Dose Monitoring to Dose Optimisation: The Challenge in the Large Scale Mining and Processing of Radioactive Ores

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Location – Olympic Dam South Australia

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Overview of BHP Billiton Olympic Dam

- Large underground mining operation
- Complex Process Plant purifying four final products
  - 9.7 million tonnes ore milled
  - 200 000 tonnes LM Grade 1 copper
  - 4 000 tonnes 98% pure U3O8
  - ~100 000 Oz Gold
  - ~ 900 000 Oz Silver
- All products (except U3O8) free of radioactivity (site standard 0.37Bq/g)
- Approximately 3000 workers with 900 of them designated workers for radiation control

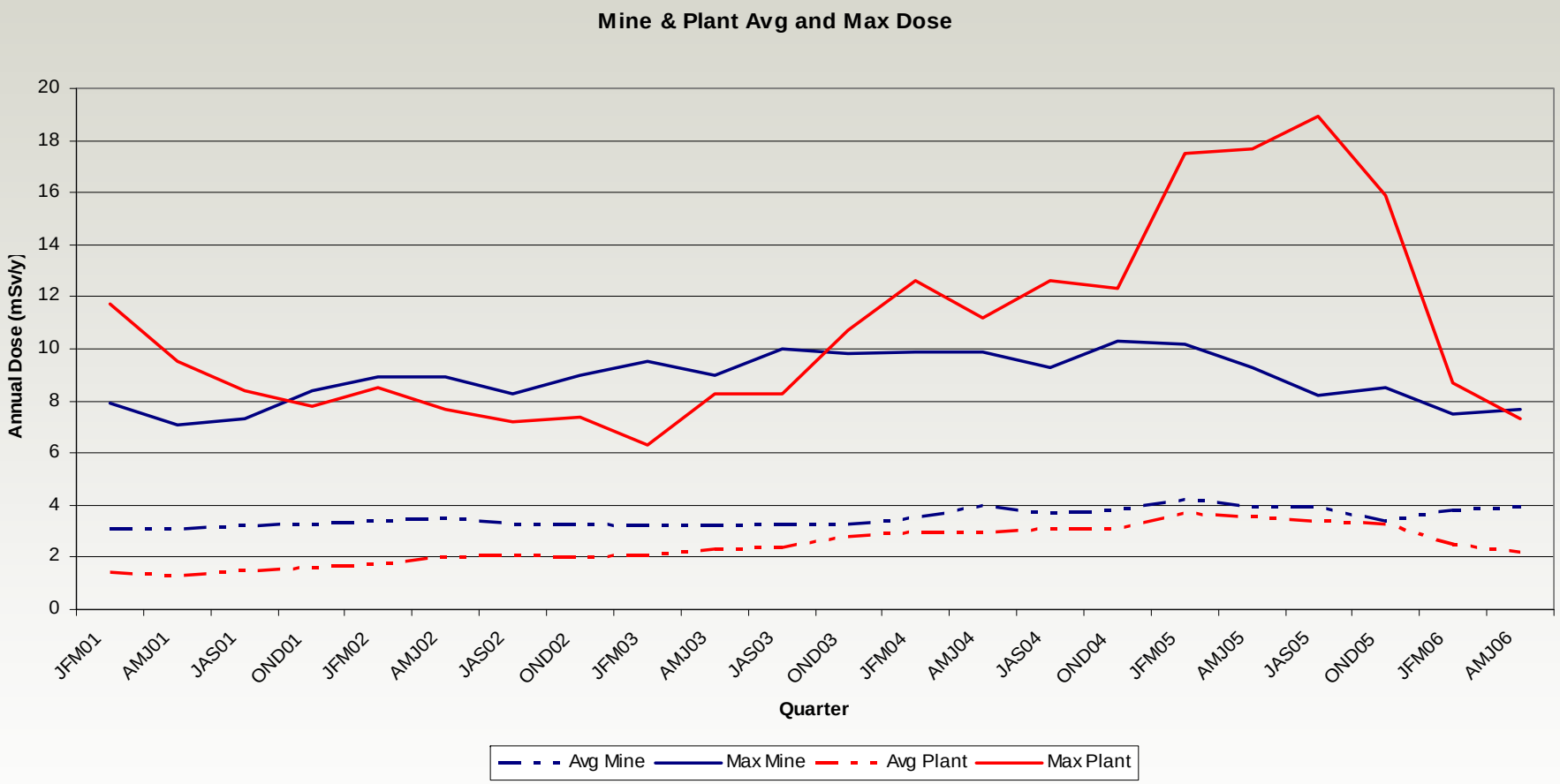
The Past

- Operation been developing and expanding
- “Bursts” of activities related to exploration, expansions, EIS’s, and construction
- Monitoring and development compliments the changes in operations
- Focus on compliance monitoring although initially there was also a significant “understanding” component
- High reliance on “grab” sampling or integrating monitors
- Development of new techniques and adoption of new technologies only during initial and “burst” phases

The Consequences

- Because of the large scale and number of designated personnel sample analysis take considerable time and resources
- Radiation Management Plans complex and hard to change
- Review of dose histories required sample analysis to be performed, individual time data to be entered and then conversion to individual doses
- Long term trends analysed annually
- Strong focus on compliance monitoring and lower focus on analysis
- Understanding of all radionuclides in the uranium series and their properties a challenge due to the complexity of the operation and the range of products being produced

Dose history for mine and process plant



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Process plant doses – Need for change in approach

- The dose history for the process plant shows the need for a change from compliance monitoring to dose optimisation
- Response to increases in dose were slow and there was uncertainty in causes of dose changes
- Conservative approaches become the default and over-estimation of doses become common (e.g. no respiratory protection factor for the use of half face respirators)
- Doses approached the 20 mSv annual limit despite a long initial lead time
- Changes, when implemented, give immediate reduction in dose

