



Australian Government
**Australian Radiation Protection
and Nuclear Safety Agency**



Rehabilitation and Stakeholder Engagement – former Nuclear Test Sites at Maralinga, Australia

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Nuclear Test Sites – Monte Bello Islands, Australia

1952 – Operation Hurricane

- First British atomic test.
- UK used HMS Plym (River-class frigate) as the detonation platform. Designed to simulate the effects of a nuclear weapon being smuggled into a British port aboard a ship.

1956 – Operation Mosaic

- 4th and 5th British atomic tests.
- Included the highest yield test ever conducted in Australia.

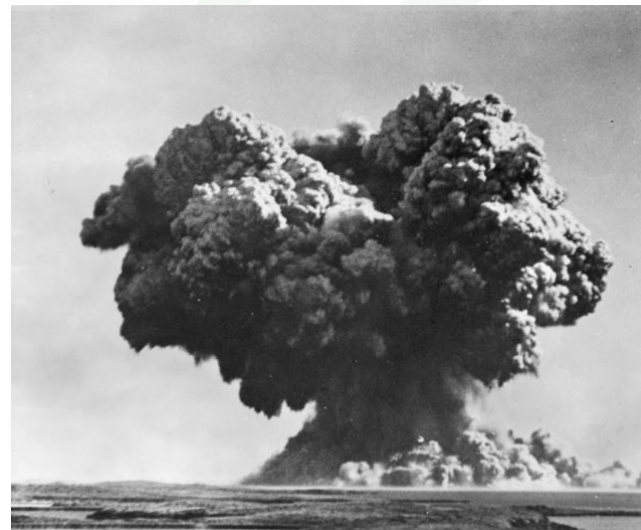
Operation: Hurricane

Date: 3 October 1952
Type: Surface water blast
Yield: 25 kt (fission)

Operation: Mosaic

Date: 16 May 1956
Type: Tower shot – 31m
Yield: 15 kt (fission)

Date: 19 June 1956
Type: Tower shot – 31m
Yield: 60kt (fission) – it's believed this yield could have been 50% larger than expected at ~92 kt, not 60kt as reported in 1956



Nuclear Test Sites – Emu Field, Australia

1953 – Operation Totem

- 2nd and 3rd major British atomic tests – Emu Field, South Australia.
- Designed to determine the acceptable limit of plutonium-240 within a nuclear weapon.
- “Kittens” - Minor (subcritical) tests, using conventional explosives, Po-210, Beryllium and natural uranium to test neutron initiators.



Operation: Totem 1

Date: 14 October 1953
Type: Tower shot
Yield: 10 kt (fission)

Operation: Totem 2

Date: 26 October 1953
Type: Tower shot
Yield: 8 kt (fission)



Nuclear Test Sites – Maralinga, Australia

1956 – Operation Buffalo

- Consisted of 4 British atomic tests.
- Used to test different nuclear devices, including standard and boosted ‘Red Beard’ tests, and the ‘Blue Danube/Smallboy’ tests with low-yield cores.

Operation: Buffalo

Name: One Tree (1st test)
Date: 27 September 1956
Type: 30m aluminium tower
Yield: 15 kt (fission)

Name: Marcoo (2nd test)
Date: 04 October 1956
Type: Ground level
Yield: 1.5 kt (fission)

Name: Kite (3rd test)
Date: 11 October 1956
Type: 150m air-burst (free fall)
Yield: 3 kt (fission)

Name: Breakaway (4th test)
Date: 21 October 1956
Type: 30m aluminium tower
Yield: 10kt (fission)



1957 – Operation Antler

- Consisted of 3 British atomic tests.
- Used to test different nuclear devices, including the small ‘Pixie’ warhead, and ‘Red Beard’ device with a composite uranium-plutonium core.

