

The Allen Consulting Group

# **National Directory for Radiation Protection Edition 1.0**

Cost benefit analysis

December 2004

Report to the Australian Radiation Protection and Nuclear Safety Agency

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## *Chapter 1*

# Introduction

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) plans to introduce a National Directory for Radiation Protection, which will provide a mechanism for ensuring and promoting a nationally uniform approach to radiation protection in Australia.

As part of the preparation of a regulatory impact statement, ARPANSA has engaged The Allen Consulting Group to prepare a cost benefit analysis of the impacts associated with adopting the National Directory.

The aim of the following analysis is to provide a clear exposition of the nature of the costs and benefits associated with the proposed adoption of the National Directory and to quantify these impacts where possible.

Ideally, all costs and benefits associated with the adoption of the National Directory should be quantified in common units (either in monetary units or physical units). This however, may not always be possible as impacts are not always known, the extent of application of the regulatory changes may be uncertain and the benefits — particularly in terms of health, safety, and environmental impacts — may be difficult to measure in advance.

Where costs and benefits have not been able to be quantified, we have prepared a comprehensive discussion of the costs and benefits together with qualitative analysis to allow for policy decisions to be based on the best available information. This approach is preferable to one where unreasonably broad assumptions are made to generate quantified impacts that are either not plausible or difficult to justify.

This cost benefit analysis should be read in conjunction with the regulatory impact statement, and assumes that the reader is familiar with the content of the regulatory impact statement and the proposed National Directory.

## *Chapter 2*

### **Costs**

The costs associated with the introduction of the National Directory can be grouped into two broad categories:

- administration, including monitoring costs — these are borne mainly by the regulatory agencies in each jurisdiction, although costs may be passed on to industry and users of radiation sources through fees and charges; and
- compliance costs — these are borne mainly by industry, users of radiation sources, and the community more broadly.

Each of these costs is discussed in turn below.

#### **2.1 Administration**

For Governments the adoption of the National Directory will involve a series of legislative changes. This will involve an initial cost of passing legislation or making new regulations and it may also, depending on the nature of the change, require additional monitoring resources to ensure compliance by industry and users of radiation sources.

##### ***Passing or making new regulations***

The National Directory will require a number of machinery changes to existing regulations, laws and or Codes. These include changes to:

- objective of radiation protection;
- principles for regulatory frameworks;
- powers and functions conferred by legislation;
- requirements for an advisory body (apart from the Northern Territory, which is in the process of establishing such a body);
- categories of authorisation;
- suspension or cancellation of an authorisation;
- preparation of an annual report;
- list of exclusions;
- licences to possess;
- mutual recognition principles; or
- competency requirements.

For the majority of changes proposed in the National Directory, jurisdictions will simply have to pass amending legislation or make new regulations to bring existing laws into line with the National Directory. No other change or outcome will be necessary. These changes are purely machinery in nature and usually don't require an impact assessment.<sup>1</sup> However, for the purposes of this cost benefit analysis we have considered this administrative cost.

In this regard, the National Directory aims to achieve consistency in definitions, licence and registration categories, and legislative requirements within existing regulatory frameworks. 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:
  - policy officer time;
  - departmental approval;
  - cabinet approval;
- drafting:
  - policy officer time;
  - Parliamentary Counsel's drafting time;
- legislative approval:
  - the Bill to be read, debated, and approved by legislative assembly or house of representatives;
  - the Bill to be reviewed by upper house;
  - the Act to be given Royal Assent by Governor or Governor General;
- promulgation:
  - printing; and
  - information and promotional material about changes.

These costs will be one-off and will have no further impact on the way in which jurisdictions regulate radiation protection issues nor will they have any impact on industry, consumers of products that use radioactive substances, nor the public more generally. Hence such administrative costs are rarely included in any assessment, although it should be recognised that even machinery of government legislative changes will impose government costs. By way of example:

- 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>2</sup> and

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<sup>1</sup> For example the ORR's *A Guide to Regulation* states that when a standard RIS is needed, as opposed to one prepared under CoAG guidelines, these costs do not need to be included — see Office of Regulation Review 1998, *A Guide to Regulation*, Second Edition, Commonwealth of Australia, Canberra, p. A2.

<sup>2</sup> Department of Local Government and Regional Development 2003, *Annual Report 2002-2003*, Perth, p. 21.

- 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>3</sup>

Using these estimates as a guide to the administrative cost of implementing the National Directory, then the total administrative cost of amending legislation in all nine jurisdictions could range from \$400 000 to \$3.6 million. This assumes that all jurisdictions need to pass some legislative amendments or that the cost of making regulation is the same as passing legislation if regulations are the method for implementing the National Directory. The actual cost however, is expected to be at the lower end of this range, as amendments are relatively non-controversial, they have been subject to considerable debate between the jurisdictions, and the impacts have been open to public comment and review for some time — hence should not consume significant parliamentary or departmental resources.

It is also noted that for some of the changes proposed in the National Directory, jurisdictions may be required to dedicate further resources in terms of monitoring and administration. Examples include:

- the coverage of radiation protection legislation to preparation of a site for construction of a nuclear or radiation facility (provision 2.6);
- the criteria for registration of non-ionizing radiation apparatus (section 4.3); or
- accreditation of third party service providers (section 4.7).

Until the nature of these changes is known, it is not possible to estimate costs or benefits. Their impact will be assessed later and it is only relevant to acknowledge that costs may be borne in the future depending on additional material being incorporated in the National Directory.

### ***The administration costs of new requirements***

While adopting parts of the National Directory may be mere machinery of government, in a number of cases the National Directory will require some jurisdictions to devote additional resources to monitoring, control, or registration of radiation sources. The administrative impact of these is discussed below.

#### ***'Advisory Body'***

Section 2.4 of the National Directory recommends that jurisdictions should establish an advisory body to provide policy and technical advice on radiation protection and nuclear safety matters.

For the Northern Territory — the only jurisdiction not to have established such a body — there will be establishment and ongoing costs associated with an advisory body. By way of example, ARPANSA's Advisory Council, which is made up of twelve members including the Chief Executive Officer meets three times a year in Sydney and Melbourne at the cost of approximately \$60 000 per year.<sup>4</sup> For the Northern Territory, perhaps a more appropriate example would be the Australian Capital Territory where a five-member committee is used. If the Northern Territory were to establish a small committee from experts residing in the Northern Territory then ongoing costs could be as low as \$10 000 to \$20 000 per

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<sup>3</sup> Department of Trade and Industry (UK) 1998, *Implementation of the Regulations on European Works Councils — Regulatory Impact Assessment*, London, p. 10.

