Australian Government
Australian Radiation Protection and Nuclear Safety Agency

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ANRDR in Review 2019

Welcome to the 2019 edition of the Australian National Radiation Dose Register (ANRDR) annual newsletter, ***ANRDR in Review***.

The past 12 months have seen some exciting developments for the ANRDR, some of which will impact our stakeholders in a positive way. The ANRDR team has initiated work on **improving the employer interface** and is also making some minor changes to the submission file format for better usability and to capture important information.

The ANRDR team continues to work with employers, regulators and other stakeholders to promote the ANRDR as a **best practice tool for dose record-keeping** and for facilitating dose optimisation for all radiation industries.

In this edition, you will also find the **latest analysis of dose trends** and information on some of the interesting local and international activities in which the ANRDR team has been involved.

We extend our thanks to all of our current and future partner organisations who support us in our journey to achieve best practice for recording and maintaining dose records for all Australians who work with radiation.

We hope that you find this newsletter of interest and, as always, we encourage your feedback and suggestions for future editions of *ANRDR in Review*.

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Significant events

NOV 2018

ARPANSA hosts the IAEA's **IRRS mission to Australia**

NOV 2018

The ANRDR's Ben Paritsky provides **radiation protection training in Malaysia**

MAR 2019

The ANRDR's Cameron Lawrence assists the **IAEA in Vienna** in enhancing radiation protection for uranium workers

JUN 2019

AdelaideVet becomes the first veterinary practice to join the ANRDR

JUN 2019

A **Singaporean delegation** spends a week learning from ARPANSA's experts

Employer interface improvements are coming!

The ANRDR team has initiated a project to make improvements to the employer interface. This work is designed to improve the quality of information provided to the ANRDR and provide employers with access to their submitted records and new reporting functionality.

ANRDR users will now be able to access the following reports:

Worker registration reports containing the details and ANRDR numbers of registered workers

Personalised ANRDR registration certificates containing the registered details and ANRDR numbers for dissemination to workers

Access to previously uploaded files to ensure organisations meet their dose record-keeping requirements

Additionally, the registration process for new users has been simplified and the following modifications have been made to the data transfer file format:

- the ability to include workers' ANRDR registration numbers for improved person matching
- additional fields have been included to collect information relating to:
    - dosimetry service provider(s)
    - dose assessment methodologies
    - other key information such as the use of protection factors.

The new release of the ANRDR is still awaiting implementation. Existing users have been contacted regarding the project and will be informed regarding the forthcoming changes once the project is complete.

Radiation Health Committee ANRDR Working Group

The Radiation Health Committee (RHC) established an ANRDR working group to provide guidance on the national implementation. The RHC members represent radiation regulators from across the country. One of the RHC's key functions is to establish and promote national uniformity in radiation protection practices.

The working group, consisting of members representing multiple jurisdictions, discussed a range of options for achieving national implementation.

The working group presented their conclusions in the form of a paper to the RHC at the July 2019 meeting, advising the Committee that the most efficient way of achieving the ANRDR vision of complete coverage of occupationally exposed workers was to obtain dose records directly from dosimetry service providers (DSPs). It was proposed that a requirement for mandatory dose record submissions should be considered as part of any future national DSP accreditation scheme.

The working group made further recommendations to develop guidance for regulators to assist with harmonised national implementation of the ANRDR and to establish an independent advisory board consisting of members independently appointed by each jurisdiction. The advisory board would provide ongoing guidance to regulators on national implementation of the ANRDR and would advise ARPANSA on regulators' requirements regarding the functionality of the ANRDR, in particular the proposed regulator portal, to ensure their expectations are met.

Accreditation scheme for dosimetry service providers (DSPs)

Personal dosimetry is the cornerstone of occupational radiation protection. There are a number of DSPs offering their services in Australia, some of which carry out analysis of dosimeters in overseas laboratories. Currently, there is no national framework for regulating this industry. To ensure that DSPs are applying best practice methodologies and providing their customers with accurate results, the RHC is working on establishing a nationally-recognised accreditation scheme for DPSs.

Establishing of a framework for national accreditation of DSPs is instrumental in ensuring accuracy and comparability of doses across different providers, and enhancing protection of Australian radiation workers.

This work will also have positive impacts on the ANRDR. ARPANSA is promoting that any future accreditation scheme should require providers to submit their customers' dose records to the ANRDR. This will make sure that workers have access to their complete dose histories, regardless of where or for whom they are working.

An added benefit is that workers and employers will have confidence that individuals' doses and industry dose trends are accurate and comparable, regardless of which monitoring service they use.

Uranium Council

The 13th Uranium Council was held in Adelaide on 6 June and Dr Cameron Lawrence attended on behalf of ARPANSA as an observer.

The main focus of the council meeting was discussion regarding the upcoming review of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), in particular the nuclear action trigger in the Act and its rationale and operation.

A key challenge facing non-uranium miners is that a number of projects are being assessed under the EPBC Act as triggering a 'nuclear action'. Many experts argue that this is resulting in an addition regulatory burden on operators, creating a drawback to the advancement of these industries. They argue that naturally occurring radioactive material (NORM) waste produced by non-uranium miners should not be regulated in the same way as uranium mining.

The Minerals Council of Australia, an industry association representing companies that generate most of Australia's mining output, recently published a policy paper in the hope that it will be considered in the upcoming review of the Act.

National Energy Resources Australia (NERA) also provided an update on a number of uranium-related projects that they are engaged in. Work is ongoing through the Council to update their factsheets and the Radiation Workers Handbook.

Full details of the meeting and copies of minutes can be obtained through the Department of Industry, Innovation and Science website.

International engagement

IAEA's Integrated Regulatory Review Service (IRRS) supports ARPANSA's ongoing implementation of international best practice

Australia partners with international organisations for cooperation on nuclear safety and security. It maintains this position by a number of means, including sharing its knowledge and learning from international best practice. An IRRS mission is a valuable regulatory benchmarking exercise involving peer review by international experts.

The most recent IRRS mission to Australia took place during 4–16 November 2018. The IRRS team reviewed Australia's national, legal and governmental framework for nuclear and radiation safety against the International Atomic Energy Agency's (IAEA) Safety Standards.

The ANRDR team were invited to provide an overview of Australia's occupational radiation protection framework and were on hand to provide additional information and resources to the IRRS reviewer responsible for this component during her time at ARPANSA.

Australia was the first multi-jurisdictional country to be comprehensively reviewed in this way. The review included all six states, two territories and the Commonwealth, and this was identified as a good practice by the IRRS team. Besides this, the report noted Australia's robust national safety framework and detailed several other good practices, while also identifying areas for improvement. These are addressed to the various Australian governments and regulatory bodies. A follow-up mission will be conducted in 2021–22.

