HEALTH AND SAFETY 22

22.1 INTRODUCTION

In recent years, programs that focus on public safety, workplace design, management systems and positive safety culture have improved health and safety performance across the mining industry. At Olympic Dam, fatalities and injuries have followed this trend and are considerably less than the Australian industry average.

However, health impacts, accidents and incidents continue to occur and the improvement of systems and an ongoing focus on health and safety remain priorities for the Australian mining industry.

The overriding commitment of the BHP Billiton Group to health and safety is reflected in its group policy and group-wide standards. These underpin systems and practices to prevent accidents and to control and minimise exposure to toxic or hazardous materials and situations.

The proposed expansion increases and adds health and safety related challenges, notably the introduction of an open pit mine and the large scale of the construction activities.

This chapter:

- outlines BHP Billiton's approach to health and safety and the issues facing the proposed expansion
- sets out how the project has been designed to manage and reduce risks associated with both routine activities and unplanned events, particularly the control of radiation and transport safety
- describes systems for emergency response
- addresses the process of ongoing assessment and continuous improvement of health and safety performance.

Controlling radiation doses to workers is an area of particular management focus and attention. The monitoring of dose levels indicates that doses have remained consistently below internationally adopted limits.

Specific safety related details of the operational components of the expansion are being developed and would continue to be refined throughout the detailed design stage of the project. As a consequence, this chapter focuses on the systems, policies and approaches to health and safety.

22.2 ASSESSMENT METHODS

The methods used to assess health and safety involved:

- reviewing the policy and approach of the broader BHP Billiton Group to health and safety
- reviewing the existing management systems, policies and approaches to health and safety at the current operation (i.e. those of BHP Billiton)
- reviewing the data from published reports and databases for the current Olympic Dam operation
- comparing the health and safety performance of the current operation with other mining operations in Australia and internationally
- identifying and assessing the key areas of health and safety concern that would arise from the proposed expansion by considering the changes that arise from the proposed expansion, the specific issues identified in the governments' EIS Guidelines and through a review of the issues raised during the public consultation program (see Chapter 7, Stakeholder Consultation and Engagement)
- an iterative process of assessing impacts, refining the project design and identifying management measures as discussed in Chapter 1, Introduction (see Section 1.6.2 and Figure 1.11).

A detailed discussion of the methodologies and assessments of radiation doses is provided in Appendix S, and a summary is provided in this chapter.

For each main component of the proposed expansion a formal risk assessment workshop was conducted for unplanned events (see Appendix C for details), and the findings are summarised in Chapter 26, Hazard and Risk.

22.3 THE BHP BILLITON GROUP APPROACH TO HEALTH AND SAFETY

The basis for the BHP Billiton Group's approach to health and safety is the BHP Billiton Group Charter, in which 'an overriding commitment to health, safety, environmental responsibility and sustainable development' is a core business value. Supporting the Charter is the Sustainable Development Policy, which includes the commitment that 'safety values are not compromised' (see Appendix E5 for the Charter and Sustainability Policy).

Further details of the approach to health and safety are provided in standards that apply to BHP Billiton Group operations worldwide. All operations are required to conform to management standards which cover areas such as:

- Leadership and Accountability
- Legal Requirements and Document Control
- Risk and Change Management
- Planning, Goals and Targets
- Awareness, Competence and Behaviour
- Health and Hygiene
- Communication, Consultation and Participation
- Business Conduct, Human Rights and Indigenous Relations
- Design, Construction and Commissioning
- Operation and Maintenance
- Suppliers, Contractors and Partners
- Stewardship
- Incident Reporting and Investigation
- Crisis and Emergency Management
- Monitoring, Audit and Review.

Plate 22.1 Safety Management System – permit to work

Health and safety guidelines, toolkits, protocols, risk assessment frameworks and programs are provided to employees and contractors to support the approach (see Plate 22.1).

BHP Billiton Group business guidelines and toolkits

To complement the requirements of the health, safety, environment and community (HSEC) standards, the BHP Billiton Group has developed a series of guidelines for health and safety related issues. These guidelines provide practical advice and assistance and cover risk management, the design of mine roads, methods of suppressing dust on haul roads, mine operations networks, drilling guidelines, managing diesel emissions, open pit operations, working in confined spaces, employee assistance programs, safeguarding equipment, ergonomic analysis, evacuation activities, explosives, fatigue management, first aid treatment for electric shock, hazardous materials management, assessing health exposure, hearing conservation, high voltage isolation, incident management, equipment isolation, lifting operations, light vehicles, manual metal arc welding, molten materials management, occupational rehabilitation, permit to work, personnel protective equipment (PPE), ground control, mobile equipment and working at heights.

Health and safety is managed through a hierarchy of controls which involves:

- eliminating the hazard through proper design
- substituting materials or processes with a less hazardous alternative
- redesigning equipment or the workplace
- separating the hazard by guarding or enclosing it
- administering controls with training or systems
- providing PPE.

Fatal Risk Control Protocols

Risks that have previously resulted in a fatality or could result in a fatality are extremely important within the BHP Billiton Group safety management systems and the BHP Billiton Group maintains a series of company-wide control protocols for potentially fatal risks.

There are 10 Fatal Risk Control Protocols covering:

- light vehicles
- surface mobile equipment
- underground mobile equipment
- underground ground control
- hazardous materials management
- molten materials management (see Plate 22.2)

- equipment safeguarding
- isolation
- working at heights
- lifting operations.

Risk management

The BHP Billiton Group uses a proprietary risk management standard to manage risk throughout its operations.
It comprises seven main components:

- risk rating and ranking
- risk assessment
- post-event analysis
- risk control assurance
- cost-benefit analysis
- risk management terminology
- control framework.

In undertaking the risk assessment for the Draft EIS, an independent approach to risk assessment has been adopted, which was adapted from several risk standards, including:

- Australian Standard (AS) Risk Management Guideline (AS 4360:2004, HB 436)
- AS Environmental Risk Management – Principles and Process (AS 4360:2004, HB 203)
- AS Guideline to Managing Risk in Outsourcing (AS 4360:2004, HB 240)
- National Mineral Industry Health and Safety Risk Assessment Guideline (2005)
- the BHP Billiton Group proprietary risk management standard.

The approach to risk assessment and risk management is discussed in Chapter 26, Hazard and Risk.

Well-being programs

The BHP Billiton Group sponsors employee well-being programs throughout its operations. The 'Fit For Work – Fit For Life' initiative seeks to promote a consistent approach to managing health issues in the work environment and workforce.
The program includes:

- drug and alcohol management
- fatigue management
- medical assessment
- travel health
- ergonomic analysis
- occupational rehabilitation
- health promotion
- employee assistance.

Plate 22.2 Engineered fume extraction and personal protective equipment used by a smelter tapper

22.4 EXISTING HEALTH AND SAFETY AT OLYMPIC DAM

This section outlines the health and safety aspects of the current operation that are most relevant to the proposed expansion.

The BHP Billiton Group approach to occupational health and safety has been progressively implemented at Olympic Dam since it acquired WMC Resources Limited in June 2005. Systems, policies, guidelines, toolkits and programs emphasising continuous improvement now form the basis for managing health and safety, and these would continue to be used for the proposed expansion.

In considering the health and safety aspects of the current operation, it is important to note that hazards and risks are encountered in all industries, including mining. These are usually characterised as either chronic or acute and this distinction is important because different management measures are usually necessary to control chronic exposure hazards and acute exposure hazards.

Chronic exposure hazards, such as exposure to noise, hazardous chemicals, radiation and dust, can result in injury or illness after prolonged exposure. These types of hazards are not always noticeable, and monitoring measures are usually necessary to detect their presence and measure their impact. Exposure limits are determined through health and other scientific studies that provide the levels at which unacceptable health effects can occur. Compliance limits are set below these levels to ensure that health effects are minimised.

Acute exposure hazards, including explosions, rock falls, manual handling, vehicle accidents, fire, hazardous chemicals and slips, trips and falls, can result in immediate or short-term injury or illness. These hazards are identified through audits and accident and incident analyses, and are controlled through risk management systems.

The main health and safety aspects of the current operation are described below.

22.4.1 OCCUPATIONAL EXPOSURE TO AIRBORNE POLLUTANTS

Airborne pollutants consist of dusts and gases. Atmospheric dust is made up of a range of different constituents from inert material through to irritants and toxics. Pollutant gases are generated from industrial and natural processes. The health effects of prolonged exposure to dusts and gases are well documented (for example Lewis 1999 and Harris 2000) and may include respiratory tract irritation, infections, allergic responses and, in extreme cases, poisoning or cancer. Other factors that influence the particular impact on health include the size of the dust particles and period of exposure to the pollutants. International and national exposure limits are developed to ensure that any effects of airborne pollutant exposure are minimised or non-existent.

Acceptable exposure limits are determined at an international level and are based on extensive toxicological and epidemiological studies. In Australia, the National Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC:1003 1995) define the acceptable exposure standards that are adopted by the industry to protect employees.

The Olympic Dam hygiene monitoring program shows that, in general, airborne contaminants are well controlled. However, the monitoring results have also identified some situations where control limits have been exceeded within the metallurgical plant and underground mine. In such cases, personal protective equipment (PPE) has been used to control employee exposures, while engineering or process solutions have been implemented to rectify the situation. One such area is the smelter, where a number of activities have resulted in short-term airborne concentrations of sulphur dioxide above relevant standards. Appropriate PPE is mandatory for these activities and the protection it affords ensures that workers' exposure to sulphur dioxide is below applicable limits.

22.4.2 OCCUPATIONAL EXPOSURE TO NOISE

The relevant regulations for noise exposure standards are the South Australian Occupational Health, Safety and Welfare Regulations 1995, along with the Occupational Health and Safety Welfare Variation Regulations 2004 and the National Code of Practice for Noise Management and Protection of Hearing at Work (NOHSC:2009 2004). The exposure standard is an eight-hour equivalent level of 85 dB (A weighted) with a peak level of 140 dB (C weighted). For shifts longer than eight hours, there is a lower exposure compliance level. For example, for 12-hour shifts the standard is 83 dB (A weighted), with a peak of 140 dB (C weighted).

Although every effort is made to control noise in industrial settings, it is sometimes difficult to control it entirely through engineering design. In the current operation, management systems, complemented by noise attenuation shielding, well maintained and serviced equipment and the mandatory use of PPE (e.g. earmuffs or earplugs in high-noise areas), ensures that the workers' exposure to noise remains controlled and within relevant exposure limits.

Currently, noise emissions from the Olympic Dam operations do not have an impact on public health and safety.

22.4.3 EXPOSURE TO RADIATION

Radiation exposure is one of the potential hazards encountered in the mining and milling of radioactive ores and it can be controlled through effective design and management practices. Radiation hazards are often misunderstood and an overview of radiation exposure, as an educational tool, is provided in Appendix S1. An overview of occupational exposure to radiation in the current Olympic Dam operation is provided below.

Approach to radiation safety

Olympic Dam uses international standards and Australian legislation as the basis for its systems of radiation protection. The International Commission on Radiological Protection (ICRP), which is the premier international body for radiation protection, has recommended a 'system of dose limitation' that has been widely adopted overseas and in Australia. The system has three key elements:

- justification – a practice involving exposure to radiation should only be adopted if the benefits of the practice outweigh the risks associated with the radiation exposure
- optimisation – radiation doses received should be as low as reasonably achievable, taking into account economic and social factors (the ALARA principle)
- limitation – individuals should not receive radiation doses greater than the recommended limits.