<sup>4</sup> Information provided by ARPANSA.

year. The Northern Territory would also need to incur the resource costs involved in establishing the body — although these are not believed to be significant. Furthermore, while it is true that establishing an advisory body will necessitate administrative costs, it is not appropriate to attribute all of these costs to the National Directory. Section 2.4 of the National Directory is only a recommendation rather than a requirement and it is noted in the regulatory impact statement that the Northern Territory was planning to establish an advisory body regardless.

### *Exemption levels*

As was seen earlier in the regulatory impact statement, the exemption levels adopted by jurisdictions vary considerably. Bringing these exemption levels into line with the International Atomic Energy Agency's (IAEA's) Safety Series 115, Schedule 1, Table I-1 will mean that some exemption levels will increase while others will decrease.

For the current draft of the National Directory, the mining and milling industries have been explicitly excluded. A protocol for consideration of exemptions for the mining and milling of radioactive ores will be developed after consultation with the industry.

The administrative costs of changing regulations (typically in the form of an amended schedule of exemption levels) were considered above. For the exemption levels though, there may be some additional administrative and monitoring costs for some regulators. The regulatory impact statement provides a discussion of the potential impact for some commonly used radionuclides. Overall the conclusion is that where exemption levels are lowered the practical impact is likely to be minimum if anything, as use or activity usually tends to be at much higher levels.

An example of where this may not be the case — and even then the potential impact is extremely small — is for strontium-90 (a sealed radioactive source) calibration sources. Lower exemption levels will require some sources and or premises to be registered where previously this was not the case. While data is not available to confirm the exact number of sources, there could be as high as 100 additional sources throughout Australia that would need to be registered as a result of lower exemption levels.<sup>5</sup>

There may be other examples where radiation sources are captured by lower exemption levels and hence require some form of registration or licensing — in fact there are over 300 radionuclides listed in Schedule 4 of the National Directory — but like with strontium-90 these are unlikely to impose any significant cost, if any. Users of radiation sources captured by lower exemption levels are unlikely to need to incur any other additional costs as it is highly likely that they are already complying with existing radiation protection legislation due to their use of other radionuclides.<sup>6</sup>

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<sup>5</sup> By way of example, if it is assumed that all these sources are based in NSW, and drawing on the NSW registration fee of \$155, which applies in the first year and \$105 in subsequent years, and assuming that fees are derived on a full cost recovery basis, then the additional cost could be around \$15 500 in the first year and \$10 500 in subsequent years. These fees were based on the rates contained in *Radiation Control Regulations 2003* (NSW), section 13.

<sup>6</sup> This view was expressed by ARPANSA during the preparation of the costs benefit analysis and in the absence of any evidence to the contrary we have no reason to doubt that this is the case. No contradictory feedback was received from jurisdictions as part of the consultation phase of the RIS.

The quantum of any such costs could be even lower if jurisdictions use the options granted under the National Directory to allow specific exemptions, for example, if the activity is above the scheduled level but the dose is considered trivial then there is the option to make it exempt, where it can be shown that optimisation of radiation risk has been achieved.

The mining and milling industry are explicitly excluded from the provisions in Edition 1.0 of the National Directory.

### *Criteria for registration*

It is acknowledged that all jurisdictions either already register premises, have plans to introduce provisions to do so, or have equivalent requirements through licensing or equipment registration. However, the National Directory will require that premises be registered separately.

This will mean that for jurisdictions that register or license premises indirectly through existing licenses or approvals then they may have to create a separate registration category. This may impact on the Australian Capital Territory and the Northern Territory. Assuming that current application fees are determined on a full cost recovery basis and that for all licences that are currently issued one in four will now be required to also apply for a premises licence then the additional aggregate costs for the jurisdiction could be as high as \$26 000 in the Australian Capital Territory and \$6 000 in the Northern Territory.<sup>7</sup> While quite likely this is a significant over estimate — as not all licensees will need to apply for a premises licence and the cost may be lower if multiple applications are assessed as part of a single application process (i.e. economies of scale) — it provides some guidance that the quantum of this change is not overly significant.

Given that these jurisdictions already oversee radiation protection on premises through existing licensing provisions, it is not expected that the National Directory will add to the cost of monitoring of or compliance by premises, businesses, institutions, hospitals, and so on that use radiation substances or sources. That is, it is believed that these premises will already have all the necessary fittings, structures, systems, etc to comply with broader radiation protection regulations.

### *Adoption of RPS1, RPS2, and RPS3*

Adoption of Radiation Protection Series No 1 (RPS1), Radiation Protection Series No 2 (RPS2), and Radiation Protection Series No 3 (RPS3) as part of the National Directory may have some administrative costs for jurisdictions. Given that the costs and benefits have already been considered for RPS2 and RPS3 then this analysis — consistent with the regulatory impact statement — has not reviewed or incorporated their net impact.

In relation to RPS1, it is understood that all jurisdictions adopt the exposure limits and the only area where additional resources may be needed is in relation to the requirement to appoint radiation safety officers in New South Wales.

Unless the New South Wales government chooses to require licensing of radiation safety officers then there is unlikely to be any administrative costs to government — compliance costs for industry are considered later.

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<sup>7</sup> This is based on the scheduled fee in ACT [see *Radiation (Fees) Determination 2002 (No1)* for a scheduled fee of \$157.50] and the scheduled fee in NT [see *Radiation (Safety Control) Regulations – Schedule 1* for a scheduled fee of \$50] and an assumption that for every license or registration currently issued — see paragraph 11 of the RIS — a quarter will need to now need to register the premises.

While the National Directory requires the appointment of a radiation safety officer, it does not necessarily require that the officer be licensed. If New South Wales decided to also require licensing then this would be an additional administrative cost but not one that is attributable to the National Directory.<sup>8</sup>

### *Adoption of a national radiation incident reporting framework*

The adoption of a national incident reporting framework is likely to have some impact on the way in which jurisdictions record and report incidents. Currently there are 300 incidents recorded on the national register, with around thirty incidents recorded each year. The categories and changes proposed by the National Directory may result in some incidents being recorded that previously were not recorded. ARPANSA estimates that the number of incidents recorded may increase by 10 to 20 per cent; that is, they could increase by four to eight incidents per year. The cost associated with reporting up to eight additional incidents using an agreed national framework is considered negligible.<sup>9</sup>

## **2.2 Compliance**

While the above section examined the administration costs to jurisdictions, this section examines the compliance costs to individuals, businesses, institutions, of complying with the provision contained in or changes brought about by the National Directory.

