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## **Regulatory Impact Statement**

**Final Version – July 2005**

### **Code of Practice and Safety Guide**

**Radiation Protection and Radioactive Waste  
Management in Mining and Mineral Processing**

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## Table of Contents

<b>Background .....</b>	<b>3</b>
<b>Problems .....</b>	<b>5</b>
Information Asymmetry.....	5
Externalities .....	9
<b>Objective .....</b>	<b>9</b>
<b>Statement of Possible Options.....</b>	<b>9</b>
<b>Impact Analysis.....</b>	<b>10</b>
Affected Parties.....	10
Cost-benefit Analysis of Options.....	10
Summary of Identified Costs and Benefits .....	25
<b>Consultation.....</b>	<b>27</b>
<b>Conclusion and Recommendation.....</b>	<b>29</b>
<b>Implementation and Review .....</b>	<b>31</b>
<b>References.....</b>	<b>31</b>
<b>Abbreviations .....</b>	<b>34</b>

This Regulatory Impact Statement (RIS) has been prepared in line with COAG's *Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies* (COAG 2004). COAG requires the preparation of a RIS at two stages in the development of a regulatory proposal. The first stage RIS is used as part of community consultation on the proposal and the second or final RIS, reflecting feedback from the community, assists the decision-making body. The Office of Regulation Review (ORR) assesses the adequacy of the RIS at each stage, and advises the decision-making body of its assessment. The ORR assesses this RIS as adequate for consultation.

## Background

- 1 There are currently three operating uranium mines in Australia, these being ERA Ranger Mine in the Northern Territory, and Olympic Dam and Beverley Uranium Mines in South Australia. Following the acceptance of an Environmental Impact Statement, a third operation in South Australia, Honeymoon, has been issued a Mineral Lease by the South Australian Government but is yet to apply for a licence to commence production. There are also other deposits that have been identified and may be developed in the future, and there are sites where past operations on uranium deposits have created legacy conditions where the management of remediation work is required.
- 2 Australian uranium production in 2002-03<sup>1</sup> was 9149 tonnes of uranium oxide ( $U_3O_8$ ), accounting for 19 percent of world production. This production provided exports of A\$ 427 million. All uranium produced in Australia is exported.
- 3 There are four heavy mineral sand mining and processing operations in Western Australia and two on the East Coast of Australia. Additional deposits of this type have been identified in the Murray basin and are expected to become operational in the future. Heavy minerals in mineral sands deposits are ilmenite ( $FeTiO_3$ ), zircon ( $ZrSiO_4$ ), rutile ( $TiO_2$ ) and a minor one, monazite (a rare earth element, thorium phosphate/silicate). Almost all rutile and ilmenite is processed into non-toxic white pigment for use in paints, plastics, paper, ink, rubber, textiles, cosmetics, leather, and ceramics. Rutile and some ilmenite is used to produce light, strong, corrosion-resistant titanium metal for use in aircraft, spacecraft, motor vehicles, desalination plants and surgical implants. Zircon is commonly used as abrasive material, and in refractories for foundry sand moulds, and zircon sand or powder is used for glazes on pottery and other ceramic surfaces. Zircon is the major source of zirconium, a corrosion-resistant metal that is used in nuclear reactors and chemical processing equipment. Monazite, one of the heavy minerals in mineral sands, contains thorium but is currently not produced in Australia. The value of the mineral sands industry to Australia for the 2003-2004 year was \$ 1.1 billion, corresponding to a total mineral sands production of 3.5 million tonnes. The data for mineral sands production and exports in Australia for the 2002-2003 and 2003-2004 years are given in Table 1 below:

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<sup>1</sup> Source: Uranium Information Centre.

**TABLE 1****EXTRACT FROM AUSTRALIAN MINERAL STATISTICS (ABARE 2005): Titanium and Zircon Minerals***(Sources: Australian Bureau of Statistics, Canberra; ABARE.)*

	Unit	2002–03	2003–04
<b><u>PRODUCTION:</u></b>			
Ilmenite concentrate (s)	kt	2 069	1 910
Leucoxene concentrate	kt	43	53
Rutile concentrate (s)	kt	208	154
Synthetic rutile (s)	kt	673	696
Titanium dioxide pigment (s)	kt	189	196
Zircon concentrate (s)	kt	458	448
<b><u>EXPORTS:</u></b>			
<b>Quantity</b>			
Ilmenite concentrate (a)	kt	1 020	783
Leucoxene concentrate	kt	41	125
Rutile concentrate (s)	kt	195	146
Synthetic rutile (s)	kt	456	470
Titanium dioxide pigment	kt	147	165
Zircon concentrate (s)	kt	445	426
<b>Value</b>			
Ilmenite concentrate (a)	\$m	135	82
Leucoxene concentrate	\$m	16	33
Rutile concentrate (s)	\$m	149	94
Synthetic rutile (s)	\$m	292	252
Titanium dioxide pigment	\$m	428	399
Zircon concentrate (s)	\$m	281	250
<b><u>PRICES</u><sup>(b)</sup>:</b>			
Ilmenite concentrate			
Bulk	A\$/t	132.51	104.56
Leucoxene concentrate			
Bulk	A\$/t	328.50	225.24
Bagged	A\$/t	490.96	543.71
Rutile concentrate			
Bagged	A\$/t	833.93	701.14
Titanium dioxide pigment	A\$/t	2 924.05	2 413.38
Zircon concentrate			
All grades – bagged	A\$/t	769.61	707.34

(a) Bulk and bagged before January 1992; bulk only thereafter. (b) Average export unit value.

(s) ABARE estimate.

- 4 There are some “hard rock” mining operations where uranium or thorium are present in concentrations which give rise to radiation exposures, or radioactive waste managements requirements, which should be controlled, such as for tantalum or niobium. Other operations, notably in the oil and gas industries, produce relatively

- small quantities of wastes potentially containing significant radionuclide concentrations that may require control.
- 5 It is necessary to protect workers, members of the public and the environment from the harmful effects of radiation exposures arising from mining and the processing of ores for the production of uranium, and the separation of heavy minerals from mineral sands ore, throughout Australia and from the radioactive wastes resulting from these activities.
  - 6 The *Environment Protection (Nuclear Codes) Act 1978* authorised the development of Codes of Practice regulating nuclear activities in Australia, in consultation with the States and Territories. Two of the Codes of Practice, developed by the Nuclear Codes Committee (NCC) under this Act, were:
    - *Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores, 1982*, known as the “Waste Code”; and
    - *Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores, 1987*, known as the “Health Code”, which was an extensive revision of the earlier *Code of Practice on Radiation Protection in the Milling and Mining of Radioactive Ores, 1980*.
  - 7 These Codes are quasi-regulatory in nature, as regulators have incorporated them into their legislation, either directly or indirectly through conditions of registration and/or licence, resulting in the dose limitation and safety practices prescribed within them being legally enforceable.
  - 8 Following the establishment of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the NCC lapsed and its work in reviewing/developing codes was incorporated into that of the Radiation Health Committee (RHC), a committee established under ARPANS legislation.
  - 9 A provision of the ARPANS (Consequential Amendments) Act 1998 was the repeal of the Environment Protection (Nuclear Codes) Act. This repeal was proclaimed in the Environment Protection (Nuclear Codes) Repeal Regulations 2000, Commonwealth of Australia Statutory Rules No. 331 dated 1 December 2000, and took effect on 4 February 2001.
  - 10 While the Environment Protection (Nuclear Codes) Act has been repealed, the *Health and Waste Codes* are now in the ARPANS regulations, and the regulations of several jurisdictions.

## Problems

### Information Asymmetry

- 11 Mining and milling of radioactive ores, such as uranium and mineral sands, could result in elevated radiation exposures to workers. In the absence of proper process controls the resulting radiation doses may easily exceed the regulatory limits. A well known past example of the resulting health hazard has been an elevated incidence of lung

cancers in the population of uranium miners, especially those from underground mining operations<sup>2</sup>.

- 12 ARPANSA Radiation Protection Series (RPS) No. 1 (ARPANSA/NOHSC 2002) requires that the annual occupational dose limit does not exceed 20 mSv per year, averaged over a period of 5 consecutive calendar years. This limit has been accepted by regulatory authorities throughout Australia and comprises both external and internal doses. Typical annual external photon doses received by mining and mineral processing workers are given in Table 2 below, typical annual external and internal doses received by full-time designated<sup>3</sup> uranium mining workers are given in Table 3 below, and typical annual internal doses received by mineral sands mining workers are given in Table 4 below:

**TABLE 2**

**ANNUAL PHOTON DOSES TO MONITORS WORN BY OCCUPATIONALLY EXPOSED PERSONNEL (2004): MINING**

(Source: *Personal Radiation Monitoring Service, ARPANSA*<sup>4</sup>)

<b>Occupational Classification</b>	<b>Maximum Dose (mSv)</b>	<b>Average Dose (mSv)</b>	<b>No. of Wearers</b>
<b>Uranium mining:</b>			
Mine workers	7.77	1.125	583
Mill workers	2.95	0.977	49
Miscellaneous	2.60	0.302	89
<b>Mineral sands mining:</b>			
Dry plant operators	6.97	1.001	108
Miscellaneous	3.38	0.574	51

<sup>2</sup> United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Report to the General Assembly, Volume II: Annex I, section E3, pp. 321-25 and Table 10, pp. 397-98.