The system is incorporated into legislation in Australia through:

- the South Australian *Radiation Protection and Control Act 1982* (and supporting Radiation Protection and Control (Ionising Radiation) Regulations 2000 and Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003)
- the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing 2005
- the Code of Practice for the Safe Transport of Radioactive Material 2008.

Radiation limits are expressed in terms of the 'effective dose' measured in sieverts. Occupational doses in mining are in the range of millisieverts (mSv = one thousandth of a sievert) and the primary radiation protection limits are:

- an annual limit to a worker of 20 mSv
- an annual limit to a member of the public of 1 mSv.

In both cases, the dose received may be averaged over a five-year period when assessing compliance with the limits. There is an absolute annual limit of 50 mSv per year (mSv/y) for workers.

Method of assessing radiation exposure

There are three primary ways (known as exposure pathways) by which workers can be exposed to radiation. These are through irradiation by gamma radiation, inhaling radioactive dust and the radioactive decay products of radon gas, and ingestion of radioactive material.

The method used for determining doses to workers follows the internationally accepted practice defined by the ICRP (see Appendix S2 for further details of the method). This involves:

- identifying how the workers could be exposed (i.e. the exposure pathways)
- measuring the radiation levels to which workers are exposed using radiation monitoring equipment such as dust samplers and personal gamma monitors
- combining the radiation levels and the time spent in those levels, to provide a measure of exposure
- applying an internationally accepted conversion factor which takes into account specific characteristics of the exposure, thereby providing a standardised measure of the estimated dose received by the worker
- combining the doses received from each of the pathways to establish the total dose received.

The basis for this method is the government approved monitoring program for radiation that involves both workplace and individual sampling. At Olympic Dam, approximately 1,500 radiation measurements are taken each month under the program and regulatory authorities routinely check the results (see Plate 22.3).

Current radiation doses to workers

In the underground mine, the most important exposure pathways are exposure to gamma radiation and inhaling radon decay products. A relatively small contribution arises from inhaling radioactive dust. The most important pathway in the metallurgical plant, particularly in the smelter, is inhaling radioactive dust.

Radiation doses to workers are based on the results of the monitoring program for radiation and are calculated for various work groups in the mine and the different areas of the metallurgical plant. The results presented below, summarised in Figure 22.1 and discussed in more detail in Appendix S2.

In the mine, the average dose to full-time underground workers, between 2001 and 2007, was 3.5 mSv/y. The most highly exposed work group received an average of 5.9 mSv/y, while the highest individual dose in any year was 9.9 mSv (compared to the applicable limit of 20 mSv).

Plate 22.3 Radiation safety officer servicing monitoring equipment

Radiation exposures in the metallurgical plant can be separated into the smelter and the remainder (i.e. the concentrator, hydrometallurgical plant and refinery). Between 2001 and 2007, the average dose for smelter workers was 3.7 mSv/y, and the highest individual dose in any one year was 17.7 mSv. For the remaining areas, the average dose was 1.4 mSv/y, and the maximum individual annual dose was 7.2 mSv in the concentrator, 6 mSv in the hydrometallurgical plant and 9.5 mSv in the refinery. Individuals in the maintenance and services group, who work throughout the plant, recorded an average dose of 1.3 mSv/y and a maximum individual dose of 8.3 mSv.

The low doses show that radiation exposures for workers at Olympic Dam are controlled and that exposure levels are consistently below radiation protection limits (see Figure 22.1).

Current radiation doses to members of the public

The current operation has been monitoring radiation levels and assessing doses to members of the public at Roxby Downs and Olympic Dam since commencement of operations. Doses have remained consistently low with the main pathways of exposure being through the inhalation of dust and the inhalation of radon decay products. Gamma radiation levels from the project are monitored and are negligible. The current doses are calculated to be approximately 0.025 mSv/y, with 0.020 mSv/y from exposure to radon decay products and 0.005 mSv/y from dust.

These levels taken together constitute 2.5% of the internationally accepted dose limit of 1 mSv/y above natural background levels for members of the public.

22.4.4 CURRENT SAFETY PERFORMANCE

Safety performance is usually assessed with indicators that measure the number of incidents over a fixed period of time. The most common safety performance indicator is the lost-time incident frequency rate (LTIFR), which measures the number of incidents that are serious enough to result in an individual losing work time for every million man hours that are worked. This indicator has been used by the mining industry for many years and provides a way of monitoring safety trends over time and for comparing performance between companies.

Company-wide, the BHP Billiton Group employs a more rigorous safety performance indicator – the classified incident frequency rate (CIFR). The CIFR measures the number of workplace injuries that result in a person not returning to their normal duties on the day that they are injured for every million man-hours worked.

The safety performance of the BHP Billiton Group and Olympic Dam in comparison to the wider mining industry is presented below.

Mining industry

The mining industry in Australia, through the Minerals Council of Australia, collates accident statistics across companies and sectors on an annual basis (Safety Performance of the Australian Minerals Industry 2006–2007). The statistics show continuous improvement for the period monitored. Relevant statistics are as follows with comparisons from other countries (note that there are some differences in data collection and reporting, however, figures are broadly comparable):

- The average LTIFR for all mining in Australia over the period 1994–1995 to 2006–2007 was 5. Statistics from other countries for a similar period are:
  - North America – 11
  - South Africa – 8
  - Canada – 5.
- Fatality rates across the mining industry in Australia averaged over the past 10 years is 0.07 per million man-hours worked, with underground metalliferous mining in Australia remaining almost four times more hazardous than open pit mining. Similar statistics for a similar period for other countries are as follows:
  - North America – 0.17
  - South Africa – 0.32
  - Canada – 0.16.

BHP Billiton Group and Olympic Dam

The LTIFR was one of the main safety performance indicators used at Olympic Dam until its acquisition by the BHP Billiton Group (see Plate 22.4). Following the acquisition in June 2005, Olympic Dam adopted the reporting requirements of the BHP Billiton Group, including the CIFR. This change is reflected in the figures below:

- the average LTIFR for Olympic Dam operations for the period 2002 to 2004 was 3.6 (compared to 7.0 for the Australian mining industry)
- the average CIFR for the BHP Billiton Group across all of its operations for the calendar year 2007 was 3.8 per million man-hours worked
- the average CIFR for Olympic Dam operations for the same period was 5.6 per million man-hours worked, down from 16.1 for the previous year.

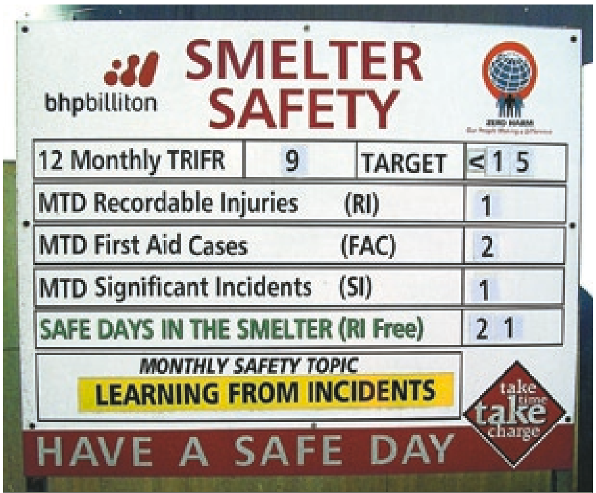

Plate 22.4 Safety board

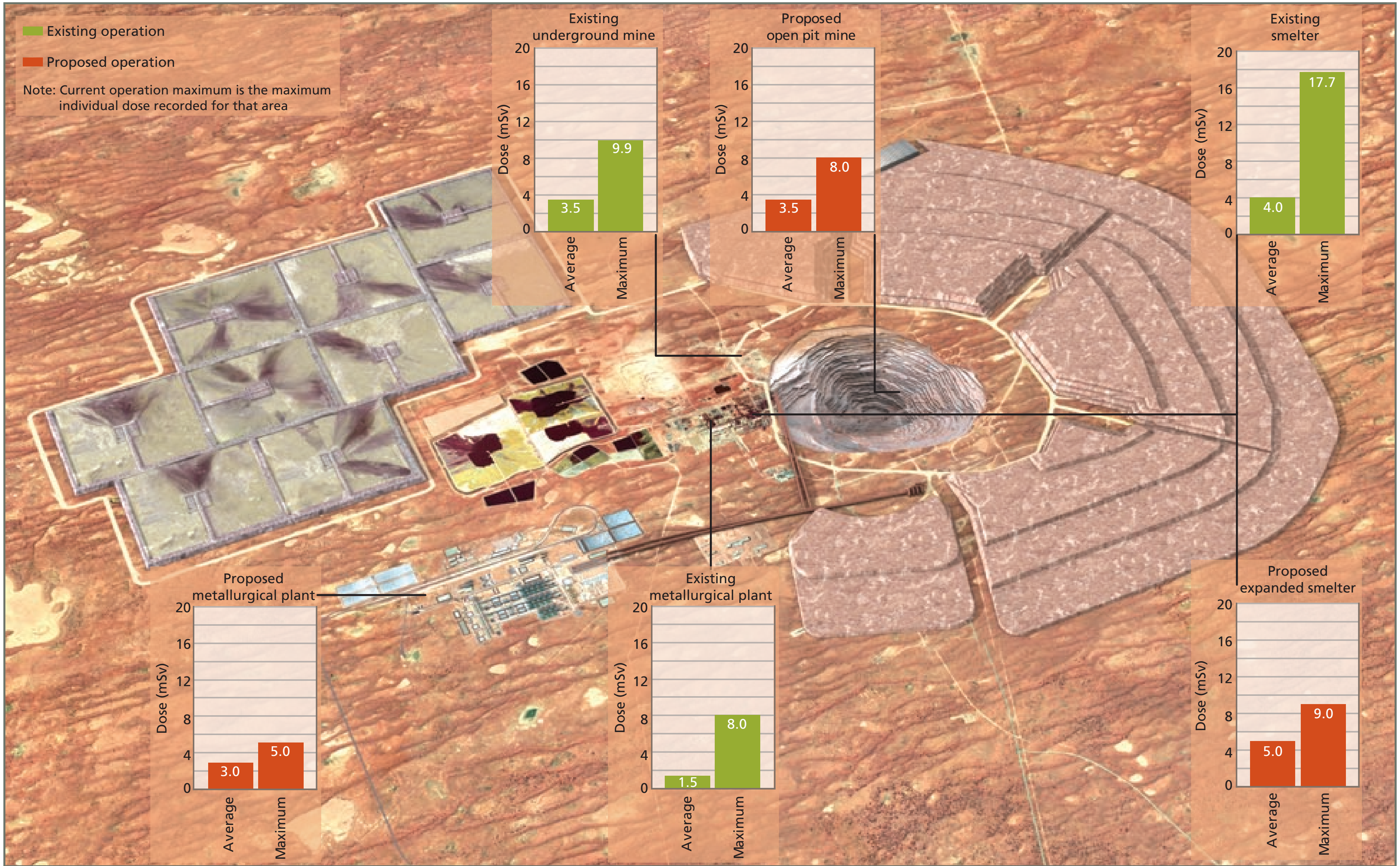

Figure 22.1 Five-year average and maximum radiation doses

A review of the reported incidents for 2007 shows that in general, the largest proportion of incidents and accidents were related to operating equipment and machinery, manual handling and being struck by moving or falling objects. Remedial actions involved improved workplace design, effective management procedures and the increased use of PPE (see Plate 22.5).

