Intractable Waste Disposal Facility (IWDF)
Mount Walton East

Mark Twain: "The report of my death was an exaggeration", 2nd June 1897

ARPS2023
EXPANDING THE SCOPE OF RADIATION PROTECTION

Contents

- What is Intractable Waste?
- Why was the IWDF conceived?
- Why was the IWDF location chosen?
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Contents

What is Intractable Waste?

- **Intractable** wastes are unwanted materials or structures which are problematic because they are highly dangerous, toxic, long-living, expensive to store or difficult to convert to other forms, and whose satisfactory disposal defies current technologies.
- Nuclear waste, toxic, non-biodegradable chemicals, and offshore oil platforms are examples of intractable waste.

What is Intractable Waste?

- Waste that is not suitable for disposal in Class I, II, III and IV landfill facilities (Landfill Waste Classifications and Waste Definitions 1996 (as amended December 2019), Western Australia: DWER, 2019).
- Intractable wastes (**Class V**), including **radioactive** and **chemical** wastes, need long-term permanent isolation to protect the community and the environment.

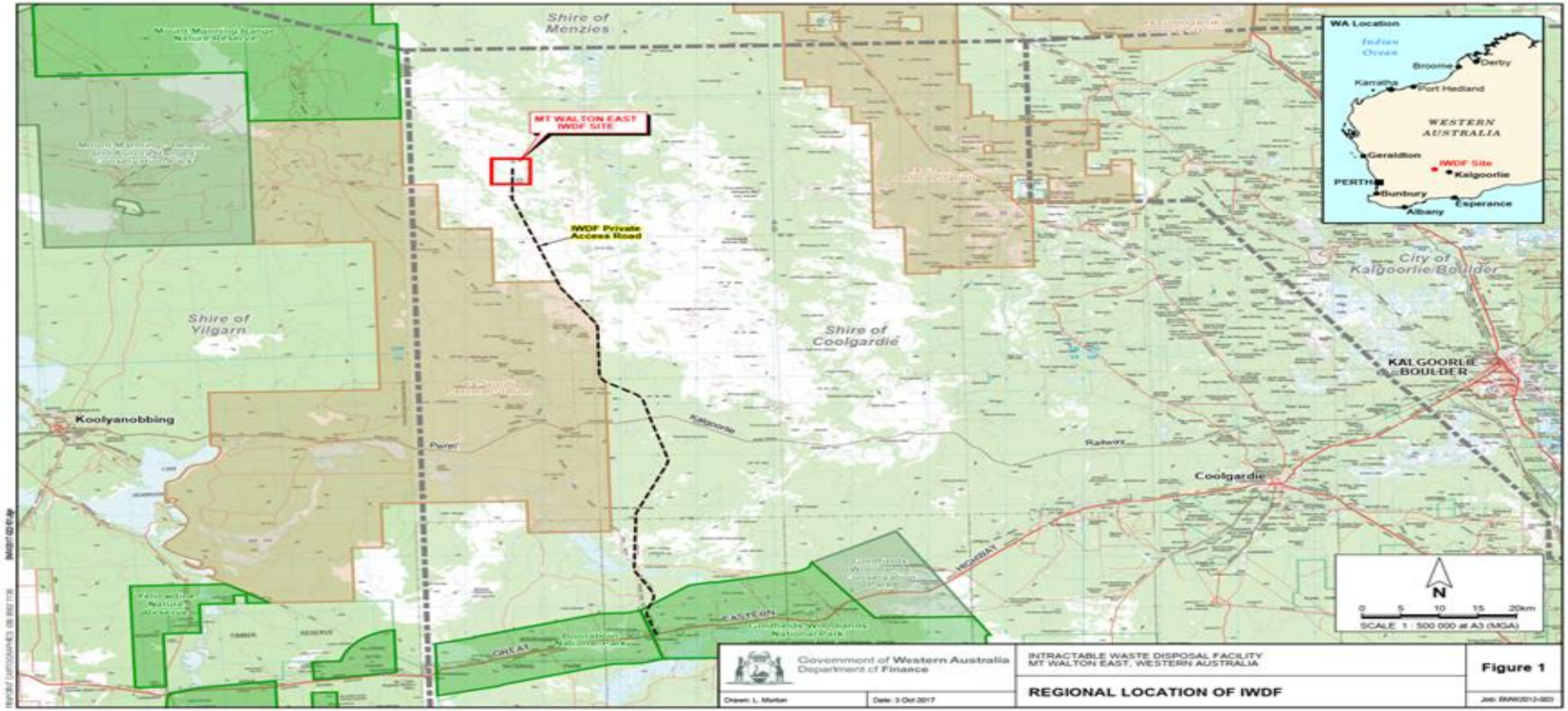
Why was the IWDF conceived?

- To ensure Western Australia had a long-term solution for the disposal of the intractable wastes it generated and that it was safe for the community and the environment.
- Before the IWDF was established there was **no approved** way to dispose of intractable wastes in Western Australia.
- For more than 20 years prior to the IWDF, low-level radioactive waste were collected and stored by the State Regulator.

Why was the IWDF conceived?

- By the late 1980s, the low-level radioactive waste store was approaching capacity, a solution was needed and the IWDF provided that solution.
- The IWDF was established in **1992** and is **owned** by the WA State Government.
- The IWDF was Australia's first long-term disposal site and can only be used for intractable waste generated in Western Australia.

Why was the IWDF location chosen?



Why was the IWDF location chosen?

- The **Code of Practice RHS35** for the near-surface disposal of radioactive waste in Australia (1992) defined the site selection criteria for near surface disposal of radioactive waste.
- The site was chosen as the preferred location after extensive scientific investigations against specific criteria:
  - Geological stability
  - Remoteness
  - Arid climate (with evaporation exceeding rainfall by ten times)
  - Lack of groundwater
  - Presence of clay to limit the potential for migration of wastes

Why was the IWDF location chosen?