A summary of the IRRS mission and the full report is available online.

ARPANSA delivers occupational radiation protection training in Malaysia

The ANRDR's Ben Paritsky travelled to Malaysia to facilitate an IAEA training course on '*A national system for occupational radiation protection*'.

The IAEA recently reviewed Malaysia's occupational radiation protection regulatory framework and practical implementations as part of an Occupational Radiation Protection Appraisal Service (ORPAS) mission to the country. At the conclusion of the mission, the expert team provided a report that identified and recommended improvements and actions.

To address some of the recommendations, the Malaysian radiation regulator, the Atomic Energy Licensing Board (AELB), requested a training course on occupational radiation protection. Ben Paritsky, together with Japanese expert Toshikazu Suzuki, attended AELB's headquarters in November 2018 to facilitate this course on behalf of the IAEA. The purpose of the course was to strengthen the protection of workers in Malaysia.

The course was attended by representatives from a range of industries and government departments responsible for establishing policy in radiation protection and regulating industries with occupational exposures.

Amid lectures and activities, a group exercise involving a scenario that starred Asia's top celebrities as radiation workers in a plotline worthy of the most dramatic soap opera, encouraged the participants to discuss the concepts that were presented to them throughout the course. After an afternoon of lively discussions, each group presented their findings to the class.

The training was a resounding success, with both IAEA experts impressed at the depth of knowledge shown by participants and facilitators.

The IAEA and ARPANSA work to enhance radiation protection of uranium industry workers

Last year, ARPANSA entered into a practical arrangement with the IAEA for continuing work related to radiation protection in uranium mining. As part of this agreement, Dr Cameron Lawrence attended two IAEA consultancy meetings in Vienna in March 2019.

The first meeting involved four international experts from Canada, Australia and Kazakhstan working with an IAEA representative to develop a training package for Occupational Radiation Protection in the Mining and Processing of Uranium. This work delivered a training package consisting of 12 core modules and 11 case studies. The core modules cover critical aspects of radiation protection for the industry, including exposure pathways, monitoring and dose assessments. The case studies focus on the various extraction methods (surface, underground, in-situ leach, etc.), processing, tailings management, transport and decommissioning.

The second meeting focused on the review and revision of the uranium mining exposure (UMEX) survey that was originally developed and rolled out to the industry in 2011. The submissions from the previous survey were incorporated into the review to improve consistency and clarity. The IAEA plans to incorporate the survey into its existing Information System on Occupational Exposure in Medicine, Industry and Research (ISEMIR) platform.

ARPANSA collaborates with UNSCEAR on evaluation of occupational exposures to ionising radiation

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was formed in 1955 to undertake scientific assessments of sources and effects of ionising radiation, including health risks to people and the environment, and report its findings directly to the United Nations General Assembly (UNGA). The Committee evaluates exposures to the human population worldwide from all natural and artificial sources of ionising radiation. It also reviews and reports on the current understanding of the effects of exposure to ionising radiation at the molecular, cellular and tissue levels, on diseases and health risks among the human population, and on the natural environment.

ARPANSA has significant involvement with UNSCEAR, with ARPANSA's Deputy CEO Dr Gillian Hirth becoming Chair of the Committee for the 66th (10–14 June 2019) and 67th (13–17 July 2020) sessions. ARPANSA is also involved with the expert group for medical exposure to ionising radiation and Dr Cameron Lawrence continues involvement with the expert group for occupational exposure. The UNSCEAR Scientific Annexes for exposure to medical and occupational sources of ionising radiation are expected to the published in late 2020.

The scientific annex being produced for worldwide occupational exposures will provide an updated reference of occupational exposures for a range of sectors, including medical, nuclear, industrial uses of radiation and others. Similar to the previously published 2008 Annex (Sources and Effects of Ionizing Radiation – Annex B Exposures of the Public and Workers from various Sources of Radiation), it will provide annual average and collective effective doses from submitting countries, estimates of worldwide exposures for workers and a review of the relevant published literature for each of the sector groups.

Singapore delegation visit ARPANSA

In June, ARPANSA hosted a delegation from Singapore keen to learn from Australia about all facets of radiation protection. While a range of topics were discussed over the course of a week, the main purpose of the visit focussed on the technical and administrative aspects of personal radiation monitoring.

During the visit, our guests also took the opportunity to learn about ARPANSA's other services, such as the ANRDR, our new state-of-the-art Radiotherapy Quality Centre, and our non-ionising radiation facilities. The ANRDR's Ben Paritsky demonstrated the Dose Register and introduced the Personal Radiation Monitoring Service's (PRMS's) project to upgrade dose reporting.

The ANRDR collects information on quarterly-assessed radiation doses for a range of dose types and exposures. Some personal information is also collected to allow us to match workers with their doses and to identify workers when they request their dose history reports. The data collected is used to monitor individual doses and generate annual statistics related to exposure trends. This may assist with the optimisation of radiation protection practices for workers.

The ANRDR currently holds the dose records for more than 44 000 individuals, primarily from the uranium industry, but also the mineral sands industry, government organisations, and veterinary and medical practices. Annual effective doses continue to remain low (71% of all workers are below 1 mSv) for all registered organisations in 2018.

ARPANSA acknowledges that doses below the minimum reporting limits from dosimetry service providers are entered into the ANRDR as a zero value, which causes the statistical results to skew downward. The ANRDR team are investigating alternative analysis methods for future editions that would more accurately represent average doses for industries and work categories. Analysis methods used to report results here are in line with those used for other national dose registers around the world.

Uranium industry data

The ANRDR has coverage of all licenced Australian uranium operators with exposure records for all operations from 2011.

The International Commission on Radiological Protection (ICRP) published changes to the dose coefficient for radon in 2018. Due to variations in legislative processes between Australian jurisdictions, these changes were introduced for South Australian uranium mines from July 2018, however, they have yet to come into effect for the Northern Territory's Ranger Uranium Mine.

Doses reported in this newsletter are derived from the official methodology used in each jurisdiction. Therefore, for 2018, there is inconsistency in the doses reported for radon progeny across the two jurisdictions with licenced uranium operations. ARPANSA recognises that it will take some time for the impact of the changes to the dose coefficient to be seen in the trends and this impact will be assessed in future analyses of ANRDR data.