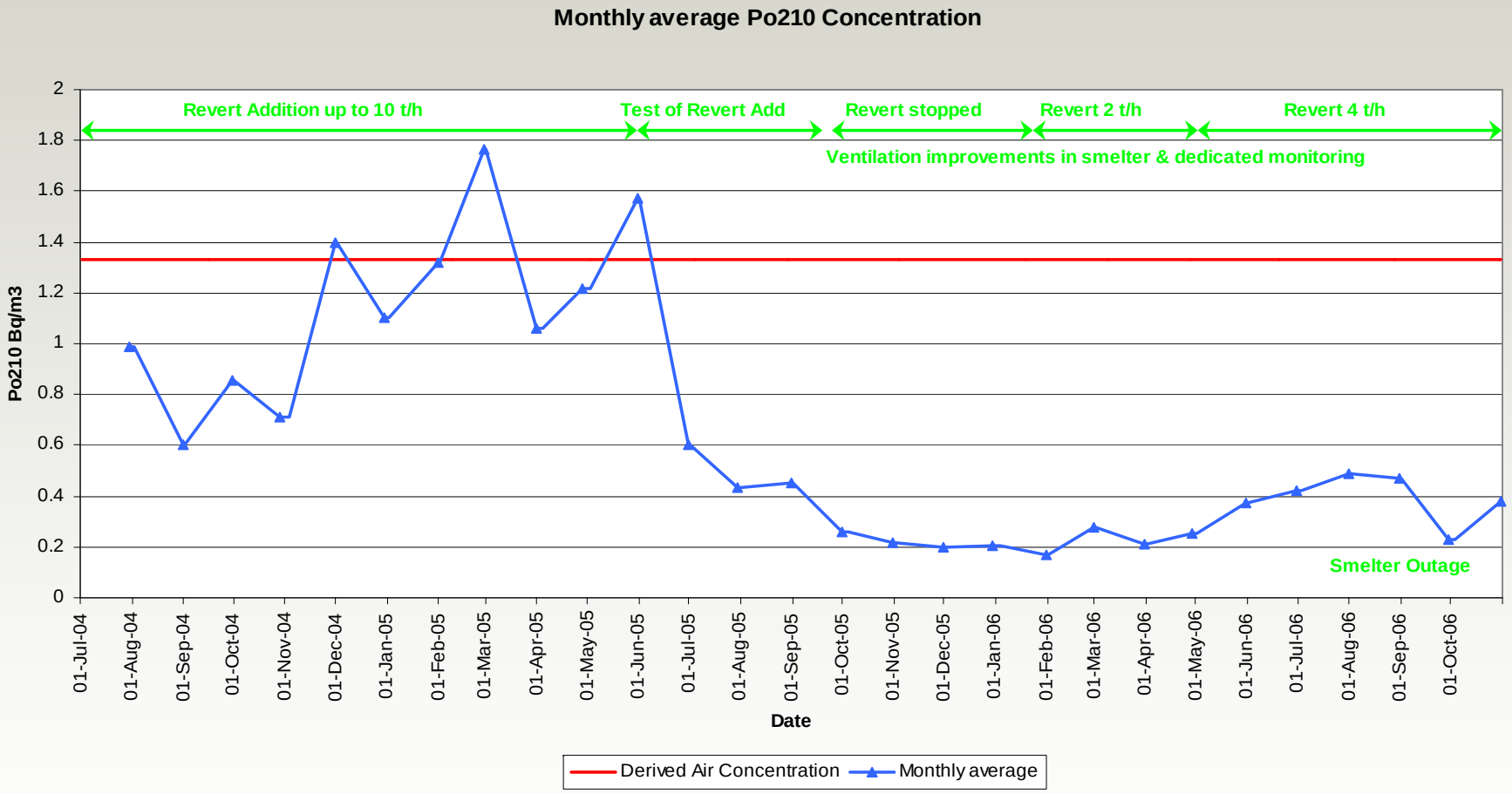
The Po210 and Revert Story A Case Study

- Revert, an untreated slag, contains Pb210 when created
- Revert stockpiled for extended period and reprocessed for copper recovery when processing capability available
- Po210 had ingrown and is driven off in fume when melted
- Alpha concentrations in smelter air increases
- Delays in isolating cause of the increase
- Lag between revert additions or reductions and airborne activities

Po210 and Revert – The actions

- Suspension of the addition of revert
- Increase in ventilation around the electric furnace
- Dedicated monitoring program for revert
- Stepped approach to revert additions (i.e. 2 t/h, 4 t/h, 6 t/h)
- Approval for revert addition subject to RSO analysis of monitoring results
- Rapid analysis of results and feedback to the workforce

Po210 and Revert Trends