### *Registration of premises*

As already discussed, the National Directory may require some premises to be registered. As it is anticipated that these premises already comply with all other radiation protection requirements — such as fittings, structures, systems, and so on — then the only cost will be the administrative cost of submitting, approving, recording, and monitoring licence applications. Given that it is unlikely that this will require anything other than filling in the form then the additional or ‘marginal’ cost are consider negligible. Industry will still need to bear the fees associated with registration though – see section 2.1 for further details.

### *Exemptions*

For the purposes of examining the costs and benefits of bringing these exemption levels into line with the *International Atomic Energy Agency’s Safety Series 115, Schedule 1, Table I-1*, only those exemptions levels that are to decrease are relevant. This is because for exemption levels that rise, there is by definition, a net benefit — fewer sources regulated while still satisfying government’s agreed safety limits.

<sup>8</sup> For completeness sake only — but not as a cost included in this cost benefit analysis — we have estimated that the administrative cost to the New South Wales government of licensing radiation safety officers could be as high as \$700 000 in the first year and \$470 000 in subsequent years. This is based on an assumption that every licensed premises will need to have a dedicated radiation safety officer and using the earlier assumption — based on ARPANSA’s best estimate — that there are on average four licences or registrations per premises, and the standard licence fee is \$155 in the first year and \$105 in subsequent years, then the cost is \$700 000 in year one and \$470 000 in subsequent years.

<sup>9</sup> This is not to say that the cost associated with each incident is negligible but rather the cost of reporting to ARPANSA the nature and extent of those incidents is unlikely to require additional administrative resources.

As discussed earlier, lower exemption levels are not expected to have any significant administrative cost impact — see table 2.1 for a list of proposed decrease for some common radionuclides — and nor are the proposed changes likely to have any significant compliance cost impact. However, the two areas where costs may be incurred are:

- if registration of a source is needed when previously not needed; or
- if the user wishes to dispose of an unwanted source and now must comply with waste disposal regulatory arrangements, whereas previously these did not apply.

Table 2.1

**EXEMPTION LEVELS THAT WILL DECREASE DUE TO THE NATIONAL DIRECTORY**

( MBq)	IAEA	ACT	NSW	NT	SA	VIC	WA
Cobalt-60	0.1	ND	0.4	0.37	ND	ND	ND
Caesium-137	0.01	0.04	0.4	0.37	0.05	0.4	0.4
Iodine-131	1	ND	ND	ND	ND	ND	ND
Americium-241	0.01	ND	0.04	0.037	ND	0.004	0.004
Technetium-99m	10	ND	40	ND	ND	ND	ND
Strontium-90	0.01	0.04	0.4	0.37	0.05	ND	ND
Thallium-204	0.01	0.04	0.4	ND	0.05	0.4	0.4
Krypton-85	0.01	4	40	ND	5	4	4
Thorium (nat)*	0.001	4	40	ND	5	4	4
Uranium (nat)*	0.001	4	40	ND	5	4	4
Iridium-192	0.01	0.04	0.4	0.37	0.05	0.4	0.4
Radium-226	0.01	ND	0.04	0.037	ND	ND	ND
Tritium	1000	ND	ND	ND	ND	ND	ND
Phosphorus-32	0.1	0.4	4	3.7	0.5	0.4	0.4

Note:

- Queensland, ARPANSA, and Tasmania are not included in this table, as the proposed changes do not decrease exemption levels for those jurisdictions;
- ND means there is 'no decrease' in the exemption level; and
- milling and mining industries are excluded in this version of the National Directory;

The impact of the potential need for registration has been discussed earlier which concluded that the impact is anticipated to be negligible.

In relation to storage or disposal it is difficult to estimate the impact without knowing how many sources will be captured by the lower exemption levels and knowing how many of these sources are likely to be unwanted and in need of disposal in the appropriate manner. As the regulatory impact statement points out the cost of disposal could be two fold: the cost of additional storage where the half-life is short or the cost of third party disposal where the half-life is longer.

In relation to storage, advice from regulators indicates that it is unlikely that additional resources will be needed for storage as most if not all storage is on licensed premises and therefore not likely to require new or additional storage facilities to be built.

In relation to disposal, it is estimated in the Australian Capital Territory that as a worst case it would cost approximately \$360 per substance and in Tasmania indicative disposal costs range between \$210 and \$300 per source depending on the size of the sealed source.

While it is not possible to quantify the total expected cost without more information, it is not expected that this would be particularly high, as the opportunity cost of storage is likely to be low — as stated above — and disposal of larger quantities of sealed sources is rare.

### ***‘Radiation Safety Officers’***

The requirement in RPS1 to appoint a Radiation Safety Officer may involve some additional costs for users of radiation sources. An officer will need to be identified, potentially licensed, and may need training and time to carry out the duties of a safety officer (eg the preparation of a safety plan).

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 \$1320 per plan. It is reasonable to expect that some of the Radiation Safety Officer’s time would form part of this cost, although that regulatory impact statement analysis does not identify the quantum.

In terms of training, depending on the number of Radiation Safety Officers needed and the time taken to train those officers the compliance cost could be as high as \$1.2 million per year.<sup>10</sup> Although we would anticipate that the actual cost would be considerably lower as it is highly likely that training and knowledge of radiation protection requirements are already being undertaken and that all the National Directory will require is a person to be nominated as the radiation safety officer.

## **2.3 Summary of costs**

Table 2.2 summarises the costs associated with introducing the National Directory. It should be acknowledged though that as part of this analysis we have not been able to definitively quantify all costs. Rather, this analysis should be seen as a guide to the range of possible costs and their quantum given certain assumptions.

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<sup>10</sup> This is based on an estimate that only larger users of radiation are likely to have to appoint a radiation safety officer and that they don’t already have one, it is assumed that one tenth of the licenses issued will need to appoint a radiation safety officer, it is also assumes on a cost of training of \$7.50 per contact student hour based on estimated costs by the Office of Tertiary Training and Education, it assumes that 2 days per year will be dedicated to training, and that the salary of the radiation safety officer is equal to average weekly earnings — and hence the cost of attending training is \$541 per officer.