The LTIFR shows that the safety performance at Olympic Dam has been better than the national average, with the CIFR showing a continuous improvement. The results also show that the CIFR for Olympic Dam is higher than the BHP Billiton Group average. This is expected to improve as the safety-focused culture of the BHP Billiton Group is further implemented and adopted throughout the Olympic Dam operation.

22.4.5 OPERATIONAL RISK AND CONTINGENCY MANAGEMENT

There are several operational risk management plans currently in place that would continue to apply to the proposed expanded operation. The most relevant plans relating to health and safety are discussed below. Contingency measures usually form an inherent part of the risk management process and are incorporated in the plans outlined.

Detailed contingencies for key project risks will be determined in more detail during the subsequent stages (Definition and Execution stages) of the project. The outcomes of the EIS risk management process (Chapter 26, Hazard and Risk) has identified a comprehensive register of risks associated with the project (4,967 individual line items), which have been captured within the broader Olympic Dam Expansion Risk Register. The risk assessment process aimed to ensure that any risks defined as 'intolerable' had immediate control measures implemented to reduce the risk to a tolerable level.

Plate 22.5 Safety Management System – personal protective equipment procedure

Specific contingency measures for the identified risks depend upon the magnitude of the risk and would be based on the use of the principles of risk management, which is an iterative approach that aims to eliminate or reduce the likelihood and/or consequence of incidents to a level considered to be as low as reasonably achievable or as low as reasonably practicable.

BHP Billiton uses an internal system to manage identified risks, leading to specific contingency measures for risk reduction. The measures and controls are developed in the stages where there is sufficient detail in order to maximise the effectiveness of controls (see Plate 22.6). Such measures also address potential risks at, and post, mine closure.

Security operations plan

Despite its remote location, Olympic Dam's size and the nature of its products create significant security issues. As a consequence a site security plan exists and this plan addresses issues such as preventing damage and the loss of property, preventing unauthorised personnel from entering the operations and employee security.

There are several levels of physical security, the first of which is a gatehouse with guards on the mine lease boundary. A second level of security is an outer perimeter fence arrangement to restrict unauthorised access to the operational site, which consists of a perimeter fence, gatehouse, locked gates, key card access and a site-access management system. A third level of security applies to the solvent extraction area, where additional security fencing has been erected and further authorisation is required for entry. An extra, higher level of security is applied to the uranium oxide product packing area, which has additional fencing, locked access and remote surveillance. A similar system of security also protects the area where gold and silver bullion is produced.

These systems also protect members of the public from harm that might otherwise arise from unauthorised entry into the site. BHP Billiton employs specialist personnel to manage the security system and security is assessed as part of the routine internal BHP Billiton Group health and safety audit program.

Emergency response

BHP Billiton employs a specialist emergency response unit, which is equipped to address emergency situations and is fully trained in first aid, firefighting, search and rescue and mine rescue. The team trains regularly, including training drills in the operational workplace, to upgrade its skills. A full-time nurse is employed and the team has formal links with regional and state-based emergency response and medical treatment facilities. The Royal Flying Doctor Service is also available to provide assistance when required. The underground mine also has a volunteer mines rescue team made up of personnel from across the operation, led by a full-time qualified emergency services officer.

A formal site-wide emergency response management plan exists, which outlines the requirements for all identified events, including mine rescue. The plan is reviewed regularly and updated as situations change, improved approaches are identified or new risks emerge.

Crisis management

Crisis management refers to managing and controlling significant incidents that are either beyond the operational response capability, have the potential to affect the company as a whole, or have the potential to spread across a number of operations. In these situations, a group-wide and corporate perspective of the incident is necessary. Within the BHP Billiton Group, Olympic Dam is part of the Uranium Customer Sector Group. Each customer group has a crisis and emergency management team and each team has a management plan. The Crisis and Emergency Management Team (CEMT) is based in Adelaide and the CEMT Plan outlines specific requirements for major incidents within the Olympic Dam operations. The CEMT Plan is regularly tested and updated as required.

If a significant incident occurs, an assessment is made that can trigger further management controls within the organisation. Site-specific processes deal directly with any emergency response to the incident, while corporate management provides assistance and support, responds to company-wide impacts and addresses broader business risks.

BHP Billiton maintains a stakeholder register which would be used to inform people of crises that may affect them.

Fire control and management

Fire is a potential hazard that requires specific attention throughout the Olympic Dam operation. Since operations commenced at Olympic Dam, there have been a number of major fires that have resulted in significant damage to plant and facilities, including two major fires in the solvent extraction area of the metallurgical plant. The findings of investigations into the fires have been incorporated into the design of the new facilities and into operating systems. They have also led to improved fire protection measures.

The metallurgical plant has high temperature processes and uses various flammable substances which could lead to fires. Management of the fire risk depends on the particular hazard. In the smelter, good design is required to contain heat and control flows of molten metal. In the solvent extraction area, there are very large quantities of flammable liquids which require specific controls, such as grounding to dissipate static electricity, designs to enable quick release and draining of liquid in the event of a fire and foam deluge fire suppression systems.

Plate 22.6 Eye wash station

Fire prevention and control is fundamental to the design of the metallurgical facilities, and includes (but is not limited to) detection, suppression and mitigation.

In the underground mine, fire can be dangerous because of the enclosed space and the ventilation system which can direct smoke and carbon monoxide to other areas of the mine. Vehicle fires underground can be particularly dangerous because they can occur anywhere, blocking access to and egress from the mine. Specific design factors that minimise the risk of fires in the underground mine include emergency refuge chambers, secondary/emergency access and egress, PPE and the fitting of fire suppression systems to all vehicles.

The existing standard management systems for fire prevention and control would be implemented in the expanded operation, including:

- fire protection requirements in the design of plant and equipment
- training and induction for all personnel
- specialist training for high-risk areas
- dedicated response personnel
- centralised fire detection
- fixed fire suppression systems
- planned workplace inspections
- hazardous materials management.

While bushfires occur naturally across much of the Australian landscape, it is important that their impact and spread are monitored to ensure that the community, the operation and the associated infrastructure are not affected. The Roxby Downs branch of the Country Fire Service (CFS) monitors regional bushfires, and intervenes by back burning to create firebreaks and maintain low natural fuel loads. If required, and at the discretion of the Olympic Dam operation Asset Leader, some of the operation's firefighting assets may be released to assist with bushfire control.

In the townships of Roxby Downs and Olympic Dam Village, domestic fire response is undertaken by the CFS.

Quality control systems

Formal quality control and quality assurance systems underpin the safe operational practices and processes within the current operation, and these systems would be upgraded as appropriate for the proposed expansion. The key systems include:

- BHP Billiton document control system
- ISO 9000 – quality assurance
- ISO 14000 series – environmental assurance
- Preventative and Scheduled Maintenance Program.

The BHP Billiton document control system is important because it ensures that all systems, processes, procedures and other documents are regularly reviewed and remain up to date. This ensures that improvements that result from incidents, changes in standards or greater knowledge are incorporated into operating systems (see Plate 22.7).

The ISO 9000 quality assurance system provides international recognition of the quality of the final products from processing (i.e. copper, uranium oxide, gold and silver). Formal accreditation occurs through a rigorous process of auditing and reviews of the production and maintenance systems. The audit covers process control, process integrity, maintenance procedures, recording systems, document control, environmental management, training and competency, and health and safety systems.

ISO 14000 is an internationally recognised system for environmental management and forms the basis of the Olympic Dam system (see Chapter 24, Environmental Management Framework).

Preventative maintenance programs, including condition monitoring and maintenance planning, are currently in place and would be implemented for the proposed expansion.

Plate 22.7 Safety Management System – tagging procedure

The quality of the health and safety systems is also monitored through regular internal BHP Billiton audits of health and safety against the HSEC Management standards.

Incident monitoring and assessment

Incident monitoring is managed using a computer-based system called ‘First Priority Enterprise’. The system manages information on all safety, health, process loss, spillage and environmental incidents, and records details of the incident, frequency rates, duration rates and severity rates. Corrective actions taken to remediate the incident and to prevent or minimise the risk of recurrence are also entered into the database.

All incidents and corrective actions are reviewed at regular management meetings and a longer-term analysis of the information is also undertaken to assist in improving safety. Near-miss information is also collected and the frequency, duration and potential severity of the near-miss incidents is monitored. Within the mining industry, information on accidents and incidents, and the associated remedial measure, is routinely shared to prevent occurrences elsewhere.

Spills and accidental release of process materials

Spillage of process materials in the current operation is a serious issue. Systems and procedures are in place to ensure that spills are identified, reported, cleaned up and investigated to prevent recurrence (see Plate 22.8).

Operational procedures at Olympic Dam require spills (or loss of containment spills) to be reported internally as environmental incidents. At Olympic Dam the frequency, duration and severity of spillages is currently monitored, including by recording information on the quantity and type of material. There are specific operational procedures for spillages of radioactive process material, uranium oxide, hydrocarbons and chemicals (including fuel, oil, xanthate, sulphur, acid and cyanide).

A process to notify external agencies if a spill triggers the external reporting requirements is also in place. Reporting criteria are based on the volume of spillage and whether the spill has occurred inside or outside the bund, which has been designed for the purpose of containing a spill.

Records to date show that since 2003, there has been an average of 120 spills reported internally each year. On average, less than 5% of these spills trigger the requirement for external reporting. As part of contingency management, all parts of the existing plant have undergone hazard and operability (HAZOP) reviews to identify the potential for spills and the likelihood of spillages. Controls include requirements for bunding and access and egress for clean-up. Those areas which require specific legislative requirements for spillage prevention, control and management are also addressed in the detailed design stage. This process would occur for all new and expanded plant during the detailed design stage of the proposed expansion (see Plate 22.9).

Plate 22.8 Spill response equipment used at existing operation

Plate 22.9 Bunding, safety shower and clean up at Olympic Dam

In the event of a spillage, there are a number of controls available for operational personnel to contain spills, including temporary bunds and spill kits for spillage response, and operational and emergency response personnel are trained in their use.

These processes would be extended and implemented for the proposed expansion (see Chapter 24 and Appendix U for details).

Transport plan for uranium oxide

The Olympic Dam uranium oxide transport plan was prepared to satisfy the specific licence requirements of the following government agencies:

- the Australian Safeguards and Non-Proliferation Office (ASNO)
- the South Australian Department of Premier and Cabinet
- the Northern Territory Government (Department of the Chief Minister).

The plan describes the procedures and processes for safely storing and transporting uranium oxide, from packaging to delivery, including the emergency response to potential incidents along transport routes. It also describes the roles and responsibilities of the various organisations involved. The plan is externally audited annually, and the three lead agencies (noted above) and the management of Olympic Dam review the audit results, recommendations and actions (see Plate 22.10).

Plate 22.10 Fully enclosed uranium packaging

22.5 DESIGN MODIFICATIONS TO PROTECT HEALTH AND SAFETY VALUES

22.5.1 VALUES

Protecting the health and safety of employees, contractors and the general public is an overriding commitment of the BHP Billiton Group and the Olympic Dam operation.

At this stage of the proposed expansion, the most effective means of managing potential health and safety issues is to instil good health and safety criteria into the project design.

