Ionising radiation and health in relation to proposed Fingerboards Mineral Sands Mine

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Fingerboards mineral sands mine Inquiry and Advisory Committee

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Key recommendations 1

areas of expert disagreement
extract from expert meeting statement

- Radiation exposures for workers and the public should be kept much lower than regulatory limits
  - Action levels that trigger prompt evaluation and response
  - “All in agreement that trigger levels will appear in the radiation plan, needs to be real time, multifaceted, include workers and offsite residents, have clear levels that would trigger review, investigation, additional measures, and should be low.”
- Comprehensive environmental (incl radon) and personal radiation monitoring for workers
- All aspects of the proposed project should take account of the greater radiation risk for children, and women and girls – currently no mention

Key recommendations 2

- Extensive environmental and foodstuff monitoring pre-, during and post-project should be established for all potential radiation exposure pathways, including downstream (supported by Dr Joyner and DoH)
  - All in agreement issues are of importance. Disagreement on scale of baseline data to collect.
  - All agreement that some baseline data would be useful for allaying concerns.
  - Comment: Data always trump modelling

- Especially with the largest radiation exposures estimated to be with HMC transport, every effort should be made to minimise dust generation
  - Multiple handling and especially dust-generating loading of HMC onto and off trucks and onto ships
  - Number and distance of truck movements transporting HMC
  - Open storage of HMC at mine or on wharves or anywhere else

Key recommendations 3

- The project should consider and plan for plausible impacts of global heating over its full life
  - Including increased frequency of drought, bushfire, intense rainfall, flooding, intense storms, high winds
  - No agreement
- A high level of timely public transparency should apply to all aspects of radiation management and monitoring
- Consultative bodies established in relation to the mine should include representatives of community and food growers' organisations, local and downstream
- Careful planning and adequate funding should be provided for mine rehabilitation with minimal risk and cost to the taxpayer
  - Reality of unstable trade, political relationship with major likely destination for HMC: China

Key recommendations 4

- Clarify nuclear safeguards implications/obligations given significant amounts of uranium and thorium in HMC (*partial agreement*)
  - Est 185 t uranium and recoverable thorium 1050 t (Mudd EWS)
  - IAEA Significant quantities: natural uranium 10 t, thorium 20 t
  - Extractable U especially could cause major long-term widespread environmental and health harm eg through nuclear weapons
- "the concern was a real issue and needed to be addressed (especially for consistency with other mineral sands and rare earth projects being considered for development around Australia).

  The example of exporting the concentrate to China was discussed. … for uranium extraction to proceed would require approval from Australia and mutual agreement on safeguards measures.

  It was noted that the final destinations for HMC from the proposed project over its life could not be confidently foreseen now, and could potentially involve nations with which Australia does not have pre-existing nuclear safeguards agreements.

  GM - the issue of potential uranium extraction was a federal responsibility and that the Fingerboards assessment process was not well placed to address a clearly federal responsibility – especially given the lack of clarity from the Federal Government on such matters."

Key recommendations 5

- Technical Note 21 (unidentified, 17 May 21, received 24 May 21)
  - Describes interactions with ARPANSA, Federal Dept of Environment and Energy re EPBC Act, and Dept of Industry, Science, Energy and Resources re export controls since 2017
  - Confirms permission to export required in view of HMC U+Th >0.05%
  - The documentation seems incomplete
  - First documentation on nuclear safety and safeguards implications of proposed mine available to me
  - Statement in attached 26 May 2017 letter from Coffey to Lisa Hogan, DEE "relating to storage of radioactive materials and that uranium will not be produced for sale … **this information does not form part of the documentation for public exhibition**" is of concern
- Highly desirable from a public health viewpoint that these matters of long-term significance and public interest are subjects of transparency and clear accountability
- Environmental consequences of mineral exports don't stop at borders

Key recommendations 5

New recommendation discussed at radiation expert meeting

- Current ICRP dose coefficients (ICRP 137, 2017) be applied to radiation dose assessment, monitoring and management for the proposed project
  - reflecting 2009 ICRP and WHO doubling of lung cancer risk estimate for radon, and halving of WHO recommended reference level for indoors to 100 Bq/m^3

Australian National Radiation Dose Register

- Most recent report in 2019 covers 2018

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.

