mSv. The maximum dose to this workgroup has also increased from 3.4 mSv in 2011/2012 to 8.2 mSv. This is attributed to the number of hours worked by the electrician in question (3095 hours). Overall, the dose rates are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

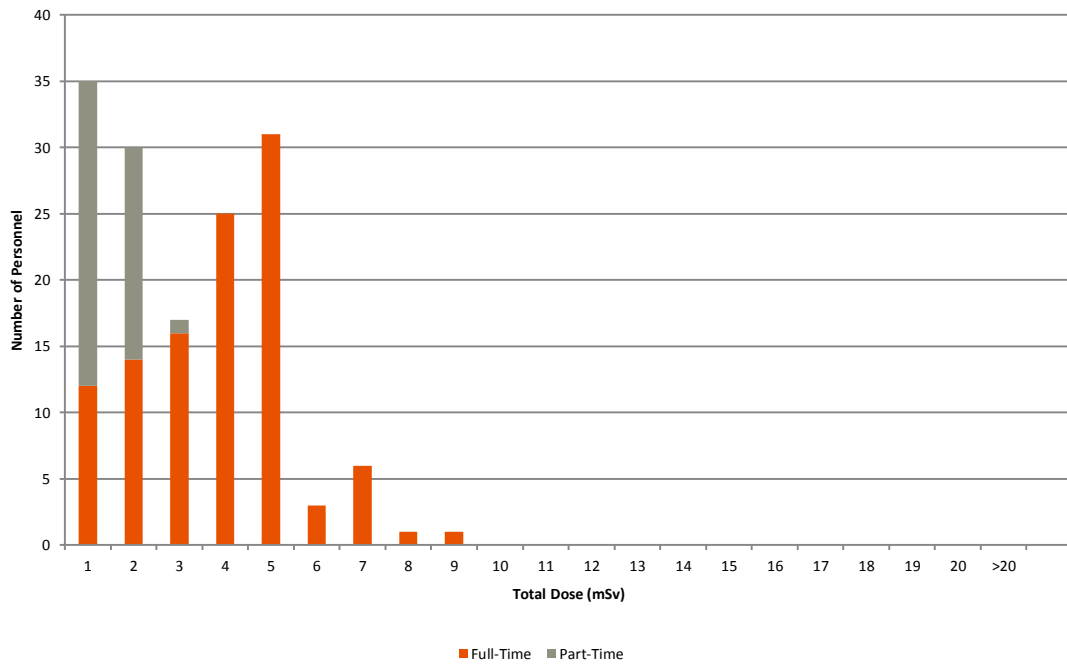


Figure 11 – Annual Dose Distribution for the Electrician Workgroup

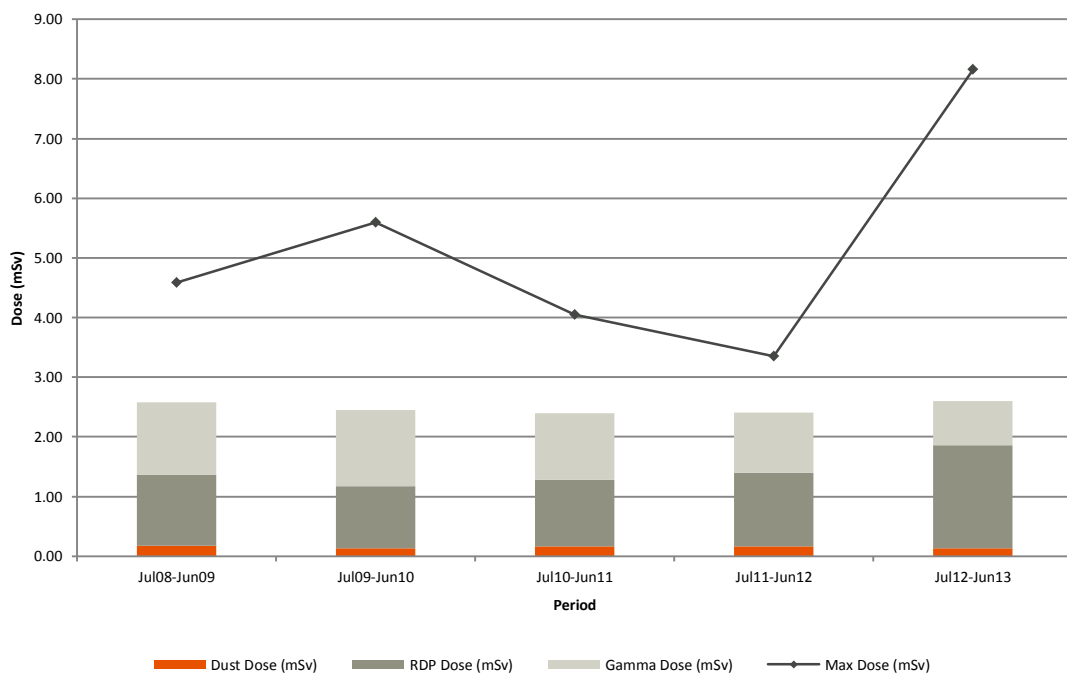


Figure 12 – Annual Dose Trends for the Electrician Workgroup

Fitters/Maintenance

The average dose to the Fitters/Maintenance workgroup has increased from 1.9 mSv to 2.6 mSv whilst the maximum dose has increased from 4.6 mSv to 5.6 mSv. These doses are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

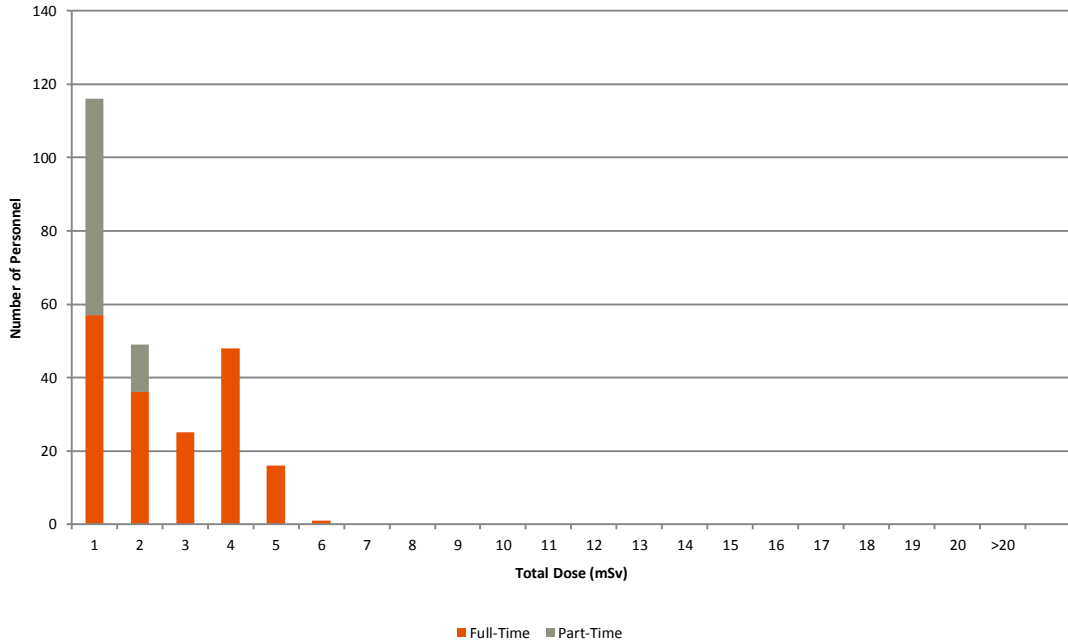


Figure 13 – Annual Dose Distribution for the Fitter Workgroup

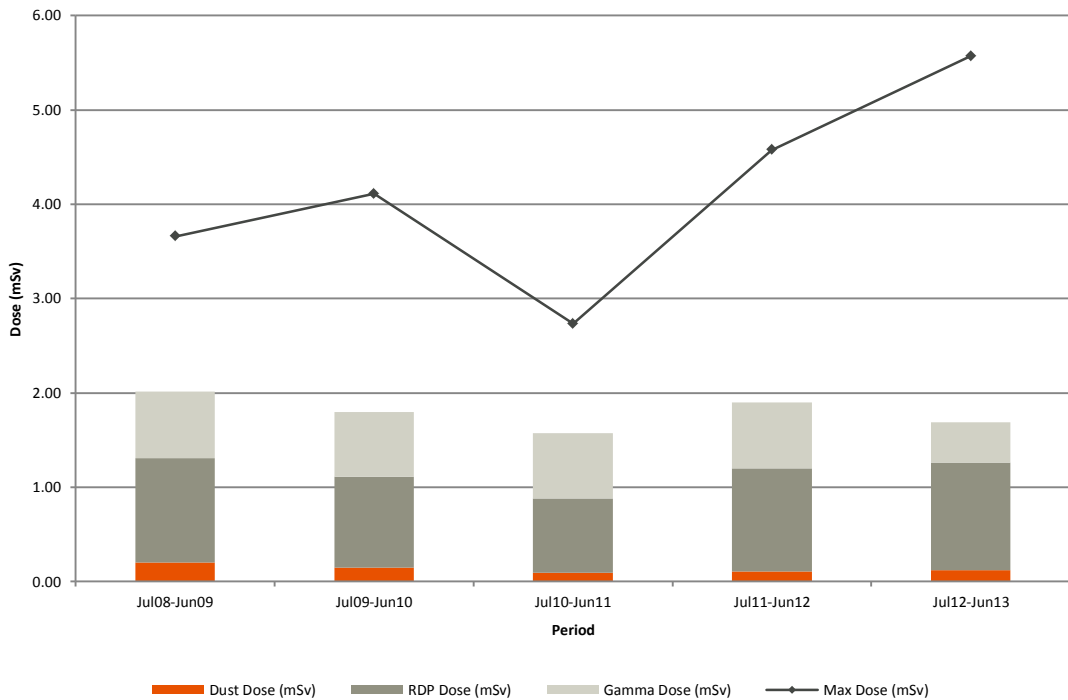


Figure 14 – Annual Dose Trends for the Fitter Workgroup

Mine Surface Personnel

The average dose has decreased from 2.1 mSv to 1.1 mSv while the maximum dose has increased from 3.3 mSv to 4.4 mSv. The average dose presents a sharp decline, especially in RDP dose, from the previous year as a result of the redefinition of the workgroup in Medgate.