- Low potential for flooding
- No potential for future mineral resources
- No infrastructure to support agriculture
- Absence or potential for human population
- No special environmental features; and
- Absence of known rare species or ecosystems

Why was the IWDF location chosen?

- The Mt Walton East site was chosen as the **ideal** location for the IWDF because it **met** all the **1992 Disposal Code** criteria.
- The remoteness of the site was chosen as much to allay community fears as to reduce the radiological risks from disposal operation.

Regulatory Framework and Approvals

Acronyms

- EPA: Environmental Protection Agency
- DWER: Department of Water and Environmental Regulation
- RCWA: Radiological Council of Western Australia
- ASNO: Australian Safeguards and Non-proliferation Office
- CLC: Community Liaison Committee

Regulatory Framework and Approvals

MINISTER FOR THE ENVIRONMENT;
LABOUR RELATIONS

Statement No.
000562

STATEMENT TO AMEND CONDITIONS APPLYING TO PROPOSALS (PURSUANT TO THE PROVISIONS OF SECTION 46 OF THE ENVIRONMENTAL PROTECTION ACT 1986)

INTRACTABLE WASTE DISPOSAL FACILITY
MT WALTON EAST, SHIRE OF COOLGARDIE

Proposals:	(1) Integrated Waste Disposal Facility, Eastern Goldfields, (Assessment No. 168); and (2) Disposal by Shaft Entombment or Trench Burial of a Range of Intractable Wastes at the Intractable Waste Disposal Facility, Mt Walton East, Shire of Coolgardie (Assessment No. 823).
Proponent:	Waste Management (WA)
Proponent Address:	Level 8, 141 St George's Terrace, PERTH WA 6000
Assessment Number:	1286
Previous Assessment Numbers:	168, 168-1, 823, 1127
Previous Statement Numbers:	Statement No. 044 published on 26 October 1988 Statement No. 205 published on 8 January 1992 Statement No. 353 published on 28 April 1994 Statement No. 533 published on 19 January 2000

Report of the Environmental Protection Authority: Bulletin 1005

Previous Reports of the Environmental Protection Authority: Bulletins 353, 572, 726 and 954

The implementation of the proposals to which the above reports of the Environmental Protection Authority relate is now subject to the following consolidated environmental conditions and procedures which replace all previous conditions and procedures:

1 Implementation

1-1 Subject to these conditions and procedures, the proponent shall implement the proposals as documented in schedule 1 of this statement.

Published on
01 FEB 2001

29th FLOOR, ALLENDALE SQUARE, 77 ST. GEORGE'S TERRACE, PERTH 6000 TELEPHONE: (08) 9421 7777 FACSIMILE: (08) 9221 4665/8

RADIATION SAFETY ACT

Thank you for your application for renewal of registration of the Mount Walton East Intractable Waste Disposal Facility (IWDF). The application has been approved and your registration certificate is enclosed.

As you are aware, Officers of the Radiological Council have been liaising with the Department of Finance, your approved Radiation Safety Officer and Aurora Environmental regarding the regulation of the IWDF and the transition from historically applying the *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* (RHS 35) to the current Australian *Code for Disposal Facilities for Solid Radioactive Waste (2018)* (RPS C-3). As part of this, draft safety case documentation was prepared and submitted to the Council; this is still under consideration.

Standard condition 203, *Disposal of low-level radioactive waste*, has now been applied to your registration under Section 36 of the Radiation Safety Act. This replaces the previous standard condition 114, *Disposal of radioactive waste at the Intractable Waste Disposal Facility (IWDF), Crown Reserve 42001.*

Special conditions have also been applied to your registration as follows –

1. The *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* (RHS 35) may be applied in the transition to compliance with the Australian *Code for Disposal Facilities for Solid Radioactive Waste (2018)* (RPS C-3) until the Safety Case referenced in 2.3 of Standard Condition 203 is approved.

2. The reporting of radioactive material received to the registered premises as required by Section 38 of the Radiation Safety Act may be made within 14 days of a campaign disposal, in place of the 'monthly' basis prescribed in 2.9 of Standard Condition 203.

OFFICIAL: Sensitive

Australian Government
Australian Safeguards and Non-Proliferation Office

Permit issued under section 13 of the Nuclear Non-Proliferation (Safeguards) Act 1987

PERMIT TO POSSESS NUCLEAR MATERIAL

This Permit granted pursuant to Section 13 of the *Nuclear Non-Proliferation (Safeguards) Act 1987* ("the Act") authorises the Permit Holder to possess the *nuclear material* designated in Part 1, subject to *the Act* and any orders, directions or regulations made thereunder and to the restrictions and conditions set out in Parts 1, 2 and 3 hereunder. Under section 21 of *the Act*, this Permit does not make it lawful for the Permit Holder to do any act or thing that, apart from *the Act*, is unlawful under another law of the Commonwealth or under a law of a State or Territory.

In this Permit, unless the contrary intention appears, words and phrases have the same meaning as in *the Act*. Terms in italics have specialised meanings, which are defined in Section 5 of the Class L2 *Compliance Code*.

The *Compliance Code* is an integral part of this Permit.

PART 1

1.	**NAME**	**Minister for Works C/- Department of Finance (Western Australia)**	
	ABN/ACN	**99 593 347 728**	
2.	**ADDRESS**		
2.1.	**Physical Address**	**Department of Finance, Optima Centre 16 Parkland Road, OSBORNE PARK WA 6017**	
2.2.	**Postal Address**	**Department of Finance Locked Bag 44, CLOISTERS SQUARE WA 6850**	
3.	**PERMIT NUMBER**	**PN207**	**Version 3** **Class L2**
4.	**DATES OF EFFECT**		
4.1.	**Commencement Date**	**30 October 2020**	
4.2.	**Expiration Date**	**30 November 2024**	