22.5.2 MAJOR ELEMENTS OF THE PROJECT DESIGN

As has occurred in previous expansion projects, BHP Billiton is developing a comprehensive set of HSEC design criteria requirements and documents for the project definition, construction and commissioning stages. These documents collate details of leading fit-for-purpose design practice and specific requirements for the proposed expansion that are to be used by the design, development and review teams.

The HSEC design criteria documents are working documents that are regularly reviewed and updated. They cover:

- the principles for the design of new facilities, which consider broad and specific design objectives and the requirements of the BHP Billiton Group fatal-risk control protocols
- specific design considerations for components of the metallurgical plant, including:
  - cleanliness (see Plate 22.11) and spillage control (including bunding requirements for tanks containing liquids)
  - dust control
  - firefighting and protection of facilities
  - noise control
  - radiation safety
  - workplace contaminants
  - stacks and emission controls
  - hazardous substances
  - dangerous goods
  - electromagnetic fields
  - molten material processing and handling
- specific design requirements for the new open pit mine, including:
  - fire suppression
  - dust control
  - diesel exhaust emissions and particulates
  - noxious gases
  - radiation safety
  - mine planning and ventilation control
  - noise control
  - haul road design
  - light vehicle safety
  - heavy mobile mining equipment safety
  - working at heights
- general industrial safety requirements, including:
  - fixed access and egress systems
  - plant layout design
  - safe work areas
  - safety showers and eyewash stations
  - manual handling
  - pedestrian and vehicle separation
  - heat management
  - lighting
  - equipment vibration
  - conveyors
  - forklifts
  - confined spaces
  - workshops
  - electrical equipment
  - high voltage

Plate 22.11 Vehicle wheel wash facility at the Olympic Dam gatehouse

  - equipment selection
  - safety signage
  - workplace amenities
  - isolation procedures.

Further to the risk assessments that have been conducted to date (see Chapter 26, Hazard and Risk), BHP Billiton is developing a 'safety case' for the existing operation and will incorporate the proposed expansion. This would include:

- identifying the hazards and risks of the proposed expansion
- describing how the risks would be controlled
- describing the safety management system that would be in place to ensure controls were effectively and consistently applied.

Developing a safety case would also comply with requirements under state-specific major hazardous facilities legislation.

22.6 IMPACT ASSESSMENT AND MANAGEMENT

There is a range of general occupational health and safety issues associated with the proposed expansion, many of which are present in the existing operation, and these would continue to be managed using the existing management systems. This section therefore focuses on issues that are not present in the current operation, key issues identified in the governments' EIS Guidelines, and issues raised during the stakeholder consultation and engagement program. These issues are:

- construction and commissioning
- open pit mining
- metallurgical plant (including expansion of the existing smelter)
- dust emissions
- radiation
- hazardous substances
- transport (including facilities at the Port of Darwin).

22.6.1 CONSTRUCTION AND COMMISSIONING

The proposed expansion requires a large on-site construction workforce, which is expected to average around 4,000 people between 2010 and 2020, with a peak of 6,000.

Large-scale construction has a reputation for being one of the more hazardous industrial activities in Australia. However, a review of the safety performance of major project management and construction organisations shows that significant safety improvements have been achieved over recent years through a focus on management systems, field procedures, training and behavioural programs.

The BHP Billiton Group has a record of good health and safety performance at its sites during construction activities. For example, at its most recent large-scale construction project (Ravensthorpe Project), BHP Billiton completed 25 million exposure hours without a fatality. The health and safety record during construction at Olympic Dam is also good. Previous significant construction activity at Olympic Dam with workforces of between 1,000 and 1,500 personnel has occurred without a fatality. These projects were well managed and safety performance statistics show the incident rates were low in comparison with industry averages.

Construction encompasses a wide range of activities and the key health and safety considerations identified through risk assessment and industry experience are:

- excavation
- surface mobile equipment and light vehicles
- scaffolding and lifting equipment
- special work conditions, including working at heights and working in confined spaces
- construction material and disposal
- fuel and chemicals
- noise and dust
- hot work and isolation
- fatigue management.

The construction of the expanded facilities would be outsourced to a major project management organisation that would subcontract components of construction work to other companies. The project management organisation would provide shared services, such as emergency response, health and safety advice and assistance, auditing and training.

Each individual contracting company would be required to undergo a pre-qualification process and demonstrate its conformance with BHP Billiton's HSEC Management Standards and the Fatal Risk Control Protocols, and its compliance with legislative requirements and Australian Standards – culminating in contractor-specific construction safety management plans that address each of the key health and safety considerations identified above. To complement the plans, a site-wide mandatory permit-to-work system would be established to manage the risks associated with activities such as excavation, scaffolding, confined spaces, equipment isolation and commissioning. All equipment (including vehicles, hand tools and electrical equipment) would be subject to maintenance and workplace inspection. In addition to site approvals and other hazardous materials procedures, the storage and use of hazardous chemicals and materials would conform to applicable legislation.

Off-site infrastructure such as the concentrate handling and storage facilities at the Port of Darwin, desalination plant, rail line, transmission line, water supply pipeline, gas supply pipeline, and the CCGT power station would be constructed in a manner consistent with BHP Billiton's health and safety standards.

BHP Billiton would provide buses for travel between the construction sites and the accommodation areas and all work vehicles would conform with the relevant BHP Billiton vehicle standards, including the Fatal Risk Control Protocols.

In all construction projects, a particular period of higher risk occurs at the time of commissioning and hand-over. This is the period when construction activities are nearing completion and the components of plant are gradually tested and handed over to operational personnel. The systems controlling safety during construction make way for the operational safety and process control systems. During this period, significant attention would be given to commissioning safety systems that bring together the construction needs and the operational systems needs.

While the proposed expansion workforce numbers would be high, the performance to date for site construction activity, combined with the BHP Billiton systems of control, indicate that the level of attention afforded to construction workers would be high and high safety performance outcomes could be expected.

22.6.2 OPEN PIT MINING

While open pit mining is new to Olympic Dam, it is a routine mining method within the BHP Billiton Group and the industry. Appropriately experienced and qualified mining engineers have been recruited from other large BHP Billiton Group open pit mining operations around the world and have been involved in the design of the proposed Olympic Dam open pit mine. Similarly experienced personnel would be involved in the pre-strip and operational mining phases. The main health and safety issues for open pit mining are described below.

Light vehicle and surface mobile equipment safety

The mining fleet would consist of a significant number of vehicles to excavate and service the open pit mine. This includes:

- more than 150 haul trucks of various sizes
- more than 11 electric shovels
- ancillary vehicles including bulldozers, graders, loaders, smaller trucks and personnel carriers
- light vehicles.

Given the large number of operating vehicles, there is the potential for vehicle incidents such as vehicle-to-vehicle collisions, vehicle-to-person contact, or single vehicle incidents such as roll-overs, collisions with fixed objects, and falls from in-pit benches (see Plate 22.12). A traffic management plan would be implemented to control risks from light vehicles and surface mobile equipment in the mine. The plan would include:

- appropriately designed roads and access ways
- formal traffic management protocols for roadways and ramps with designated speed limits, clearly marked roadways and windrows to identify road edges
- rigorous ongoing driver education and training
- high-visibility work environments through in-pit lighting, road watering to suppress dust and high-visibility equipment for smaller vehicles

Plate 22.12 Controlled traffic movements in open pit in Escondida, Chile

- communication protocols
- scheduled maintenance of all vehicles.

On occasion, personnel would be outside vehicles and on foot within the open pit (e.g. to sample rocks, or inspect and maintain vehicles). All personnel entering the open pit would be required to have a proper induction, conform with internal and external regulations and wear appropriate high visibility PPE. Those on foot in the pit would be required to wear appropriate high-visibility PPE and comply with communications protocols.

Blasting

Blasting uses explosives to break up large amounts of rock that are subsequently removed from the mine workings. In the current underground mine, large production blasts and smaller development blasts occur on a daily basis. The safety precautions employed comply with legislative requirements and conforms to best practice. The main blasts in the proposed open pit would be expected to occur every second day, and consist of three or four patterns each covering an area of approximately 100 m x 100 m, generating up to 1.5 to 3 million tonnes of material. There may also be smaller blasts on a daily basis. There are a number of potential hazards associated with blasting, including noise, dust and fly-rock from the blast that may harm personnel should they be inside the blast exclusion zone. BHP Billiton recognises the hazards associated with fly-rock and has rigid design and operations procedures. Ongoing work is also occurring to further minimise impacts and determine optimum clearance distances for the characteristics of the mine rock. A standard measure is to pack crushed aggregate into explosive loaded drill holes to optimise the control of blast energy and to also further reduce the risks of fly-rock.

The safety issues for large-scale blasts are well understood and a wide variety of measures are used to control the risks, including safe working procedures and adherence to explosives regulations and standards. Blasts would be detonated at set times of the day (known as the 'firing time'), which would be well known and displayed at entrances to relevant work areas. Before firing time, a predetermined area surrounding the blast site (both on the surface and underground), known as the 'exclusion zone', would be cleared of personnel and equipment. The zone would be expected to extend at least 500 m from the blast site. Depending on the blast risk assessment, personnel may be removed from the underground mine or required to muster in a meshed and shotcreted refuge during the blast. A final check of personnel would be made to ensure no-one was in the exclusion zone and the blast would then be detonated remotely. The actual blast time is usually brief, and is sequenced over a period of approximately 30–45 seconds. Once the blast has occurred, a check takes place to ensure that all explosives have detonated and that all the areas are safe to re-enter. Normal operations in both the surface and underground mine are not permitted until these checks have been completed and an 'all clear' signal is given.

As the proposed pit advanced towards the existing underground operation, the interaction between blasting within the open pit and the underground operation would become more important. In addition to the exclusion zones mentioned earlier, precautionary measures such as seismic monitoring and workplace inspections in both surface and underground areas would occur throughout the operation phase. Standard monitoring includes laser based ground movement monitors that measure the effects of blast vibrations on the stability of the pit walls and underground mine. This data would be reviewed regularly as part of the operational management plan to ensure pit wall stability and the ongoing safety of personnel in both mine areas. Ultimately, underground mining areas would be progressively decommissioned as the surface mine advanced close enough to make them potentially unsafe.

Underground blasts are of a much smaller scale and unlikely to have an impact on the open pit.

The residual impact to health and safety associated with the normal blasting operations is considered low due to the high level of regulation and the fact that the safety issues and control measures for large-scale blasts are well understood.

In-pit stability

In all open pits there is a potential for the walls, or parts of the walls, to become unstable and collapse. This occurs when weaknesses in ground conditions cause the pit wall to slip. Twenty five years of underground mining at Olympic Dam and 2.5 million samples collected and analysed from the area of the proposed open pit have provided a comprehensive understanding of the geotechnical characteristics of the rock to be mined, and based on this knowledge slippage events are considered to be unlikely.

Nevertheless, real-time geotechnical monitoring equipment for ground movement and slope stability would be installed to monitor ground conditions in the underground mine and open pit, and to monitor wall movements in the open pit. In addition, conservative designs of pit slopes (see Chapter 5, Description of the Proposed Expansion) would further minimise such events.