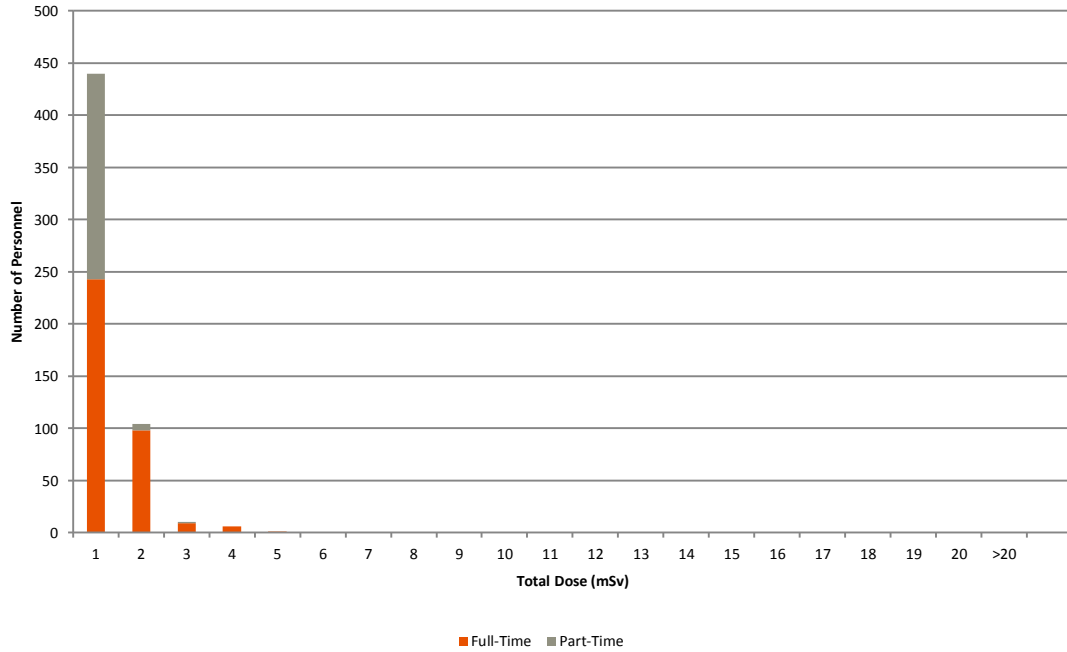


Figure 15 – Annual Dose Distribution for the Mine Surface Personnel Workgroup

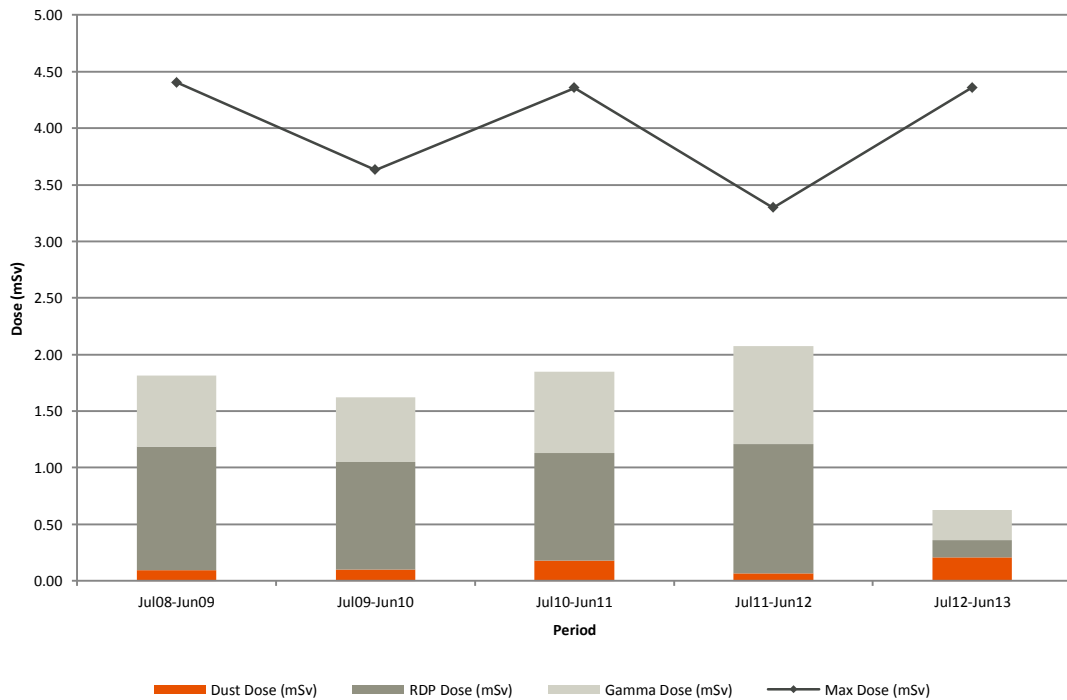


Figure 16 – Annual Dose Trends for the Mine Surface Personnel Workgroup

Ore Handling

The average dose has increased from 3.0 mSv to 4.0 mSv while the maximum dose has also increased from 4.8 mSv to 5.5 mSv. These doses are in line with normal variations and do not reflect any significant changes in work practices for this workgroup.

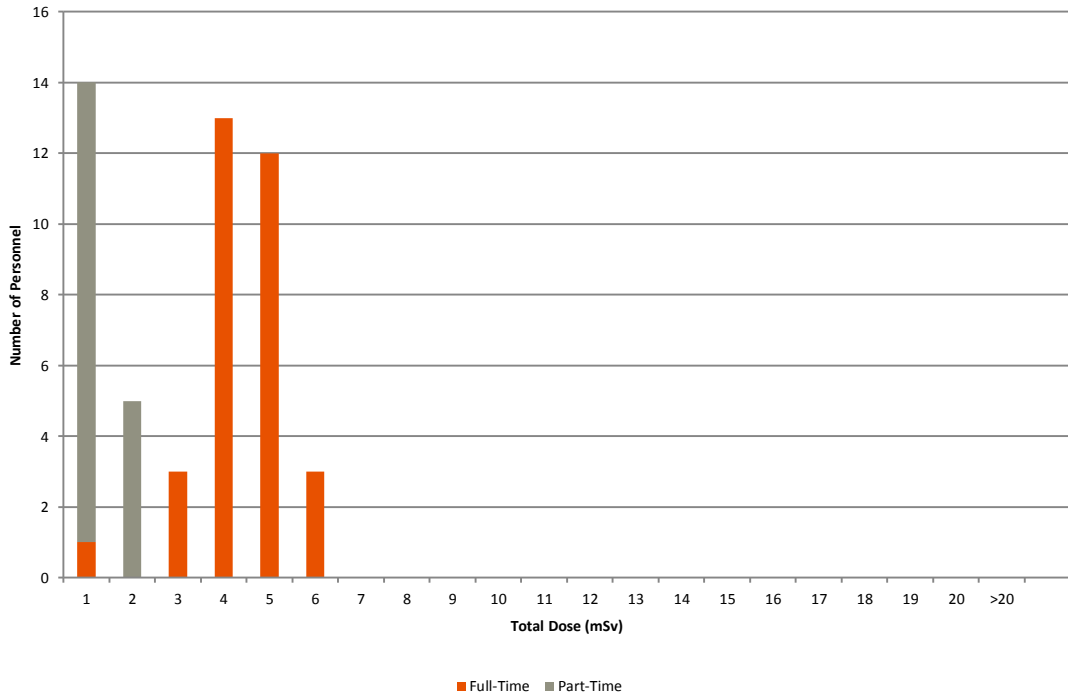


Figure 17 – Annual Dose Distribution for the Ore Handling Workgroup

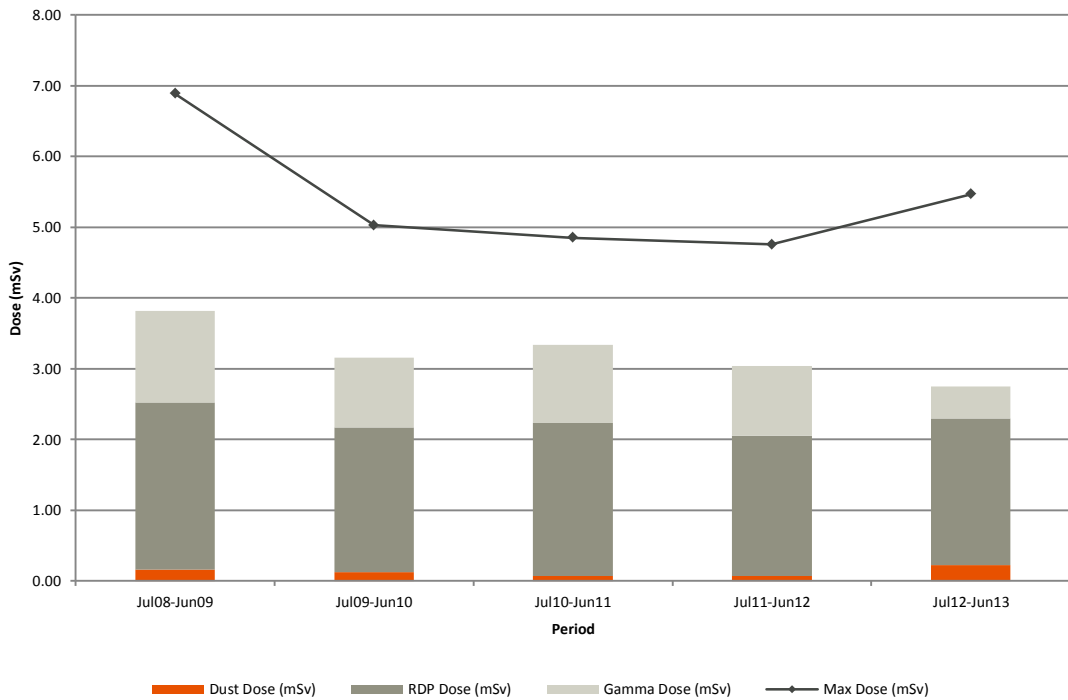


Figure 18 – Annual Dose Trends for the Ore Handling Workgroup

Production Charging

The average dose for Production Chargers has increased from 3.5 mSv to 4.9 mSv while the maximum dose also increased from 4.7 mSv to 6.5 mSv. The exposures are in line with historical exposures recorded for the workgroup.