<sup>3</sup> “Designated employee” means an employee who works under conditions such that their annual effective dose equivalent might exceed 5 mSv in a year.

<sup>4</sup> Morris, ND, Thomas, PD & Rafferty, KP 2004, *Personal Radiation Monitoring Service and Assessment of Doses Received by Radiation Workers (2004)*, Australian Radiation Protection and Nuclear Safety Agency Technical Report Series No. 139, June 2004, ARPANSA, Yallambie, Table 5, p.25.

**TABLE 3****TYPICAL ANNUAL EXTERNAL AND INTERNAL EFFECTIVE DOSES RECEIVED BY FULL-TIME DESIGNATED URANIUM MINING WORKERS***(Sources: WMC Olympic Dam Corporation<sup>5</sup>, ERA Ranger Mine<sup>6</sup>)*

<b>Radiation Work Group</b>	<b>Maximum Total Dose (mSv)</b>	<b>Mean Total Dose (mSv)</b>	<b>Mean Dose from Radon from Decay Products (mSv)</b>	<b>Mean Dose from Dust/Long Lived Alpha Activity (mSv)</b>	<b>Mean External Gamma Dose (mSv)</b>
Mine Production	8.8	3.6	1.4	0.2	1.9
Mine Maintenance	4.1	1.4	0.6	0.1	0.7
Mill Production	6.7	1.5	0.2	0.5	0.8
Mill Maintenance	6.2	1.7	0.2	1.2	0.3
Electrician	9.0	1.9	0.7	0.3	0.9

**TABLE 4****TYPICAL ANNUAL INTERNAL DOSES RECEIVED BY MINERAL SANDS MINING WORKERS FOR PERIOD 1 APRIL 2002 TO 31 MARCH 2003***(Source: Department of Industry and Resources, WA)*

<b>Maximum Internal Dose * (mSv)</b>	<b>Average Internal Dose * (mSv)</b>
14.3	1.9

\* Obtained from 5 mineral mining sites.

- 13 The Australian Radiation Incidents Register (ARIR) lists two incidents involving the mining and mineral processing industry. One incident involved the spillage of yellowcake powder, which contains natural uranium, from a bin during product packing. This resulted in the ingestion/inhalation of powder by two workers. The other incident involved a group of five workers, who were replacing the roof of a building at a mining site, were inadvertently exposed to uranium product dust while they were working near an extraction fan, which had collected product dust from the product hopper and trommel facilities that became pressurised due to a blockage in the exhaust system.

<sup>5</sup> Data obtained from WMC Olympic Dam Corporation, Roxby Downs, SA, for the 2002/2003 reporting year.

<sup>6</sup> Data obtained from Energy Resources of Australia Ltd (ERA) – Ranger Mine, Jabiru, NT, *Radiation Protection and Atmospheric Monitoring Program - Annual Report for the Year Ending 31 December 2002*.

- 14 The *Health and Waste Codes* do not have expiry dates but are outdated (published in 1982 and 1987 respectively). Whilst there is some international general guidance on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ICRP 2000, IAEA 1995, IAEA 2002, IAEA 2003a, IAEA 2003b) there is no specific Australian guidance. Consequently, employers, workers, consumers and the public do not have any up-to-date publicly available Australian radiation protection information to satisfy themselves that their health and safety is being adequately protected from radiation exposure in mining and mineral processing, and the management of radioactive wastes arising from these practices.
- 15 The International Commission on Radiological Protection (ICRP) released its 1990 recommendations (ICRP 1991), which changed the system of radiation protection and introduced revised dose units for radiation workers and the public. The International Atomic Energy Agency (IAEA) published its new Basic Safety Standards (IAEA 1996), which established the basic requirements for protection of people against exposure to ionizing radiation and for the safety of radiation sources.
- 16 The current Australian radiation protection regime, through ARPANSA Radiation Protection Series (RPS) No. 1 (ARPANSA/NOHSC 2002), incorporates the dose limitation and protection philosophies in ICRP Publication 60 (ICRP 1991). However, the 1987 *Health Code* and the 1982 *Waste Code*, while also adopting ICRP recommendations and dose limits, relied on ICRP Publication 26 (ICRP 1977). These differences in dose limits are shown in Table 5 below:

**TABLE 5****COMPARISON OF PREVIOUS AND CURRENT DOSE LIMITS**

Code	Application or Quantity	Annual Dose Limits		
		Designated Employees <sup>7</sup>	Non-Designated Employees	Public
1987 Health Code & 1982 Waste Code	Effective dose equivalent	50 mSv	5 mSv	1 mSv *
ARPANSA RPS 1	Effective dose	20 mSv per year, averaged over a period of 5 consecutive calendar years		1 mSv

\* A subsidiary dose limit of 5 mSv in a year was permissible for some years, provided that the average annual effective dose equivalent over a lifetime did not exceed the principal limit of 1 mSv per year.

- 17 The Environment Protection (Nuclear Codes) Act has now been repealed and responsibility for the review of these Codes belongs to ARPANSA. ARPANSA needs to ensure that workers and the public are able to obtain reliable information on

<sup>7</sup> “Designated employee” means an employee who works under conditions such that their annual effective dose equivalent might exceed 5 mSv in a year.

permissible levels, what measures to take to avoid radiation exposure, and on measures to effectively manage radioactive wastes.

### Externalities

- 18 Wastes arise from mining and processing of ores containing naturally occurring radioactivity. If not adequately managed on-site, such wastes have the potential to cause harm to humans or to the environment external to the mining site. The potential costs of such harm, both to current and future generations, are substantial. Remediation of past practices, which have not been adequately regulated during operation, can be costly and those costs are generally born by governments and society in general. The Mary Kathleen Uranium Mine, in far north-west Queensland, was Australia's first major rehabilitation project of a uranium mine. The project was completed at the end of 1985 at a cost of about \$19 million<sup>8</sup> and in 1986 the project won an award for environmental excellence from the Institution of Engineers Australia. The cost of rehabilitation of the Nabarlek Uranium Mine, Northern Territory, which was decommissioned in 1994-95, was about one third of Mary Kathleen's rehabilitation<sup>9</sup>. The costs of the rehabilitation of Mary Kathleen and Nabarlek Uranium Mines were borne by the operators. Another example was the rehabilitation of Rum Jungle in the Northern Territory from 1983-88<sup>10</sup>, which cost \$16.2 million and was funded by the Commonwealth Government. An additional funding of \$1.8 million was later provided for the rehabilitation of Rum Jungle South.

### Objective

- 19 To cost-effectively protect workers, members of the public and the environment from the harmful effects of radiation exposures arising from mining or mineral processing and from the waste resulting from these activities both now and in the future.

### Statement of Possible Options

- 20 Three regulatory options were considered:
- (a) *status quo* — no change to any regulations and hence governments would continue to rely on the *Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores 1987* (known as the Health Code) and the *Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radiative Ores 1982* (known as the Waste Code) to ensure radiation protection in the mining and mineral processing sector.
  - (b) self-regulation — this option would allow the mining and mineral processing industry to set directly its own radiation safety and waste management requirements, while still remaining subject to general occupational health and safety and environmental regulatory controls.

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<sup>8</sup> Obtained from Uranium Information Centre web site: [www.uic.com.au/mku.htm](http://www.uic.com.au/mku.htm)

<sup>9</sup> Obtained from Uranium Information Centre web site: [www.uic.com.au/nabarlek.htm](http://www.uic.com.au/nabarlek.htm)

<sup>10</sup> Obtained from Uranium Information Centre web site: [www.uic.com.au/fmine.htm](http://www.uic.com.au/fmine.htm)

- (c) a new Code of Practice and Safety Guide — this involves replacing the existing *Health Code* and *Waste Code* with a new Code of Practice and Safety Guide for radiation protection and waste management in mining and mineral processing.

## Impact Analysis

### Affected Parties

- 21 The parties who are likely to be affected by the proposed ARPANSA Code of Practice and Safety Guide include:
- (a) mining and mineral processing industries
  - (b) mining and mineral processing workers
  - (c) Government regulators (State, Territory and Commonwealth)
  - (d) the community.