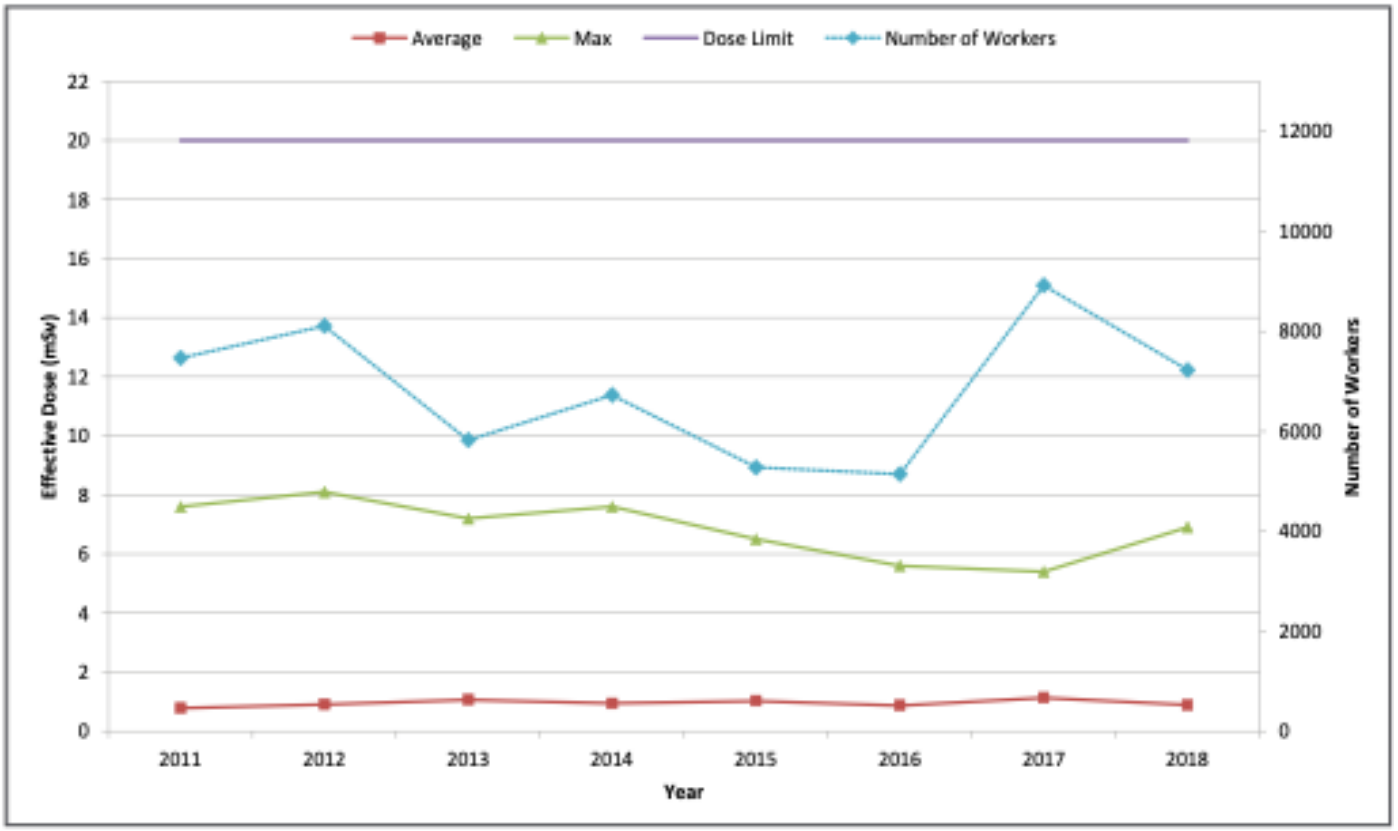

Figure 1: Uranium industry average and maximum effective doses with workforce numbers (2011–18)