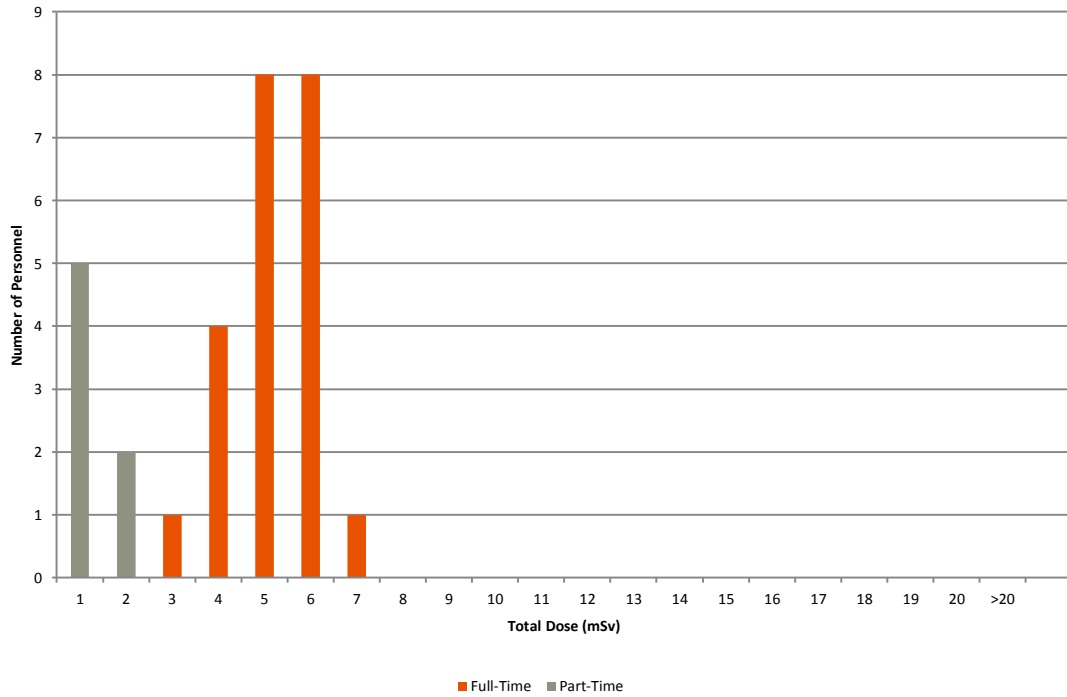


Figure 19 – Annual Dose Distribution for the Production Charger Workgroup

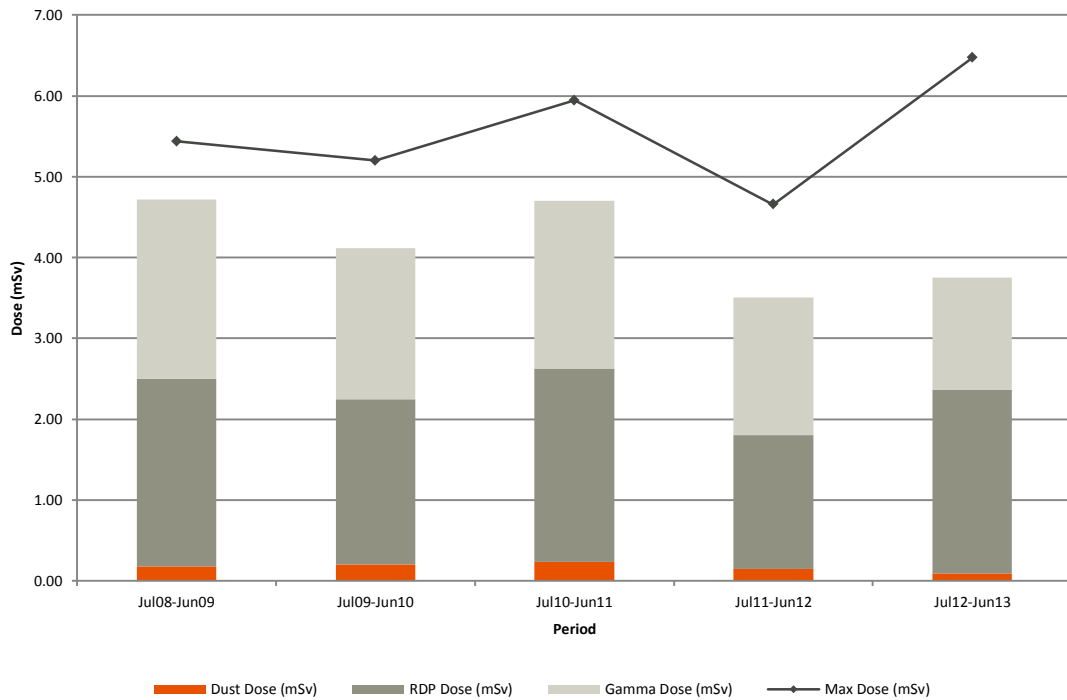


Figure 20 – Annual Dose Trends for the Production Charger Workgroup

Production Drilling

The average dose for the production drillers has increased from 3.2 mSv to 4.3 mSv and the maximum dose has also increased from 4.2 mSv to 5.5 mSv. The results are in line with historical exposures recorded for the workgroup.

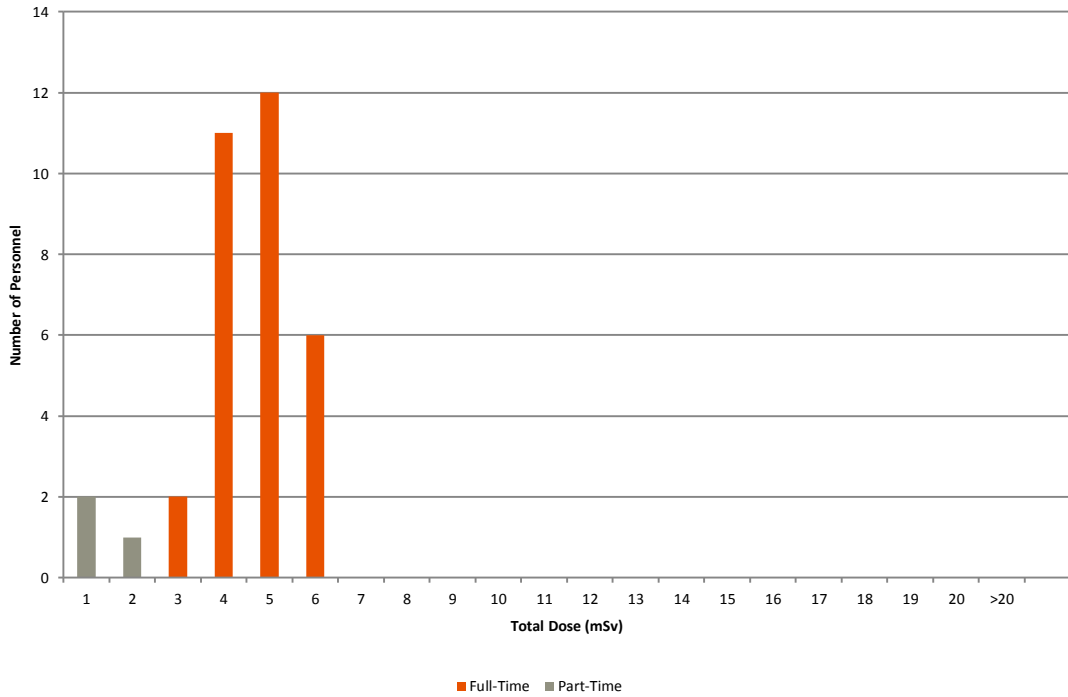


Figure 21 – Annual Dose Distribution for the Production Driller Workgroup

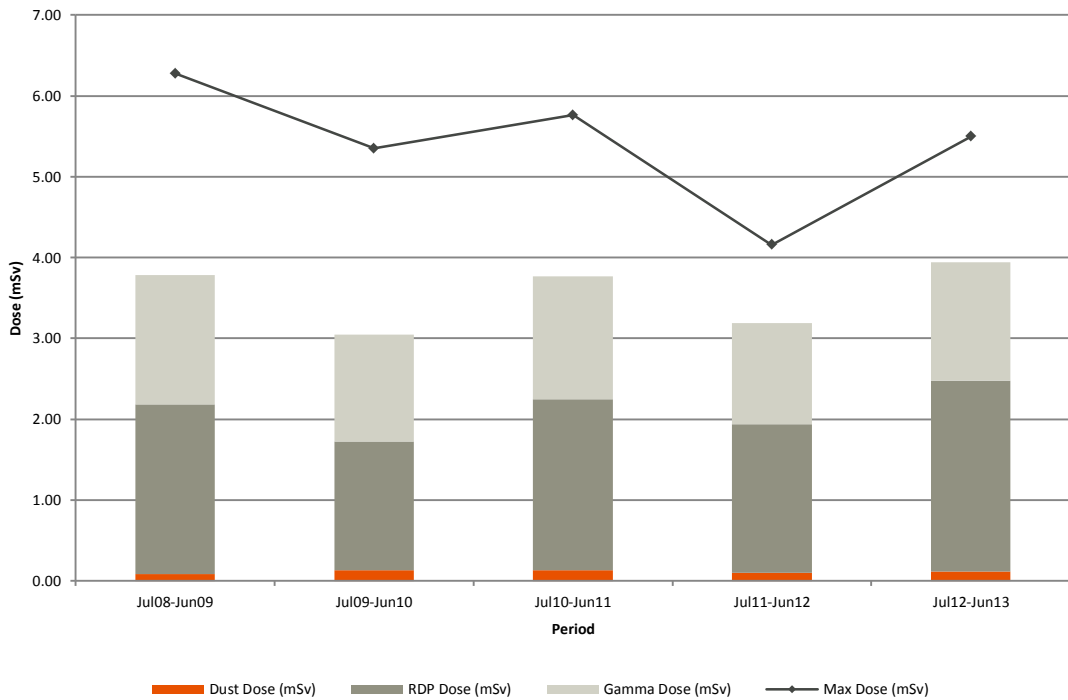


Figure 22 – Annual Dose Trends for the Production Driller Workgroup

Raise Drilling

The average dose has increased from 3.9 mSv to 5.0 mSv and the maximum dose has slightly increased from 6.6mSv to 6.9mSv. Focus on radon decay product exposure continues to be the main priority for radiation exposure to this workgroup.