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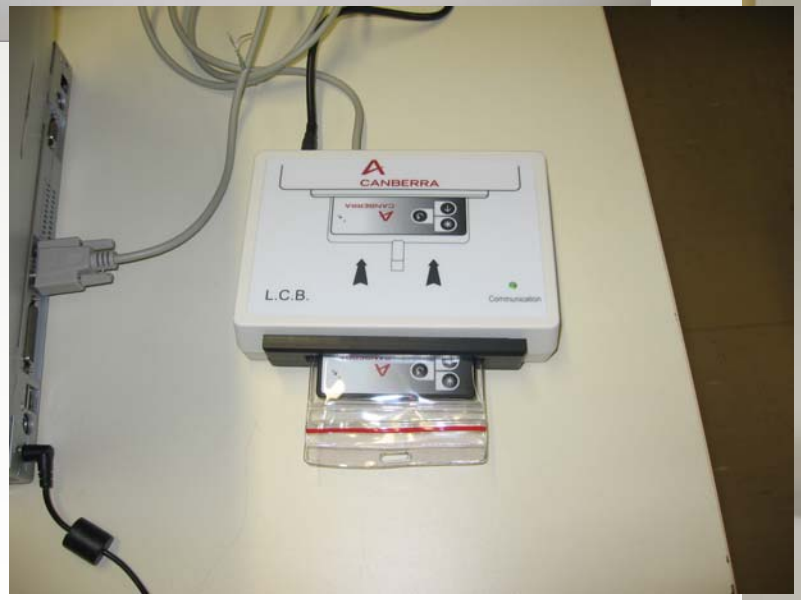
The Future

- Move to real time, continuously recording technology
- Prioritisation of real time monitoring based on dose results
- Quick interpretation of results with feedback to individuals and workgroups
- Relate dose to task
- Focus on achieving real reductions in dose
- Often can provide operational benefit and enhanced understanding

Radon Decay Product and Gamma Technology



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Conclusion

- Compliance monitoring alone is not sufficient
- As size and complexity increases, dose optimisation becomes more difficult
- Understanding of the causes of doses needed
- Need for better instrumentation and associated systems to ensure doses remain optimised
- Good dose control goes hand in hand with good operations