A comprehensive review of the ANRDR data analysis procedures was performed this year and it was found that the data used for reporting, in some instances, contained duplicate entries for workers. As such, the dose for some individuals for a given year was split across these entries. This has resulted in lower average doses being reported in previous editions of the ANRDR newsletter. The number of duplicates in each year depended on the number of links made in that year and ranged between 10–25% of the entries. Investigation revealed that this was a result of the way that the data extraction query reported linked individuals when data is extracted for analysis. The analysis performed for this year has corrected the issues associated with the duplicate entries for this and previous years.

In managing a large database containing personal information it has always been acknowledged that some records may not be correctly linked due to changes in names or errors in submission files. The ANRDR makes every effort to ensure that the records are linked correctly, it is monitored as a metric and reviews of the data have been performed annually since 2016. Correctly linking records in the ANRDR was a key driver for the employer interface improvement project which will use the ANRDR number as a primary identifier. While the issue in this case was related to the query used to extract data from the database the way records are linked within the database was a significant contributing factor. This issue has not impacted the data in dose reports issued to individuals.

Analysis of data

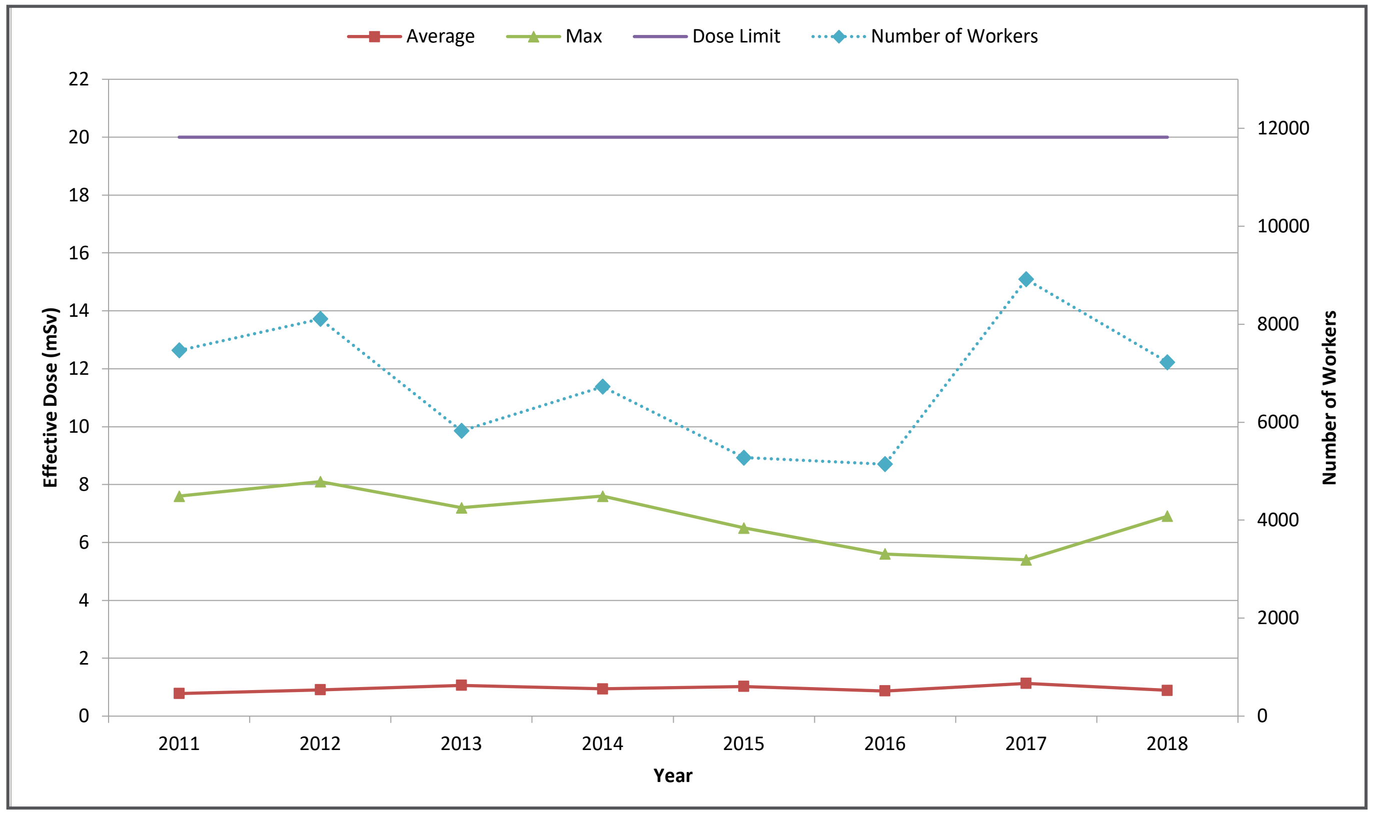


Figure 1: Uranium industry average and maximum effective doses with workforce numbers (2011–18)

An impact of the duplicated entries for workers is an increase to the previously reported uranium industry average effective dose. The impact sees the long term average effective dose for uranium industry workers from 2011–17 increase from 0.86 mSv/year to 0.96 mSv/year. This is still well below the occupational dose limit of 20 mSv/year and less than the public dose limit of 1 mSv/year. The maximum values reported for workers previously have not been impacted.

Figure 1 shows the trends for the average and maximum effective doses combined for workers in all work categories. Applying the corrected worker numbers (with duplicates removed), the average effective dose for workers decreased from 1.13 mSv in 2017 to 0.89 mSv in 2018 while the maximum increased from 5.4 mSv to 6.9 mSv.