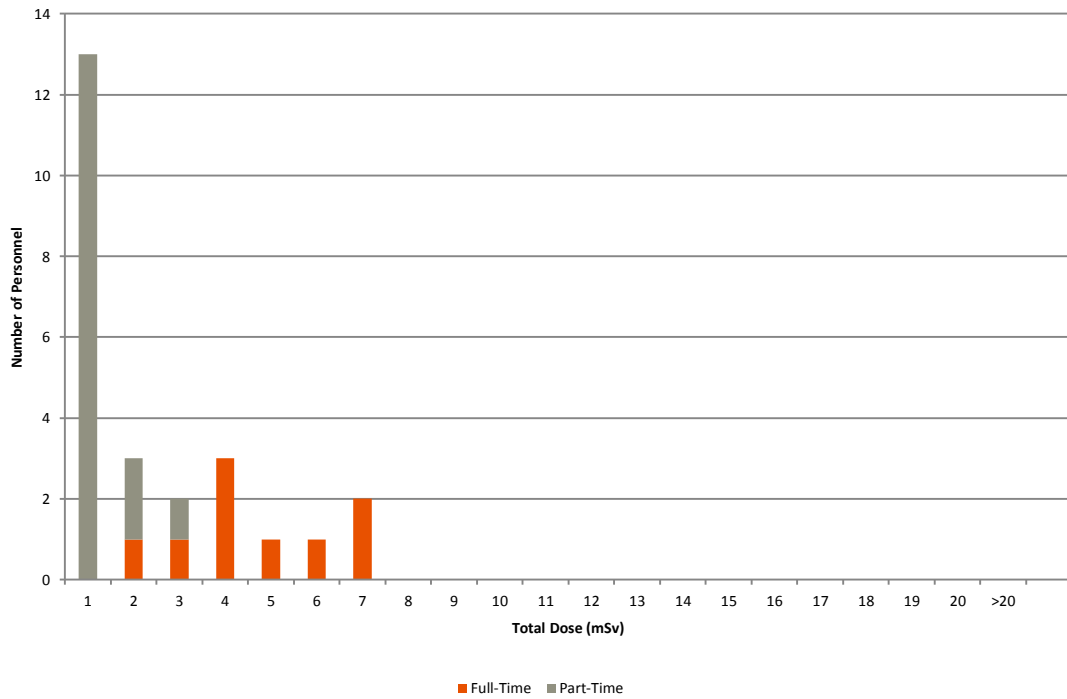


Figure 23 – Annual Dose Distribution for the Raise Drilling Workgroup

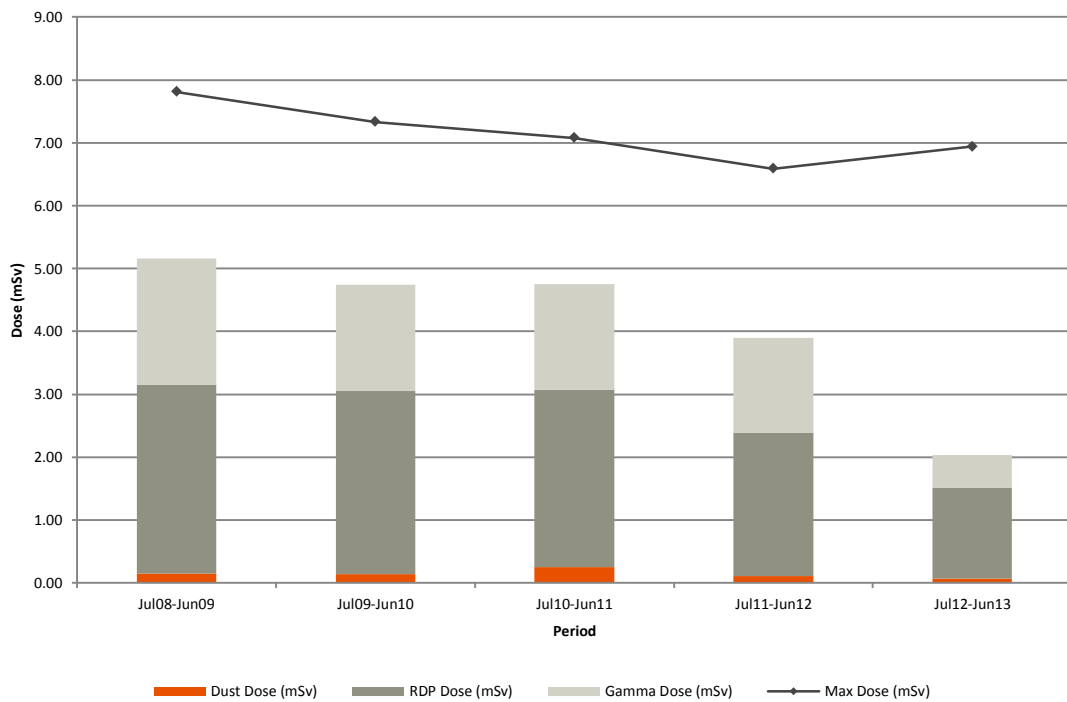


Figure 24 – Annual Dose Trends for the Raise Drilling Workgroup

Underground Services Full Time

The average dose has increased from 3.1 mSv to 3.6 mSv and the maximum dose has slightly increased from 5.3 mSv to 5.7 mSv. The exposures are in line with historic exposures.

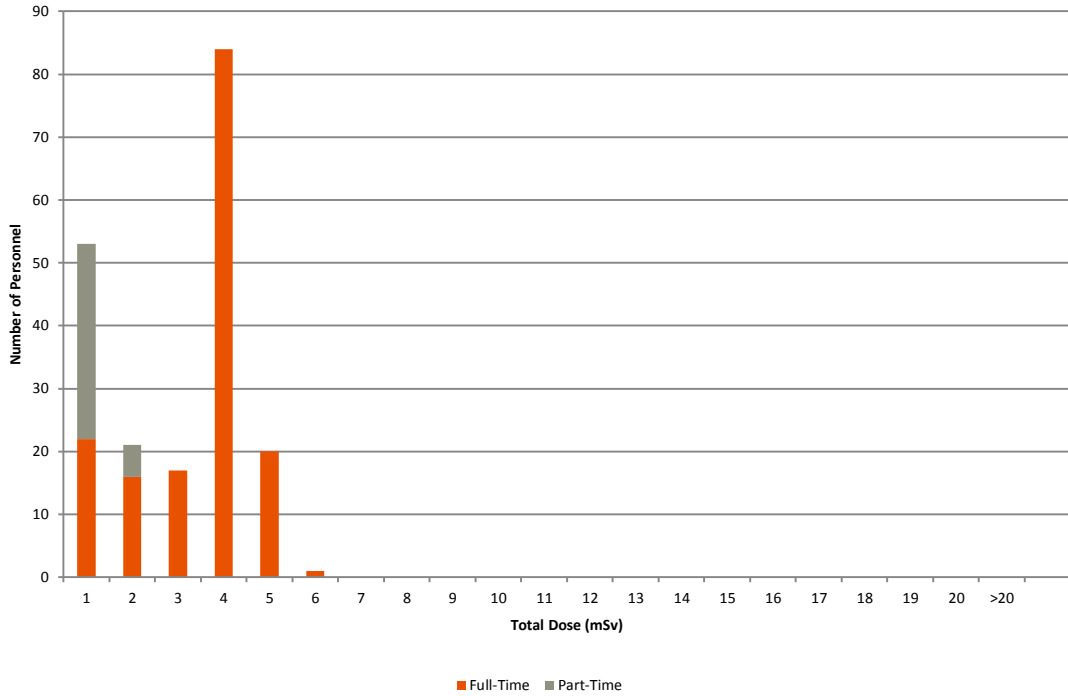


Figure 25 – Annual Dose Distribution for the Underground Services Full Time Workgroup

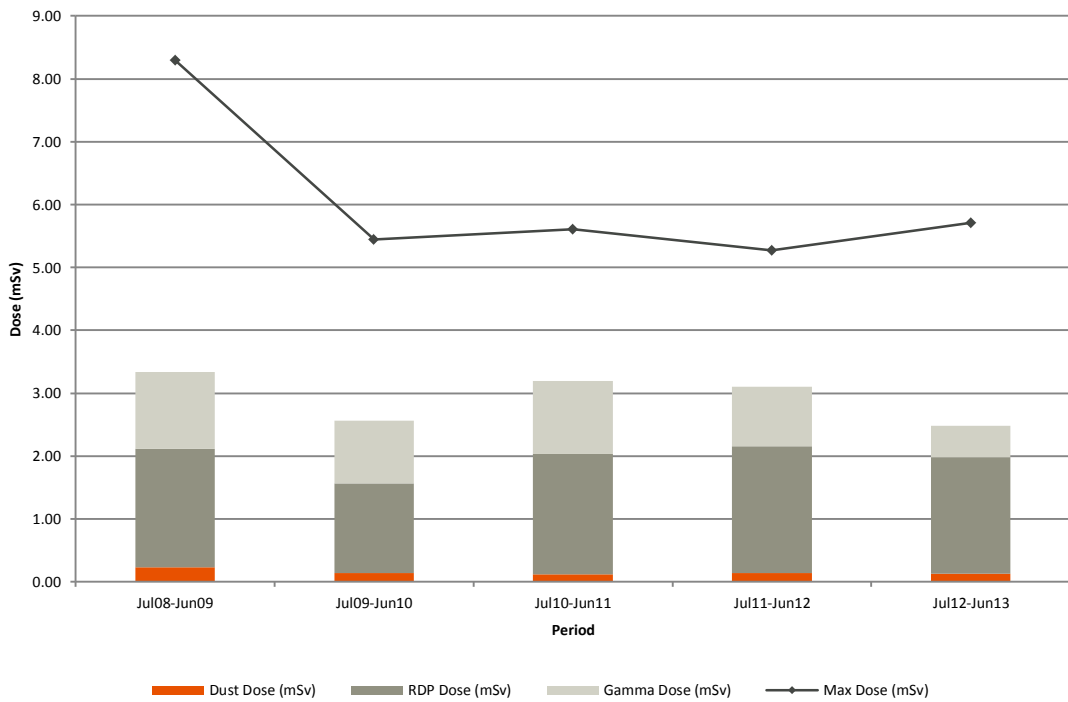


Figure 26 – Annual Dose Trends for the Underground Services Full Time Workgroup

3.1.3 Strategies for Dose Reduction

There is a continuous focus on reducing dose to workers at the mine and some of these measures include:

- Trial and implementation of Personal Alpha Dosimeters (PAD) for high risk underground workgroups to better assess their personal radon decay product exposure
- Trial of continuous radon decay product monitors
- Implementation of raise drill enclosed rig cabin to reduce radon decay product exposure
- Reviewing historical results and trending higher exposed workgroups

The mine ventilation department has continued to focus on ensuring that exposure to radon decay products are minimised 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 for the previous five years.

There were a total of 1064 designated Mine workers who worked continuously at the Mine during the period 1 July 2008 to 30 June 2013. This number has increased from the 649 workers reported for the period 1 July 2007 to 30 June 2012. The maximum dose for a Mine worker was 32.9 mSv for the five year period ending 30 June 2013, as compared with 31.3 mSv for the 2006/2007 to 2011/2012 five year dose period. The arithmetic mean for the group was 9.5 mSv, a decrease from 15.8 mSv for the five year dose period 2005/2006 to 2010/2011.

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

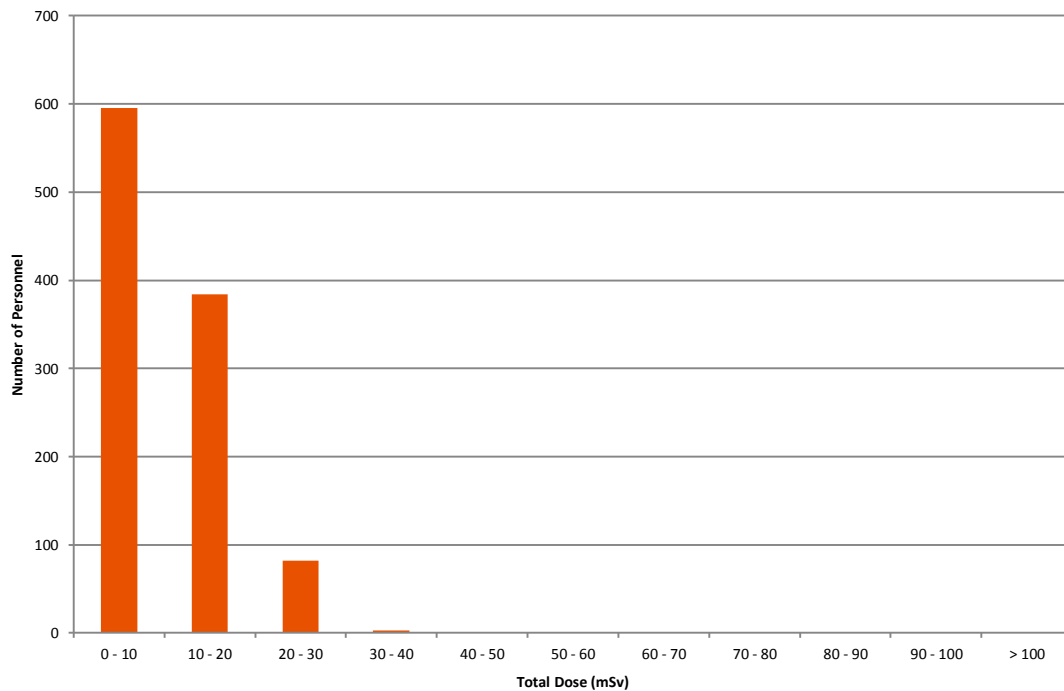


Figure 27 – Five Year Cumulative Dose Distribution Mine

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	1064	1064
Arithmetic Mean (mSv)	9.5	1.9
90th Percentile (mSv)	19.0	3.8
Min (mSv)	0.0	0.0
Max (mSv)	32.9	6.6
Mean % Dose from Dust	5%	
Mean % Dose from RDP	60%	
Mean % Dose from Gamma	35%	

3.2 Doses to Metallurgical Plant Workers

3.2.1 Descriptive Statistics

A total of 1460 full-time Metallurgical Plant workers' doses were calculated for the period 1 July 2012 to 30 June 2013. This included most BHP Billiton Olympic Dam Metallurgical Plant workers and associated contractors who work full time in the plant.