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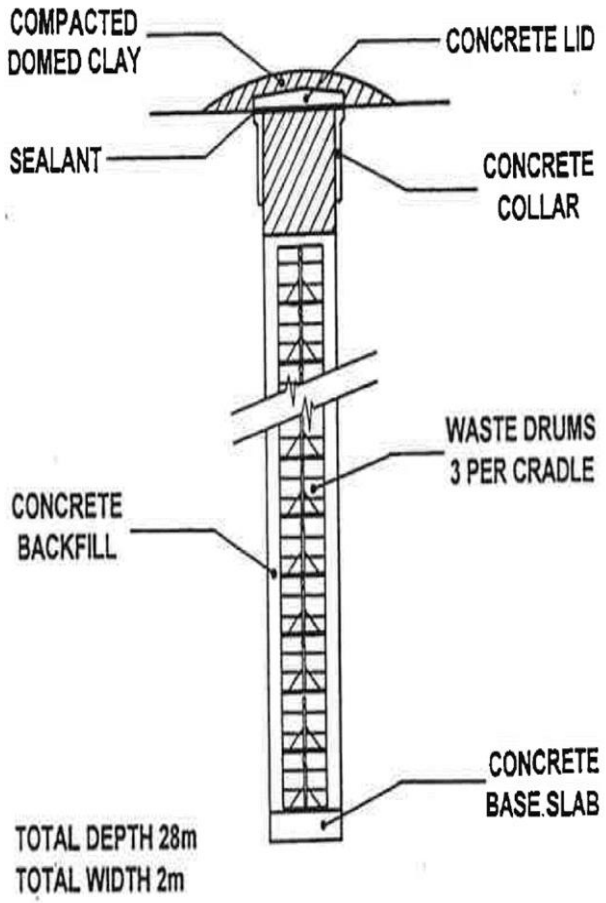
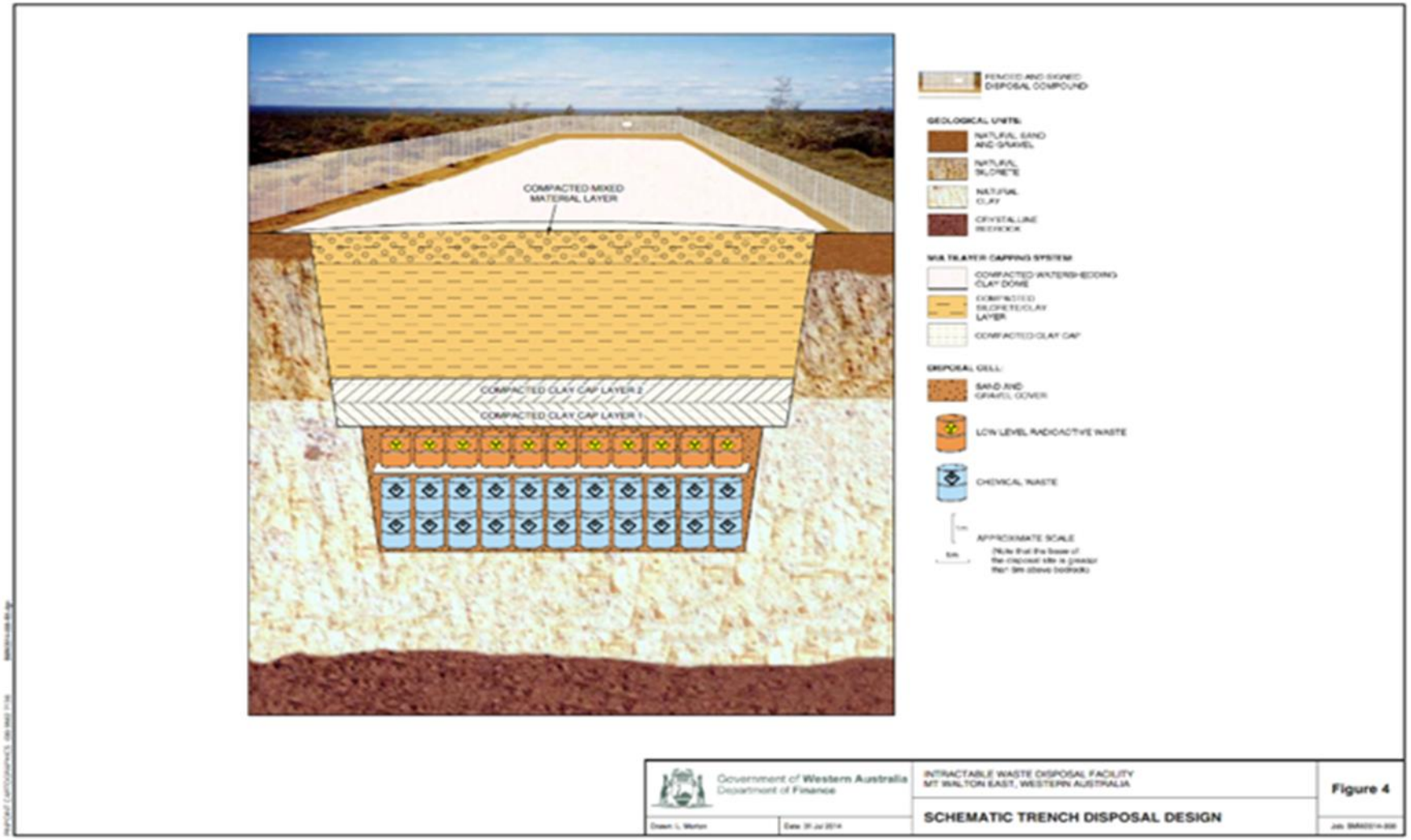
How does the IWDF operate?

- Inquiry, initiation (WAP) and *safety assessment*.
- Planning, documentation and regulatory approvals (*disposal permit*).
- Excavation of the trench or shaft.
- Conditioning and packaging of the waste, radioactive and chemical.
- Waste loading and transport.
- Waste delivery acceptance and approval.
  - Shaft burial.
  - Trench burial.

How does the IWDF operate?





How does the IWDF operate?