Table 2.2

**SUMMARY OF COSTS**

Category	Discussion
<b>Administration</b>	
Amending legislation	The total cost could range from between \$400 000 and \$4 million but this is a one-off cost and is not usually costed in regulatory impact statements.
Advisory body	May require the Northern Territory to incur costs of around \$10 000 to \$20 000 p/a plus establishment costs.
Exemptions	May add up to \$15 000 per year to New South Wales' administration costs but this will be charged to registrants.
Criteria for registration	May add \$26 000 to the Australian Capital Territory's administration costs and \$6 000 to the Northern Territory's administration costs but this will be charged to registrants.
Radiation Safety Officers	Will have zero admin costs. If NSW chooses to require safety officers to be licensed then this will result in some administrative costs but these costs are not attributable to the National Directory.
Incident reporting	This may increase the number of incidents that are reported by 4 to 8 but the cost is considered negligible.
<b>Compliance</b>	
Criteria for registration	This may increase the costs to users who have to fill in forms to register premises that previously were not registered. The marginal cost of this is believed to be negligible though.
Exemptions	This may result in some additional storage and disposal costs but these are expected to be very low.
Radiation Safety Officers	This may be between zero and \$1.2 million p/a in New South Wales depending on the requirements imposed on safety officers and the degree to which radiation safety training is already undertaken.
<b>Total Costs</b>	The total cost of implementing the National Directory are largely incurred in the first year — thus the majority of costs represent implementation costs rather than ongoing costs. The total costs are estimated to range between \$500 000 to \$5.3 million in the first year dropping back to around \$50 000 in subsequent years.

## Chapter 3

# Benefits

### 3.1 Benefits

The benefits of adopting the National Directory can be grouped into two broad categories:

- health, safety and environmental benefits flowing from adopting the latest available internationally agreed standards; and
- national uniformity benefits.

#### *Health, safety and environmental benefits*

The primary philosophy of radiation protection is based on trying to protect the population as a whole, through the timely application of the principles of radiation protection (justification, optimisation, and limitation) to those sub-groups within the population who are exposed to radiation as part of their normal working life.<sup>11</sup>

In terms of health and safety — and to a lesser extent environmental impacts — there are likely to be three types of benefits flowing from the establishment and implementation of the National Directory:

- improved outcomes for workers;
- improved outcomes for the public more generally; and
- reduced number of incidents of radiation exposure.

#### *Improved outcomes for workers*

Radiation protection regulations are often assessed in terms of their impact on annual effective dose.<sup>12</sup> Based on the latest available information — material published by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)<sup>13</sup> — the average annual effective dose for all workers in Australia is 0.24 mSv per annum.<sup>14</sup> This is close to 100 times lower than the exposure limits set out in RPS 1 — which sets a maximum limit of 20 mSv per year averaged over consecutive years and a maximum of 50 mSv in any one year — and is more than 200 times lower than exposure limits set out in ICRP 26 which were the basis for exposure limits prevailing during the monitoring period.

Even though the exposure limits provide an upper bound for exposure to radiation, the resulting low levels of average annual effective dose are due to a combination of:

<sup>11</sup> B. Cassels and M. Carter 1992, 'Radiation Protection and Occupational Health', *Radiation Protection in Australia*, vol. 10, no. 3. p.83.

<sup>12</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>13</sup> This figure is based on a weighted average of average effective annual doses 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>14</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.

- the application of the ALARA principle — which 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; and
- the application of the overall regulatory system — which includes registrations, licensing, monitoring, reporting, and so on. That is, employers and users of radiation employ systems and controls that result in significantly lower levels of exposure than set by the exposure limits.

Low levels of exposure, as measured by effective dose, highlight that radiation protection is more than simply setting exposure limits, it must be seen as a whole regulatory approach. In this regard, it is reasonable to expect that moving to a national directory, which promotes uniformity and coordination of regulatory approaches and hence improves nation-wide understanding and compliance with regulatory controls, would lead to a further reduction in the average annual effective dose for workers. Given that this is already quite low, any further reduction resulting from the establishment of the National Directory is also likely to be small.

For the purpose of this analysis it is assumed that the establishment and adoption of the National Directory will result in a reduction in the average annual effective annual dose of between 0.15 percent and 1 per cent.<sup>15</sup> Such a reduction would result in a benefit to the community in the range of \$4 000 to \$25 000 per annum.<sup>16</sup>

#### *Improved outcomes for the public*

A similar approach can be used to estimate the benefit to the community more broadly rather than just workers. To do this requires an estimate of the average annual effective dose received by the public. The only basis for assessing this is the average annual effective dose received as a consequence of medical treatment. While exposure from medical treatment is not relevant — i.e. not counted — in the exposure limits set out in RPS1 they are still relevant in terms of overall exposure to radiation for the community as a whole.

In the same way that the establishment of the National Directory is likely to reduce average annual effective dose for workers it is also reasonable to expect that the introduction of the National Directory would have a marginal impact on the use of radiation for medical treatment.<sup>17</sup> The uniform, consistent approach to radiation protection under the National Directory should encourage consistent monitoring of equipment, better information to users on radiation protection and improved monitoring and oversight of radiation use. In short the National Directory should further promote the ALARA principle.

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<sup>15</sup> This is consistent with the approach adopted by New South Wales in the recent regulatory impact statement, which assessed proposed regulations as leading to a 0.15 per cent reduction in effective dose — see New South Wales 2003, *Regulatory Impact Statement: Radiation Control Regulations 2003*, Sydney, p. 53. The range of up to 1 per cent is also adopted on advice from ARPANSA that the establishment of the National Directory and its implementation across all jurisdictions is likely to lead to a slightly larger reduction in average annual effective dose than that assessed in New South Wales.

<sup>16</sup> This is based on: a population of workers of 145 000 — see earlier in the RIS for a description of the number of effected parties — who would benefit from a reduction in effective dose; and an estimate of the cost per person sievert of \$80 000 — based on an inflation adjusted and exchange rate converted estimated cost by the United Kingdom National Radiological Protection Board (see NRPB 1986, *Board advice on cost-benefit analysis*, Chilton, UK, p10.).