Mining and mineral processing workers and industries, as listed in items (a) and (b) above, need to implement appropriate procedures to ensure health and safety in the workplace, protection of the environment, as well as ensuring a duty of care to protect the wider community ((d) above) from any health effects from mining or mineral processing operations.

Governments must implement the provisions of the proposed Code.

### Cost-benefit Analysis of Options<sup>11</sup>

- 22 The aim of this analysis is to provide a clear exposition of the nature of the costs and benefits associated with each option, and to quantify these impacts where possible.<sup>12</sup>

#### **Option 1 – Status quo**

- 23 This option does not require any regulatory changes to be made. Radiation protection and radioactive waste management in the mining and mineral processing sector will continue to be governed by the *Health Code* and the *Waste Code*, which are still adopted under the Australian Radiation Protection and Nuclear Safety Regulations 1998, and the regulatory frameworks in several jurisdictions.

#### ***Option 1 - Benefits***

##### *Health, Safety and Environment*

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<sup>11</sup> Cost-benefit analysis prepared for ARPANSA by the Allen Consulting Group, October 2004.

<sup>12</sup> While cost-benefit analysis requires all costs and benefits associated with the options to be measured quantitatively in common units (either in monetary units or physical units) to the fullest extent possible, to the extent that quantification is not possible, a comprehensive list of the costs and benefits together with a strong qualitative analysis can often provide a simple but still compelling case. Indeed, this approach is preferable to one where unreasonably broad assumptions are made to generate quantified impacts, which provide a false sense of accuracy.

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- 24 Mining and milling of radioactive ores, such as uranium and mineral sands, creates the potential for radiation exposure to workers. In the absence of proper process controls radiation doses may easily exceed regulatory limits.
  - 25 In terms of measuring the benefits associated with ‘avoided’ exposure radiation, it is reasonable to consider occupational exposure and public exposure in terms of average or collective annual effective dose.<sup>13</sup>
  - 26 Based on the latest available information — material published by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)<sup>14</sup> — the average annual effective dose for all occupational exposure in Australia is 0.24 mSv per year.<sup>15</sup> For uranium mining and mineral processing operations, the average annual effective dose has ranged between 1.4 mSv per year for mine maintenance workers to 3.6 mSv per year for mine production workers.
  - 27 While the effective dose tends to be higher in the uranium and mineral processing industries than other industries, exposure is still significantly below the exposure limits set out in the *Health Code* (50 mSv per year).
  - 28 It is reasonable to conclude that the *Health Code* and the *Waste Code* have contributed to low levels of exposure. So much so that factors other than merely specifying a maximum exposure limit must be influencing the cautious approach to radiation protection in mining and mineral processing. The most likely explanation is the promotion and adherence to the ALARA principle.<sup>16</sup>
  - 29 In addition to keeping occupational exposure low (at least relative to the exposure limits), the *status quo* regulatory arrangements have also resulted in an extremely low level of incidents. The *Australian Radiation Incidents Register* only lists two incidents involving the mining and mineral processing industry since the register was established. This compares with over 300 incidents from all other sources of radiation in other industries.
  - 30 Of the incidents that have been recorded, one incident involved the spillage of yellowcake powder, which contains natural uranium, from a bin during product packing and resulted in the ingestion/inhalation of powder by two workers — exposure was estimated to be between 67 mSv and 137 mSv. The other incident involved a group of five workers who were exposed to uranium dust while working near an extraction fan which had collected product dust from the product hopper and trommel facilities — exposure was assessed as being around 10 mSv.

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<sup>13</sup> N. Morris 1996, *Personal Radiation Monitoring and Assessment of Doses Received by Radiation Workers (1996)*, report prepared for Australian Radiation Laboratory, Department of Health and Family Services, Commonwealth of Australia, Yallambie.

<sup>14</sup> This figure is based on a weighted average of average annual effective annual dose for worker’s monitored. The data was taken from United Nations Scientific Committee on the Effects of Atomic Radiation 2000, *Sources and Effects of Ionising Radiation: UNSCEAR 2000 Report to the General Assembly, with Scientific Annexes*, United Nations, New York.

<sup>15</sup> This is based on a weighted average of the average effective dose and the number of workers monitored over the period 1975 to 1994.

<sup>16</sup> The ALARA principle encourages users of radiation to ensure that radiation exposure is kept as low as reasonably achievable (ALARA) after taking into account economic and social factors – as is set out in the general principles of ARPANSA Radiation Protection Series No. 1 (ARPANSA/NOHSC 2002).

- 31 While the number of incidents may be low relative to other sectors, there is some concern held by regulators that the requirement to report incidents is not clear in all cases, partly due to the uncertainty as to what constituted an incident. A recent Senate inquiry into the regulation of uranium mining noted that incident reports were not always required to be completed in writing and submitted to the regulatory authority nor were incident reports always made publicly available.<sup>17</sup> In response, authorities and mine operators acknowledged that there has been environmental contamination from mining activity but argue that even though there have been hundreds of incidents, the number is not significant and that, in any case, environmental damage has not been proved.<sup>18</sup>

### ***Option 1 - Costs***

#### *Administration*

- 32 The *status quo* option does not alter existing regulatory obligations and responsibilities for the mining and mineral processing industries. As such, the costs associated with establishing the current regulatory regime are sunk and therefore not an ongoing cost associated with this option.
- 33 Like with other areas of radiation protection there are likely to be some administration costs for governments and regulators associated with monitoring and enforcing the *Health Code* and the *Waste Code*, including:
- processing approvals and authorisations;
  - consultation with mine operators on management and potential changes to the management of radiation protection and waste management arrangements; and
  - assessment of plans for the control of radiation exposure and dose assessment.
- 34 In addition to the specific administration of the two codes, regulators in each jurisdiction need to ensure that staff continue to be appropriately trained and educated about the regulatory requirements. Given that the *Waste Code* was implemented in 1982 and the *Health Code* was developed in implemented in 1987, it is believed that costs associated with maintaining staff knowledge and skill in this area would be minimal, and no more than the costs associated with training and other related expenses due to staff turnover.
- 35 From a national perspective, these costs will be lower than other areas of radiation protection as given the nature of uranium mining; the administrative burden falls on South Australia and the Northern Territory and for mineral processing the administrative burden also falls on Western Australia, New South Wales, Queensland, and Victoria. By way of example as to the quantum of these costs the fees paid by Heathgate Resources (Beverley Uranium Mine) and WMC (Olympic Dam Project) were \$129 967.19 and \$317 208.05 respectively.<sup>19</sup> These fees are meant to reflect the full cost recovery cost to government, which are passed through to industry.

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<sup>17</sup> The Senate Environment, Communications, Information Technology and the Arts Reference Committee 2003, *Regulating the Ranger, Jabiluka, Beverley and Honeymoon uranium mine*, Senate Printing Unit, Parliament House, Canberra, pp. 183, 186, 187.

<sup>18</sup> *ibid* p. ix.

<sup>19</sup> Information provided by South Australia's Environment Protection Authority.

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*Compliance*

- 36 Both the *Health Code* and the *Waste Code* impose regulatory costs on mining and mineral processing businesses, including the costs associated with applying for approvals and authorisations, preparing safety plans, complying with stipulated duties and responsibilities for employers and employees, reviewing and reporting on the health of employees, and satisfying the general requirements for management of radioactive wastes.
- 37 Many compliance costs would most likely already have been incurred by business, and, like the administrative costs for regulators and government, they are sunk. The only relevant costs therefore are margin costs — such as renewal fees or updates on existing arrangements — rather than the need for significant expenditure in setting up and complying with the Codes. Nevertheless, it is still important to consider the costs involved.
- 38 In relation to preparing a radiation management plan it is expected that all uranium mining and mineral processing business would maintain working arrangements to satisfy their occupational health and safety obligations. Preparation of radiation management plans would require mining and mineral processing companies to review all aspects of safety, including defining emergency procedures as well as dedicating resources — i.e. people and money — to draft such a plan.
- 39 While in other areas of radiation protection — such as gauges, dentistry, or medical research — the cost associated with the preparation of a radiation management plan is likely to vary according to the size of the business, for mining and mineral processing the relative homogeneity of mining processes is likely to mean that the cost will be fairly similar across mining companies.
- 40 In the regulatory impact statement for the *Portable Density/Moisture Gauge Code* it was estimated that the cost of preparing a plan ranged between \$352 and \$1 320 per plan.
- 41 For uranium mining and mineral processing though, it is unlikely that the cost associated with preparing a radiation management plan will be this low. Depending on the complexity of the mining operation, it has been estimated that it would take around 40 to 160 person hours to prepare a radiation management plan. When developed in house by a radiation safety officer it will cost between \$25 and \$75 per hour.<sup>20</sup> This implies a cost of preparation in the range of \$1 000 and \$12 000 per plan. If an external consultant were used to prepare the plan, then with consultant rates of between \$70 per hour and \$150 per hour, the cost of preparing a plan would be in the range of \$2 800 and \$24 000. Given that there are nine mines — three uranium mines and six mineral sands mines — then the total cost of preparing a plan could range between \$9 000 and \$216 000.
- 42 As the *Health Code* has been in place since 1987, it is reasonable to assume that the cost of preparing a plan has already been incurred then the real compliance cost will relate to updates of the plan and costs incurred in honouring the commitments in the plan.