The process plant performed below the planned budget. Approximately 10 million tonnes of material (ore and slag) was milled producing a total of 166,201 tonnes of copper cathode, 4,102 tonnes uranium oxide concentrate, 113,240 ounces gold bullion and 880,223 ounces silver bullion.

The mean dose to all plant workers was 0.5 mSv in 2012/2013, a decrease from the 2011/2012 value of 1.9 mSv.

The mean dose for full-time plant workers was 0.8 mSv in 2012/2013, a decrease from the 2011/2012 value of 2.1 mSv.

The mean dose for part-time plant workers was 0.1 mSv in 2012/2013, a decrease from the 2011/2012 value of 0.4 mSv.

For this period the distribution of doses is shown in Figure 31, 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	1460	1554	3014
Arithmetic Mean (mSv)	0.8	0.1	0.5
90th Percentile (mSv)	1.7	0.3	1.4
Min (mSv)	0.0	0.0	0.0
Max (mSv)	5.4	1.3	5.4
Mean % Dose from Dust	80%	82%	80%
Mean % Dose from RDP	5%	3%	5%
Mean % Dose from Gamma	15%	15%	15%

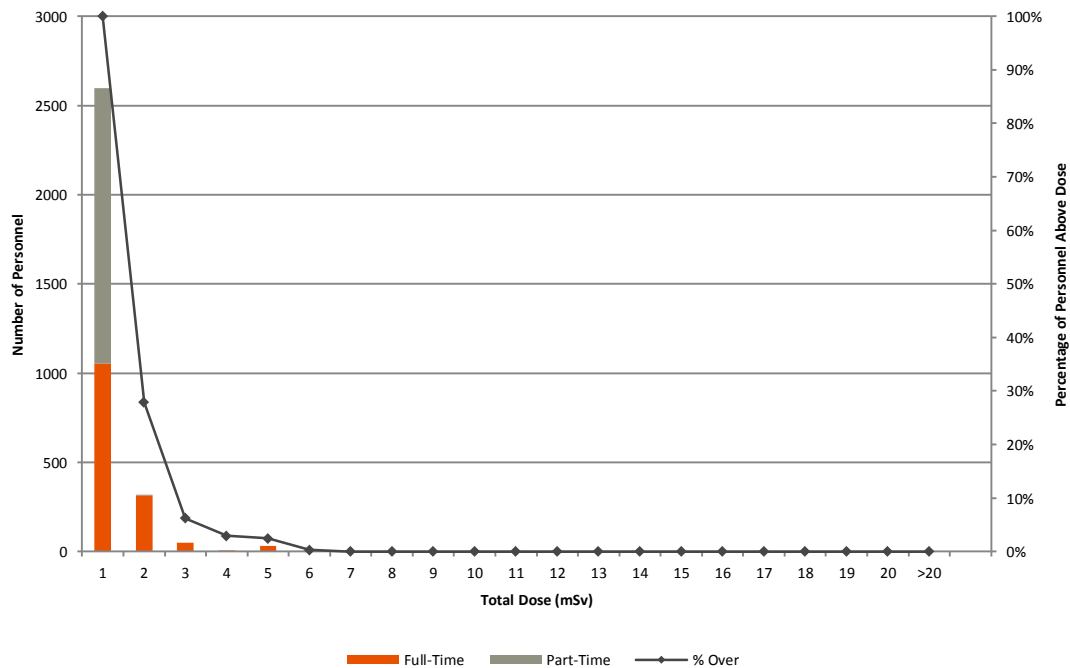


Figure 28 – Annual Dose Distribution for all Metallurgical Plant Workers

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 2012/2013 year from the Metallurgical Plant areas show most areas are in line with historical levels. There has been a decrease in average and maximum doses at the Concentrator. This is attributed to the redefinition and reclassification of the workgroups in Medgate.

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	143	0.56	0.00	1.30	1.04
Hydromet	235	0.89	0.01	4.13	1.63
Plant Services	422	0.44	0.00	2.32	0.71
Refinery	165	0.42	0.04	1.70	0.72
Smelter	495	1.35	0.04	5.43	2.40

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	60%	0.0	6%	0.2	34%
Hydromet	0.6	69%	0.1	7%	0.2	24%
Plant Services	0.3	70%	0.0	8%	0.1	22%
Refinery	0.3	75%	0.0	9%	0.1	16%
Smelter	1.2	89%	0.0	3%	0.1	8%

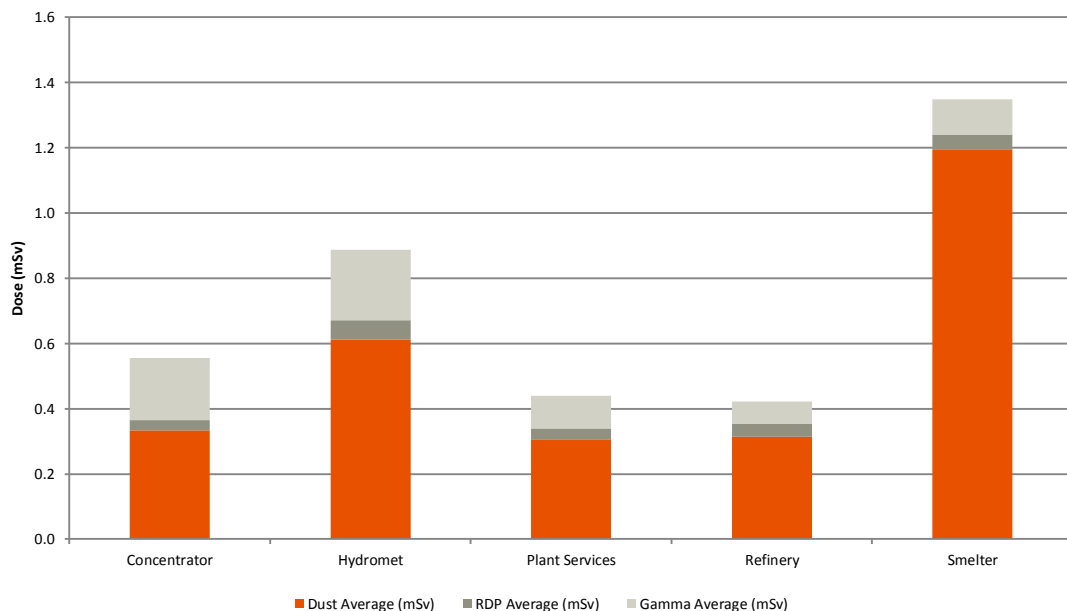


Figure 29 – Annual Dose Components by Metallurgical Plant Workgroup

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 1.6 mSv to 0.5 mSv while the maximum dose has also decreased from 2.2 mSv to 1.2 mSv. The average dose presents a sharp decline, especially in dust dose, from the previous year as a result of the redefinition of the workgroup in Medgate.

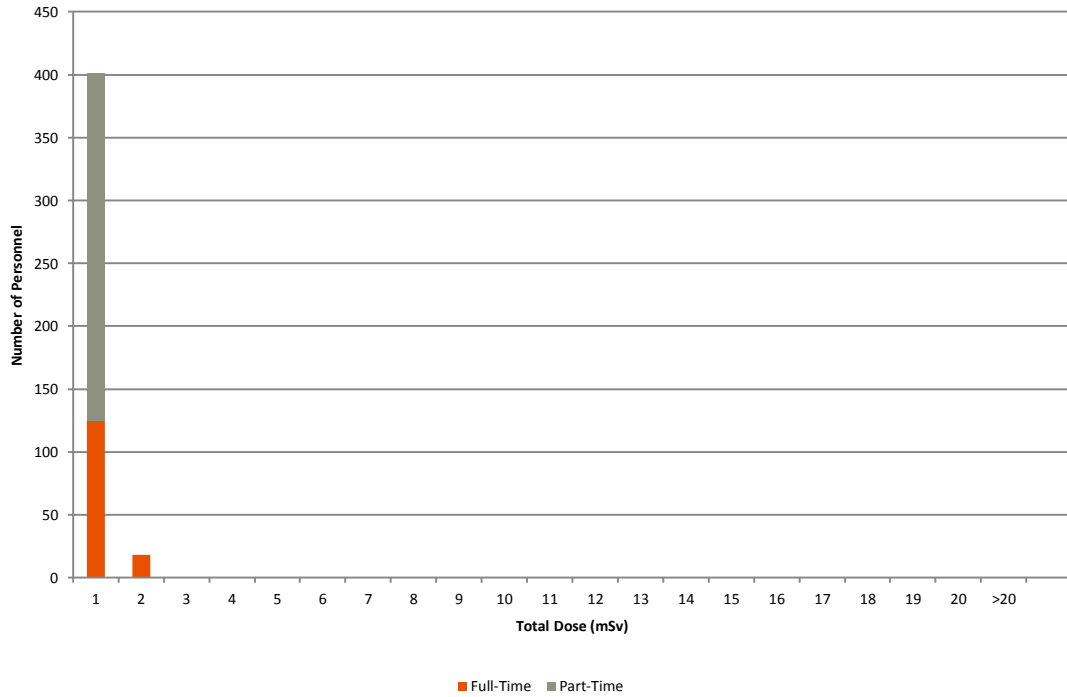


Figure 30 – Annual Dose Distribution for the Concentrator Workgroup

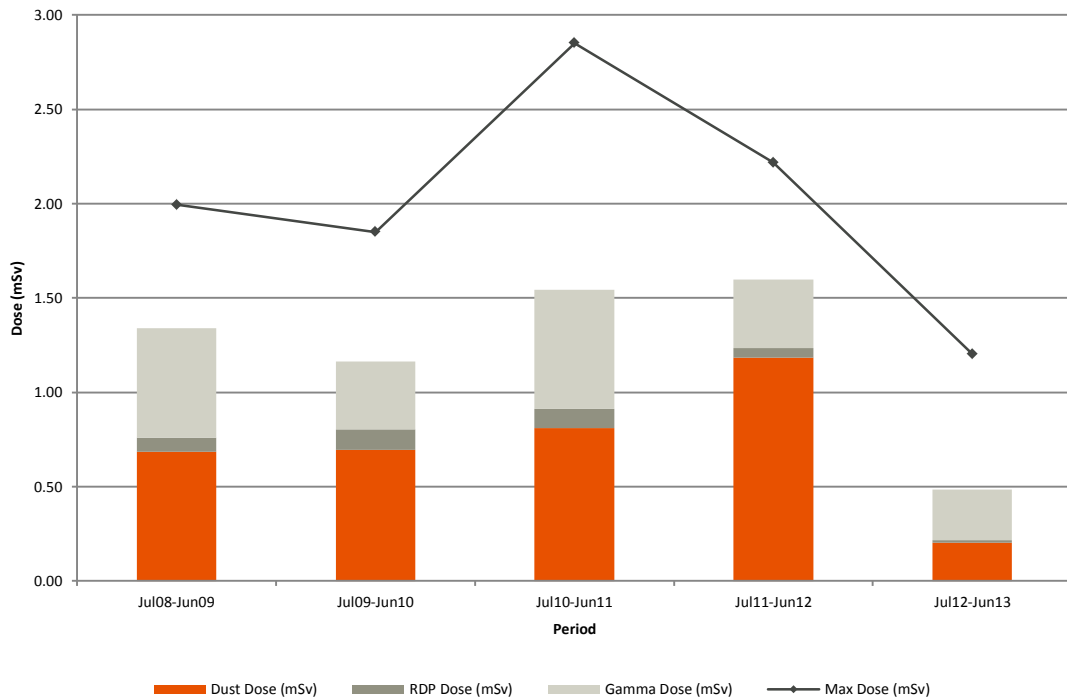


Figure 31 – Dose Trends for the Concentrator Workgroup

Hydromet

The average and maximum dose for Hydromet workers in 2012/13 were consistent with 2011/2012 levels.