ANRDR in Review 2019. ARPANSA

Australian National Radiation Dose Register

- Uranium average effective doses 2011-8

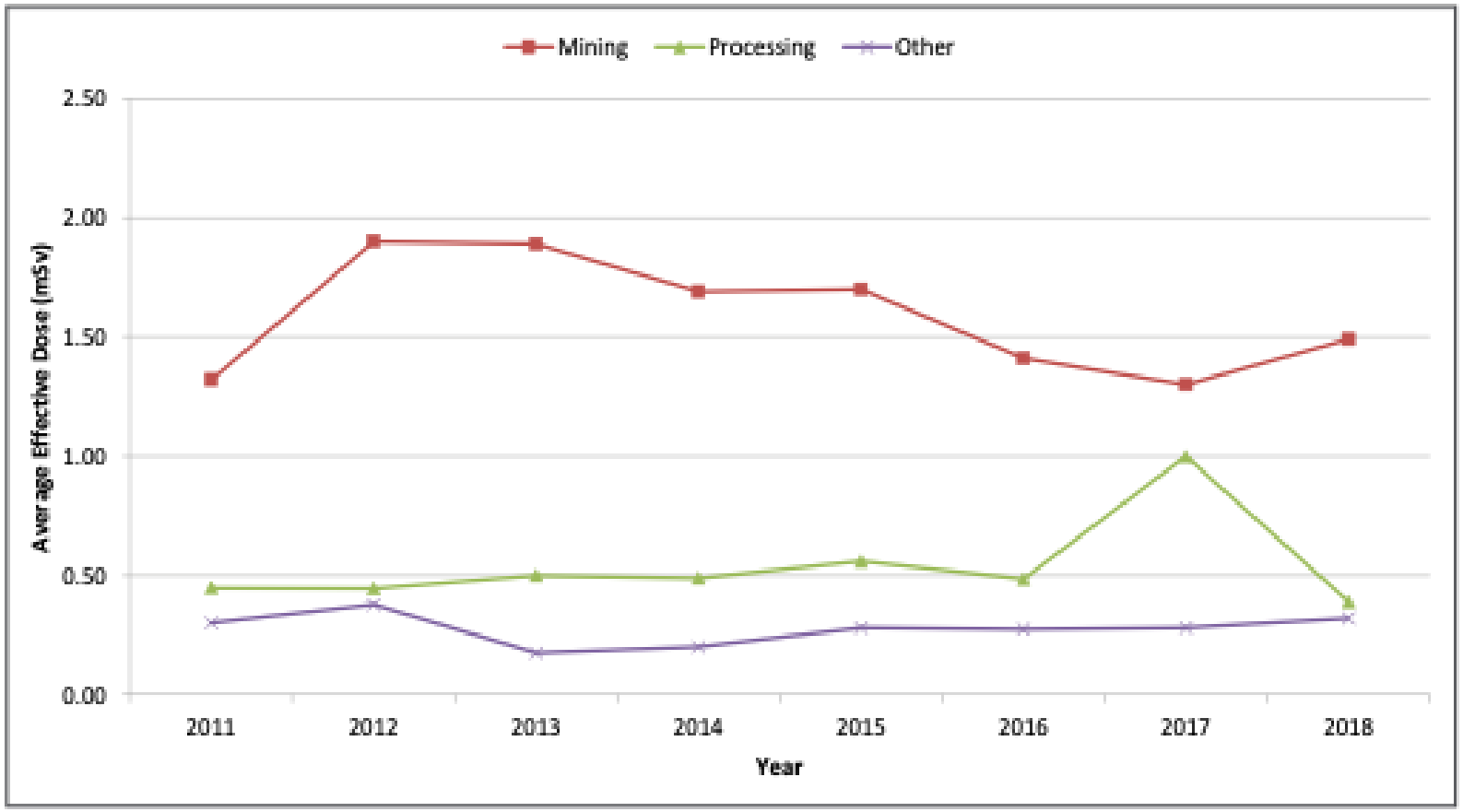

Figure 2: Uranium industry average effective doses by worker categories (2011–18)

ANRDR in Review 2019. ARPANSA

Radiation doses in WA NORM mining 2018-9

- Including 7 mineral sands mines
- External dose max 0.4 - 1.54 mSv, mean 0.1 – 0.82 mSv
- Internal dose max 0.6 - 3.66 mSv, mean 0.22 - 2.50 mSv
- Maximum CED 4.4 mSv, mean 0.97 mSv

Table 8. Contribution to CED from exposure pathway.