Radiation monitoring of the IWDF:

(i) Environmental gamma radiation (pre and post disposal)
(ii) Radionuclides in air (during disposal)
(iii) Radon concentrations in air (during disposal)
(iv) Radionuclides in soils (post disposal)
(v) Worker and public dose radiation levels (during disposal)

All data is reported to the Radiological Council.

How does the IWDF operate?

Ongoing periodic monitoring other than for radioactivity at the IWDF includes:

(i) rehabilitation monitoring; (annual)
(ii) disposal dome (capping) monitoring; (annual)
(iii) groundwater monitoring; (twice yearly); and
(iv) flora, vegetation, and fauna surveys as required.

Waste Acceptance Criteria

- A **Waste Acceptance Proforma** must be completed by waste owners to enable an assessment of waste suitability for disposal at the IWDF.
- The acceptance of radioactive waste for disposal at the IWDF is dependent upon compliance with **waste acceptance criteria** and **disposal permit** issued by the Radiological Council and the approval of operational procedures by the Environmental Protection Authority (EPA).

Waste Acceptance Criteria

- The disposal of waste at the IWDF is regarded as an option of last resort. Thus, for waste to be accepted at the IWDF, **it must be proven that there is no readily available, or practicable option for reuse, recycling, treatment, destruction, or disposal in Australia.**

- The **waste acceptance criteria** also details the properties and characteristics that deem wastes unsuitable for a near-surface disposal facility. As such, these wastes are **not accepted without prior conditioning.**

Waste Acceptance Criteria

Waste that is proposed for disposal at the IWDF must be packaged in accordance with the IWDF waste acceptance criteria:

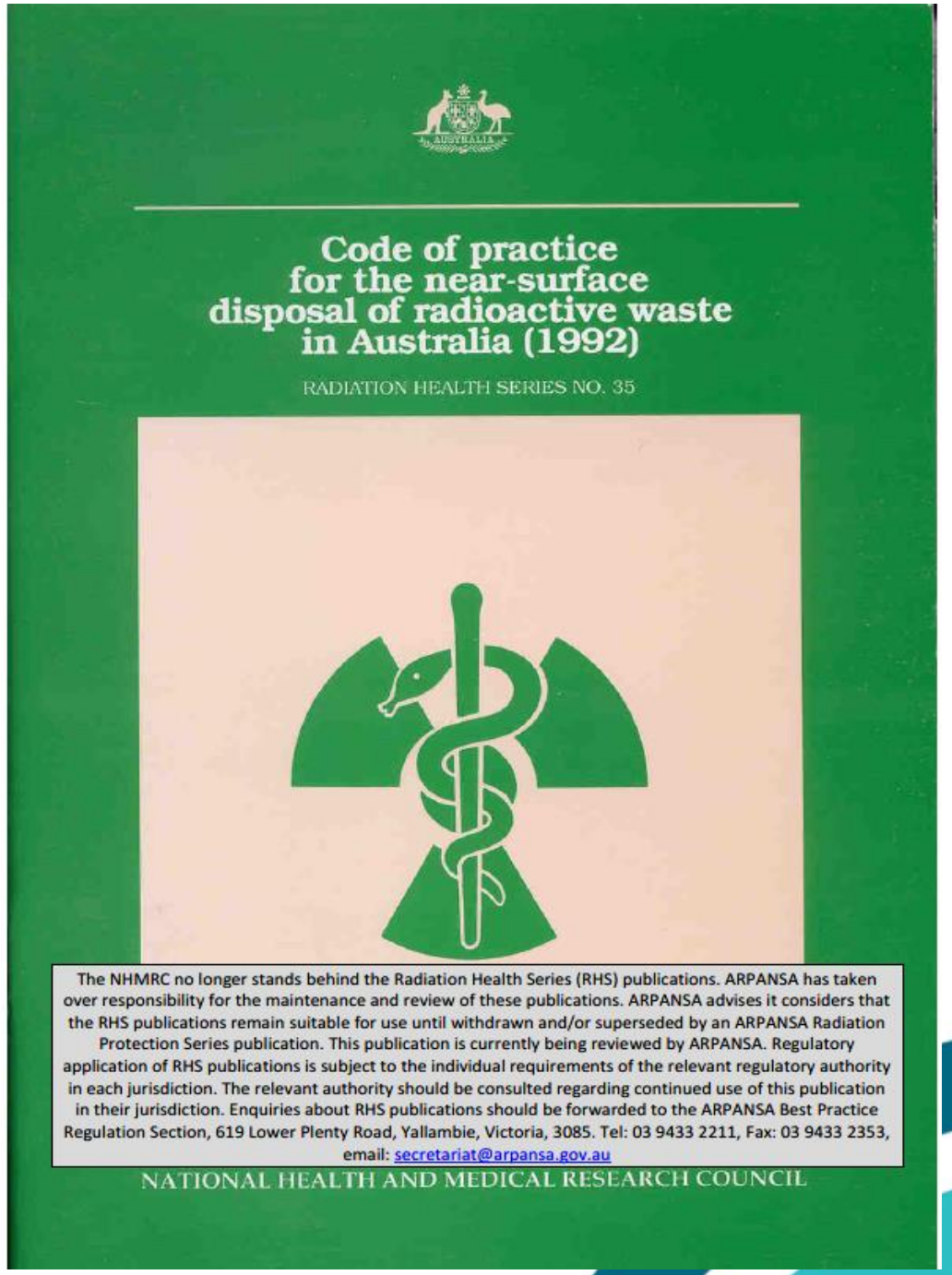
- **Free** liquid or sludge (except in small volumes)
- **Explosive** materials
- Highly **flammable** materials
- Highly **reactive** or chelating agent materials
- **Compressed** gases (greater than 5% by waste volume)
- Materials that may **decompose**
- Toxic, pathogenic, or **infectious** radioactive materials

Waste Acceptance Criteria

Key Parameters for Radioactive Waste Inventory

Radioisotope	Type of radiation emitted – Alpha, Beta, Gamma or Neutron	Physical State - Solid, Liquid or Gas	Physical Form – Sealed or Unsealed	Initial Activity (if known)	Current Activity	Date of Current Activity	Manufacturer (if applicable)	Manufacture Date (if applicable)	Source Serial Number (if applicable)	Volume or Mass of Source Material	Current packaging (type)	Waste package weight and volume/dimensions

1992 Disposal Code



1992 Disposal Code

- The **Disposal Code** contained provisions for the development of qualitative and quantitative waste acceptance criteria which were based upon primary dose limitation and safety assessments in the form of:

a. derived activity concentration **limits** for radionuclides in the waste;
b. a restriction on the **total activity** of radionuclides to be disposed of at any near-surface facility;
c. performance **standards** for waste forms and waste packages; and
d. restrictions on **public access** and land use during the operation of the facility and during a subsequent specified period of **institutional control**.