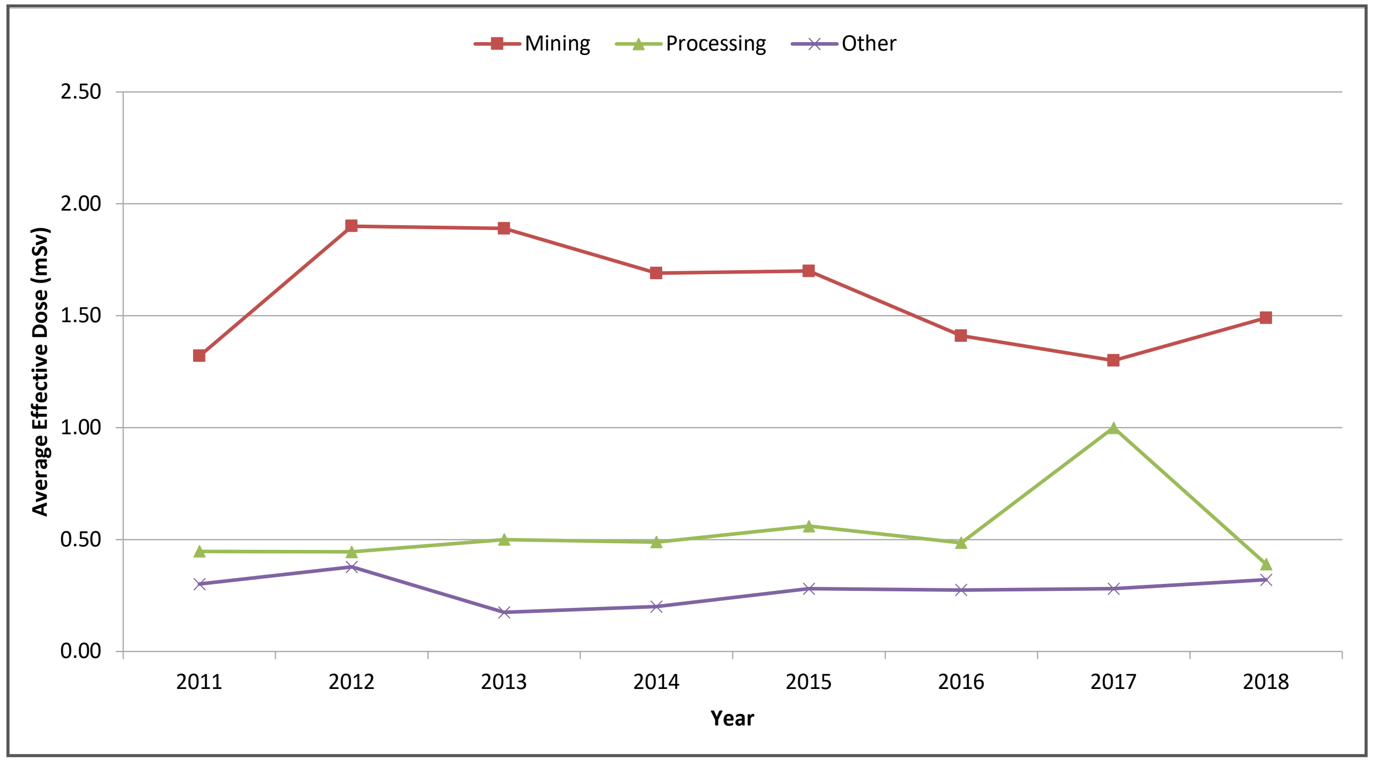


Figure 2: Uranium industry average effective doses by worker categories (2011–18)

For previously reported work category data, the variation due to duplicates was minor for most years (1–3%) with the exception being for 2015 and 2016 for which large amounts of linking occurred. The variation for the doses received for the work categories during 2015 and 2016 ranged from 10–30%. Figure 2 shows the trends for average effective doses for the work categories of mining, processing and other. When compared with the previous year, 2018 data shows an increase in the average effective dose for workers in the mining and other categories, while a decrease has been observed in the average effective dose for workers in the processing category. The average effective doses for mining, processing and other for 2018 are 1.5 mSv, 0.4 mSv and 0.3 mSv respectively.

The decrease for the processing work category from 1 mSv in 2017 to 0.4 mSv in 2018 brings it back within the range of the long term values observed from 2011–16. As noted in last year's edition, there was a large increase in shutdown workers performing maintenance work in 2017 that resulted in higher exposures in the processing category, which accounted for the peak observed in that year.

Collective effective dose

The collective effective dose can be used as a comparative tool for the optimisation of radiation protection practices. It has been used by UNSCEAR for reporting and comparing exposures from different practices around the world (UNSCEAR 2008).

The collective effective dose is simply the sum of the individual doses incurred by a group per year, and is expressed as 'man-sieverts' (man Sv), to distinguish the collective dose from the individual dose (IAEA 2007). More recently, the term 'person-sieverts' is becoming common. The collective effective doses from the uranium industry are shown in Figure 3.

As a result of the aforementioned data analysis review, previously reported collective effective doses were generally higher than the actual values. A reassessment for collective effective dose is shown in Figure 3 with corrected worker numbers.