	Mean CED from source (mSv) and (%)			
Site	External	Internal LLα	Internal TnP, RnP	Sum of Mean CED (mSv)
#1	0.57 (44%)	0.42 (33%)	0.30 (23%)	1.29
#7	0.82 (25%)	2.05 (62%)	0.45 (14%)	3.32
#8	0.20 (16%)	0.30 (24%)	0.74 (60%)	1.24
#9	0.78 (57%)	0.34 (25%)	0.24 (18%)	1.36
#15	0.35 (66%)	0.01 (2%)	0.17 (32%)	0.53
#16	0.11[a] (18%)	0.03[a] (5%)	0.48 (77%)	0.62
#22	0.25 (48%)	0.25 (48%)	0.016 (3%)	0.516
Range	16% to 57%	5% to 62%	3% to 77%	—
Mean	39.2%	28.4%	32.4%	—

[a] Estimate from time and motion studies.

Ralph MI et al. A review of radiation doses and associated parameters in Western Australian mining operations that process ores containing naturally occurring radionuclides for 2018–19. *J Radiol Prot* 2020 40 1476

Radiation doses in WA NORM mining 2018-9

- “the relative contribution of each exposure pathway can vary significantly between operations” p 1490

- “it is important that each mining operation monitors each exposure pathway and determine its contribution to CED” p 1490

- “the advent of the decreased derived annual limit, coupled with the emergence of new operations and revised dose coefficients as published in ICRP-137 and ICRP-141 presents a compelling case for robust evaluation of worker doses arising from exposure to NORM in the WA mining industry.” p 1493

Ralph MI et al. A review of radiation doses and associated parameters in Western Australian mining operations that process ores containing naturally occurring radionuclides for 2018–19.
J Radiol Prot 2020 40 1476

NORM dust exposures in WA mining

- Evaluating effects of revised ICRP dose co-efficients on effective radiation doses, including 7 mineral sands mines
  - Significantly increased DCs for radon and thoron progeny

- Mean CED per unit intake of inhaled insoluble dust increase between 1.9 and 2.9 times
- Assuming secular equilibrium (valid in WA); DCF inversely related to AMAD;
- Committed effective doses (CEDs) 2018-9 greater by a factor of 0.74 – 1.26
  - For AMAD 5µm, Th to U decay series ratio 10:1

- Max CED (mineral sands) 4.4 → 7.9 mSv
  - Contribution from long-lived alpha emitters 3.5 → 6.7 mSv

- WA regulator has committed to revising NORM-5 guidelines to accommodate revised DCs

Ralph MI et al. Impacts of revised dose coefficients for the inhalation of NORM- containing dusts encountered in the Western Australian Mining Industry. *J Radiol Prot* 2020 40 1457

New dose coefficients for radon progeny: Impact on workers and the public

Advisory Note ARPANSA 5 February 2018

- “The International Commission on Radiological Protection (ICRP) has recently [2010] re-evaluated its estimates of lung cancer risk for radon progeny and doubled its estimate of risk from exposure.”
- “Implementing the new ICRP dose coefficients in Australia will increase the radon progeny inhalation doses assessed for workers and members of the public.”
- “Studies carried out in Australia indicate that radon progeny inhalation doses assessed for workers in the uranium mining industry and in show caves will increase by a factor of two or more from current assessments.”
- This document has sections addressing underground uranium mines, show caves and homes, but not mineral sands mines

https://www.arpansa.gov.au/understanding-radiation/sources-radiation/radon/new-dose-coefficients-radon-progeny-impact-workers

Changes to dose coefficients for occupational exposures

Advisory note (>2018, undated)

- Discusses updated ICRP Occupational Intake of Radionuclides (OIR) series from 2015 – includes radon, radium, thorium and uranium (ICRP 137, 2017)
- "Advice to implement changes

  Regulators are advised to review the above documents and associated annexes against their licence holders monitoring programs and dose assessment methodologies. They should decide on an implementation plan for changes from currently used dose coefficients to ones published in this series. Changes should be considered as soon as the new data for the relevant radionuclides is available."
- Notes inconsistencies re radon retention in ARPANSA guides for mining and mineral processing (RPS 9 and 9.1) – commends WA Guideline NORM 5

https://www.arpansa.gov.au/understanding-radiation/sources-radiation/radon/changes-dose-coefficients-occupational-exposures