1992 Disposal Code

- Activity concentration limits for **Category B** waste (recommended values for 100-year and 200-year institutional control periods)

Table 2 Activity concentration limits for Category B waste

(Recommended values for 100 year and 200 year institutional control periods)

Radionuclide group	Concentration limit ($Bq.kg^{-1}$)	
	100 y	200 y
Tritium	10^{10}	$5x10^{12}$
Carbon-14	$5x10^{7}$	$5x10^{7}$
Alpha emitting radionuclides. (including U-238, Pu-239, Am-241)	10^{7}	10^{7}
Radium-226	$5x10^{5}$	$5x10^{5}$
Beta/gamma emitters with half lives > 5y	10^{8}	10^{9}
Beta/gamma emitters with half lives ≤ 5y	no limit*	no limit*

Note: * in practice, consideration of surface dose rates from waste packages during transport and handling operations will lead to more restrictive values

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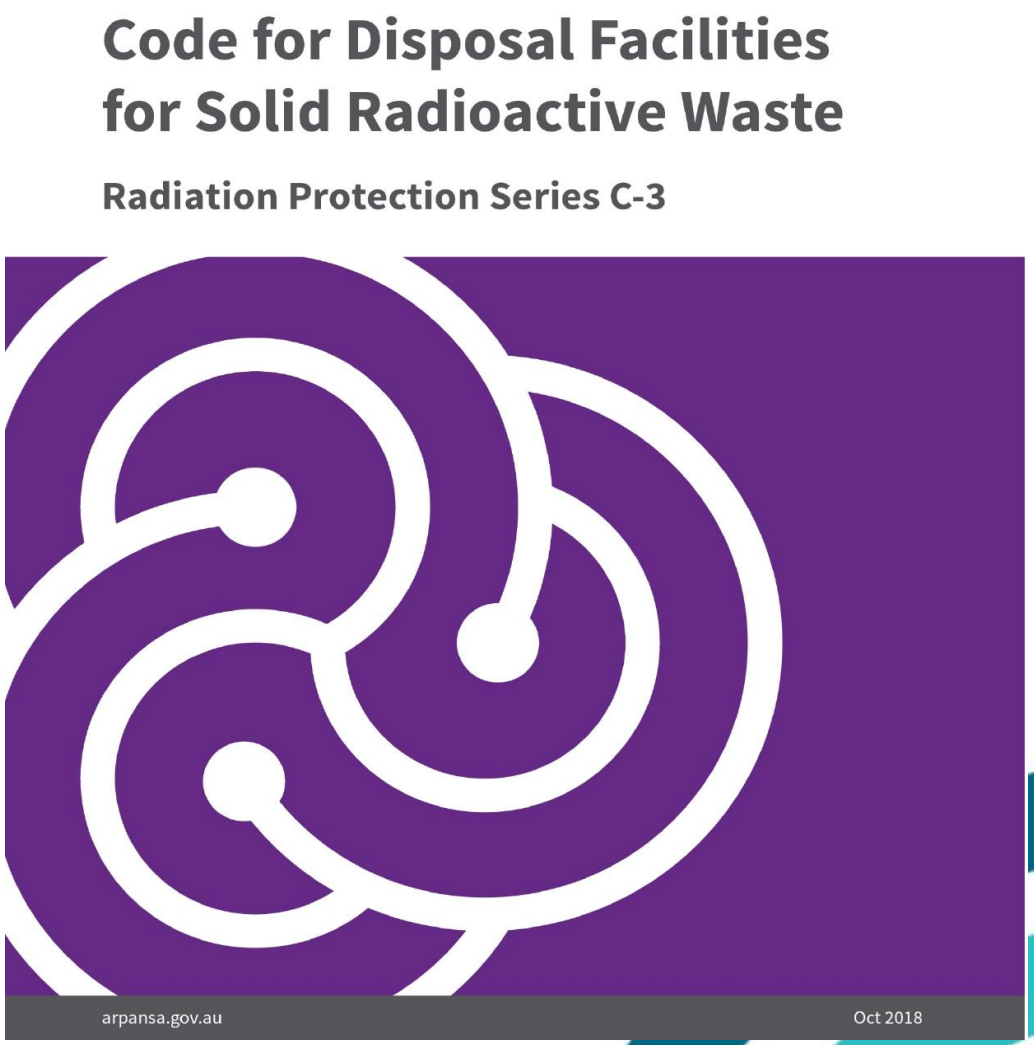
2018 Disposal Code

Australian Government
Australian Radiation Protection and Nuclear Safety Agency

arpansa



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2018 Disposal Code

- The international **best practice** framework for safety of radioactive waste management has been developed around the concept of the **safety case**. Through ARPANSA, Australia has **adopted** the Disposal Code.
- A **safety case** is the collection of scientific, technical, administrative and managerial arguments and evidence that demonstrate the safety of a disposal facility.
- It addresses the **suitability** of the selected site and the design of the facility, its construction and operation, the assessment of **radiation risks** and assurance of the adequacy and quality of all safety-related work associated with the disposal facility.