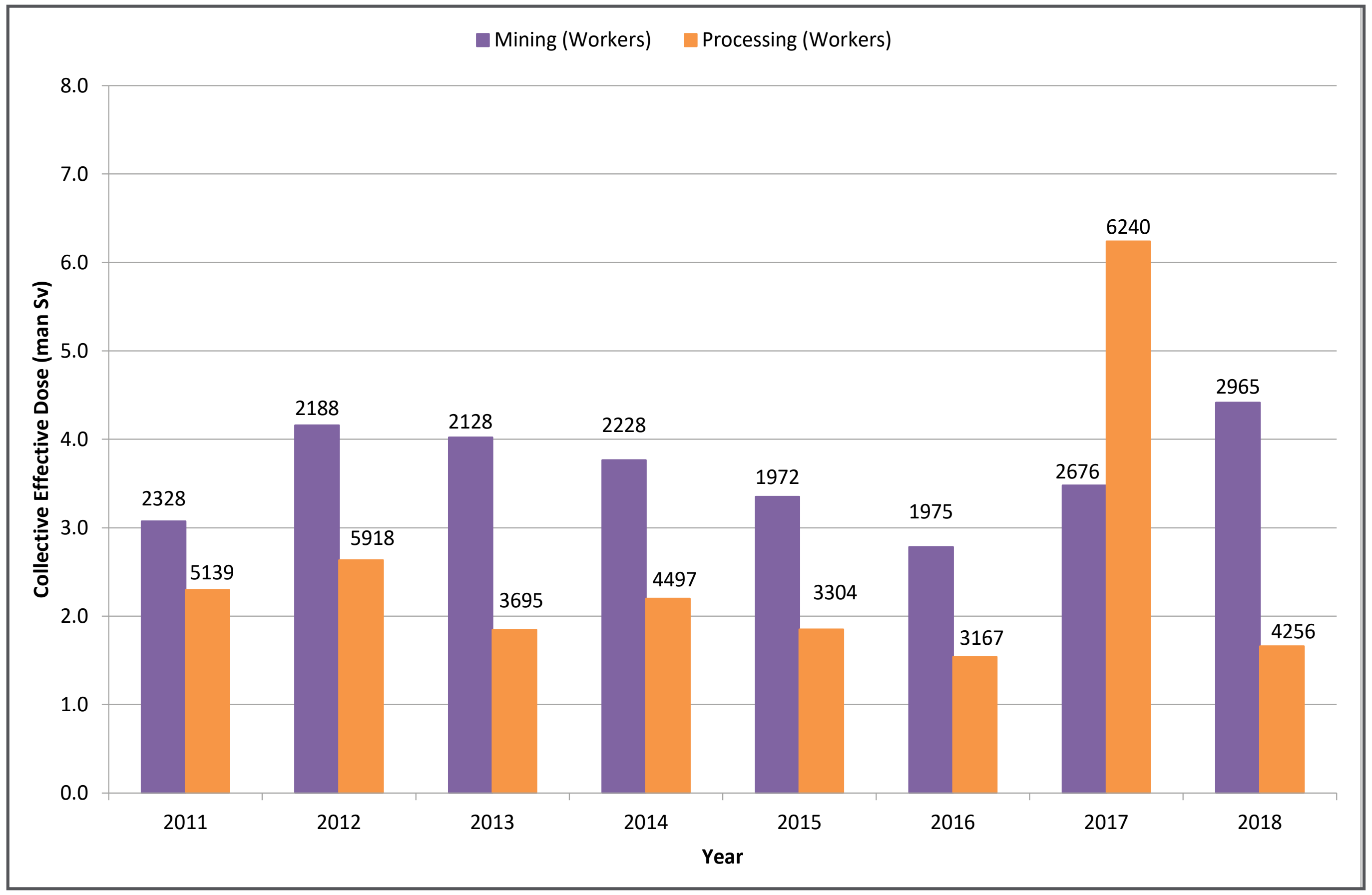


Figure 3: Australian uranium industry collective effective dose with worker numbers above columns

Mineral sands industry

Due to delays in submission of dose records, an analysis of the doses received in this industry from for 2018 is not possible. The ANRDR will provide updated data analysis for this industry in the next newsletter.

Regulatory authorities

Submission of dose records from ARPANSA and the South Australian Environmental Protection Agency allows for the reporting of exposure to regulators. Three years of data from 2016 is now available and the developing trend is shown in Figure 4.

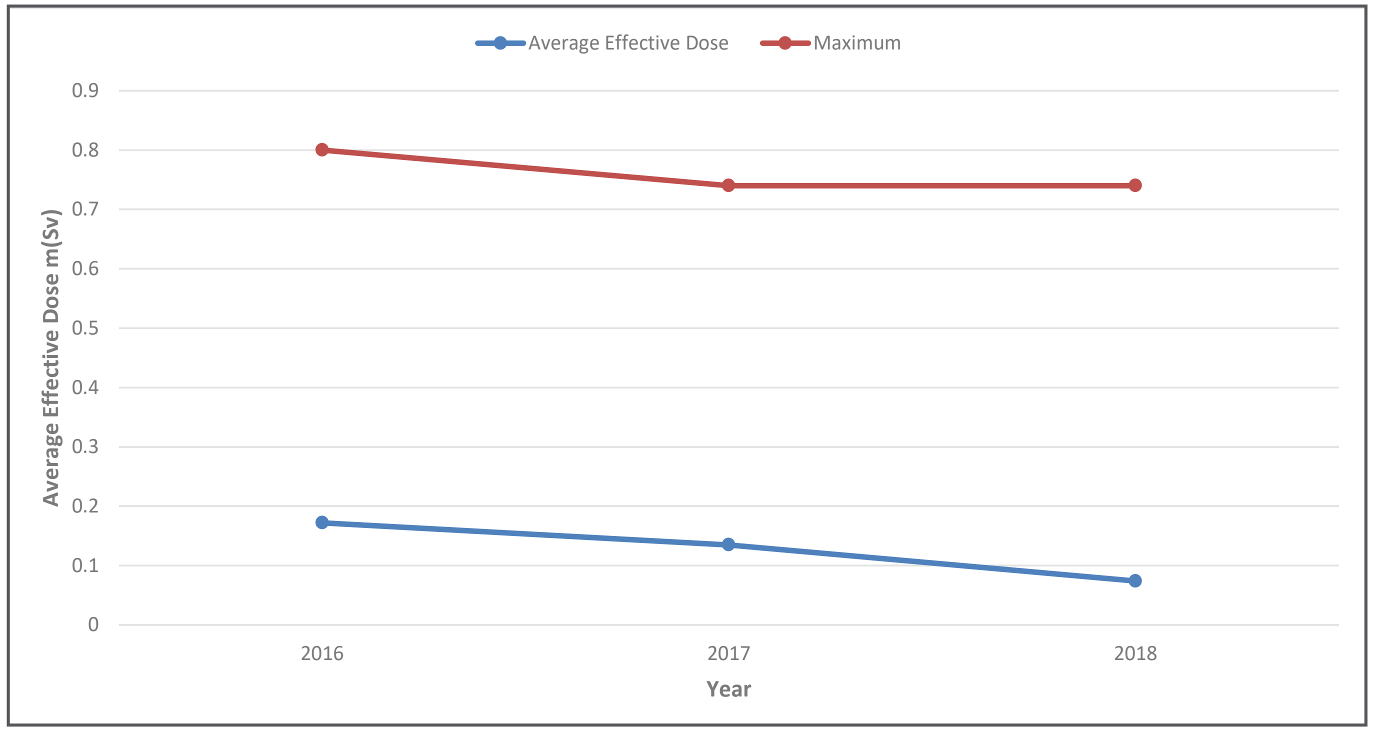


Figure 4: Participating regulatory authorities' average and maximum effective doses (2016–18)

Commonwealth organisations

Since the amendments to the ARPANS Regulations came into effect in July 2017, all relevant Commonwealth organisations must submit or make efforts to submit dose records to the ANRDR within a reasonable timeframe. The ANRDR team has been working with all of ARPANSA's licence holders to ensure the submission of their dose records occurs within appropriate timeframes.

With the inclusion of data from the Australian Nuclear Science and Technology Organisation (ANSTO) and Australian National University (ANU) for 2018, new work categories have been introduced, and previously reported trends for Commonwealth organisations cannot be continued. As shown in Table 1, analysis has been made for four work categories, three of which have been compiled into miscellaneous (Scientific Research, University and Other Source Licence Holders). The remaining category of 'Nuclear Installations and Prescribed Radiation Facilities' incorporates operations at the OPAL reactor and Australian Synchrotron.

The data provided in this table are routine occupational exposures only and do not included incident-related exposures.

Table 1: Average and maximum effective doses for submitting Commonwealth organisations 2018

Work categories	Average effective dose (mSv/year)	Maximum effective dose (mSv/year)	Number of workers
Miscellaneous	0.18	1.65	595
Nuclear installations and prescribed facilities	0.39	5.47	818

Top 100 doses for submitting Commonwealth organisations

Shining a spotlight on the highest doses allows organisations and regulators to implement dose optimisation more efficiently than focussing on the whole data set. This method also eliminates the downward skewing effect of doses below the minimum reportable dose (<MRD), represented in the ANRDR as zero doses.