<sup>17</sup> This is based on the advice of ARPANSA, who expect that coordination and cooperation across jurisdictions will lead to improved optimisation under the ALARA principle and therefore more judicious use of radiation as part of medical treatment.

The UNSCEAR report on sources and effects of ionising radiation estimated that the world wide average annual effective dose for the population from exposure from diagnostic and medical x-ray examinations was 1.2 mSv.<sup>18</sup> Assuming the National Directory would result in the same reduction to average annual effective dose — that is, assuming a reduction of between 0.15 per cent and 1 per cent — then the establishment of the National Directory is likely to lead to a benefit to the community of between \$852 000 and \$5.7 million per year.<sup>19</sup>

#### *Reduced number of incidents*

While the National Directory, through the application and optimisation of ALARA, is likely to lead to a tangible reduction in the average annual effective dose for workers and the community, an additional benefit flowing from better management and coordination of radiation protection across jurisdictions should be a reduction in the number and/or severity of incidents.

It will never be possible to completely avoid accidents in relation to radiation protection, but incidents may be reduced if through better coordination and understanding of radiation protection measures, the National Directory promotes safer work places and reduces injudicious use of radiation sources.

Over the last five years there have been around thirty incidents reported to ARPANSA every year. In fact in:

- 1999 — there were fifteen incidents (two recorded in the ARPANSA Radiation Incident Register and 13 recorded in annual reports from five jurisdictions);
- 2000 — there were eighteen incidents (two in the Register and sixteen in annual reports);
- 2001 — there were 29 incidents (seven in the Register and twenty two in annual reports);
- 2002 — there were 48 incidents (twenty on the Register and twenty eight in annual reports);<sup>20</sup> and
- 2003 — there were thirty five incidents (eleven on the Register and twenty four in annual reports).<sup>21</sup>

For those incidents where effective dose was recorded, the average effective dose per incident in 2003 was around 5 mSv.

<sup>18</sup> UNSCEAR 2000, op. cit., p. 7.

<sup>19</sup> This is based on a estimated population of 20 million and an estimated cost per person sievert of \$23 664 — again adjusted for inflation and exchange rates from the NRPB 1986 study.

<sup>20</sup> The number of incidents in 2002 was higher because ARPANSA, states, and territories ran a trial of a new reporting framework, which seem to result in higher than normal reporting rather than higher number of incidents *per se*.

<sup>21</sup> Information provided by ARPANSA.

The implementation of the National Directory is expected to facilitate consistency in reporting of incidents. Publishing that information should help reduce the number of incidents by increasing awareness of causality and consequences. Assuming the National Directory will result in a reduction in incidents of between 0.15 per cent and 1 per cent — i.e. the same reduction as adopted above — then this would generate a benefit of approximately \$500 per year. Even if the reduction in the number of incidents was closer to 50 per cent rather than 1 per cent the benefit would still only be around \$5 000 to \$6 000.

These benefits may seem small; however, it is important to acknowledge that radiation incidents can sometimes be highly public, cause great media interest, and raise public consternation about the regulatory regime. Reducing incidents is likely to create enhanced community confidence in the regulatory environment and hence promote further the ALARA principle — the benefits of which were highlighted above.

#### *Caveat on health and safety benefits*

While there is basis to expect that there will be significant benefits flowing from the establishment of the National Directory it is important to at least acknowledge that there is some academic debate about the effects of low doses of radiation on humans.<sup>22</sup>

Some scientists believe that at doses below about 100 mSv, the evidence of radiological harm is not clear-cut. While some studies indicate evidence of radiation-induced effects, epidemiological research has been unable to establish unequivocally that there are effects of statistical significance at doses below a few tens of millisieverts. That is, in questioning the veracity of the linear non-threshold relationship, some scientists are challenging whether current exposure standards are set too restrictively.

It is noted however, that the United Nations Scientific Committee on the Effects of Atomic Radiation has supported the linear non-threshold and the basic assumptions that underpin the ICRP 60 and hence exposure limits set in RPS1 and endorsed as part of the National Directory.<sup>23</sup> It is also noted that there is no alternative regulatory approach adopted elsewhere in relation to radiation protection standards and exposure limits.

While The Allen Consulting Group acknowledges that there is some debate on these issues, the absence of any demonstrated or agreed alternative leads us to believe that the above assessment of health and safety benefits flowing from the establishment of the National Directory is reasonable.

#### *National uniformity standards*

In addition to health and safety benefits for workers and the community, the adoption of the National Directory will also have benefits in terms of:

<sup>22</sup> This issue was most recently raised in an article in the *Australian Financial Review* (see D. Taverne 2004, *Exposed: some facts about radiation*, *Australian Financial Review*, Review, 13 August, p. 3). For a full discussion and further background on this debate see OECD Nuclear Energy Agency 1998, *Developments in Radiation Health Science and their Impact on Radiation Protection Committee on Radiation Protection and Public Health*, Report of the Working Group on Science and Technology Affecting Radiation Protection Sub-Group on Radiation Health Sciences (WGST-RHS), pp. 11-17. Also see OECD Nuclear Energy Agency 2000, *A Critical Review of the System of Radiation Protection: First Reflections of the OECD Nuclear Energy Agency's Committee on Radiation Protection and Public Health (CRPPH)*.

<sup>23</sup> UNSCEAR 2000, *op. cit.*, p. 14.

- allowing jurisdictions to easily incorporate proposed changes — such as adoptions of RPS1, RPS2, RPS3; and
- providing a framework for agreeing, and incorporating future changes — such as, new Codes, Standards or other changes to radiation protection arrangements.

These coordination benefits for different stakeholders are discussed below.

### *For government*

In principle, the adoption of the National Directory should provide for some efficiency savings. These could result from better coordination across jurisdictions and the ability to draw nationally on the expertise and scrutiny of developments and new regulatory proposals rather than each jurisdiction developing regulations separately. Peer review and joint jurisdictional oversight should ensure that bad policy initiatives are avoided and only those policies that have demonstrable benefits proceed.

It is expected that across all jurisdictions less resources would be needed to ensure up-to-date radiation protection arrangements — regulatory agencies should benefit from the collective wisdom of nine jurisdictions, and a national approach may allow for the preparation of only one impact statement for future changes, with consultation coordinated and stakeholder views consolidated at the same time.

At the same time though, there may be some potential drawbacks for government. National agreements are often difficult and time consuming to achieve, as has been the case for the adoption of this National Directory, and as such national agreements may not always be responsive to change — that is, it may prove costly to ensure the National Directory remains dynamic and represents best regulatory practice.