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<sup>20</sup> Obtained from Energy Resources of Australia (ERA) — Ranger Mine Jabiru, Northern Territory.

- 43 In relation to the costs of complying with the radiation management plan, it is quite difficult to differentiate expenditure on radiation protection and waste management from other regulatory requirements. For example, it is noted that ERA spent \$2.2 million on earthworks in late 2002 to improve water management controls and ERA's environmental division employs around 30 people with an annual budget of nearly \$3 million.<sup>21</sup> While the majority of these costs can be attributed to other environmental regulations, it is not unreasonable to expect that some of the resources dedicated to environmental measures are due to the current requirements in the *Waste Code* and the *Health Code*.
- 44 Without further information on the breakdown it is not possible to attribute specific costs to the *Health Code* or the *Waste Code*; however, the cost of complying with the existing codes will be at least the cost of preparing the plan and likely to be significantly higher.

#### *Regulatory Approach*

- 45 The *Health Code* exposure limits were based on the radiation protection standards of the 1977 International Committee on Radiation Protection Publication 26, which allowed up to 50 mSv per annum for radiation workers, where as ARPANSA's *Radiation Protection Series No.1* recommends exposure limits of 20 mSv per annum averaged over five consecutive calendar years. As such, the *status quo* option does not use the most recent science for exposure limits, which is inconsistent with radiation protection requirements overseas and in the radiation protection regulations of most jurisdictions.
- 46 There is a risk under the *status quo* option that compliance with other health and safety standards may be compromised (or achieved at greater cost) if inconsistencies between the *Health Code* and the *Waste Code* and other regulatory controls create confusion as to which standard is relevant in any particular situation.
- 47 Lack of currency and certainty as to what radiation protection standard applies suggests that dynamic efficiency is compromised under the *status quo*. Furthermore, this option does not provide regulatory flexibility and does not necessarily allow for best practice developments.

#### **Option 2 – Self-Regulation**

- 48 Industry self-regulation describes a regulatory system where industry participants primarily determine the type of actions or procedures that constitute appropriate conduct.
- 49 To develop some concept as to what are the costs and benefits of a self-regulatory regime it is necessary to make a judgement as to what the self-regulatory arrangements will look like.
- 50 The most likely self-regulatory regime that would evolve with respect to mining and mineral processing is what Priest calls 'firm-defined regulation' — see Table 6.<sup>22</sup>

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<sup>21</sup> Information taken from <http://www.uic.com.au> accessed on 15 July 2004 and from ERA's Social and Environment Report 2002, p6.

<sup>22</sup> See M. Priest (1997-98), 'The privatization of regulation: Five models of self-regulation', *Ottawa Law Review*, Vol. 29, p. 233.

While it is noted that Priest also outlines other models for self-regulation — most notably, ‘regulatory self-management’ where a peak industry body manages regulatory compliance on behalf of government — the ‘firm-defined regulation’ model is perhaps the most likely model as it may not be possible for a peak industry body to effectively enforce regulatory control over all industry participants.<sup>23</sup>

**TABLE 6****THE ‘FIRM-DEFINED REGULATION’ MODEL OF SELF-REGULATION**

Characteristic	Description
Government involvement	Government requires (or permits) private industry to establish regulatory structure, often at firm level
Source of power	Primarily the firm’s control over its own processes and employees. Secondly found in legislation that mandates self-regulation
Involvement of the public	Depends. The structure may remove rulemaking from public consultation process
Accountability	Government monitoring of private rule enforcement. Employee accountability to firm; firm to shareholders
Rulemaking	Rules made at firm or industry level specific to firm or industry requirements. May be approved by government regulator
Adjudication	Initial stage of firm discipline/labour relations. Secondly through courts or tribunals
Sanctions	At first instance at firm level. May include fines, employment sanctions, dismissals; the emphasis is remedial. Second instance, fines and other regulatory sanctions imposed by government
Offences	Offences in regulatory legislation continue to exist. Adjudication in civil courts continues. First step is private enforcement
Membership/coverage	The overall legislation covers an industry, the tailored rules cover a firm or smaller industry group

Source: M. Priest (1997-98), ‘The privatization of regulation: Five models of self-regulation’, *Ottawa Law Review*, Vol. 29, p. 233.

### **Option 2 - Benefits**

51 For regulators, there may be some administrative savings due to the fact that regulators would no longer administer, monitor or enforce the *Health Code* or the *Waste Code*. In practice, however, this benefit is likely to be small as the expenditure would likely be diverted to:

- monitoring more general occupational health and safety activities in the mining industry (i.e. regulators are unlikely to ‘save’ the reduced administrative costs); or
- spent on litigation and enforcement of several occupational health and safety standards related to mining and mineral processing operations.

<sup>23</sup> For example, membership of the Minerals Council of Australia and the Association of Mining and Exploration Companies is voluntary and radiation safety is not part of their core objectives.

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- 52 For mining companies, self-regulation should provide the opportunity to manage radiation risks in a manner which is consistent with those company's priorities, circumstances, and mine characteristics. This would afford mining companies flexibility in how they respond to radiation risks. In general, self-regulation should lead to reduced compliance costs — no plans to complete, no forms to fill in, no regulators to respond to, and so on.
- 53 At the same time though, self-regulation potentially allows for mining companies to minimise resources spent on managing radiation protection issues, hence to lower radiation protection standards. If this occurs then workers may need to undertake more effort to satisfy themselves that they are not unduly exposed (possibly with greater involvement of unions as employee representatives and advocates).
- 54 While in principle there should be cost savings for industry, in practice self-regulation is likely to result in a slightly more complicated and costly regulatory environment. Uranium mining and mineral processing companies will still be required to satisfy more general occupational health and safety obligations yet regulators will have less direct information about compliance and hence may have to dedicate more resources than is currently the case to ensure radiation protection.
- 55 The public consultation draft of the Regulatory Impact Statement requested information from stakeholders on the extent to which self-regulation was likely to reduce compliance costs – particularly if radiation protection standards were to be appropriately maintained. One submission commented that they believed there would be little, if any, reduction in compliance costs as a result of self-regulation.

### ***Option 2 - Costs***

#### *Administration*

- 56 Under self-regulation the administrative costs for government associated with the *Health Code* or the *Waste Code* will be reduced to zero. There will however, be the cost of repealing the relevant components of the *Australian Radiation Protection and Nuclear Safety Regulations 1998* and those regulations of other jurisdictions which contain the *Health Code* and the *Waste Code*. Given that this would be a relatively straightforward matter the cost is not considered significant.
- 57 From a broader perspective though, administrative costs in relation to radiation protection for mining and mineral processing will still be incurred. As indicated in Table 6, enforcement of safety standards will be through:
- The public enforcement of existing radiation safety regulations in each State and Territory;
  - the public enforcement of more general occupational health and safety regulations in each State or Territory;
  - the public enforcement of more general environmental protection regulations in each State and Territory; and
  - legal action by members of the public or employees for damages in the event that appropriate steps are not undertaken to ensure radiation protection or appropriate management of radioactive waste from mining or mineral processing activities.

- 58 The public consultation draft of the Regulatory Impact Statement requested information from jurisdictions on the extent to which they believed self-regulation would vary, if at all, if self-regulation were to be introduced. However, the public submissions did not provide any additional information.

### *Compliance*

- 59 As a result of moving to self-regulation:

- mining companies may alter their approach to radiation protection and hence could apply different standards across operations in Australia, this could lead to higher costs for individual mining companies as well as reduce consistency in health and safety standards;
- workers may need to undertake more effort to satisfy themselves that they are not being unduly exposed thus perhaps necessitating a much higher level of involvement in the mining industry by unions or non-government organisations (NGOs);
- legal avenues — such as lawyers and court — may be used more often to interpret, mediate, and award compensation in the event of a problem and as such these costs would be borne by workers who would face a less standardised approach to occupational health and safety for radiation protection and waste management;
- other regulatory areas may be undermined — particularly confidence in the regulatory system — as radiation protection will be more strictly regulated in all other sectors but in uranium mining it will be self-regulated; and
- community concerns may be increased if it is viewed that government does not believe that radiation protection in the mining industry (particularly for waste management) is a high priority.