To assist ARPANSA's regulatory team, the ANRDR has reviewed the top 100 doses from participating Commonwealth organisations, as shown in Figure 5. Regulators can use this method to tailor their inspection regime and more effectively communicate with licence holders. In future editions, the ANRDR can use this data to plot trends of annual average and maximum doses to allow the regulatory team to focus on and evaluate the impact of regulation on the highest exposure groups.

The top 100 doses range between 0.80 – 5.47 mSv with an average of 1.76 mSv in 2018.

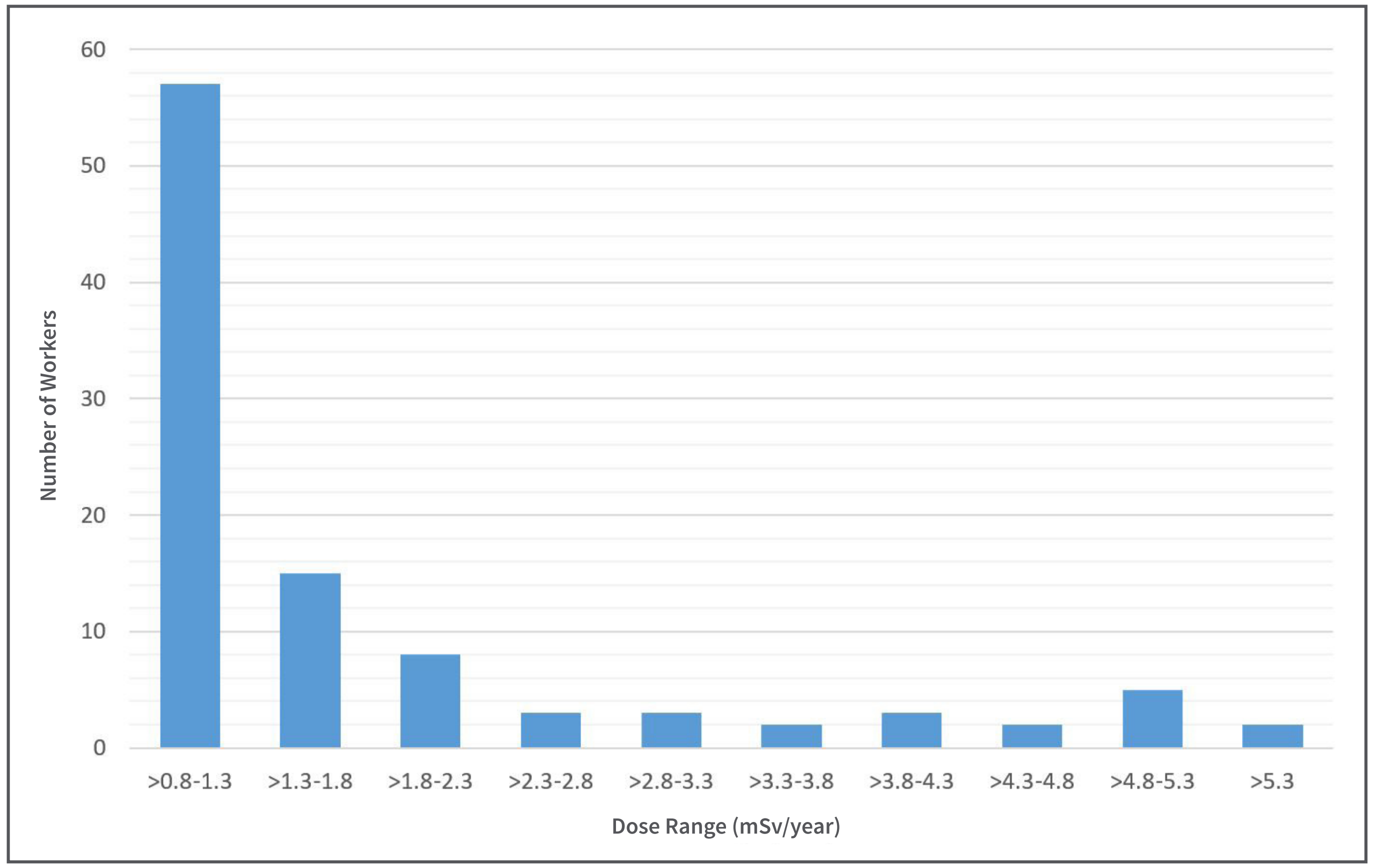


Figure 5: Dose distribution for the top 100 doses at participating Commonwealth organisations in 2018

Dose distribution histogram

The data for all twelve organisations contributing to the ANRDR has been analysed to produce a dose distribution histogram for 2018. The dose distribution histogram is an effective way to demonstrate the distribution of occupational doses. As with Figure 5, this approach eliminates the skewing effect on the average effective doses of the <MRD doses that have been reported as zero doses. The average effective dose for all data in the ANRDR in 2018 is 0.77 mSv with a maximum dose of 6.91 mSv received in the uranium industry.

The analysis of the cumulative frequency shows that more than 72% of workers in the ANRDR received an annual effective dose in 2018 of 1 mSv or less. This increases to more than 86% for annual effective doses of 2 mSv or less. Less than 5% of occupationally exposed workers received an annual effective dose greater than 3 mSv and the maximum annual effective dose recorded in 2018 was 6.91 mSv.