2018 Disposal Code

- A **safety case** and supporting **safety assessments** provide the basis for demonstration of safety and authorisation. They assist and guide decisions on **siting, design, operation and closure**.
- A **safety case** will also be the main basis on which **confidence in the safety** of the disposal facility will be **developed** and on how dialogue with stakeholders will be conducted.

Operations Safety Assessment

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Intractable Waste Disposal Facility Operations Safety Assessment

Prepared For: Department of Finance

Locked Bag 44
Cloisters Square WA 6850

Report Number: AP-2022-053

Report Version: V4

Report Date: 13 February 2023

ARPS2023

Deterministic and Probabilistic Safety Assessment

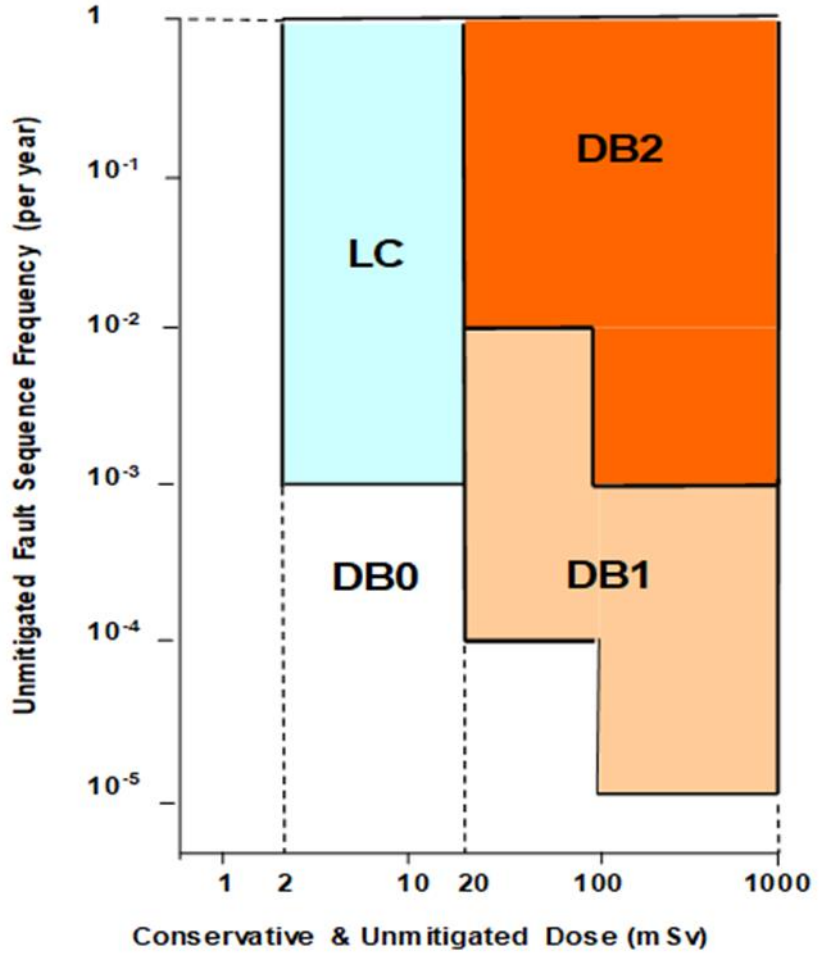
- **Design Basis Accident Analysis** (DBAA) is a conservative, **deterministic** and pragmatic methodology for identifying the number of **protective safety measures** that are required against an **internal or external hazard**. These claimed protective safety measures will provide confidence that the potential dose to workers and the public is **controlled**.

Deterministic and Probabilistic Safety Assessment

- **Protective safety measures** can take the form of **engineered measures** or **operator actions** that limit the development of an internal hazard.
- The required number of protective safety measures for an internal hazard is determined by the combination of frequency and dose, and there are four regions of classification, three associated with **DBAA (DB2, DB1, DB0)** and one associated with **LCM (LC).**

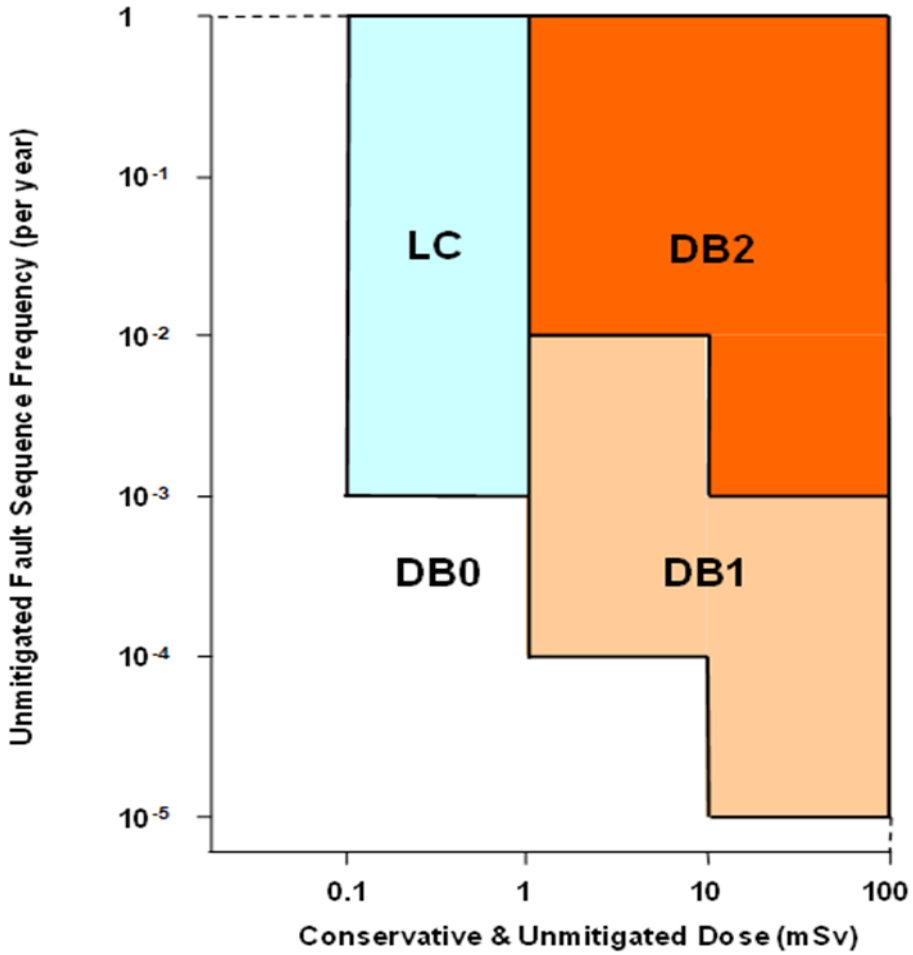
Deterministic and Probabilistic Safety Assessment