Dust, noise and heat

Occupational exposure to dust, noise and heat would be managed through a range of controls, including:

- equipment design (e.g. air-conditioned enclosed cabins on vehicles)
- dust suppression protocols (see Chapter 13, Greenhouse Gas and Air Quality, for further discussion on airborne dust management techniques)
- appropriate induction and awareness training
- the use of PPE (see Plate 22.13)
- relevant monitoring and maintenance procedures.

The temperature in the pit is predicted to increase by 1 °C for every 100 m of depth. As the pit deepened, this could cause some health concerns during the summer months, including an increased risk of heat stress. The management of heat stress is already an important subject within the mining industry and measures for its control include providing air-conditioned vehicles and personnel training. Existing BHP Billiton management systems to prevent and manage heat stress would be used. The potential health and safety impacts associated with dust, noise and heat within the pit are considered to be low.

22.6.3 METALLURGICAL PLANT

The proposed expanded metallurgical plant is based on the proven technologies and processes currently used in the existing plant. The expanded plant would consist of a new, larger concentrator, hydrometallurgical plant and an upgrade to the existing smelter and refinery. The throughput of the existing smelter would be approximately doubled and the refinery would be expanded to accommodate the additional copper from the smelter. This new arrangement is not expected to create any new health and safety issues and the residual impact would be low.

The concentrator plant is being designed to produce copper concentrate in excess of the capacity of the expanded smelting facility and it is planned to make the surplus concentrate available as a saleable product (i.e. as copper concentrate with recoverable quantities of uranium oxide, gold and silver; hereafter termed concentrate).

Plate 22.13 Worker with personal monitoring equipment and safety equipment

Increasing the throughput of the existing flash smelter for the expanded operation would result in increases in the amount of gas and dusts produced. Additional and improved ventilation systems would be installed as part of the upgrade to ensure that exposures remained well controlled. The experiences with ventilation in the existing smelter and the BHP Billiton design criteria would be integral to minimising the occupational health impacts. Real-time monitoring of sulphur dioxide in the smelter would be used as an indication of pollutants to assess the continuing effectiveness and adequacy of the ventilation system.

Following previous fires in the solvent extraction plants at Olympic Dam, new and improved safety designs were adopted to prevent recurrence. The design of the existing plant incorporates current industry leading practice in preventing, detecting, suppressing and mitigating fire and this would be incorporated into the expanded solvent extraction plant.

Overall, the plant would be designed and constructed to conform with leading engineering practices and BHP Billiton's design standards and regulations. The specific safety aspects of any new process would be considered at the detailed design stage through hazard and risk studies, as required by BHP Billiton's approach to health and safety.

A requirement of the BHP Billiton design criteria is to ensure that there is sufficient bunding and containment for process materials in the event of spillages. Despite the best intentions, some spillages do occur and a procedure is in place to report spills at the site. Where the spillage is above a set volume, there is a requirement to report the spill and the remedial measures to regulatory authorities. Process spills are considered to be incidents that are to be investigated and remedial action initiated to prevent recurrences.

The tailings pipeline lies within a bunded corridor for its entire length. Traverse bunds would be constructed at intervals to ensure that any spillages were contained within a discrete section of the pipeline corridor.

Wastes from the metallurgical plant would be managed in accordance with the existing site protocols and comply with appropriate legislative requirements. Hazardous wastes, which are unable to be recycled, would be disposed of in an approved manner in either a designated area of the site's solid waste disposal area or within the tailings retention system, or through a licenced waste disposal contractor. The potential for exposure to employees or the public is expected to be negligible and would be controlled and limited through the protocols. Emergency response plans as outlined in Section 22.4.5 would come into operation in the event of an incident.

Interaction of mining and metallurgical plant emissions

Emissions from each of the mining and metallurgical operations have the potential to affect the health of workers in other areas of the operation. An assessment of the predicted ground level concentrations of pollutants (particulates and sulphur dioxide, SO_2) has been undertaken using the results of the air quality modelling described in Chapter 13, Greenhouse Gas and Air Quality, assessed against the criteria contained within the National Occupational Health and Safety Council Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC 1995a).

Particulates within the metallurgical plant

The emission of particulate material from the new open pit mining operation is likely to result in concentrations of particulates within the metallurgical plant in excess of that in the existing metallurgical plant. The particulate contours presented in Chapter 13, Greenhouse Gas and Air Quality, indicate that PM_{10}-sized particulate (providing an over-estimation of inspirable dust) concentrations would average between 15 and 30 ug/m^3 at the new metallurgical plant and between 100 and 500 ug/m^3 at the existing metallurgical plant, with the maximum 24-hour average ground level PM_{10} concentration predicted to be around 200 to 400 ug/m^3 at the new plant and between 400 and about 2,000 ug/m^3 at the existing plant. These values are significantly less than the 10,000 ug/m^3 criteria specified for non-toxic dusts. As stated in the NOHSC Guidance Note on the Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC 1995b), provided the airborne particulate does not contain other hazardous components, conformance to the exposure standard for dusts in general should prevent impairment of respiratory function even over many years of exposure. The exposure standards are established to minimise health impacts and the predicted dust levels are expected to conform with appropriate levels.

Sulphur dioxide within the open pit mine

Providing sulphuric acid to the new metallurgical plant would necessitate the construction of up to four new sulphur-burning acid plants, plus an additional acid plant to treat metallurgical gases from the expanded smelter. This would result in an increase in the volumes of sulphur dioxide (SO_2) emitted. The SO_2 contours presented in Chapter 13, Greenhouse Gas and Air Quality, indicate that, during normal operations, SO_2 concentrations around the area of the proposed open pit and RSF would average around 10 to 15 ug/m^3, with 1-hour maximum ground level concentrations of around 1,000 to 2,000 ug/m^3. The NOHSC criteria for sulphur dioxide is 5,200 ug/m^3 averaged over an eight-hour work period (equating to around 2,600 ug/m^3 over a 12-hour shift, using the Brief and Scala model presented in NOHSC 1995b) with a 15-minute maximum concentration criteria of 13,000 ug/m^3.

The potential interaction between emissions from the metallurgical plant and mine have been assessed and it is considered that these interactions would not have any likely impacts on health.

22.6.4 EXPOSURE TO DUST EMISSIONS

The primary potential source of dust for the proposed expansion would be from the open pit operation, where drilling, blasting, excavating and transporting ore would generate dust. A second potential source of dust would be the metallurgical plant, as is currently the case. This would include ore dust from conveyors, stockpiles and crushing operations, as well as various stack discharges and fugitive emissions. The third main potential source of dust would be from waste products, mainly dried tailings, and from mine rock piles.

The exposure of workers to dust would be controlled by reducing the amount of dust generated and minimising the dust that entered the workplace through effective ventilation controls such as extraction systems, enclosure systems (i.e. enclosed conveyors) or dust suppression (i.e. water sprays). Procedural controls, including the mandatory wearing of PPE, would also be used to reduce exposures. Dust exposure would be controlled in the mine by using water sprays to suppress dust sources and engineering controls such as air-conditioned cabs on vehicles.

The ground level concentrations as a result of the expansion have been modelled and compared against health and environmental standards. The predicted dust emission levels show increases for dust concentrations at ground level and operational controls would be implemented as required to comply with legislative standards (generally during periods of unfavourable climatic conditions) (see Chapter 13 for details). An approved monitoring program would validate the predictions.

22.6.5 WORKFORCE EXPOSURE TO RADIATION

The main pathways by which workers can be exposed to radiation are:

- external gamma radiation
- inhaling radioactive dusts
- inhaling radon decay products.

The expanded operation would apply the same approach to radiation protection used in the existing operation (see Section 22.4.3). The estimated doses to workers are presented in the following sections (see Plate 22.14) and detailed in Appendix S2.

Mining

The overall radiation doses in the proposed open pit mine are expected to be lower than in the current underground mine. Gamma exposure would be lower because workers underground are surrounded by ore, whereas in the open pit workers have no exposure from above. Doses from inhaling dust and radon decay products are also expected to be lower as the natural ventilation of the open pit would result in lower concentrations than in the underground operations.

Average doses to miners would be expected to be less than 3.5 mSv/y. Workers who continually work on ore (e.g. drillers) would be likely to be exposed to higher doses. It is possible that some individual workers could receive doses of approximately 8 mSv/y, but that is still well below the limit of 20 mSv/y. These dose estimates are conservative (i.e. overestimate the exposure) because enclosed cabins on vehicles would provide an additional level of protection from airborne contaminants, and this protection factor has not been included in the dose estimates.

Processing

There are no significant differences in processing between the existing operation and the proposed expansion. The radiation exposure pathways in the expanded metallurgical plant would be expected to remain the same as the present pathways, with the potential to inhale polonium-210 released as a fume during smelter tapping remaining the dominant exposure pathway.

The history of exposures in the smelter over the past seven years shows the critical importance of the ventilation system in controlling exposures to polonium-210. The ventilation and management systems for the expanded smelter would be expected to control average annual doses to those levels experienced in the current smelter, which is on average 4–5 mSv/y, and maximum individual annual doses would be expected to be up to 9 mSv.

For the remainder of the metallurgical plant, the level of exposure would not be expected to change. The dose of gamma radiation from larger stockpiles, ore bins and tanks would not increase significantly. Dust sources would increase with the greater throughput of material in the expanded plant, but the plant would be physically larger, and the concentration of dusts in the workplace would not be expected to increase. Average doses for the rest of the plant would be expected to be less than 3 mSv/y, with maximum individual annual doses of approximately 5 mSv/y.

With appropriate design and operation, radiation doses would be low and well below the recommended limits. BHP Billiton has set a goal to maintain employee doses at less than 50% of the recognised standard and would undertake a radiation protection optimisation study during the detailed design of the pit and the metallurgical plant.

Optimisation of radiation protection

In addition to complying with dose limits, a key principle of radiation protection (as defined by the ICRP) is ensuring that radiation exposures are as low as reasonably achievable. The ICRP calls this 'optimisation' and it is known as 'the ALARA principle' in which ALARA means 'As Low as Reasonably Achievable' (social and economic factors taken into account). The radiological assessment of the proposed expansion has

Plate 22.14 Radiation monitoring equipment

shown that the predicted doses would comply with the internationally accepted dose limit of 20 mSv/y for workers and 1 mSv/y for general members of the public (see Section 26.6.6) above natural background. The ALARA principle requires that additional work be undertaken to ensure that doses are as a low as reasonably achievable.

In practice, optimisation occurs at two main phases of a project, namely in its design and during operation.

For the design phase, BHP Billiton would undertake an 'optimisation program', which aims to ensure that considerations for radiation safety are integral to the design of the expansion, leading to the minimisation of potential doses. The program would address four main areas as follows:

- radiation training and awareness – this would involve general awareness training for all expansion staff and targeted training of engineers and technical staff
- radiation risk assessment – this would involve formal radiation risk assessment workshops covering the design of the mine, the metallurgical plant, the waste management facilities and the overall expansion as a whole
- establishing mandatory design criteria for radiation protection
- developing a program of research to obtain more information on the radiation parameters of the expansion.

In the operation phase, various methods would be employed to minimise exposures, including the use of PPE in particular situations, real-time monitoring to identify changes in exposure situations (thereby identifying where controls may be needed), investigations to ensure that the exposures remained low, training of all workers in radiation protection methods and promoting a site-wide safety culture (see Plate 22.15).

Further details on dose assessment for employees are presented in Appendix S2.