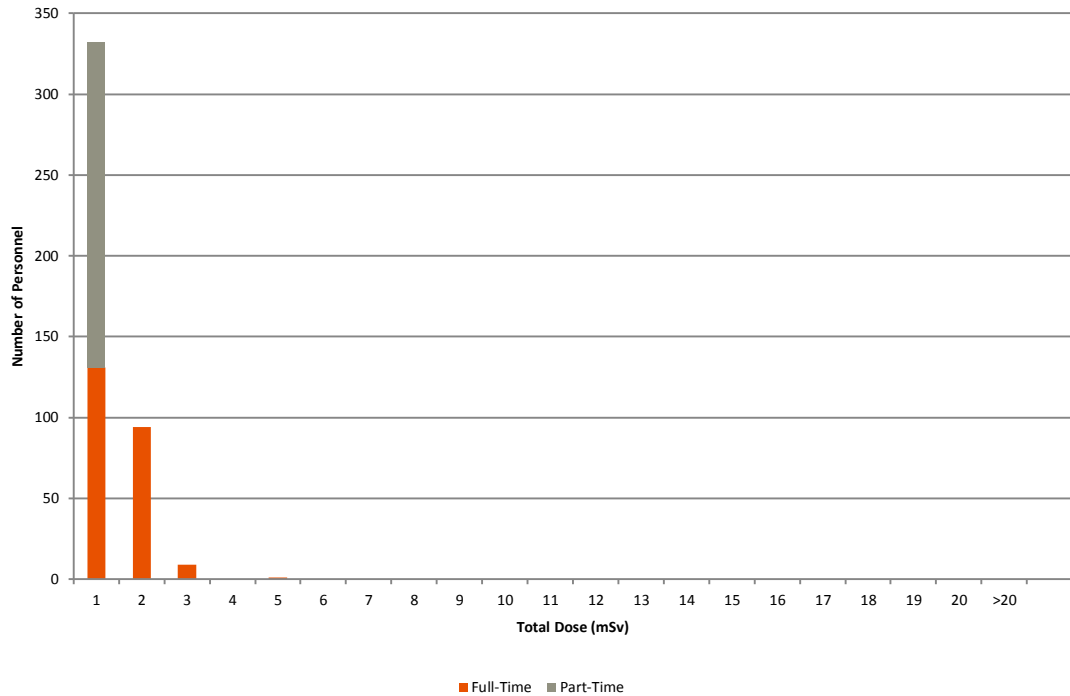


Figure 32 – Annual Dose Distribution for the Hydromet Workgroup

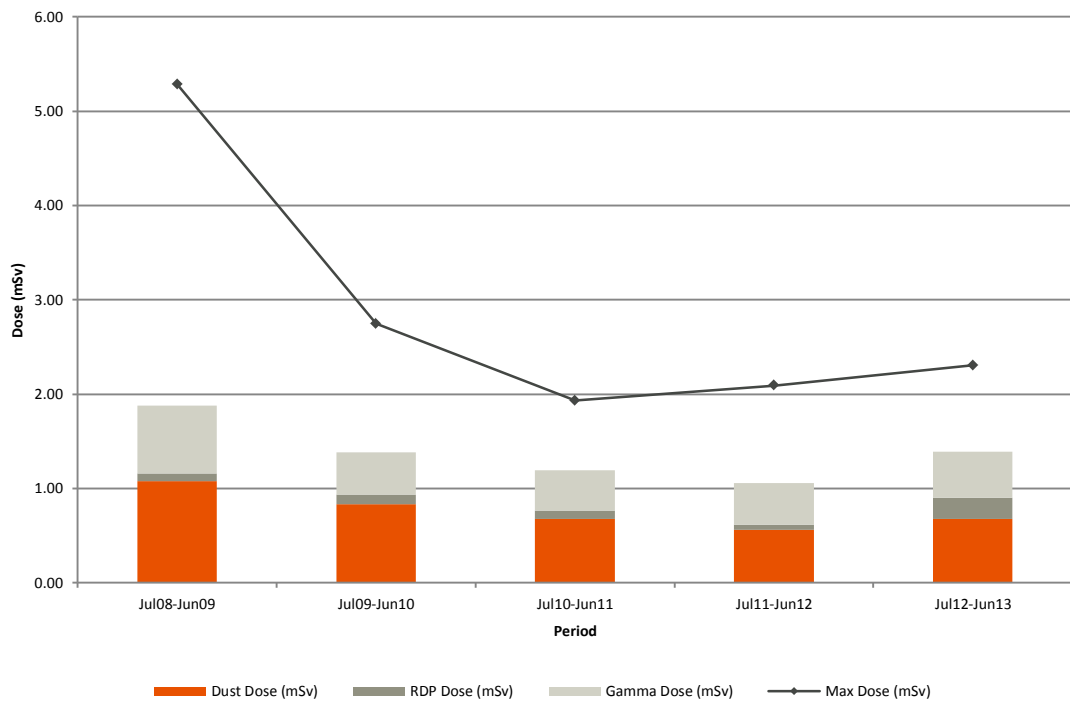


Figure 33 – Dose Trends for the Hydromet Workgroup

Smelter

Average doses in the smelter decreased to 2.8 mSv from 3.6 mSv. Maximum dose also decreased from 8.8 mSv to 5.4 mSv with the 90th percentile dose decreasing to 2.4 mSv. The smelter has continued to closely monitor Polonium 210 (Po210) 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.

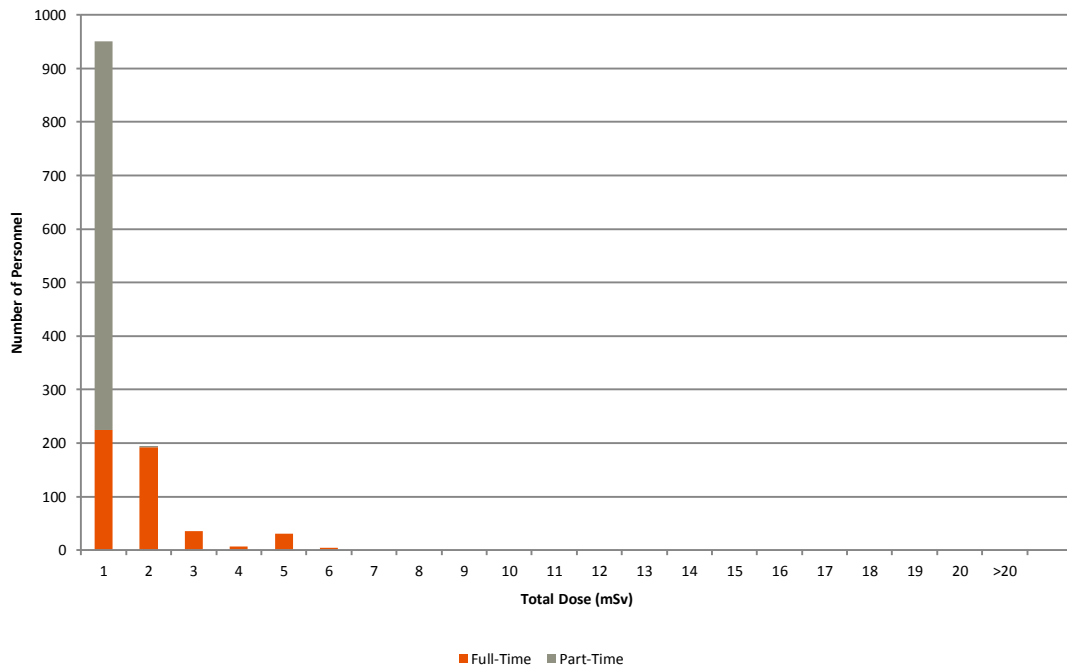


Figure 34 – Annual Dose Distribution for the Smelter Workgroup

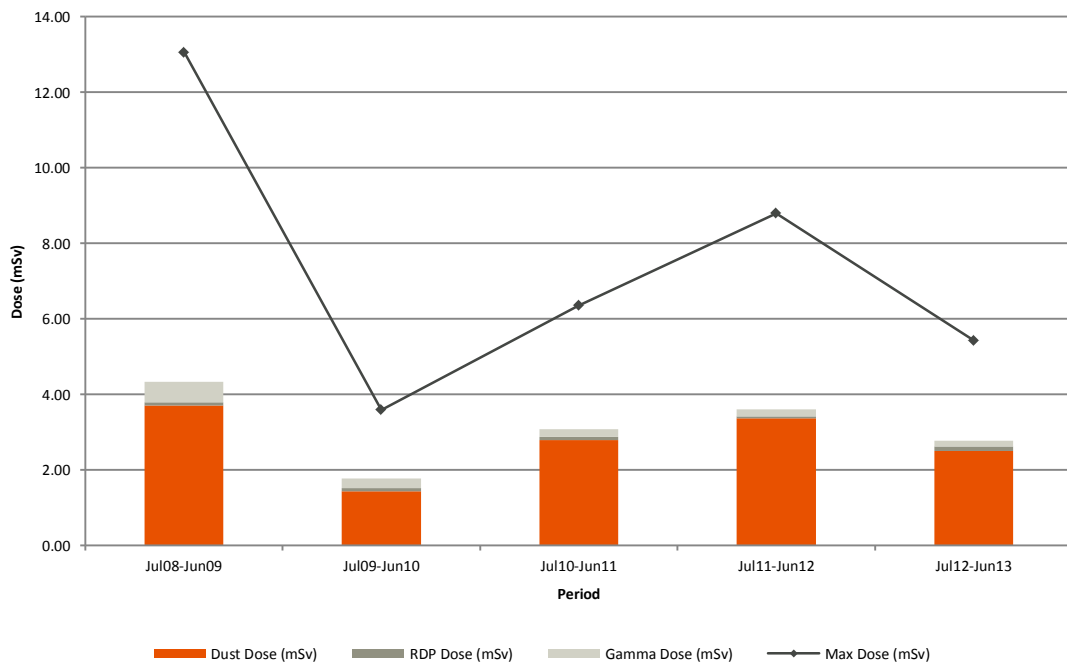


Figure 35 – Dose Trends for the Smelter Workgroup

Refinery

The Refinery workforce recorded the lowest annual average (0.35 mSv) of any designated workgroup in the Metallurgical Plant, while the maximum dose increased to 1.7 mSv.