Internal Hazard - Assessment Regions for a Worker



Deterministic and Probabilistic Safety Assessment

Internal Hazard - Assessment Regions for a Member of the Public



Deterministic and Probabilistic Safety Assessment

- A **probabilistic risk assessment** is a calculation based on the fault frequencies, doses and claimed protective safety measures as identified by the deterministic assessment and recorded on the hazard schedule.
- The probabilistic assessment assumes that the level of risk will be maintained for a year (or more).
- The risk calculation is compared against defined **risk limits and targets** as defined for the IWDF site.

Deterministic and Probabilistic Safety Assessment

IWDF Site Probability Risk Limits and Targets

	Worker	Public
Upper Tolerable (Limit)	1×10^{-4} /y	1×10^{-5} /y
Broadly Acceptable (Target)	1×10^{-6} /y	1×10^{-7} /y

Internal Hazards

- Dropped drum during forklift movements (D1)
- Forklift drum impact during transfers (D2)
- Damaged drum due to vehicle fire (D3)
- Higher activity drum sent for disposal (D4)
- Insufficient coverage for capping layer (D5)
- Damaged drum due to consignor error (D6)

External Hazards

- Seismic event (D7)
- Erosion of capping layer due to tropical cyclone (D8)
- Damaged drums due to a bush fire (D9)
- Aircraft crash (D10)
- Damaged drum due to lightning strike (D11)

Australian Government
Geoscience Australia

Australian Government
Bureau of Meteorology

30 YEARS
1990 - 2020

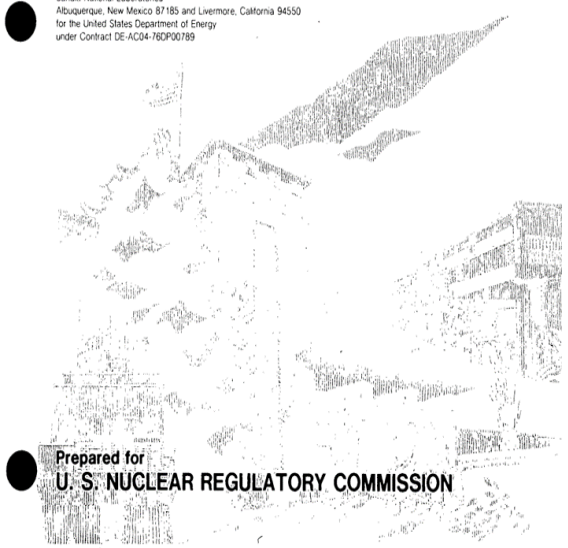
NUREG/CR-1278
SAND80-0200
RX, AN
Printed August 1983

Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications

Final Report

A. D. Swain, H. E. Guttmann

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
under Contract DE-AC04-76DP00789



Prepared for
U. S. NUCLEAR REGULATORY COMMISSION

SF2900Q(8-81)

STD
SAFETY TECHNOLOGY DEPARTMENT

WSRC-TR-93-581

Key Words: Human Reliability Analysis
Safety Analysis Reports
Probabilistic Risk Assessment
Data

SAVANNAH RIVER SITE UMAN ERROR DATA BASE DEVELOPMENT)R NONREACTOR NUCLEAR FACILITIES (U)

by

H. C. Benhardt
S. A. Eide*
J. E. Held
L. M. Olsen
R. E. Vail

Issued: February 28, 1994

TS
NOT MEASUREMENT SENSITIVE

DOE-HDBK-3010-94
December 1994

DOE HANDBOOK

AIRBORNE RELEASE FRACTIONS/RATES AND RESPIRABLE FRACTIONS FOR NONREACTOR NUCLEAR FACILITIES

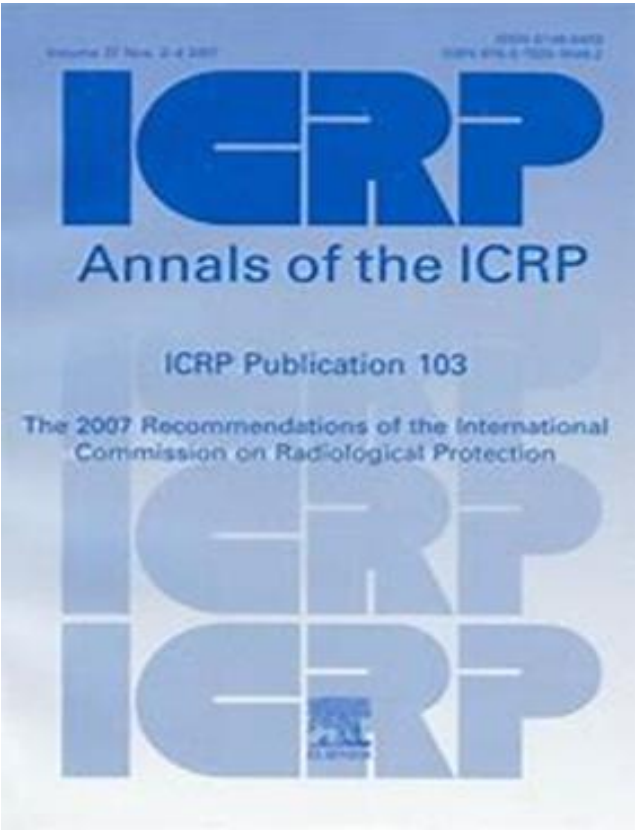
Volume I - Analysis of Experimental Data