Plate 22.15 Metallurgical samples being checked for contamination prior to shipment

22.6.6 PUBLIC EXPOSURE TO RADIATION

Members of the public most exposed to radiation from the expanded operation would be the residents of Roxby Downs. As noted earlier, current doses to members of the public are low, however, it is expected that doses would increase as a result of the expansion. Predicted doses are expected to still be low at one-sixth of the international public dose limit of 1 mSv/y.

The main exposure pathways for members of the public are inhalation of dust and inhalation of the decay products of radon. Gamma radiation dose drops off rapidly as the distance from the source increases and the project related levels beyond the lease boundary are expected to be negligible.

The estimates for dust and radon decay product exposure are based on the air quality modelling (see Chapter 13, Greenhouse Gas and Air Quality). The radionuclide content of the mine dust is low, therefore the radiation dose from dust inhalation would be low, despite the dust concentration levels predicted in Chapter 13. In addition, radioactive dust from the proposed expansion would be generated only when the ore itself had been reached, which would be about five to six years after the expansion project commenced, allowing further opportunities to reduce dust generation at the source gained through operational experience at the new open pit mine.

The major exposure pathway is the inhalation of radon decay products from radon emanation from the mine, the rock storage facility (RSF), the tailings storage facility (TSF) and the metallurgical plant. Estimates of the radon sources were used as inputs to the air quality model to determine estimated radon concentrations at Roxby Downs.

An additional potential exposure pathway is through the ingestion of radionuclides. Two potential exposure scenarios were assessed being; foraging of native foods by Aboriginal people and the consumption of locally grown produce.

The most conservative estimate of radiation exposure to Aboriginal people through the consumption of locally sourced foodstuffs is assessed to be low. This is based on the fact that the area is not a regular foraging area and that the general abundance of foodstuffs in the area is low. A most conservative case for ingestion dose from home grown vegetables and drinking water from rainwater tanks for the public in Roxby Downs is estimated to be 0.01 mSv/y. Based on the most recent sampling (BHP Billiton 2005), conservative estimates of doses from the regular consumption of beef from the local area are between 0.02 and 0.04 mSv/y.

Further details on the dose assessment for members of the public are provided in Appendix S2.

Radiation doses have been calculated using the methods outlined in ICRP and are shown in Table 22.1.

Public radiation doses from the transport of concentrate and the operation of the storage and handling facilities at the Port of Darwin were assessed. Three possible exposure scenarios were considered and conservative assessments were made for each:

- Member of public at the edge of the rail easement – a member of the public might be present at the edge of a rail easement while a concentrate train passes or may be at a rail crossing. If the individual was 5 m from the train and the train was to pass at walking pace, the total dose to the individual would be 0.0008 mSv.
- Member of the public living near the rail easement – this scenario simulates the situation of a person living 20 m from the rail line and assumes that trains pass each day. This gives a dose estimate of 0.0018 mSv/y.
- Member of the public living in Darwin – the concentrate handling system is designed as a 'closed system' and there is expected to be no dust generated by the operations at the Port of Darwin. Radon would emanate from the concentrate and a conservative estimate from exposure to radon decay products predicts that doses in Darwin to be a maximum of 0.02 mSv/y.

The internationally accepted limit is 1 mSv/y above natural background levels. Further details on the dose assessment for members of the public for the transport of concentrate is provided in Appendix E4.

22.6.7 COMMUNITY HEALTH AND SAFETY

The community health and safety issues identified in Chapter 19, Social Environment, and also from community consultation are:

- safety associated with increases in vehicle movements in Roxby Downs from the increased population and construction workforce
- safety issues related to crime
- health effects of airborne particulates.

The broader safety issues are addressed elsewhere in this document, in particular, crime and its mitigation are addressed in Chapter 19 and road safety is addressed in Section 22.6.9.

The health effects of inhaling airborne particulates range from coughing, through to an increased need for medications such as 'puffers' and antibiotics (*Mine dust and you,* NSW Department of Health Factsheet 2007). At high enough concentrations and exposure to certain types of particulates, effects could include respiratory diseases and increased risks of cancer.

A review was conducted of the literature on the community health impacts related to mining by Mining Minerals and Sustainable Development (MMSD) in 2001 (MMSD 2001). This work collated findings from 330 published papers. The review showed that the occupational effects of particulates are well understood and that limiting exposure (through air quality standards) controls health impacts. Although there is less information available on community impacts, the same approach is used, in which exposure limits are established by national authorities to minimise the health effects on members of the general public. The limits take into account both the short-and long-term health impacts.

Chapter 13, Greenhouse Gas and Air Quality, uses modelling to predict concentrations of particulates in Roxby Downs and it is noted that the annual average is one third of the recognised limit. Modelling was also conducted on sulphur dioxide and the predicted levels are less than 25% of the standard at both Roxby Downs and Hiltaba Village. The health impacts of dust are therefore considered to be low. BHP Billiton would aim for ongoing public health protection through compliance with applicable legislation and would keep abreast of studies in this area.

The main difference for the community at Roxby Downs is that once ore was being mined, any particulate matter that reached Roxby Downs would contain radioactive material. This is already recognised and monitored. The exposure levels have been estimated in Section 22.6.6 and show the average population total exposure would be approximately one-sixth of the recognised limit. The impact is therefore categorised as low.

22.6.8 HAZARDOUS SUBSTANCES

Large quantities of various chemicals are used in the existing operation, some of which are classified as 'dangerous substances'. It is not expected that any new hazardous substances would be introduced in the expanded operation but the quantities of materials used would increase.

Table 22.2 shows the approximate forecast annual chemical use for significant dangerous substances for the proposed expansion. The current rate of use is also provided for

Table 22.1 Estimated doses to members of the public in Roxby Downs

Dust dose (mSv)	Radon decay product dose (mSv)	Gamma dose (mSv)	Ingestion dose (mSv)	Total dose (mSv)	Limit (mSv)
0.003	0.120	0.000	0.050	0.173	1.0

comparison. As consumption rates may vary depending upon the mineralogy of the ore being processed at the time and plant conditions, the volumes provided below are estimates only.

It is also anticipated that approximately 350 million litres of diesel fuel would be consumed by the mining fleet each year.

Chapter 5, Description of the Proposed Expansion (Tables 5.8, 5.15, 5.33, 5.48) outlines other chemicals and substances (including those not defined as dangerous substances) that would also be used in the expanded operation.

There are specific regulatory requirements for storing and using hazardous substances and dangerous goods, including specific licences to own, use and dispose of these substances. Licences are currently held by the existing operation and would also be sought for the expanded operation.

Under current arrangements with South Australian Government authorities, some hazardous materials are covered by special requirements, exemptions and licences. These are expected to remain in force for the licence period and may be updated or extended from time to time. For example, emissions of solid particles, acid gases, sulphur trioxide and sulphuric acid as a result of abnormal and emergency events require specific notification and reporting under EPA exemption 3014. This allows improved control of emissions whilst allowing operational control and response to changes in operational conditions. Conditional exemptions or requirements have been granted for other materials from time to time to ensure or improve environmental protection and reporting.

Bulk storage facilities for hazardous liquids would be designed and constructed according to applicable standards and legislation. As a minimum, the South Australian Environment Protection Authority (SA EPA) standards would be used (EPA Guideline 080/07), which require bund sizes and volumes to be 120% of the net capacity of the largest tank and 133% for flammable material.

All chemicals delivered to the site (not just hazardous or dangerous chemicals) are managed by the stores warehouse. Warehouse personnel undergo regular training to ensure that hazardous goods are stored safely in a manner that complies with dangerous goods regulations and requirements. Material safety data sheets are provided to users with each consignment of chemicals and materials. Personnel also receive appropriate training in the safe use and handling of hazardous material.

In addition to the dangerous substances listed in Table 22.2, the site inventory of chemical substances lists over 250 items for which material safety data sheets are available.

It is expected that a range of chemicals and materials would be used during construction. All contractors would be required to comply with standard procedures for hazardous substances to ensure that construction material that arrived on the site was obtained, stored, used and disposed of in a safe and responsible manner.

The operation of the proposed open pit mine, combined with existing usage in the underground mining operation, would require a significant quantity of explosives. The explosive of choice is known as ANFO (ammonium nitrate and fuel oil). ANFO consists of a number of individual components, which by themselves are relatively inert, including ammonium nitrate, emulsion (usually fuel oil), additives and detonators. A dedicated explosives facility would be constructed to produce and store the required amount of ANFO for the expanded operation. The licensing requirements for explosives facilities

Table 22.2 Forecast annual dangerous substances usage

Substance	Dangerous goods classification	Current use	Proposed expansion
Ammonia	2.3	2,700 t	11,000 t
Caustic soda	8	5,200 t	25,000 t
Copper extractant (Oxime)	9	320 t	880 t
Diluent – CuSX	3	2,700 m^3	6,300 m^3
Diluent – USX	3	3,300 m^3	7,700 m^3
Ethanol	3	2,000 m^3	17,300 m^3
LPG	2.1	17,000 t	45,000 t
Oxygen	2.2, 5.1	122,000 t	525,000 t
Sodium chlorate	5.1	5,700 t	63,900 t
Sodium cyanide	6.1	95 t	410 t
Solvent extraction modifier (Isodecanol)	9	205 m^3	680 m^3
Sulphur	8	80,000 t	1,720,000 t
Uranium extractant (Amine)	8	175 m^3	270 m^3
Xanthate	4.2	460 t	2,000 t

are significantly more stringent in South Australia than in other states of Australia through the following legislation:

- Explosives Act and Regulations
- Dangerous Substances Act and Regulations
- Explosives (Security Sensitive Substances) Regulation.

These detailed requirements address storage, handling and use. ANFO is also considered to be a 'security sensitive substance' for which there are additional requirements relating to the design of a storage facility, including minimum distances from infrastructure, roads and public access areas.

BHP Billiton would conform to HSEC standards and comply with the licensing requirements to ensure the safe construction and operation of the explosives facility. In addition, risk assessments would be conducted as part of the design phase of the project.

22.6.9 GENERAL TRANSPORT SAFETY

Transport considerations

The transportation of materials, including goods, supplies, fuels, chemicals and products, to and from the operation is a significant logistical exercise. Currently, approximately one million tonnes per annum (Mtpa) of material is transported to and from Olympic Dam by road. This equates to about 66 truck movements per day (where a truck travelling to and from Olympic Dam is counted as two truck movements) between Port Augusta and Olympic Dam.

During the construction period, operational supplies, products and construction material would be transported to site initially by road, and then by rail after the new rail line becomes operational. In addition to this material, there would be a significant number of over-dimensional loads that would be transported by road to Olympic Dam from both Adelaide and the landing facility south of Port Augusta via the pre-assembly yard on the outskirts of Port Augusta.

In the final expanded operation, it is expected that the quantity of transported materials would increase to approximately 4.6 Mtpa, with the majority being transported to or from the site by rail after the new line was completed.

A Traffic Impact Assessment (TIA) was conducted (see Appendix Q9) to assess the impacts of the increase in freight volumes and as part of the risk assessment, a review of the traffic risk was conducted (see Appendix C). The social impacts of increased traffic due to the expansion are presented in Chapter 19, Social Environment, and the safety related impacts are presented in this section.