On balance, it is believed that the benefits for government in terms of potential efficiency and economies of producing regulation are likely to outweigh the costs of obtaining agreement from nine jurisdictions. This conclusion is based on the observation that similar national agreements have or were expected to produced significant benefits, for example:

- In 1995 the Industry Commission (now the Productivity Commission) estimated the benefits of national coordination and uniformity in both technical and administrative building and planning controls would be around \$350 million per annum (or close \$500 million in current dollar terms);<sup>24</sup>
- the Second Reading Speech, for the Trans-Tasman Mutual Recognition Agreement legislation, noted some additional practical benefits from the *Mutual Recognition Agreement*, including:
  - greater cooperation between regulatory authorities;
  - the accelerated development of national standards where appropriate; and

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<sup>24</sup> Industry Commission 1995, *The Growth and Revenue Implications of Hilmer and Related Reforms*, AGPS, Canberra, pp. 134-135.

- greater discipline on individual jurisdictions contemplating the introduction of new standards and regulations;<sup>25</sup>
- the introduction of a national food safety regulatory regime were assessed to provide Australia with the opportunity for national consistent food safety legislation, thereby simplifying procedures for businesses which operate in more than one jurisdiction and to bring Australia into line with measures introduced by many of Australia’s major trading partners;<sup>26</sup> and
- in relation to agricultural and veterinary chemicals, the establishment of the National Registration Authority (now called the Australian Pesticide and Veterinary Medicines Authority) was directed towards agreeing to use centralised assessment programs, thus avoiding duplication, decreasing costs and reducing the burden on industry.<sup>27</sup>

While it is acknowledged that radiation protection is different in nature from the above examples, it is believed that the national regulatory regime for radiation protection displays enough similar characteristics — such as nationally similar objectives, multiple jurisdictional responsibility, regulation based on objective scientific criteria, and so on — to conclude that it is highly likely that national uniformity through the establishment of the National Directory will have benefits for government.

#### *For industry*

Adopting the National Directory ensures that for all matters covered by the National Directory there is a single uniform regulatory standard that applies across Australia. For industry this should result in a number of benefits.

First, the National Directory will provide certainty about radiation protection requirements, certainty about how changes to regulation will be made in the future, and certainty as to how industry can participate in such changes.

Regulatory certainty lowers the regulatory cost to industry and hence improves decision-making processes and leads to better investment and resource allocation decisions. Given that radiation has such wide application in industry — ranging from the use of gauges in industry, mining and milling of radioactive ores, security applications through to the diagnostic and therapeutic use of x-rays as well as broader medical research — then the dynamic efficiency gains associated with greater regulatory certainty could be significant. This is likely to be particularly important for small businesses where it is disproportionately more costly to keep track of multiple regulatory requirements.

Estimating these benefits however, is somewhat problematic. For example, despite an eight-month study which generated a 400 page report, the Productivity Commission’s evaluation of the mutual recognition schemes was not able to quantify the benefit of the scheme — although they did conclude that the mutual recognition has contributed to the objectives of:

- increasing trade and workforce mobility across jurisdictional borders;

<sup>25</sup> Productivity Commission 2003, *Evaluation of the Mutual Recognition Schemes*, Research Report, 17 AGPS, Canberra.

<sup>26</sup> Australia New Zealand Food Safety Authority 1999, *Food Safety Standards — Costs and Benefits*, AGPS, Canberra.

<sup>27</sup> Environment Australia 1998, *National Profile of Chemicals Management Infrastructure in Australia*, AGPS, Canberra.

- contributing to the integration of participating economies;
- enhancing internal and external competitiveness;
- increasing uniformity of standards;
- increasing choice and lower prices for consumers;
- decreasing costs to industry; and
- increasing access to economies of scale.<sup>28</sup>

Specific to the area of professionals who use radiation equipment, radiographers have the second highest take up of mutual recognition registrations after optometrists.<sup>29</sup> This suggests that there are at least some professionals or businesses who work across jurisdictions and hence would benefit from the adoption of the National Directory.

Second, the National Directory should reduce compliance costs, particularly for industry or professionals that work in multiple jurisdictions. Having to comply with a single or at least consistent set of regulatory requirements means that industry or professionals will only need to dedicate resources once to registration, safety plans, radiation protection measures, training requirements, and so on. By way of example, in the recent study on occupational health and safety regulations it was found that differences across jurisdictions add significant costs to industry:

The lack of a nationally consistent approach [to occupational health and safety] appears to have imposed significant compliance costs on business and may have led to inequities for injured workers in terms of benefits payable and entitlement to benefits ... the costs for multi-state employers of complying with multiple arrangements can be considerable, sometimes amounting to millions of dollars a year.<sup>30</sup>

Third, adoption of the National Directory provides for a greater degree of transparency in regulatory requirements. The promulgation of agreed radiation protection standards in the one document makes it easier to observe the regulatory requirements and it ensures that changes to those requirements are more easily identified. Nine jurisdictions promoting the same information, the same regulatory requirements, in the same document surely promotes greater regulatory transparency and hence greater accountability to industry and other stakeholders.

#### *For the community*

From the community's perspective there is a strong desire to see that radiation is managed and regulated in a manner that not only satisfies genuine risks associated with radiation but also that government manages perceived risks about the use of and exposure to radiation sources — which may manifest themselves in broader concerns that are not necessarily based on science.

In part, perceived concerns may be due to the magnitude of highly public failures of the regulatory system in relation to radiation protection, such as:

- the economic, social, and environmental costs associated with Chernobyl or Three Mile Island;

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<sup>28</sup> Productivity Commission 2003, op. cit.

<sup>29</sup> Productivity Commission 2003 op. cit., p. 43.

<sup>30</sup> Productivity Commission 2004, *National Workers' Compensation and Occupational Health and Safety Frameworks*, Public Inquiry, AGPS, Canberra.