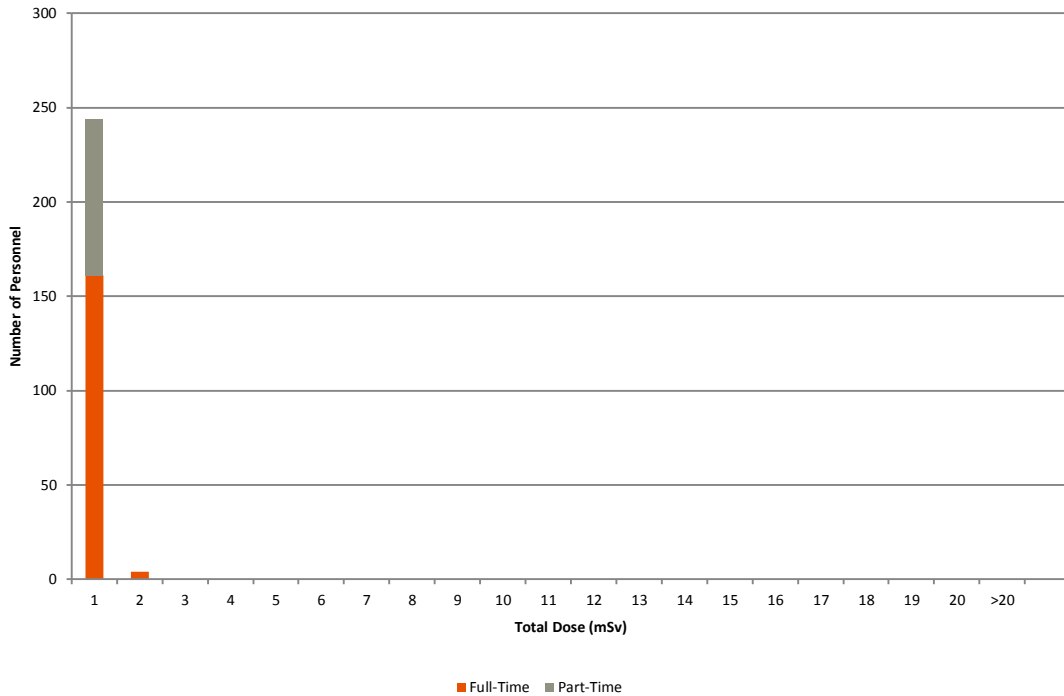


Figure 36 – Annual Dose Distribution for the Refinery Workgroup

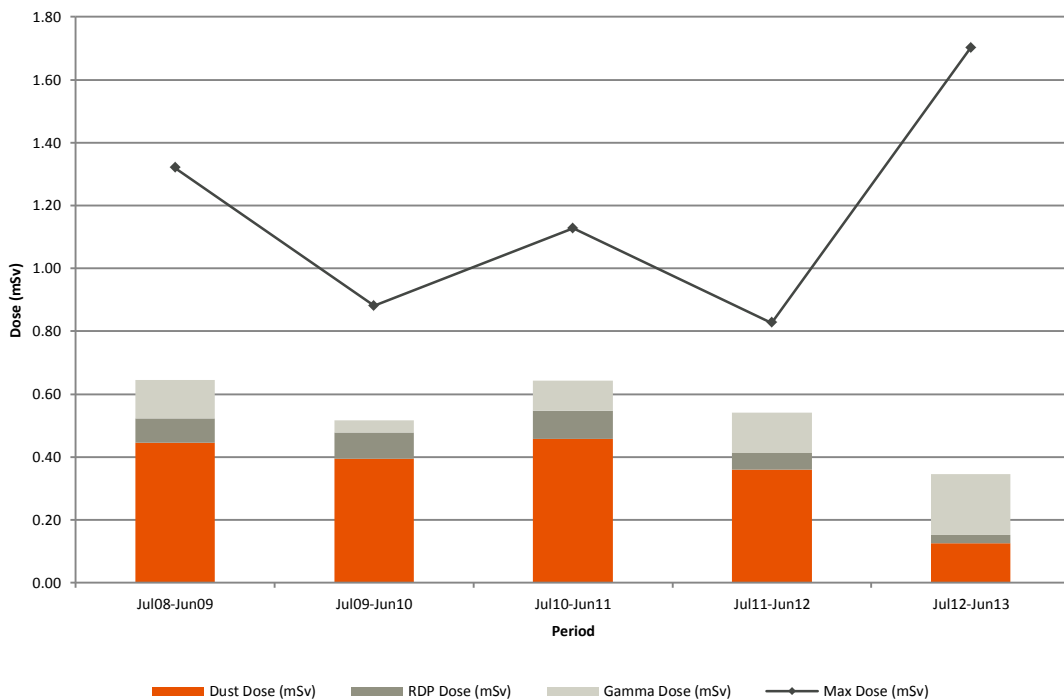


Figure 37 – Dose Trends for the Refinery Workgroup

Maintenance/ Services

The variable nature of the maximum dose is due to the fact that some of these personnel are spending time both underground and in the smelter building. The annual average dose increased from 1.2 mSv to 1.6 mSv as a result of an increase in the RDP dose.

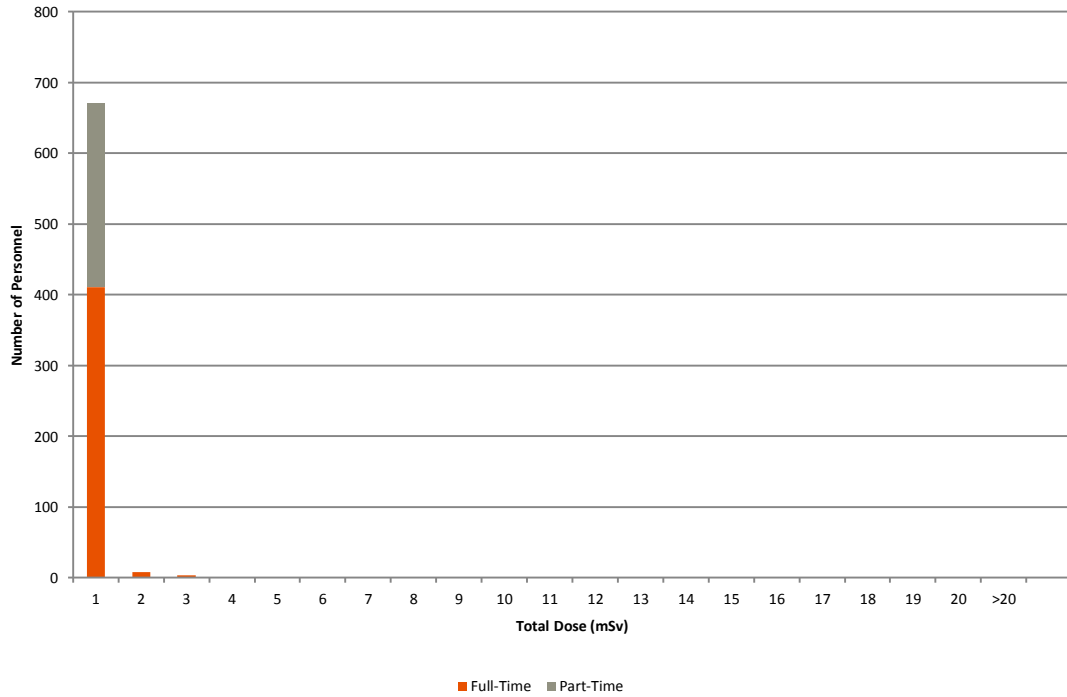


Figure 38 – Annual Dose Distribution for the Maintenance/Services Workgroup

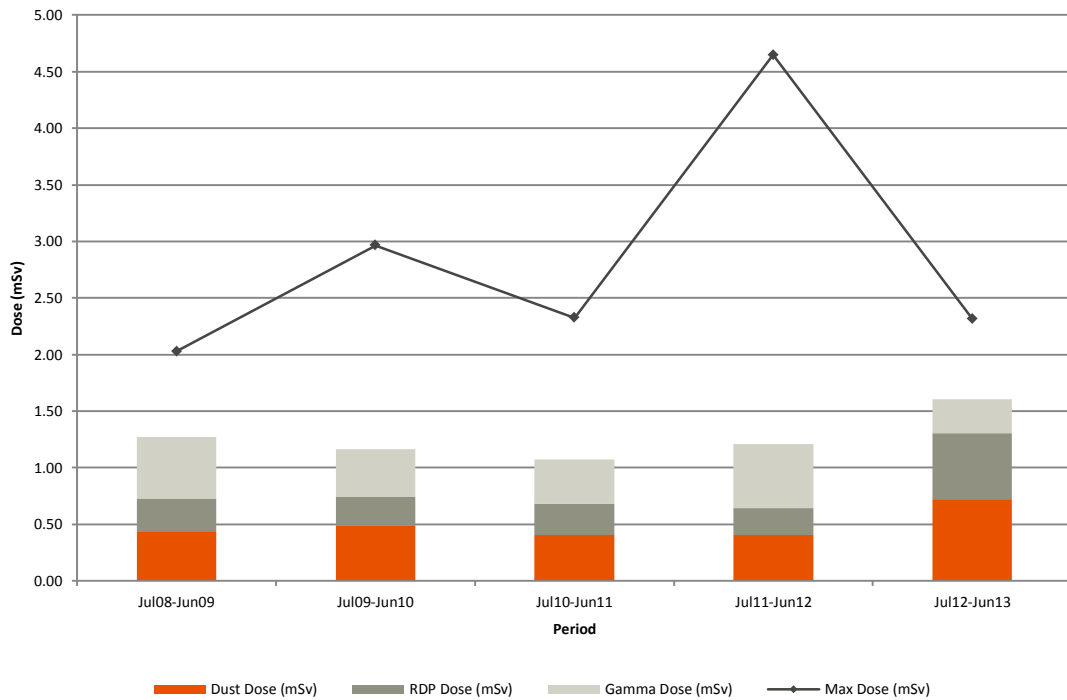


Figure 39 – Dose Trends for the Maintenance/Services Workgroup

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.

Monthly meetings are now in place to ensure that dust leach performance is compared against monitoring results. This ensures Smelter staff and in particular the area metallurgists are well informed of the effects and impacts of process changes. The radium content in slag is also currently being investigated to assess its contribution to total exposure.

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 impact on radioactive dust concentrations.

3.2.4 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 Metallurgical Plant workers who were employed at Olympic Dam for the previous five years.

There were a total of 288 designated Metallurgical Plant workers who worked continuously at Olympic Dam during the period 1 July 2008 to 30 June 2013.

The maximum dose for the five year period was 34.0 mSv, compared to the value of 35.2 mSv calculated in 2011/2012. The arithmetic mean for the five year dose period for the Metallurgical Plant has decreased from 10.9 mSv to 6.8 mSv. The distribution of doses for the cumulative five year dose is shown in Figure 40.