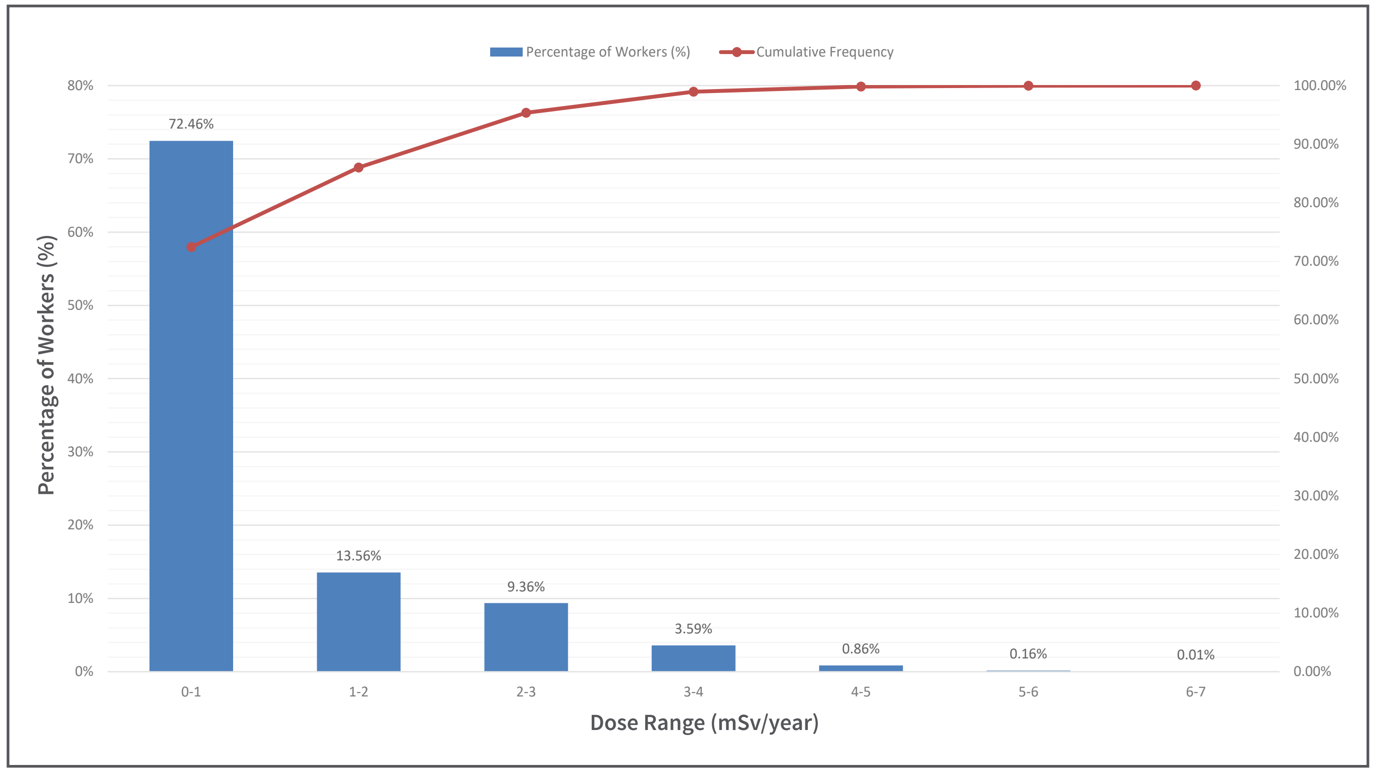


Figure 6: 2018 dose distribution histogram for all ANRDR data

Radiation in our daily lives

We are all exposed to some level of radiation every day. Sources of radiation include; rocks in the ground (terrestrial), space (cosmic), the air we breathe (radon), and the food and water we eat and drink (mostly K-40 and Ra-226). This type of radiation is called 'background' radiation. Humans have evolved to survive and even thrive in a radioactive world.

The level of background radiation can vary significantly around the world. This is mainly due to the diverse geology that exists on Earth and the altitude at which people live. The average annual background radiation in Australia is about 1.5 mSv, lower than the global average of 2.4 mSv. There are, however, regions in other parts of the world with much higher levels of natural background radiation. People living in Cornwall in the UK, for example, receive an average annual background dose of around 7.8 mSv. Radon gas is the main contributor to this dose (6.9 mSv) due to the higher than average amount of Ra-226 in the soil.

The Earth's atmosphere is highly effective at shielding us from harmful cosmic radiation. However, there is less protection at higher altitudes where the atmosphere is thinner, and the contribution to background radiation dose from cosmic radiation rises as our altitude above sea level increases. The annual cosmic radiation dose from living in a high elevation city such as Denver, for example, is around 0.8 mSv, whereas at sea level the dose decreases to around 0.3 mSv.

Because background radiation is unavoidable, occupational doses are considered in addition to background radiation, and the background radiation is subtracted during dose calculations. Due to the strict regulation of the use of radiation sources and good safety culture in most workplaces, the occupational doses for Australian radiation workers are generally low. For example, the average annual dose for Australian uranium workers is about 1 mSv, whereas the average dose for all workers in the ANRDR for 2018 is 0.77 mSv. This is less than the average annual natural background exposure most Australians receive just from living their everyday lives.

An interesting contrast is the commercial aviation industry. Despite not being classified as radiation workers, commercial aircrew are the most highly exposed occupational group in Australia due to exposure to elevated levels of cosmic radiation at cruising altitudes. The average annual dose to domestic Australian aircrew is around 2 mSv. However, the Australian Airline Pilots' Association (AusALPA) has reported that some Australian cohorts of pilots receive exposures up to 5.7 mSv and cabin crew up to 6.5 mSv. The global average dose to aircrew is around 3 mSv annually.

Analysis of data

For Australia, a reference level of 6 mSv per year is considered appropriate. Where the doses of aircrew are likely to exceed this reference level, and it is not possible to reduce exposure below this reference level (optimisation), then the relevant clauses for occupational exposure in planned exposure situations as described in the Code for Radiation Protection in Planned Exposure Situations, RPS C-1 (ARPANSA 2016) apply. In this case, the 6 mSv reference level is used as a dose constraint.