- the estimated cost of radioactive contamination in industry — for example the United States Nuclear Regulatory Commission estimates that the cost of contamination of a steel mill if a single orphan source became mixed with recycled metal could be as high as US\$100 million;<sup>31</sup> or
- the direct personal cost of exposure to an unobservable risk with the potential for life-threatening consequences — for example, in a recent survey of public perceptions it was found that between 75 per cent and 90 per cent of the public surveyed thought that imaging providers (i.e. x-ray providers) should be highly educated and highly regulated.<sup>32</sup>

To understand why sometimes scientific and perceived risk differs, it is necessary to understand how the risk is defined. Usually risk is defined by the multiplication of the potential consequences (the magnitude of the hazard) and the likelihood of the potential consequences occurring (probability). In contrast, some have argued that public perceptions of risk takes into account the potential hazard as well as qualitative attributes associated with the risk that leads to ‘outrage’ — see box 3.1 for a more detail.<sup>33</sup>

Box 3.1

#### PERCEIVED RISK

##### **Risk = Hazard + Outrage**

‘Hazard’ encompasses the technical assessment of risk

‘Outrage’ is the psychological or emotional perceptions, which may or may not have basis in fact. Influences on the degree of outrage include:

- voluntary or coerced;
- natural or industrial;
- familiar or exotic;
- not memorable or memorable;
- not dreaded or dreaded;
- knowable or not knowable;
- controllable by the individual or controllable by others;
- fair or unfair;
- morally irrelevant or morally relevant;
- trust or no trust; and
- responsive process or unresponsive process.

Outrage will be higher, the greater the prevalence of the second named component.

Source: Sandman 1997, *Responding to Community Outrage: Strategies for Effective Risk Communication*, American Hygiene Association, Fairfax VA.

<sup>31</sup> United States Nuclear Regulatory Commission 2001, *Regulatory Analysis: Requirements for the Possession of Industrial Devices containing By-product Material*, Rockville, MD.

<sup>32</sup> R. Ludwig and L. Turner 2002, ‘Effective Patient Education in Medical Imaging: Public Perceptions of Radiation Exposure Risk’, *Journal of Allied Health*, Fall 2002, 31,3; Career and Technical Education, p. 159.

<sup>33</sup> Sandman 1997, *Responding to Community Outrage: Strategies for Effective Risk Communication*, American Hygiene Association, Fairfax VA.

Depending on the nature of the risk, the public sometimes misperceives the hazard associated with radiation, while experts often misperceived the community's outrage.<sup>34</sup> While not based on science, managing perceptions can often be an important part of regulation. To this extent, the adoption of the National Directory provides a basis for managing perceptions. Jurisdictions can promote their respective radiation protection regulatory regimes as:

- adopting the most up-to-date and internationally agreed exposure limits for radiation protection;
- consistent with all other jurisdictions in Australia and hence there is no confusion for non-experts as to what constitutes radiation protection and why; and
- coordinated at a national level to ensure that future radiation protection initiatives are developed on a national basis taking on board jurisdictional and whole-of-country factors.

Caution should be added here as responding to 'outrage' without due consideration can sometimes lead governments to magnify the extent of perceived risk and hence over regulate. For example, in a survey conducted by Market and Opinion Research International in the United Kingdom in 2002 it was found that 84 per cent of parliamentarians thought that the public were concerned about the use of nuclear power when in fact only 25 per cent of the public surveyed were unfavourable towards nuclear energy.<sup>35</sup>

The Allen Consulting Group believes that the best way for jurisdictions to manage perceptions is to promote consensus among radiation protection experts about key radiation protection issues, such as exposure or exemption limits — supporting the adoption of the National Directory is one way this can be achieved. In particular, the adoption of the National Directory by all jurisdictions allows radiation protection agencies to promote — for the first time in Australia — a nationally uniform approach to radiation protection based on the best available scientific information and international benchmarks, thus enhancing the agencies ability to assuage any perceived community concerns about radiation exposure.

#### *For international standing*

The adoption of the National Directory will also have some international benefits including:

- adopting across all jurisdictions the ICRP 60 exposure limits, thus ensuring that Australia's regulatory regimes are consistent with Australia's participation in the establishment of those limits;
- improving Australia's standing in the international community by adopting internationally agreed limits rather than advocating one approach internationally but adopting different limits domestically; and

<sup>34</sup> S. Chapman and S. Wutzke 1997, 'Not in my backyard — media coverage of community opposition to mobile phone towers: an application of Sandman's outrage model of risk perception', *Australian and New Zealand Journal of Public Health*, vol 21, pp. 614-620.

<sup>35</sup> M. Grimston 2002, 'Nuclear Energy: Public Perceptions and decision-making', *World Nuclear Association Annual Symposium 4-6 September 2002 — London*, p. 4.

- providing a forum in which all jurisdictions in Australia can participate in international debates and influence international policy on radiation protection.

An example of these points can be seen in Australia's participation in developing agreements on the trafficking of radioactive materials, import/export, and environmental releases. There has been considerable international effort put into establishing accepted safety standards, particularly for transportation, and for strengthening the regulatory systems in each country to be able to enforce those standards. This was the motivation behind the international multi-party sponsored Basic Safety Standards.<sup>36</sup> The expectation following the endorsement of the Basic Safety Standards by each of the sponsoring bodies was that member states should enact legislation embodying the standards. As Australia sponsored and endorsed the Basic Safety Standards, then there is some responsibility on Australia to honour the endorsement of the Basic Safety Standards and provide standards consistent with international best practices.<sup>37</sup>

Another example is Part IV, Article 11 of Chapter 3 of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*, which indicates that contracting parties are obliged to:

provide for effective protection of individuals, society and the environment, by applying at the national level suitable protection methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards.

Also, it is noted that section 23(1)(d) of the *Australian Radiation Protection and Nuclear Safety Act 1998* on the functions of the Radiation Health Committee requires the Committee to review national policies, codes and standards in relation to radiation protection to ensure that they continue to substantially reflect world best practice. Adopting RPS1, RPS2, RPS3, and the proposed exemption levels would appear consistent with this legislative requirement.

### 3.2 Summary of benefits

Table 3.1 summarises the benefits associated with introducing the National Directory. An assessment based on reduced effective dose, along with the potential benefits associated with national uniformity suggest that there are reasonable benefits for the community, industry and government in moving to a more coordinated national regulatory regime for radiation protection.

<sup>36</sup> The BSS was jointly sponsored by the IAEA, International Labour Organisation (ILO), the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), the Pan American Health Organisation (PAHO), the Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO). It reflects the consensus of experts from over fifty countries who participated in drafting the document.