The TIA shows that during the anticipated construction period of about 11 years, construction and operations related traffic would peak after five years and reduce significantly once the rail system became fully operational. The TIA describes a baseline case against which additional traffic is compared and also identifies the Stuart Highway between Port Augusta and Pimba and the road between Pimba and Olympic Dam (Olympic Way) as the roads mainly affected by the proposed expansion. The risk assessment also identifies these two sections of road as significant. Consequently, the safety assessment focuses on these sections of road.

For the section of road between Adelaide and Port Augusta, the TIA notes that the increase in road use is low, with an increase of 8% for heavy vehicles in the peak year reducing to 3% by the end of construction.

The impact of traffic increase for different phases of construction are discussed in the following section (see also Figure 19.20 in Chapter 19, Social Environment).

Current operation

The current operation transports about one million tonnes of goods, supplies and products each year by road to and from Olympic Dam.

Construction Phase 1 – Road

The intermodal facility at Pimba is scheduled for construction in this phase and planned to be operational early in 2012. Traffic volumes would increase as follows.

Stuart Highway (section between Port Augusta and Pimba):

- heavy goods vehicles (carrying construction materials, operational materials, products and ancillary goods to support the township) would increase by up to 30% during this period over the baseline case.
- buses and small truck traffic would build to 60% over the baseline case
- personal and light vehicle traffic is predicted to increase by 65% over this period.

Olympic Way:

- heavy goods vehicles would increase by up to 60%
- buses and small truck traffic would increase significantly, up to 250% above the baseline case
- personal and light vehicle traffic is predicted to increase by up to 90%.

Construction Phase 2 – Pimba intermodal

The rail spur between Olympic Dam and Pimba would be constructed during this period. With the intermodal facility being commissioned and becoming operational in early 2012, a large proportion of the operational and construction freight would be railed to Pimba and then trucked between Pimba and Olympic Dam. Traffic volumes would increase above the baseline case as follows.

Stuart Highway (section between Port Augusta and Pimba):

- even though it is predicted that both construction and operational transport requirements would increase during this period, heavy goods vehicles would only slightly increase to 40% over the baseline case due to the operation of the intermodal facility
- buses and small truck traffic would increase during this period to be over double the baseline case
- personal and light vehicle traffic is predicted to continue to increase to over 130% of the baseline case.

Olympic Way:

- heavy goods vehicles would increase in this period by 80% above baseline levels
- buses and small truck traffic would drop significantly, to 50% above the baseline case
- personal and light vehicle traffic would continue to increase to almost 200% of the baseline levels.

Ongoing operations – Pimba intermodal plus rail

Following completion of the rail line, the majority of the construction freight and a significant proportion of the operational freight would be transported by rail. Traffic volumes would increase above the baseline case as follows.

Stuart Highway (section between Port Augusta and Pimba):

- there would be a reduction in heavy goods truck movements, although traffic would continue to be 20% above baseline case levels due to ancillary traffic supporting the expanded township of Roxby Downs
- buses and small truck traffic would remain at over double the baseline case levels
- the increase in personal and light vehicle traffic would stabilise at over 130% of the baseline case.

Plate 22.16 Large project components being transported for the 1997 Olympic Dam expansion

Olympic Way:

- due to ongoing ancillary heavy goods requirements in Roxby Downs, traffic would stabilise at about 30% above the baseline levels
- buses and small truck traffic would remain at 50%–60% above the baseline case
- personal and light vehicle traffic would gradually reduce to almost 150% of the baseline levels by 2020.

Over-dimensional loads

BHP Billiton intends to transport over-dimensional, pre-assembled and prefabricated materials to Olympic Dam (see Plate 22.16).

Over-dimensional loads refer to truck movements with large loads that have additional requirements for transport due to the width, height or length of the vehicle or load. The requirements range from transport permits, through to escorting of loads by a pilot vehicle and/or police escort, through to special assessment by the Department for Transport, Energy and Infrastructure (DTEI) for loads greater than 8 m wide. For Olympic Dam expansion, loads greater than 8 m wide would be transported based on a series of temporary road closures, subject to DTEI approval. The vehicles normally travel slower than the regulatory speed limit for safety reasons.

The majority of the larger over-dimensional loads (greater than 8 m in width) would travel from the landing facility to the pre-assembly area in Port Augusta via a private access corridor. From the pre-assembly yard the loads would be transported to Olympic Dam via the Stuart Highway and Olympic Way (see Appendix Q9 for further descriptions of the proposed route).

Similarly, most over-dimensional loads that are between 5.5 m and 8 m in width would also be transported by sea to the landing facility near Port Augusta and would follow the same route as described above.

The remainder of the over-dimensional loads (less than 5.5 m wide) would require escorts or permits only and would predominantly travel between Adelaide and Olympic Dam.

During the first three years of construction, over 50% of all over-dimensional loads would be transported to Olympic Dam at a rate of approximately six per day. For the remainder of the construction period, the number would reduce to an average of approximately two per day. Each of these movements would require detailed planning and approval from appropriate authorities, with proper road safety precautions including a transport plan prepared in conjunction with the South Australian Police and the DTEI. To facilitate the movement of the over-dimensional loads, BHP Billiton would install up to 15 passing points (passing bays or rest areas) along the Stuart Highway (nine points) and Olympic Way (six points) that would enable traffic to move around the loads safely. The installation of additional passing points and rest areas along the route would be the subject of further investigation in collaboration with the DTEI.

BHP Billiton recognises that there would be a nuisance factor associated with each of the movements and would aim to minimise this impact, with rest areas, amenity and snack facilities provided.

From a safety perspective, the movement of over-dimensional loads would be expected to have a negligible impact given the traffic management measures that would be developed. These traffic management measures would be consistent with the relevant DTEI policies and guidelines and would require the approval of the DTEI.

Safety impacts of transport

The South Australian Government, through the DTEI, has released a statewide plan to reduce the number of road accidents *(South Australian Road Safety Action Plan 2008–2010)*. The action plan is aligned with a national initiative on road safety. Statistics show that in 2004, South Australia was above the national road fatality rate of 8.0 per 100,000 people at 9.1 fatalities per 100,000 people. The South Australian Road Safety Action Plan 2008–2010 reports that rural driving in South Australia contributes disproportionately to the accident statistics with speed, alcohol and fatigue identified as causes in the majority of accident cases. Accidents involving hitting fixed objects and rollovers contributed to more than 60% of accidents supporting the causal factors identified.

The proposed Olympic Dam expansion would increase the volume of road transport, and this has the potential to increase the number of vehicle accidents that may occur. For this impact assessment, the main areas considered were long-haul trucking, light vehicles (personal vehicles) and bussing.

AusRap (Australian Road Assessment Program through the Australian Automobile Association) has produced three annual reports in recent years (*How Safe Are Our Roads*? 2005(a), 2005(b), 2007) which provide information on relative risks on sections of road across Australia. Information is provided on collective risk, which is a relative measure of casualty crashes on a particular stretch of road, and accident rate, which is a relative measure of casualty crashes per vehicle kilometres travelled. Compared to other roads, the Port Augusta to Pimba road is rated low-medium for collective risk and high for accident rate.

The average accident rate for the AusRap reporting periods (1998–2002, 1999–2003, 2000–2004), is approximately 20 casualty crashes per 100 million vehicle kilometres travelled. The accident rate, being related to the distance that an individual travels, is not expected to change as a result of the proposed expansion. However, if more accidents were to occur, then the collective risk would rise.

AusRap note that the combination of the two risk measures provides an indication of the relative safety of a stretch of road, and that a high rating in both categories indicates a region that requires attention.

The safety impact assessment for the Draft EIS is based on scaling up the statistics for existing traffic numbers (see Appendix Q9 for details). However, extrapolating accident rate figures from these statistics assumes that conditions will remain the same, which could result in an overestimate because no account is taken of the behaviours of individual drivers, changes to road conditions, systems of control (such as vehicle speed checks) or variability in the statistics.

BHP Billiton recognises the impacts of increases in road use, and would implement a broad range of initiatives, including installation of additional passing bays for over-dimensional loads which also act as traffic rest areas, the development of traffic management plans specifically for over-dimensional loads for the main construction period and the provision of public information so the public can plan their travel. The presence of slower vehicles and additional measures may act to slow drivers and check behaviours which could lead to safer situations. In developing and implementing these initiatives, BHP Billiton will work with the DTEI and the SA Police with the aim of reducing the potential for accidents. It is noted that predictions based on statistics should be considered as indicative only.

Long-haul trucking

Predicted trucking figures indicate that there would be a peak increase of up to 8% in heavy goods traffic on the national highway between Adelaide and Port Augusta due to the expansion, and this increase would not change the level of service on this route (level of service being a measure of operational conditions within a stream of traffic: see Appendix Q9 for details).

The increase in traffic would be more noticeable on the Stuart Highway between Port Augusta and Pimba, with heavy vehicle traffic increasing by more than 40% for a number of years during construction. However, it is expected that the impact on safety would be low as BHP Billiton would implement a traffic management plan by which truck service providers would be required to comply.

Personal vehicles

Fatality rates for personal vehicles are usually measured in 'fatalities per 100,000 population' and 'fatalities per 100 million kilometres travelled'. The average annual rates for the period 2001 to 2006 are shown in Table 22.3 (Department of Infrastructure, Transport, Regional Development and Local Government 2008).

Although the number of light vehicles and the number of kilometres travelled would both be expected to rise as a result of the proposed expansion, the accident rate would not be expected to change because the rate is related to individual distances travelled, and the distance that an individual would travel should not change.

Table 22.3 Personal vehicle fatality rates

Fatality rate (per 100,000 population) (average from 2001 to 2006)		Fatality rate (per 100 million km travelled) (average from 2001 to 2006)	
South Australia	Australia	South Australia	Australia
9.4	8.3	0.9	0.8

Bus transport

Transporting the construction and operation workforce by bus has been proposed for logistical purposes and as a means of reducing the number of smaller vehicles on the road. During the peak years of construction, there would be up to 180 daily bus trips between the accommodation facility at Hiltaba Village and Olympic Dam. It has also been estimated that there would be an additional 50 daily bus movements along the Stuart Highway between Port Augusta and Olympic Dam. The risk assessment (see Appendix C) notes that bussing results in a fatality rate of 1.15 per 100 million kilometres travelled. Conservatively, based on the predicted bus usage as outlined in the TIA, it is estimated that there would be approximately 5 million kilometres travelled per year. Given that any bus service provider supporting the expansion would be required to have suitable fatigue management and safety management systems, the projected impact is categorised as low.

Rail transport

Once the rail line had been installed, it would displace a large proportion of the operational and expansion trucking requirements and thereby reduce the amount of road traffic resulting in a positive impact on safety. The safety implications of the additional rail use can be determined by using current national statistics and projected rail usage rates.

The expanded operation would generate 28 rail movements per week between Adelaide and Olympic Dam for freight and some products. In this context a movement is a one way trip. This equates to approximately 900,000 km per year.

In addition to the supplies for the mine and operation, there would be seven train movements per week transporting concentrate to the Port of Darwin for export and seven return trips to Olympic Dam. This equates to an additional 1.9 million track kilometres per year, of which 700,000 kilometres is in South Australia and 1.2 million km are in the Northern Territory.

Overall, additional annual rail traffic as a result of the project is estimated to be:

- 1.6 million km in South Australia
- a total of 2.8 million km in Australia.