- 60 It is difficult to quantify how changes in compliance costs will flow through the industry as this will be highly dependent upon individual strategies of the mining and milling companies. It is interesting to note that a recent Senate inquiry into uranium mining concluded that self-regulation had resulted in poorer compliance than would otherwise be the case. For example:

Debate centred on the extent to which these [environmental spills] incidents have impacted on the environment and whether or not they are attributed to an over-reliance on self-regulation, unsatisfactory management practices and/or inadequate monitoring, reporting, oversight and enforcement by regulating authorities.<sup>24</sup>

- 61 The public consultation draft of the Regulatory Impact Statement requested information from industry and stakeholders on the likely compliance costs if radiation protection was governed by self-regulation and each company had to determine its own radiation protection approach. However, the public submissions did not provide any additional information.

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<sup>24</sup> The Senate Environment, Communications, Information Technology and the Arts Reference Committee 2003, *Regulating the Ranger, Jabiluka, Beverley and Honeymoon uranium mine*, Senate Printing Unit, Parliament House, Canberra, p. ix.

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*Health and Safety*

- 62 Historically, workers in high risk areas — particularly in relation to radiation protection in uranium and mineral sands mining — have preferred dose limits to be well defined and enforced by regulators.
- 63 Under self-regulation, regulators cede direct control over exposure and dose limits and safety procedures to the mining and mineral processing companies. Exposure limits and other radiation protection measures would need to be set by industry. Yet the setting of these standards could be influenced by commercial interests and subject to change without a rigorous scrutiny. This could result in significantly reduced occupational health and safety outcomes — in terms of higher levels of occupational exposure — in areas that are remote and somewhat difficult to monitor.
- 64 By way of example of the possible quantum of these costs, if self-regulation resulted in a 1 per cent increase in the average annual effective dose for uranium mining workers — this would be consistent with the analysis by New South Wales in a recent regulatory impact statement<sup>25</sup> — then this would result in a cost of around \$3 000 per year.<sup>26</sup> If self-regulation resulted in a 50 per cent increase (i.e. an average annual effective dose of 5.4 mSv per year as compared to current levels of 3.6 mSv per year) then the cost would be \$153 000 per year, and an increase of 100 per cent (i.e. an average annual effective dose of 7.2 mSv per year) would cost \$307 000 per year.
- 65 While such increases in exposure would raise considerable concern among regulators, they would still be below the current and proposed exposure limits and hence highlight that under self-regulation there is scope for health and safety costs to increase without breaching current or proposed exposure limits.
- 66 Further, providing for self-regulation in an industry as important and prominent and uranium mining and mineral processing while maintaining strong regulation for all other areas is likely to lead to confusion about radiation protection priorities and the need to adhere to strict radiation protection protocols. This may in turn lead to a reduced adherence to ALARA for more general uses of radiation sources — such as industry, dentistry, and medical treatment and diagnosis. By way of example, if it was assumed that the move to self regulation resulted in a 0.1 per cent increase in the average annual effective dose for the general public from medical exposure to radiation — this could occur if mixed signals and misunderstanding about radiation protection priorities occurred due to self-regulation in the mining industry — then this could result in a cost to the community of around \$567 000 per year.<sup>27</sup>

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<sup>25</sup> New South Wales 2003, *Radiation Control Regulations 2003: Regulatory Impact Statement*, Appendix C, Sydney, p. 53.

<sup>26</sup> This is based on:

- an assumed increase in average annual effective dose of 0.03 mSv per year (i.e. going from current occupational exposure of 3.6 mSv per year to the average occupational exposure of 3.63 mSv per year);
- a total of 1275 workers in the uranium mining industry in Australia; and
- an estimated cost per person sievert of \$71 000 — which is an inflation adjusted and exchange rate converted estimate taken from United Kingdom National Radiological Protection Board 1986, *Board advice on cost-benefit analysis*, Chilton, UK, p10.

<sup>27</sup> This is based on:

- an estimated population for Australia of 20 million people;

- 67 While it is hard to predict the full health and safety costs of self-regulation, this analysis shows that any increases in the average annual effective dose will lead to considerable ongoing costs to workers in the mining and mineral processing industry and the community more broadly.
- 68 The public consultation draft of the Regulatory Impact Statement requested information on the extent to which stakeholders believed that moving to self-regulation would increase or decrease the average effective dose to workers, the public and others. One submission commented that they did not believe there would be any increase in the effective dose to workers from self-regulation. They also commented that their company currently operate to a worker dose limit far below the proposed 20 mSv per year and regarded the regulatory limit as the minimum standard to achieve.

### *Security Issues*

- 69 In an environment increasingly concerned about terrorism, self-regulation of the uranium mining and mineral processing industry is likely to increase worries about security. Self-regulation may lessen:
- the scope for monitoring radiation protection at mines and mining companies;
  - the ability to ensure that uranium mines and mineral processing operations are maintained to appropriate standards; and
  - the ability to satisfy government, regulatory agencies, policing and security agencies, and the broader public that uranium mining and mineral processing operations are secure and inaccessible to terrorists.
- 70 The terrorist attack on 11 September 2001 showed the world that terrorism costs communities dearly — personally and financially. In this light, any move to self-regulation that resulted in reduced security of uranium and radioactive minerals, and if that reduced security contributed to a terrorist attack then the cost to Australia would be extremely high.

### **Option 3 – Proposed Code of Practice**

- 71 The third option involves repealing the *Health Code* and the *Waste Code* and replacing it with the proposed *Code of Practice and Safety Guide: Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (the proposed Code).<sup>28</sup>
- 72 The main differences between the *proposed Code* and the requirements in the *Health Code* and the *Waste Code* are that the *proposed Code* will:

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- an estimated cost per person sievert of \$23 664 — which is an inflation adjusted and exchange rate converted estimate taken from United Kingdom National Radiological Protection Board 1986, *Board advice on cost-benefit analysis*, Chilton, UK, p10; and
  - UNSCEAR's estimate that the world wide average annual effective dose from diagnostic and medical x-ray examination is 1.2 mSV per year (UNSCEAR 2000, op. cit., p. 7.).

<sup>28</sup> The costs and benefits associated with the Safety Guide has not been considered as it is a non-binding guide or aid for mining and mineral processing companies to help understand, interpret and comply with the proposed Code. Of itself, the Safety Guide does not impose any additional costs — although as a comprehensive discussion of important matters relevant for the proposed Code it should reduce some compliance costs for industry.

- stipulate exposure limits based on *Radiation Protection Series No.1 (RPS1)* and not those which were based on *International Commission on Radiological Protection Publication No. 26*, hence exposure limits will be up-to-date and consistent with other areas of radiation protection;
- ensure that occupational categories are consistent with the *RPS1* and that there is no longer a distinction between designated and non-designated employees;
- require all mining and mineral processing operations to prepare and review a radiation management plan — although to some degree this is already a requirement of the *Health Code*;
- require all mining and mineral processing operations to prepare a radioactive waste management plan — although to some degree this is already a requirement of the *Waste Code*; and
- promote performance-based standards for radiation protection rather than prescriptive requirements on what mining and mineral processing operations must do.

### **Option 3 - Benefits**

#### *Health and Safety*

- 73 Given the small number of mines covered by the proposed Code — three uranium mines and six mineral sands mines — the direct health and safety benefits are limited to a small number of workers.
- 74 At the same time, the proposed requirement for radiation management plans and radioactive waste management plans will increase safety awareness in the industry and provide a formal reference point with which to assess regulatory compliance and demonstrate to the community that radiation protection is being appropriately managed in uranium and mineral sands mining.
- 75 Given the extent to which worker dose levels are already well below the regulatory requirements, it may be difficult to establish a quantifiable benefit for workers from the *proposed Code*. For the community more broadly however, it will take only a small decrease in the average annual effective dose from diagnostic medical x-rays for a large benefit to be achieved. The proposed Code will promote uniformity in radiation protection and this could encourage a more rigorous application of the ALARA principle. By way of example, if this led to a 0.1 per cent reduction in average annual effective dose from diagnostic medical x-rays then the community as a whole would benefit in the order of \$567 000 per year.<sup>29</sup>
- 76 In addition to lower average annual effective dose levels, it will not take many avoided radiation incidents to also generate significant benefits. For example, a human capital model of workplace costs suggests that major categories of indirect costs associated with workplace-related disease-induced death (i.e. consequential overtime, loss of productivity, staff turnover costs, retraining costs; lost future earnings, legal costs, pain and suffering, loss of income, health and medical costs, loss of gross domestic product (i.e. human capital), and loss of tax & revenue) are worth in excess of \$500 000 per

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<sup>29</sup> See footnote 26 for background information.

work-place related death.<sup>30</sup> If the proposed Code is able to help avoid such incidents then this is a significant benefit, although one that is not possible to predict.