U.S. Department of Energy
Washington, D.C. 20585

AREA SAFT

NPRD 2016

NONELECTRONIC PARTS RELIABILITY DATA



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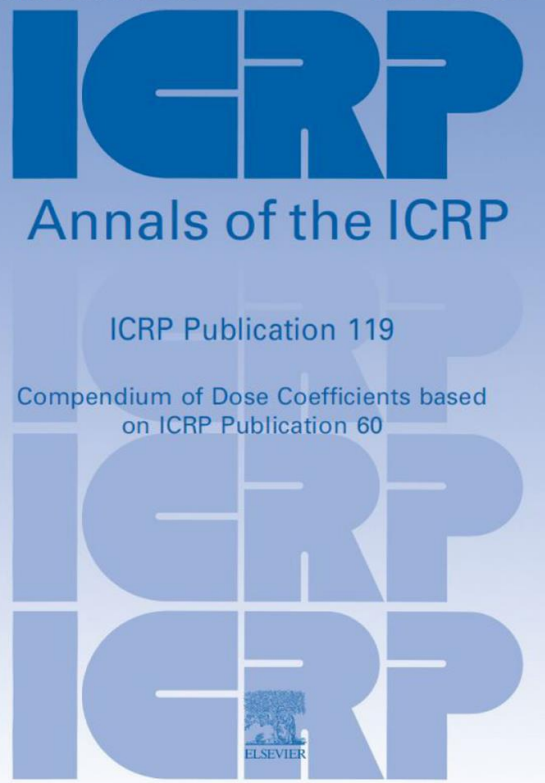

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Operations Safety Assessment

- Total collective dose was 0.164 man-mSv/year, with an average worker dose of 0.023 mSv/man/year and a maximum individual dose of 0.111 mSv/man/year. Dose exposures are well below the worker dose rate limit of 20mSv/year.
- All public dose exposures during IWDF operations are negligible and therefore doses are well below the 1mSv/year limit.

Operations Safety Assessment

- The deterministic and probabilistic safety assessments demonstrated that for **all** credible internal and external hazards, the workers and public dose consequences and risks will be **acceptable** for the IWDF.

Post-Closure Safety Assessment

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Intractable Waste Disposal Facility
Post-Closure Safety Assessment

Prepared For: Department of Finance
Locked Bag 44
Cloisters Square WA 6850

Report Number: AP-2022-052

Report Version: V5

Report Date: 27 January 2023

ARPS2023

Post-Closure Safety Assessment

Fault Schedule and Design Basis Accident Analysis for Post-Closure

Fault No	External Hazard	Initiating Event	Initiating Event Frequency (/y)	Worst Case Unmitigated Dose Consequences (mSv)	DB / LCM Class Public	Passive Safety Features/Protective Safety Measures	DBA/LCM Safety Measures	Dose Reduction/ ALARA Safety Measures	Assumptions
EH1	Spread of contamination	Exposed Drums	1.00E+00	1.46E+02	DB2	Concrete matrix of drums	Several layers of sand, kaolin clay and silcrete material above packages (minimum of 5 metres coverage)	Remote location of facility	Erosion Human intrusion
EH2	Increased Direct Dose	Exposed Drums	1.00E+00	3.92E-01	LC	Concrete matrix of drums	Several layers of sand, kaolin clay and silcrete material above packages (minimum of 5 metres coverage)	Remote location of facility	Erosion Human intrusion

Post-Closure Safety Assessment

Probabilistic Safety Assessment for Post-Closure

Fault ID	Dose (Sv) (A)	Public Dose Risk Factor (/Sv) (B)	Initiating Event Frequency (/y) (C)	Protection Failure Probability, Pf (D)	Risk per Fault (/y) (AxBxCxD)
EH1	1.46E-02	0.05	1.00E+00	1.00E-04	7.30E-08
				Total Risk (/y)	7.30E-08
				Broadly Acceptable (/y)	1.00E-07

Post-Closure Safety Assessment

- The deterministic and probabilistic safety assessments have demonstrated that for **all** external events to the public, dose consequences and risks will be **acceptable** post-closure.
- A public dose constraint of less than **0.3 mSv/year** has been set for the IWDF after the 100-year ICP, based on the IAEA SSR-5. The legal limit for the public will be 1 mSv/year.
- **0.3 mSv/year** expressed as a public dose rate constraint = 0.03 μSv/h, i.e., equivalent to a trench coverage of 90cm of material c.f. 5 metres actual.

Facility Safety Case

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Intractable Waste Disposal Facility Safety Case

Prepared For: Department of Finance

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Report Number: AP-2021-360

Report Version: V3

Report Date: 27 February 2023

Facility Safety Case

- This document presents the **safety case** for the Intractable Waste Disposal Facility (IWDF), in support of the site licensing requirements.
- The **safety case** and **supporting safety assessments** have been produced in accordance with the ARPANSA **2018 Disposal Code**.
- The safety assessments include an Operations Safety Assessment (**OSA**) and a Post-Closure Safety Assessment (**PCSA**).

Facility Safety Case

- The **FSC** concluded that all credible internal and external hazards are acceptable when judged against the dose consequence and risk targets set for the IWDF for workers, members of the public and the environment for the ICP (100 years).

Facility Safety Case

- All worker and public doses are judged to be As Low as Reasonably Achievable (ALARA).
- Public dose constraint of 0.3 mSv/year, based on the IAEA SSR-5, will not be exceeded.

Acknowledgements

- Department of Finance – Eleanor Hopkins and Sze-Wan Ng
- Aurora Environmental – Mark Shepherd and Leanne Morton
- ARPANSA – Andrew McCormick, Rick Tinker and the late Robert Godfrey
- Radiation Health Unit – Hazel Upton and Duncan Surin