The Australian Rail Safety Occurrence Data (May 2008) indicate that in 2007 the total freight train kilometres travelled was 74.8 million km, of which 8 million km was in South Australia and 1,197,000 in the Northern Territory. Therefore, the proposed freight train traffic represents an increase of 20% in train traffic in South Australia, 100% in the Northern Territory and 4% of train traffic nationally. Accident rates for South Australia and the Northern Territory are shown in Table 22.4.

The TIA conducted a review of rail crossings, including crash statistics, and this indicated that crash rates are low (approximately 0.3 per million km). Using predicted rail travel distances, a theoretical increase in crashes could also be expected.

A relative increase in accident rates could be expected due to the increased rail operations. Trains would operate under the ARTC and FreightLink operating procedures and comply with rail safety requirements.

Increased traffic in Roxby Downs

While the main trucking route would be via the heavy vehicle bypass which avoids the Roxby Downs township centre, there would be increased traffic in Roxby Downs. Peak periods for vehicles in Roxby Downs would occur at the shift changes, 5 am to 7 am, and 5 pm to 7 pm. At these times, it is expected that there would be a significant amount of traffic on the road to the Olympic Dam site. Traffic conditions in Roxby Downs during normal business hours (9 am to 5 pm), including school hours, should not be adversely affected.

Table 22.4 Safety related incident for South Australian rail operations 2001 to 2007

Type of incident	Average annual number of incidents (2002–2007)-SA	Average annual number of incidents (2002–2007)-NT
Level crossing – people	3	0
Level crossing – vehicles	10	0.5
Derailments	23	2
Fatal accidents	4	0.3
Serious accidents	5	1.0
Running line or stock collisions	1	1.0
Collisions with people	2–3	<1
Collisions with infrastructure	3	<1
Collisions with vehicles	2	<1

In consultation with the DTEI and the Roxby Downs Council, BHP Billiton would install additional traffic safety measures around Roxby Downs, including roundabouts and traffic calming measures to control vehicle speeds. BHP Billiton would also provide buses for construction personnel and its own employees to minimise the number of vehicles on the roads.

In the peak year of construction, traffic along Olympic Way to the new western access road would increase by 50% over current levels (see Appendix Q9 for details).

22.6.10 PRODUCT TRANSPORT SAFETY

Transportation of uranium product

Currently, the uranium product (i.e. uranium oxide) is packed and sealed into 200 L drums, which are then sealed inside standard ISO (or equivalent) 6 m shipping containers and transported by road to Port Adelaide. Most of the product is shipped from Port Adelaide, and a proportion of the product is railed from Port Adelaide to the Port of Darwin for export. Transport by road and rail complies with all legislative requirements.

In the proposed expanded operation, uranium oxide would be railed directly from Olympic Dam to appropriate ports, subject to compliance with all legislative requirements.

Uranium oxide shipments must conform to two sets of requirements:

- Transport requirements are defined in the Code of Practice for the Safe Transport of Radioactive Materials 2008, issued by ARPANSA. This covers maximum external radiation levels, packing and packaging, signs and labels and the documentation that must accompany each consignment (see Plate 22.17).
- Security is determined by the Australian Safeguards and Non-Proliferation Office, which includes requirements to ensure that uranium oxide is secure from theft.

The radiation doses received by the drivers of the trucks carrying uranium oxide for the current operations are estimated from measurements made inside the truck cabins prior to departure. Existing data indicates that dose rates average approximately 1µSv per hour. A driver who makes 100 seven-hour trips with uranium oxide per year (in an estimated worst-case situation) receives an estimated annual dose of 0.7 mSv. It is estimated residents and bystanders receive only minute doses (i.e. fractions of a µSv) when containers pass by. Similar considerations apply to the transport of uranium oxide by rail, although doses to train crews would be expected to be considerably less because of the greater separation between the uranium oxide and the crew.

Accidents create the potential for transport workers, rescue workers and bystanders to be exposed to radiation. Exposure could occur only if an accident was severe enough to breach both the transport container and the drums, releasing uranium oxide which was then inhaled. Given the structural integrity of both the containers and drums, such an outcome is unlikely. It is also anticipated that any potential exposures would be small because the exposure period would be short.

Plate 22.17 Operator securing drum of uranium oxide concentrate into shipping container

The clean-up of any resultant spillage of uranium oxide would require specialised equipment and currently containers with such specialised equipment, including PPE, are held in readiness at Olympic Dam and in Adelaide. For the expanded operation, a clean-up container would accompany each train carrying uranium oxide, and appropriate personnel along the route (e.g. CFS/SES) would be trained in clean-up procedures. The clean-up would, however, be no more difficult than for other non-liquid dangerous goods spilt under similar conditions. Government officials and a radiation safety officer would oversee the clean-up.

A risk assessment workshop was conducted on the possible event of an accident between a train and a truck carrying uranium oxide. The event was determined to have a very low probability due to the small number of containers being shipped. In addition, the existing protection measures, including heavy-duty packaging of lined drums within a shipping container, would provide protection against spillage. In the event that containers were ruptured, systems and procedures are currently in place to control spillages, including the use of specialised hazardous material clean-up equipment based in Adelaide and Olympic Dam and specially trained personnel.

Transport of concentrate

It is proposed that concentrate would be railed to the Port of Darwin for export to overseas customers. As described in Chapter 5, Description of the Proposed Expansion, the concentrate would be loaded at the Olympic Dam site into rail trucks fitted with lids, and seven trains per week of up to 60 loaded wagons would transport the material to the Port of Darwin. An enclosed warehouse at the port would store the concentrate until the dedicated concentrate ships arrived at the East Arm wharf for loading. A fully enclosed reclaim system would transfer the concentrate from the storage shed to the ship.

The rail wagons would be dedicated to the task of transporting concentrate and wash facilities would be installed to ensure that the outside of the wagons were cleaned after loading at Olympic Dam and unloading at the Port of Darwin.

The concentrate would contain up to 2,000 ppm of uranium and would therefore be defined as radioactive. Compliance with appropriate transport requirements as detailed in the ARPANSA Code of Practice for the Safe Transport of Radioactive Material 2008 would be required. Doses to members of the public along the transport route would be negligible and well below compliance limits.

Radiation doses to full-time train drivers are expected to be approximately 0.5 mSv/y.

Emergency response for the transport of concentrate

The existing Olympic Dam Corporation Emergency Incident Response Plan would be modified to address aspects of the transport of concentrate. The plan would include requirements from the South Australian Government document 'Emergency Response to a Leakage or Spillage of a Hazardous Material during Transport, Storage or Handling' and the 'South Australian Hazardous Materials Hazard Plan', which is currently in draft form.

In the event of an incident, the initial response would be to provide basic security to restrict access and to contain the product at the incident site. Access control equipment, including bunting, flagging and safety cones, would be carried in an incident response container that would travel with each train movement between Olympic Dam and the Port of Darwin. The incident response containers would assist in an incident and be used by agencies such as the Metropolitan Fire Service, Country Fire Service and the State Emergency Service. Agencies would be trained in the specific requirements relating to the Olympic Dam concentrate.

Clean-up would involve trained personnel under the supervision of representatives from the appropriate state or territory government agencies. Spilled material would be collected into rail wagons and returned to Olympic Dam for treatment. BHP Billiton would work with all service providers and emergency services to ensure alignment of response plans. Equally, service providers would have their own plans to secure crew and equipment safely.

Shipping of concentrate

The Australian Maritime Safety Authority (AMSA) is the statutory body that would oversee the shipping of concentrate. In conjunction with AMSA, BHP Billiton has prepared an 'in principle agreement' on a transport plan covering the shipment of concentrate to overseas destinations. Areas that would be covered in the plan include; the use of dedicated and specifically designed ships, stowage and segregation, loading and unloading requirements, shipping routes, radiation safety during shipment and emergency response.

BHP Billiton is intending to use dedicated ships for the transport of concentrate and shipping companies would be vetted using the ship risk management system called Rightship.

The transport plan covers emergency events such as an incident at sea, ship in distress and oil spills. If an incident were to occur, international maritime agreements require the nearest sovereign state and the ship owner to render assistance.

Storage and handling facilities at the Port of Darwin

BHP Billiton would build a concentrate handling system at the Port of Darwin (see Chapter 5, Description of the Proposed Expansion). The main health and safety features of this system are dedicated handling facilities for the Olympic Dam concentrate and a 'closed system' to ensure containment of the material and control dust emissions.

Dedicated rail wagons would be loaded with concentrate in an enclosed warehouse at Olympic Dam. Concentrate would be sealed in the rail wagons with air and water proof lids, then washed before leaving Olympic Dam and railed to the Port of Darwin, where they would be unloaded automatically using a tippler operation in an enclosed facility fitted with automatic doors and a negative pressure particulate filtration system. Concentrate would be stored in a sealed shed and reclaimed using front end loaders onto an enclosed conveyor which would transfer the material into a dedicated bulk transport ship.

Access to the area would be restricted. Operators would be required to shower and change at the end of shift to manage the potential for spread of concentrate from their workclothes. The system has been designed so that locomotives and drivers do not enter the concentrate shed.

Within the shed, there may be dust generated, although the moisture levels of the concentrate (8% to 11%) indicate that dust levels would be low. Loader operators would be in air conditioned equipment, therefore their exposures would be low.

The 'closed system' would ensure that dust levels from the transport process would be minimal. In the event that a derailment occurs during transport resulting in spillage of product, emergency response and cleanup procedures would be instigated and the impact is assessed to be low because the concentrate is insoluble in water, contains low levels of radionuclides and can be easily cleaned up.

The construction of the facilities would be in accordance with BHP Billiton occupational health and safety standards as described earlier.

22.7 FINDINGS AND CONCLUSIONS

The proposed expansion of Olympic Dam poses a suite of health and safety related challenges that are faced by other operating mines. A systematic approach to health and safety is embedded in the business culture of BHP Billiton and is intended to provide the basis for identifying and managing these issues. The key safety challenges for the expanded operation are as follows.

Safety during construction and commissioning

The high number of construction workers needed for the proposed expansion requires effective management and control systems. Formal construction safety management plans and focus would be used for all phases of the project, and particularly during the construction phase, when workers, tasks and circumstances are generally new and the safety risks correspondingly higher than in the operation phase.

Operation of the open pit mine

BHP Billiton operates open pit mines in a range of environments around the world. However, open pit mining would be new to Olympic Dam, and the health and safety issues would be different from those of the underground mine. BHP Billiton would apply the company's existing principles and safety culture to the development of a safety regime to suit the new method of mining.

Transportation during construction

The transportation of material to and from the operation during the construction period represents a major logistical exercise for BHP Billiton. The corresponding increase in road traffic, particularly heavy trucks and over-dimension loads, has the potential to increase the road travel impacts resulting in a moderate impact. BHP Billiton has recognised this and would install a rail spur from Pimba to Olympic Dam and an intermodal road/rail freight facility at Pimba, which would significantly reduce transportation impacts. In addition, BHP Billiton would implement other measures such as specific traffic management plans, 15 passing points between Port Augusta and Olympic Dam and traffic control measures in Roxby Downs.

Radiation Safety

Radiation exposure to employees and members of the public would be expected to remain low in the expanded operation, consistent with exposure levels from the existing plant and mine. The open pit would present a set of conditions that have not been experienced before at Olympic Dam, however the assessment shows that the exposures to miners should be less than current levels. Exposures to members of the public at the closest receptor (Roxby Downs) would increase compared to current levels, but would remain almost one-sixth of the legislated limit.