- 77 One public submission, received through the public consultation process, suggested that the benefit of avoiding a couple of days' shutdown due to a radiation incident could mean a cost saving of around \$200 000.
- 78 The public consultation draft of the Regulatory Impact Statement requested information from industry and other stakeholders on whether the *proposed Code* was likely to help reduce the risk of incidents. One submission commented that they did not believe that the *proposed Code* was likely to further reduce the risk of incidents or the dose to workers because both were already at very low levels.
- 79 While the *proposed Code* may have some subsidiary benefit in regard to security, that matter is expected to be covered in a separate Code of Practice currently being developed.

### *Regulatory Approach*

- 80 While there are costs associated with complying with the proposed Code, there are also some benefits associated with this regulatory approach, including:
- providing clear up-to-date guidance on safety obligations and exposure limits;
  - consolidating the requirements of the *Health Code* and the *Waste Code* into a single Code, hence promoting a uniform approach to radiation protection for uranium and mineral sands mining in Australia; and
  - providing confidence to the public that radiation protection in the area of uranium and mineral sands mining is being considered seriously and regulatory requirements are reviewed regularly.
- 81 The adoption of the *proposed Code* will have some international benefits, in that it would be consistent with expectations that having developed the exposure limits in *RPSI* based on ICRP 60, Australia would also adopt those standards. This would also be consistent with section 23(1)(d) of the *Australian Radiation Protection and Nuclear Safety Act 1998* which requires national policies, codes and standards to substantially reflect world best practice.

### *Option 3 – Costs*

#### *Administration*

- 82 For regulatory agencies there will be a number of administrative costs that will be incurred, including the costs of making new regulations, training and educating regulatory staff, and the costs associated with any new requirements for regulatory staff — such as vetting radioactive waste management plans.

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<sup>30</sup> Derived from Industry Commission 1995, *Work, Health and Safety*, AGPS, Canberra. Collins and Lapsley note that 'The human capital approach is necessarily always adopted in benefit-cost analysis (BCA) where the nature of the task is to compare, on a common basis, time streams of costs and benefits.' — D. Collins and H. Lapsley 2002, *Counting the Cost: Estimates of the Social Costs of Drug Abuse in Australia in 1998-99*, Monograph Series No. 49, Commonwealth Department of Health and Ageing, Canberra, p. 14.

- 83 In terms of making new regulations, introducing the *proposed Code* is likely to require each jurisdiction to amend their relevant radiation protection regulations. Changing legislation or regulations governing these issues will require resources and costs on behalf of government. While somewhat stylised, the process will involve:
- policy approval — which could include policy officer time, departmental approval, cabinet approval, and so on;
  - drafting — which could include policy officer time, Parliamentary Counsel’s drafting time, and so on; and
  - promulgation — which could include printing and information and promotional material about changes.
- 84 These costs will be one-off and once passed should have no further impact on the way in which jurisdictions regulate radiation protection. By way of example of what this might cost:
- in Western Australia, the average cost of legislative amendments that was directly attributable to a department was estimated to be around \$45 000 — although it was acknowledged that this was an underestimate of the costs;<sup>31</sup> and
  - in the United Kingdom it was estimated that to implement regulatory changes relating to European Works Councils would involve an administrative cost of amending legislation of approximately \$400 000.<sup>32</sup>
- 85 Using these estimates as a guide to the administrative cost of implementing the *proposed Code*, then the total administrative cost of amending legislation in four jurisdictions could range from \$180 000 and \$1.6 million. The true cost however, could be considerably lower as the proposed Code would have been subject to considerable debate and scrutiny, and the impacts open to public comment and review — hence implementation should not consume significant additional resources.
- 86 In terms of training regulatory staff on the proposed Code, the South Australian Radiation Protection Regulator has provided an estimate that the cost of familiarising and training would be in the order of 40 person-hours. Using an average figure of approximately \$30 per hour per staff member and allowing for on-costs, then the estimated cost for training/familiarisation would be of the order of \$6 000.<sup>33</sup> In estimating this cost it was noted that the introduction of the *proposed Code* would also require briefing work with other government agencies, which would be of the order of \$3 000, and so would result in a total cost of around \$9 000. Using this as a guide, and assuming that the same costs will be incurred by all jurisdictions where uranium and mineral sands mining occurs then the total cost for training and education could be as high as \$36 000.
- 87 In terms of new monitoring requirements, the only significant change is that regulators will be required to approve and review radiation management plans and radioactive waste management plans. While the *Health Code* and the *Waste Code* already require

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<sup>31</sup> Department of Local Government and Regional Development 2003, *Annual Report 2002-2003*, Perth, p. 21.

<sup>32</sup> Department of Trade and Industry (UK) 1998, ‘Implementation of the Regulations on European Works Councils — Regulatory Impact Assessment, London, p. 10.

<sup>33</sup> Information provided by the South Australian Radiation Regulator to ARPANSA.

approval to be obtained for plans to control radiation exposure the *proposed Code* will now require that reviews of those plans be undertaken as often as determined by the relevant regulatory authority. This may increase slightly the administrative costs associated with monitoring uranium and mineral sand mining operations, although given that much of this work is likely to already be undertaken and that in practice radiation safety plans and radioactive waste management plans don't need significant review once established, then the additional cost to government is likely to be very small.

- 88 The public consultation draft of the Regulatory Impact Statement requested information from jurisdictions on what they believed would be the direct and indirect costs to them of implementing and administering the *proposed Code*. A submission from the South Australian regulator suggested that the cost of amending licence or registration conditions is significantly less than that proposed above.

### *Compliance*

- 89 The *proposed Code* will require uranium and mineral sands mining operations to dedicate additional resources to satisfy new radiation protection regulatory requirements. This may include resources to:
- ensure that radiation protection and radioactive waste management arrangements satisfy the lower exposure limits set out in *RPSI*;
  - train staff to ensure that they understand new regulatory requirements;
  - review on an ongoing basis radiation management plans and radioactive waste management plans; and
  - satisfy ongoing disclosure requirements.
- 90 A submission from the South Australian regulator noted that operations in South Australia had already implemented the lower exposure limits set out in *RPSI*. They suggested that this would probably be the same case in all jurisdictions so there should be no additional resource requirement. The South Australian regulator also commented that radiation management plans and radioactive waste management plans are already being reviewed on an ongoing basis so there should be no additional resource requirement.
- 91 While the *Health Code* and the *Waste Code* allowed for exposure limits of 50 mSv per year for designated employees, the *proposed Code*, consistent with *RPSI*, will only allow for 20 mSv per year, averaged over a period of five consecutive years. Ordinarily this would imply that additional costs would be needed to ensure occupational exposure to radiation was lowered from below the current limit of 50 mSv per year to below the proposed limits of 20 mSv per year. Apart from the two incidents recorded on the ARPANSA incident register, occupational exposure in uranium mining and mineral sands operations are significantly lower than *RPSI* requirements. That is, while some mining companies may take the opportunity to improve radiation protection measures as a result of the *proposed Code*, there does not appear to be any regulatory obligation on mining companies to incur additional compliance costs due to lower exposure limits.
- 92 Furthermore, at the time when the International Commission on Radiological Protection determined new dose limits — now incorporated into *RPSI* — it was considered that

mining companies would need to undertake very little to comply with the then new limits. For example:

Whilst the mining industry in general will have little difficulty in complying with the new dose limits — the only needs are likely to be improvements in ventilation and an increased radiological surveillance effort — there may be many instances when underground uranium mining may be at threat.<sup>34</sup>

- 93 Given that this was the assessment twelve years ago, it is quite reasonable to expect that any ‘improvements’ would have been made by now and therefore will not be incurred again. That is, the cost associated with complying with the exposure limits in the *proposed Code* — i.e. *RPSI* — as opposed to the *Health Code* limits would be very low if anything.
- 94 While, the compliance costs associated with the exposure limits in the *proposed Code* may be low it still should be recognized that constant changes to the regulatory system impose costs on industry. Keeping up-to-date and maintaining new regulatory arrangements takes time and effort, for example in an article by M. Carter and A. Coundouris it was noted that the mineral sands industry has had to contend with numerous changes to radiation protection standards.<sup>35</sup> Each time regulators change the rules, industry incurs additional costs.
- 95 The cost of preparing a radiation management plan is likely to be in the range of range between \$9 000 and \$216 000, as it is the same requirement as imposed under the status quo option. While this cost does not differ from the *status quo* option, the *proposed Code* requires that uranium mining and mineral sand companies prepare a radioactive waste management plan. Presuming that this will cost the same to prepare as a radiation management plan, then the *proposed Code* will add an additional \$9 000 and \$216 000 to compliance costs to the industry, that is, the total cost to industry will be between \$18 000 and \$432 000.
- 96 Given that radiation management plans have formed part of the *Health* and *Waste Codes* and coupled with broader environmental regulatory requirements, it would seem that it is unlikely that industry will incur additional compliance costs other than those associated with the initial preparation. That is, industry already has the systems in place to manage radiation protection and radioactive waste management, they just will now have to prepare a plan to demonstrate this capacity.
- 97 The public consultation draft of the Regulatory Impact Statement requested information from industry and other stakeholders on what they believed the compliance costs would be (above what is already incurred complying with existing regulations) as a result of the *proposed Code*. Regarding the costs of implementing the *proposed Code*, one submission commented that “all of these costs are already being borne by operators, and that new operations already know they have obligations under the present regime”. A submission from the South Australian regulator commented that industry already had to prepare a plan to demonstrate the capacity to manage radiation protection and radioactive waste under the *Health* and *Waste Codes* so the cost of initial preparation

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<sup>34</sup> R. Fry 1992, ‘Implications of the 1990 ICRP Recommendations for the Mining Industry’, *Radiation Protection in Australia* (1992), Vol. 10, No. 3, p 76.