<sup>37</sup> G. Dicus 1998, 'Why We Need to Harmonize Radiation Protection Regulations', Nuclear Regulatory Commission paper presented at the Women in Nuclear Global Annual Meeting, Taipei, Taiwan, 24 April, <http://www.nrc.gov/reading-rm/doc-collections/commission/speeches/1998/s98-13.html>.

Table 3.1

**SUMMARY OF BENEFITS**

<b>Category</b>	<b>Discussion</b>
<b>Health and safety</b>	The health and safety benefits have been estimated to range between: <ul style="list-style-type: none"> <li>• \$4 000 and \$25 000 pa for occupational exposure;</li> <li>• \$852 000 and \$5.7 million pa for the community; and</li> <li>• \$500 and \$5 000 for those involved in incidents.</li> </ul>
<b>National uniformity</b>	
For government	There are potential efficiency savings for government, although these need to be balanced against the resource costs of facilitating the agreement of nine jurisdictions.
For industry	There are potential savings for industry, particularly for those industries or professionals who work across multiple jurisdictions. Benefits flow from greater regulatory certainty, reduce compliance costs, and improved regulatory transparency.
For the broader community	The National Directory should allow for better and more coordinated promotion of radiation protection arrangements, thus allowing jurisdictions to better align regulatory regimes with community's expectations for managing radiation risks.
<b>Total benefits</b>	The total health and safety benefits are likely to range between \$856 000 and \$5.73 million per year. There will also be benefits to regulators, industry, the community and international relations flowing from efficiencies, better coordination, and uniformity of radiation protection regulations.

## Chapter 4

# Costs and benefits compared

In drawing any definitive conclusion as to the costs and benefits of the National Directory it should be noted that it is generally easier to quantify costs of safety-related regulations because these are crystallised as actual expenditures, whereas the health benefits are less easily quantified because these tend to be avoided costs (such as avoided incidents, illnesses, or cancers). Keeping this in mind, The Allen Consulting Group believes that on balance it would appear that the benefits are likely to more than exceed the costs. Table 4.1 provides summary of this assessment.

Table 4.1

### SUMMARY OF BENEFITS

Category	Discussion
<b>Costs — Administration</b>	
Amending legislation	The cost to all jurisdictions could range between \$400 000 and \$4 million but this is a one-off cost and is not usually costed in regulatory impact statements.
Advisory body	May require Northern Territory to incur costs of around \$10 000 to \$20 000 p.a. plus establishment costs.
Exemptions	May add up to \$15 000 p.a. to New South Wales' administration costs but this will be charged to registrants.
Criteria for registration	May add \$26 000 to Australian Capital Territory's administration costs and \$6 000 to Northern Territory's administration costs but this will be charged to registrants.
Radiation Safety Officers	Will not add to administration costs, although if New South Wales requires licensing then this will result in some administrative costs but these are not attributable to the National Directory.
Incident reporting	This may increase the number of incidents that are reported by four to eight per year but the cost is considered negligible.
<b>Costs — Compliance</b>	
Criteria for registration	This may increase the costs to users who have to fill in forms to register premises that previously were not registered. The marginal cost of this is believed to be negligible though.
Exemptions	May result in some additional storage and disposal costs but these are expected to be low.
Radiation Safety Officers	May add between zero and \$1.2 million p.a. in New South Wales, depending on the requirements for radiation safety officers and the degree to which training is already undertaken
<b>Benefits — Health and Safety</b>	Total health and safety benefits are likely to range between \$856 000 and \$5.73 million p.a.
<b>Benefits — National Uniformity</b>	
For government	There are potential efficiency savings for government, although these need to be balanced against the resource costs of facilitating the agreement of nine jurisdictions.
For industry	There are potential savings for industry, particularly for those industries or professionals who work across multiple jurisdictions and for small business that will no longer need to keep track of multiple regulatory requirements.
For the broader community	The National Directory should allow for better and more coordinated promotion of radiation protection arrangements, thus addressing public expectations about radiation risks.
<b>Net Impact</b>	Overall, there is likely to be a net benefit for Australia from adopting the National Directory. The net present value of this benefit ranges between \$3.2 million p.a. and \$56.1 million p.a. (this Net Present Value estimation is explained on the next page)

While table 4.1 provides a holistic view of both the quantifiable and non-quantifiable costs and benefits, it is useful to look specifically at the quantifiable net impact. Conscious of the uncertainty of the estimates provided earlier, an upper and lower estimate are provided:

- the lower bound net present value estimation is based on comparing the lower bound benefit — estimated to be \$856 000 per year — with the upper bound costs — estimated to be \$5.3 million in the first year and \$50 000 in subsequent years. This lower bound provides a worst-case scenario where by the maximum costs are compared to the lowest expected benefits. By discounting these impacts over twenty years at a discount rate of 8 per cent provides a net present value estimate of \$3.2 million;<sup>38</sup> and
- the upper bound net present value estimate is based on comparing the upper bound benefits — estimated to be \$5.73 million per year — with the lower bound costs — estimated to be \$500 000 in the first year and \$50 000 in subsequent years. This upper bound provides the most optimistic estimate of net benefits with the maximum benefits and the lowest expected costs. Again using a discount rate of 8 per cent this provides a net present value estimate of \$56.1 million.

Thus, the impact of the National Directory's introduction is likely to provide a net benefit of somewhere between \$3.2 and \$56 million in net present value terms.

While this analysis provides an estimate of the expected benefits, it is highly dependant on the realisation of improved health and safety outcomes. The overall results should therefore be interpreted more as an indication that it is quite likely that the introduction of the National Directory will result in a net benefit for Australia rather than as a definitive estimate of the actual net benefit. Nevertheless, the fact that some benefits have not been quantified and that the majority of the costs are one-off implementation costs, it is reasonable to recommend that the National Directory should be implemented.

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<sup>38</sup> A discount rate of 8 per cent is used in this analysis in accordance with advice from the Office of Regulation Review. While the Office of Regulation Review indicates that there is some debate as to the most appropriate discount rate — or cost of capital for government — 8 per cent is broadly consistent with the approach outlined in Department of Finance 1991, *Handbook of Cost Benefit Analysis*, AGPS, Canberra. For completeness sake, sensitivity analysis was undertaken on the discount rate. This analysis highlighted that with a 5 per cent discount rate the NPV ranged from between \$5.3 million and \$72 million and with a 10 per cent discount rate the NPV ranged between \$2.19 million and \$48.4 million.

## Appendix A

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