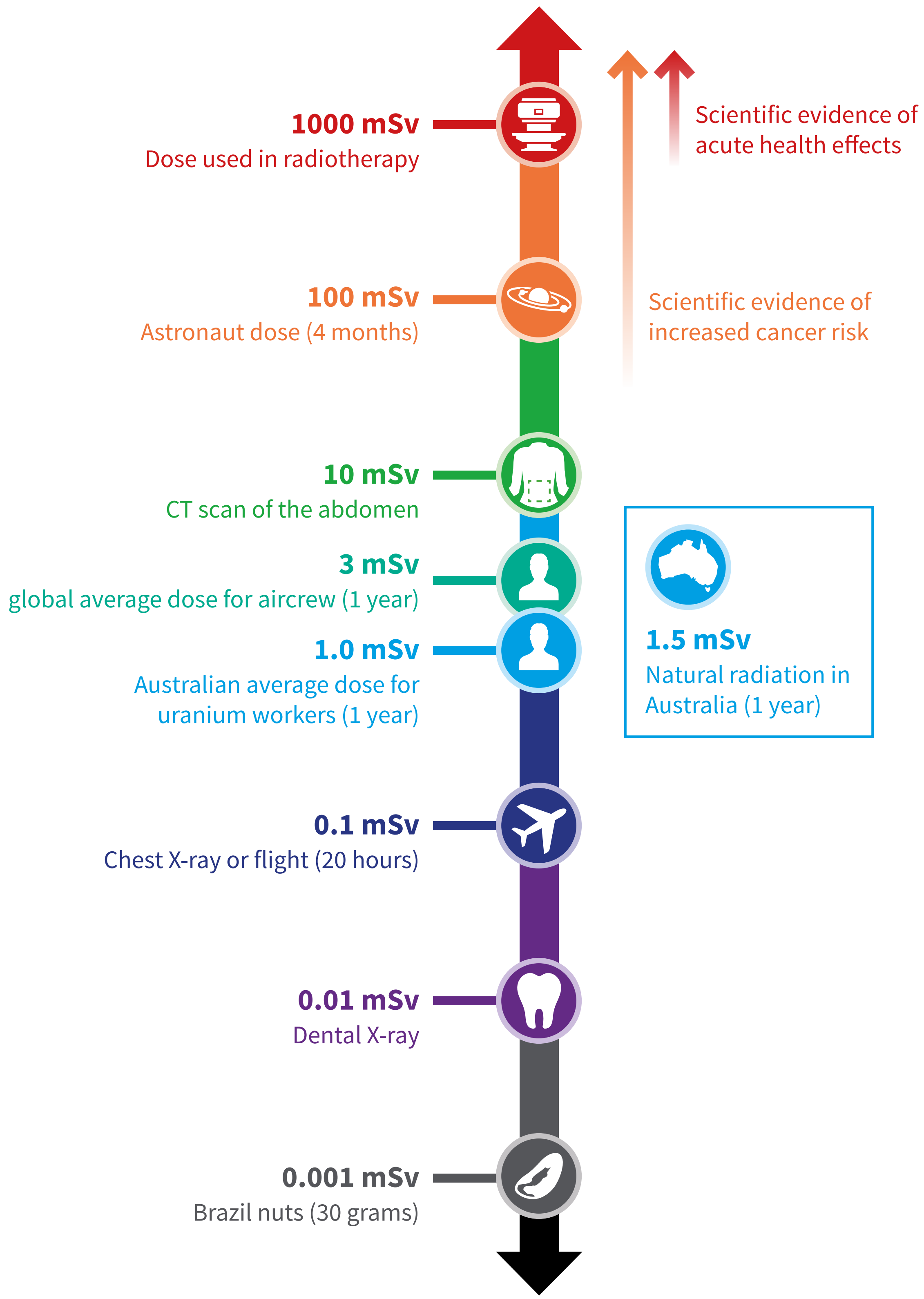
The selected reference level is not a dose limit, but represents the level of dose below which exposure should be maintained and reduced as low as reasonably achievable, taking into account economic and societal factors.

While aircrew doses may be higher than most occupational exposure groups in some circumstances, they are considered relatively low risk as doses are unlikely to exceed the reference level. More importantly, no health effects that might be expected from radiation exposure have been observed in aircrew.

The airline industry employs a large number of females. For this reason, workers should be informed about the radiation exposures they receive in the course of their work, and should be encouraged to notify their employer when they become aware of pregnancy to minimise exposure to the unborn child. Exposure to cosmic radiation should be kept below 1 mSv (public exposure limit) for the duration of the pregnancy.

The largest source of artificial (or man-made) radiation comes from medical exposures, such as diagnostic imaging. While doses from medical exposures vary significantly, Australians receive around 1.7 mSv from medical exposures annually, averaged over the whole population.

The diagram on the right compares doses from a range of sources.



Publications of interest

RPS C-2 (Rev. 1) Code for the Safe Transport of Radioactive Material (2019)

This edition of the *Code for the Safe Transport of Radioactive Material*, RPS C-2 (Rev. 1) (commonly referred to as the Transport Code) adopts the *International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material 2018 Edition* (SSR-6, Rev. 1).

The objective of the code is to establish uniform requirements for the transport of radioactive material in Australia by road, rail and those waterways not covered by Maritime legislation.

It is intended to be adopted into legislation by all Australian jurisdictions.

RPS C-3 Code for Disposal Facilities for Solid Radioactive Waste (2018)

This code describes the objectives for protection of human health and of the environment, drawing upon international best practice in relation to radiation protection and radioactive waste safety. The safety case and supporting safety assessment provide the basis for demonstration of safety and for authorisation. They will evolve with the development of the disposal facility, and will assist and guide decisions on its siting, design, operation and closure.

This publication, together with the *Planned Exposure Code* (RPS C-1, ARPANSA 2016), supersedes the Radiation Health Series (RHS) No. 35 *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* (NHMRC 1992).

RPS C-4 Code of Radiation Protection Requirements for Industrial Radiography (2018)

The *Code of Radiation Protection Requirements for Industrial Radiography (2018)*, Radiation Protection Series C-4 (RPS C-4) sets the specific radiation protection requirements in Australia for the protection of occupationally exposed persons and the public in planned exposure situations involving industrial radiography. It complements the overarching requirements contained in *Radiation Protection in Planned Exposure Situations (2016)*, Radiation Protection Series C-1 (RPS C-1).

RPS C-5 Code for Radiation Protection in Medical Exposure (2019)

This Code for Radiation Protection in Medical Exposure (2019) (RPS C-5) sets out the requirements in Australia for the protection of patients, their carers and comforters, and volunteers in biomedical research projects, in relation to their exposure to ionising radiation. The Radiation Health Committee (RHC) has developed this Code in light of the previous Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (RPS 14) but having regard to the requirements relating to medical exposure described in the International Atomic Energy Agency's (IAEA) Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements (GSR) Part 3.

RPS C-6 Code for Disposal of Radioactive Waste by the User (2018)

This code sets out the levels for disposal to landfill and discharge to sewer and the atmosphere below which no authorisation is required from the relevant regulatory authority. These requirements are currently published in Schedule 14 of the *National Directory for Radiation Protection (NDRP)* (RPS 6) and have now been published as a stand-alone code at the request of the Radiation Health Committee. Schedule 14 will be removed from the NDRP when the next edition is published.

It is intended that the code can be incorporated into regulatory instruments to ensure a uniformed approach to the disposal and discharge of radioactive material across Australia.

RPS G-3 Guide for Radiation Protection in Emergency Exposure Situation (2019)

This *Guide for Radiation Protection in Emergency Exposure Situations (2019)* describes objectives for protection of human health, drawing upon international best practice in relation to planning, preparedness, response and transition in nuclear or radiological emergencies. There are two Guides. Part 1 of the Guide establishes a national framework and sets the relevant safety requirements in Australia for protection of human health in emergency exposure situations. Part 2 of the Guide sets out guidance for the planning, preparedness, response and transition required in order to effectively respond to a nuclear or radiological emergency.