<sup>35</sup> M. Carter and A. Coundouris 1993, ‘Radiation Protection in the mineral sands industry in New South Wales’, *Radiation Protection in Australia* (1993), Vol. 11, No. 3, p. 95.

should be low. They also suggested that the cost of changing a clause in regulations, licence or registration conditions should be fairly low.

### Summary of Identified Costs and Benefits

98 Relative to the status quo, the key points to be drawn from the analysis associated with:

- Self-regulation is that:
  - a degree of regulatory flexibility is provided by self-regulation, which may result in reduced compliance costs for mining companies but also could result in lower radiation protection standards;
  - radiation regulators will save some direct administrative costs associated with the *Health Code* and the *Waste Code*, but total administrative and enforcement costs are unlikely to be reduced as additional resources will need to be dedicated to better enforcement of radiation protection and general OH&S regulatory arrangements;
  - there will be a greater onus on workers to protect themselves by being knowledgeable of risks, and enforcing their rights under other regulatory obligations. Given that employees and the general public are not usually in the best position to protect themselves, largely because of information asymmetries, they will likely bear the costs associated with any reduced health and safety outcomes. These costs could be as high as \$1 million per year depending on the impact of self-regulation on effective dose levels for workers and the community more broadly; and
  - security of uranium and radioactive materials from mining and milling may be reduced and hence raised concerns about national security and terrorism.
- The *proposed Code* is that:
  - mining companies will bear the costs associated with the development of radiation management plans and radioactive waste management plans;
  - costs for regulators will increase as there will be a need to change existing regulations and to train regulatory staff. Such costs are not considered significant;
  - the promotion of uniform, consistent radiation protection regulations in industry, medicine, research, thus leading to lower effective dose levels in the work place; and
  - radiation protection requirements will be standardised across Australia, which should provide benefits for industry, government, and the community through improved understanding, reduced uncertainty, and enhanced regulatory consistency.

99 A summary of the costs and benefits for each of the three identified options (with the *status quo* options used as the base comparator) is shown in Table 7.

**TABLE 7**  
**NATURE OF IMPACTS COMPARED TO THE *STATUS QUO***

Date		Self-Regulation		New Code	
Cost	Impact	Description	Impact	Description	
Administration	<i>Minor to slight increase</i>	While direct expenditure will decrease, more resources will be needed to enforce general radiation protection requirements.	<i>Increase</i>	Government will need to incur additional expenses in terms of introducing new legislative or regulatory requirements, in training staff, and monitoring and enforcing new requirements. These could be as high as \$4 million in the first year but be significantly lower in subsequent years.	
Compliance	<i>Slight decrease</i>	Compliance costs may be reduced for mining and mineral processing but this may be more due to reduced occupational health and safety outcomes rather than efficiencies in radiation protection.	<i>Increase</i>	Industry will incur additional costs in terms of having to comply with new exposure limits, prepare and maintain plans, train staff, and satisfy the broader requirements of the Code. These may not be all that high but could be as high as \$200 000 to \$300 000 in the first year but significantly below this in subsequent years.	
<b>Benefit</b>	<i>Reduced benefits</i>	Regulatory certainty is reduced, while genuine flexibility is not provided for due to other more broad OH&S and environmental regulatory requirements on the industry. If this leads to lower health and safety outcomes then this could add up to \$1 million per year in costs.	<i>Increase</i>	The proposed Code ensures that exposure limits are up-to-date and consistent with radiation exposure limits in other sectors. Depending on the extent to which this results in a more rigorous application of ALARA, the community could benefit by up to \$567 000 per year.	
<b>TOTAL</b>	<b><i>Net cost</i></b>	Overall, self-regulation is likely to result in lower net benefits to the community than the <i>status quo</i> , as occupational health and safety standards and environmental waste management may be compromised and worse than would otherwise be the case.	<b><i>Marginal benefit</i></b>	Overall, the proposed Code amends slightly the requirements under the <i>status quo</i> . It is believed that on balance the benefits of clarifying the regulatory requirements, introducing consistent, up-to-date exposure limits, and promoting national uniformity outweigh the costs of implementation. This is particularly so given the implementation costs are one-off but the benefits are ongoing.	

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## Consultation

- 100 The *proposed Code*, and associated Safety Guide, was developed by a working group of the Radiation Health Committee. This working group contained people with experience in industry and regulation. The Radiation Health Committee includes representation from all Commonwealth, State and Territory radiation protection regulators, a person representing the interests of the public, and members of medical and academic institutions. All Radiation Health Committee members participated in the development of the proposed Code via their membership of the Committee.
- 101 Following a recommendation by the Radiation Health Committee, a Consultative Group was formed to review drafts. The Consultative Group consisted of members representing organisations including:
- Dept of Industry, Tourism and Resources, ACT
  - Environment Protection Authority, Radiation Protection Division, SA
  - Australian Petroleum Production and Exploration Association (APPEA)
  - Minerals Council of Australia
  - Dept of Business, Industry & Resource Development, NT
  - The Chamber of Minerals and Energy of Western Australia
  - Office of the Supervising Scientist, Dept of Environment and Heritage, NT
  - Australian Council of Trade Unions (ACTU)
- 102 The *proposed Code* therefore contains the views of those who would be regulated by such a Code and those who would use the *proposed Code* to regulate radiation exposures arising from mining and mineral processing and from the radioactive wastes resulting from these activities.
- 103 The draft Code and Safety Guide was released for a period of public comment from 17 December 2004 until 16 March 2005. Copies of the proposed Code and Safety Guide were also available on the ARPANSA web site at [www.arpansa.gov.au](http://www.arpansa.gov.au). One hundred and twenty-two organisations were advised of the availability of the proposed ARPANSA Code and Safety Guide and this Regulatory Impact Statement and their comments were requested. These organisations consisted of:
- Radiation Regulatory Authorities (Radiation Protection and Mining) in all jurisdictions
  - Radiation Advisory Committees/Councils in all jurisdictions
  - Industry and employee bodies for mining and mineral processing industries (Association of Mining & Exploration Companies (Inc.) (AMEC), Australian Aluminium Council, Australian Council of Trade Unions (ACTU), Australian Petroleum Production and Exploration Association (APPEA), Energy Supply Association of Australia (ESAA), Minerals Council of Australia (MCA), Queensland Mining Council, South Australian Chamber of Mines & Energy, The Chamber of Minerals and Energy of Western Australia)
  - Commonwealth, State and Territory Government Departments, Agencies & Committees (Australian Nuclear Science and Technology Organisation (ANSTO), SA Chief Inspector of Mines, Commonwealth Dept of Industry, Tourism and Resources, CSIRO Exploration & Mining, NT Dept of Business, Industry & Resource Development, WA Dept of Environment, Qld Dept of Health – Scientific Services, WA Dept of Industry and Resources, Qld Dept of Natural Resources and Mines, Vic Dept of Primary Industries, NSW EPA Radiation Control Section, Qld EPA Contaminated Land Section, SA EPA

Operations Division, SA EPA Radiation Protection Division, Geoscience Australia, Office of the Supervising Scientist NT, Workplace Services SA)

- Industry (Alcoa of Australia Limited, ATA Environmental, Australian Radiation Services Pty Ltd, Bayside Mineral Services, Cable Sands (WA) Pty Ltd, Comalco Limited, Consolidated Rutile Ltd, Currumbin Minerals Pty Ltd, Radiation-Wise, Energy Resources of Australia Ltd, ERA - Ranger Mine, GMA Garnet Pty Ltd, Heathgate Resources Pty Ltd, HLA-Envirosiences Pty Ltd, Iluka Resources Limited Victoria, Iluka Resources Limited WA, Lynas Corporation Ltd, Mount Isa Mines Ltd, Sons of Gwalia Ltd, Southern Cross Resources Australia Pty Ltd, Tantalum Australia NL, Tiwest Pty Ltd, Western Radiation Services, WMC (Olympic Dam Corporation) SA, WMC Resources Ltd Victoria)
- Professional societies and associations (Australasian Radiation Protection Society (ARPS))
- Community organisations (Australian Conservation Foundation (ACF), Friends of the Earth Australia, Greenpeace Australia)
- Other (Australian Bureau of Agricultural and Resource Economics (ABARE), Dr Bill Toussaint (WA), Dr Malcolm Cooper – Consultant (Vic), Industrial Foundation for Accident Prevention, Mr Colin Winsor (SA), Ms Sybella Blencowe (SA), Uranium Information Centre)