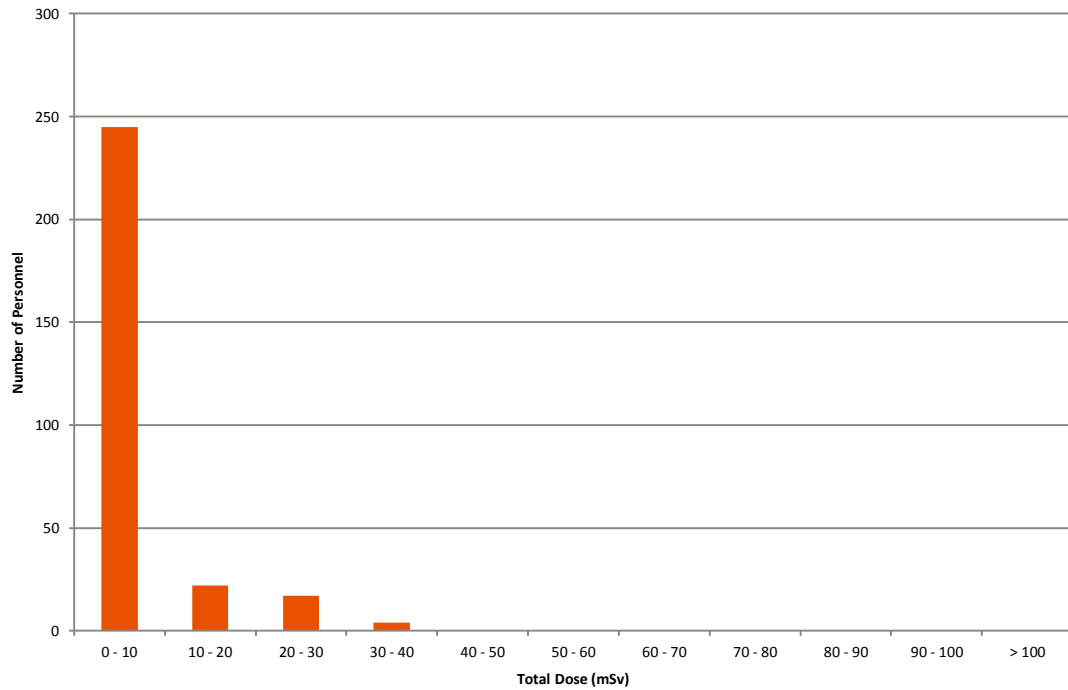


Figure 40 – 5 Year Cumulative Dose Distribution for Process Plant Workers

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	288	288
Arithmetic Mean (mSv)	6.8	1.4
90th Percentile (mSv)	14.0	2.8
Min (mSv)	0.0	0.0
Max (mSv)	34.0	6.8
Mean % Dose from Dust	48%	
Mean % Dose from RDP	28%	
Mean % Dose from Gamma	25%	

3.3 Annual Dose Trends

The average total effective dose to all workers at the Mine and Metallurgical Plant since 2008/2009 are shown in Figure 41 and Figure 42, respectively. The annual dose for the last year has been dominated by radon decay product exposure in the Mine and by dust exposure in the Process Plant, in particular, due to polonium-210 in the Smelter.

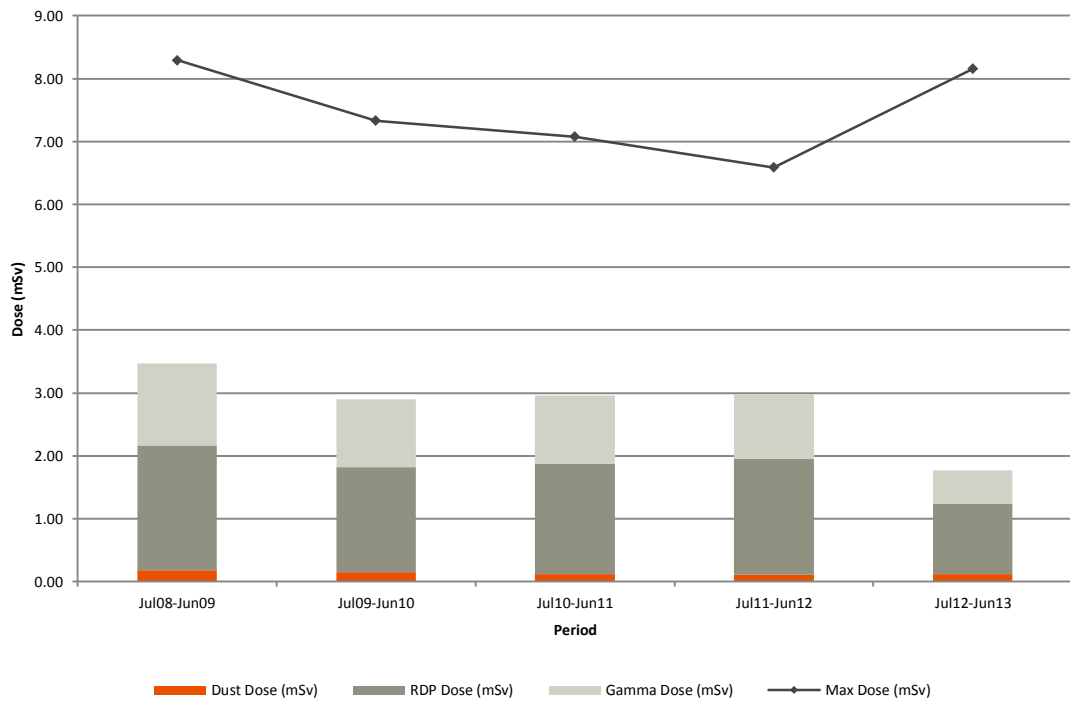


Figure 41 – Mine Annual Dose Trend

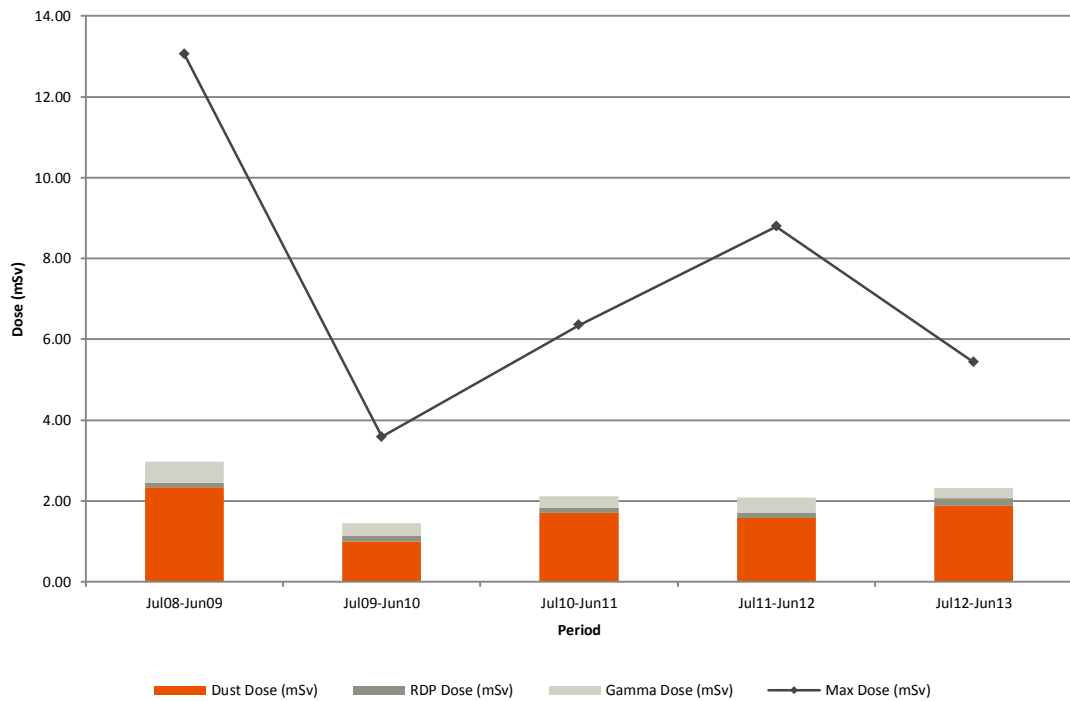


Figure 42 – Plant Annual Dose Trend

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 2012 to June 2013 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

2012/2013 Dose to Members of the Public Living at	Dose (mSv)	Dose Limit (mSv)
Roxby Downs	0.03	1
Olympic Dam Village	0.03	1

Figure 43 presents the public dose trends for Olympic Dam Village and Roxby Downs since 2004. The FY13 dose to the members of the public has continued to remain below the minimum detection limit of 0.048 mSv.

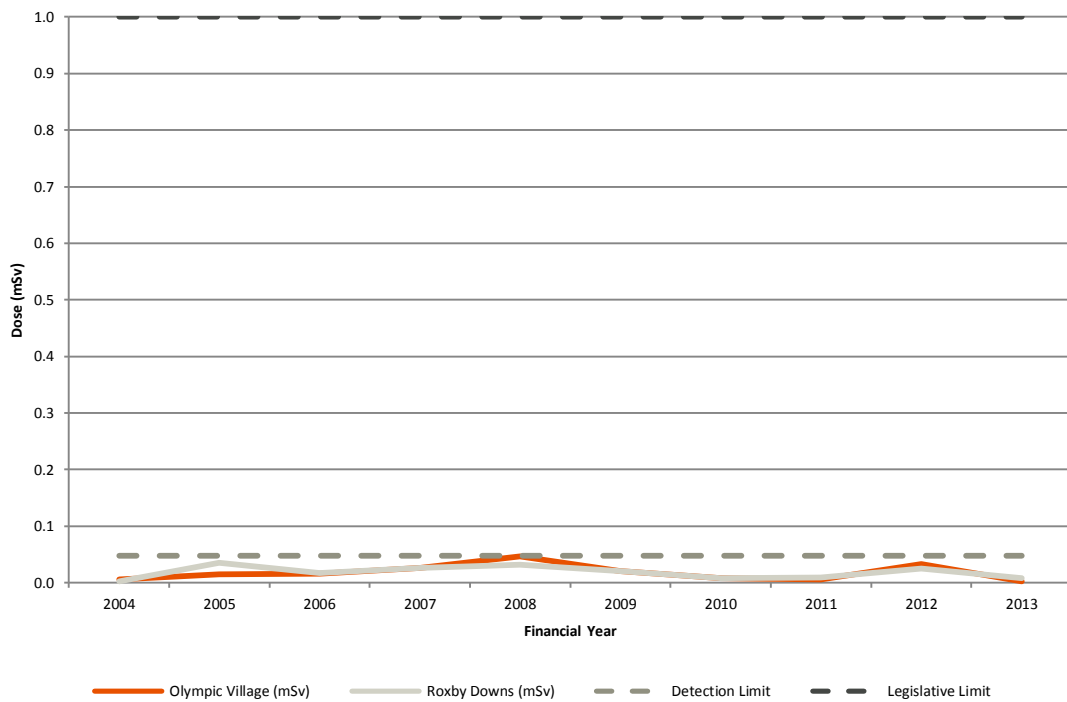


Figure 43 – Total Dose Trend for Olympic Dam Village and Roxby Downs

Appendix A

Dose Conversion Factors 2012/2013

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 ($\mu\text{Sv}\cdot\text{m}^3/\text{Bq}\cdot\text{hr}$)
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 $1.41 \text{ mSv}\cdot\text{m}^3/\text{mJ}\cdot\text{hr}$ (5 mSv/WLM).