104 The public consultation process resulted in 14 submissions commenting on the *proposed Code*, and associated Safety Guide, and the Regulatory Impact Statement. The following issues were raised in the submissions:

- The structure of the Code;
- The application of the Code to non-uranium mining and to industries dealing with Naturally Occurring Radioactive Material (NORM);
- The definition of radioactive waste;
- The application of other codes, such as the *Code of Practice for the near surface disposal of radioactive waste in Australia (1992)* (NHMRC 1992), and their requirements;
- The Radiation Safety Officer (RSO) training that was required to develop a Radiation Management Plan;
- Baseline monitoring needs more prominence in the Radioactive Waste Management Plan;
- The default dose conversion factors in Schedule 2 of the Code;
- The status of the previous Guidelines;
- Clarification of who bears remediation costs was needed in the Regulatory Impact Statement; and
- The Regulatory Impact Statement did not describe the State/Territory regulatory systems adequately and their role in the implementation of the Code.

105 ARPANSA held a *National Conference on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* from 11 to 13 April 2005 in Melbourne to discuss the proposed Code and Safety Guide, this Regulatory Impact Statement, and other radiation protection and radioactive waste management issues affecting the mining and mineral processing industries in Australia. In addition to a session describing the rationale for the proposed Code and Safety Guide and the

Regulatory Impact Statement process, the Conference also included a half-day Workshop where issues relating to the proposed Code and Safety Guide were discussed in detail. The following additional issues were raised at the National Conference and Workshop:

- The Code needed to be aligned with international requirements/standards;
- The Code puts the onus of *Optimisation* on the operator via the Radiation Management Plan/Radioactive Waste Management Plan but perhaps there was a need for further guidance on optimisation;
- As low as reasonably achievable (ALARA) needs to be dealt with in the Code;
- The Scope of application of the Code is unclear, both with respect to material and site;
- The Code may need some words on abandoned sites; and
- Clarification is needed of non-bulk wastes, such as equipment and pipes containing radioactive material.

106 An additional submission was received after the National Conference commenting on the application and use to the *Code of Practice for the near surface disposal of radioactive waste in Australia (1992)* (NHMRC 1992) in the proposed Code.

107 The proposed Code and Safety Guide and this Regulatory Impact Statement were revised taking into account the comments made in the public submissions, the issues raised at the National Conference and Workshop, and the comments made in the additional submission.

108 The public consultation draft of the Regulatory Impact Statement included requests for information from stakeholders on compliance costs. Some additional information was received and this has been incorporated into this Regulatory Impact Statement as appropriate.

## Conclusion and Recommendation

109 Option 1, *status quo*, does not meet the objective as the Codes are already inconsistent with Australian and international radiation protection guidelines and will become even more so over time. The lack of currency and certainty as to what radiation protection standard applies suggests that dynamic efficiency is compromised under the *status quo* option. Furthermore, this option does not provide regulatory flexibility and does not necessarily allow for best practice developments.

110 Option 2, self-regulation, would result in a net cost for the following reasons:

- (a) Although compliance costs for mining and mineral processing companies may be reduced by the regulatory flexibility provided by self-regulation, this flexibility could result in lower radiation protection standards and reduced occupational health and safety outcomes.
- (b) While direct administrative expenditure will decrease under self-regulation, the total administrative and enforcement costs will increase due to additional resources being required to enforce general radiation protection requirements.

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- (c) Self-regulation will not satisfy community concern that mining and mineral processing companies will adequately protect public health and safety and the environment.
  - (d) There will be greater onus on workers to protect themselves by being knowledgeable of risks, and enforcing their rights under other regulatory obligations. Given that employees and the general public are not usually in the best position to protect themselves, they will likely bear the costs associated with any reduced health and safety outcomes. These costs could be as high as \$1 million per year, depending on the impact of self-regulation on the effective dose levels for workers and the community.
  - (e) Security of uranium and radioactive materials from mining and milling may be reduced causing national security and terrorism concerns to be heightened.
  - (f) Overall, self-regulation will result in a net cost to the community as occupational health and safety standards and environmental waste management may be compromised and thereby be worse than would otherwise be the case.
- 111 On balance, Option 3, the *proposed Code*, is preferred as it provides a marginal benefit for the following reasons:
- (a) The *proposed Code* will provide up-to-date radiation protection information, which will ensure that there is no information gap. Up-to-date information will ensure that exposure limits are consistent with radiation protection exposure limits in other sectors. Depending on the extent to which this results in a more rigorous application of ALARA, the community could benefit by up to \$567 000 per year.
  - (b) The *proposed Code* will provide a contemporary uniform set of radiation protection requirements for adoption by all Australian jurisdictions to enable the protection of workers, members of the public and the environment from the harmful effects of radiation exposures arising from mining and mineral processing and from the radioactive wastes resulting from these activities. Standardised radiation protection requirements across Australia will provide improved understanding, reduced uncertainty, and enhanced regulatory consistency.
  - (c) While industry will incur additional costs in terms of having to comply with new exposure limits, prepare and maintain radiation management and radioactive waste management plans, train staff, and satisfy the broader requirements of the Code, many of the safety requirements of the proposed Code are already being carried out as a requirement of current State/Territory licensing requirements so the costs may not be all that high. Costs could be of the order of \$200 000 to \$300 000 in the first year but significantly below this in subsequent years.
  - (d) Similarly, jurisdictions will incur additional administrative costs to implement, monitor and enforce compliance with the *proposed Code* although these costs are unlikely to be substantially higher than current costs. These costs could be as high as \$4 million in the first year but will be significantly lower in subsequent years.
  - (e) The *proposed Code* enables ARPANSA to be a reference point for information, advice and clarification. ARPANSA has the appropriate scientific resources and

international liaison framework in place to ensure that the Code is updated to reflect current international guidelines and scientific research.

- (f) The *proposed Code* will ensure that community concern is overcome by providing a system of effective regulatory control.
  - (g) The *proposed Code* is accompanied by a Safety Guide, which gives detailed advice to the mining and mineral processing industries on achieving compliance with the requirements of the proposed Code.
- 112 The key issue is whether the benefits of implementing the Code outweigh the costs. It is believed that the benefits from introducing a new single ARPANSA Code, which clarifies the regulatory requirements, introduces consistent, up-to-date exposure limits, implements a radioactive waste management regime, and promotes national uniformity, outweigh the costs of implementation. This is particularly so given the implementation costs are one-off but the benefits are ongoing. Additionally, the costs will be relatively small because many of the safety requirements of the proposed Code are already being carried out as a requirement of current State/Territory licensing requirements.
- 113 The public consultation draft of the Regulatory Impact Statement requested that stakeholders who disagreed with the conclusions above substantiate their view with a description and quantification of costs to apply, implement, administer or enforce the proposed ARPANSA Code of Practice. However, the public submissions did not provide any additional information.

## Implementation and Review

- 114 The *proposed Code* will be published by ARPANSA as a Radiation Protection Series publication. After publication the Code will be proposed for incorporation into the next edition of the *National Directory for Radiation Protection*. All regulators in the Commonwealth, State and Territory, who manage activities pertaining to the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*, will be expected to adopt the Code by express reference in their regulations, or within their licensing frameworks.
- 115 The Code will be reviewed through the ARPANSA Radiation Health Committee within 10 years of its commencement to ensure it is still relevant to the radiation protection needs of the community. Earlier review would be undertaken if there are identified problems in the implementation of the Code or if international or national radiation protection objectives change, or if there is new information from international research.

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## Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ALARA	As low as reasonably achievable, economic and social factors taken into account
ARIR	Australian Radiation Incidents Register
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CEO	Chief Executive Officer
COAG	Council of Australian Governments
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
MCA	Minerals Council of Australia
NCC	Nuclear Codes Committee
NOHSC	National Occupational Health and Safety Commission
NRPB	National Radiological Protection Board (UK)
OH&S	Occupational Health and Safety
RHC	Radiation Health Committee
RMP	Radiation Management Plan
RPS	Radiation Protection Series (published by ARPANSA)
RWMP	Radioactive Waste Management Plan
UIC	Uranium Information Centre
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WHO	World Health Organisation