Operation: Antler

Name: Tadge (1st test)
Date: 14 September 1957
Type: 30m aluminium tower
Yield: 1 kt (fission)

Name: Biak (2nd test)
Date: 25 September 1957
Type: 30m aluminium tower
Yield: 6 kt (fission)

Name: Taranaki (3rd test)
Date: 09 October 1957
Type: 300m air-burst (balloon)
Yield: 27 kt (fission)

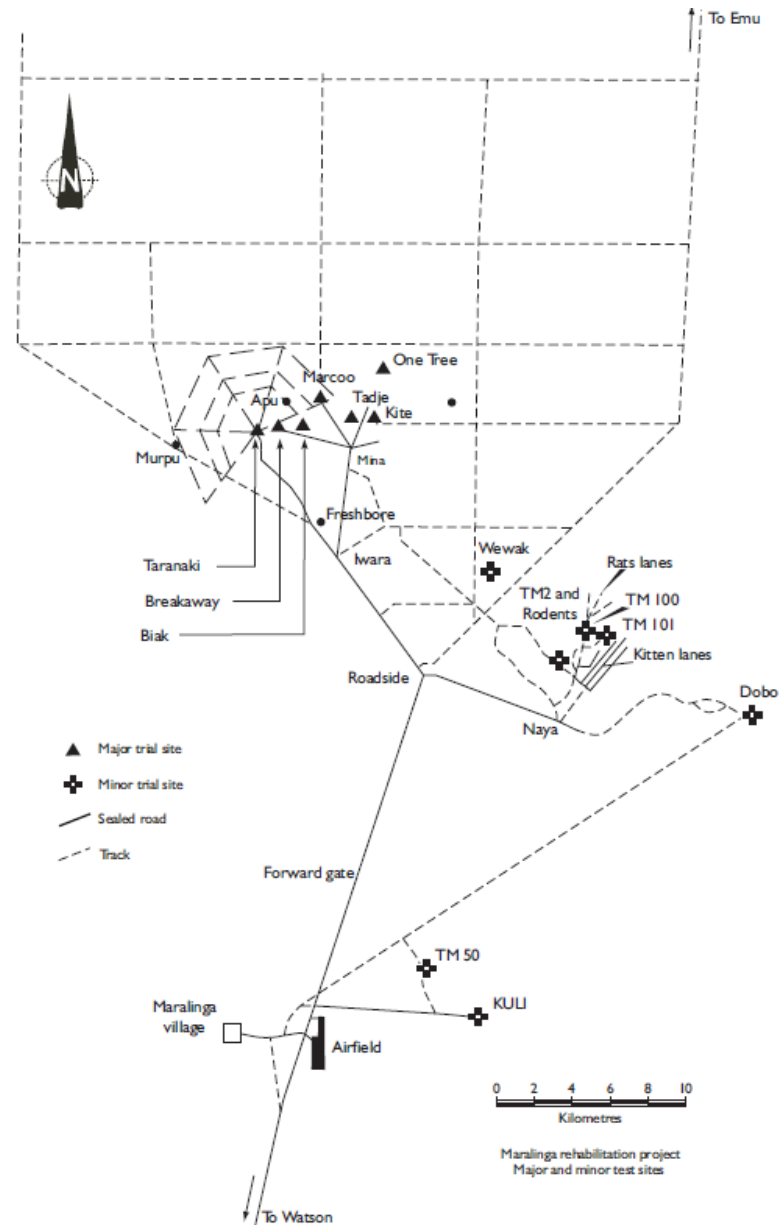


Minor Trials – Maralinga, Australia

- The British carried out minor trials at both Emu Field and Maralinga.
- More minor trials carried out at Maralinga than Emu Field.
- Minor trials were developmental experiments, investigating:
 - The performance of various components of a nuclear device, both separately and in combination.
 - Almost all involved radioactive materials in conjunction with conventional high explosives.
- A number of these trails caused significant radiological contamination with both short-lived and long-lived materials.
- The Vixen trails were potentially the most dangerous due to the high amount of explosives and plutonium used. The Vixen B series explosively dispersed 22kg plutonium from Taranaki.

Code Name	Location	Sub-location
Kittens	Maralinga (1955-1961)	Naya-2 Naya-3
Tims	Maralinga (1955-1961, 1963)	TM100 TM101 Kuli TM50
Rats	Maralinga (1956-1960)	Dobo Naya-1 Naya-3
Vixen A	Maralinga (throughout 1959 and 1961)	Wewak
Vixen B	Maralinga (1960, 1961 and 1963)	Taranaki

Major/Minor Trial Locations at Maralinga

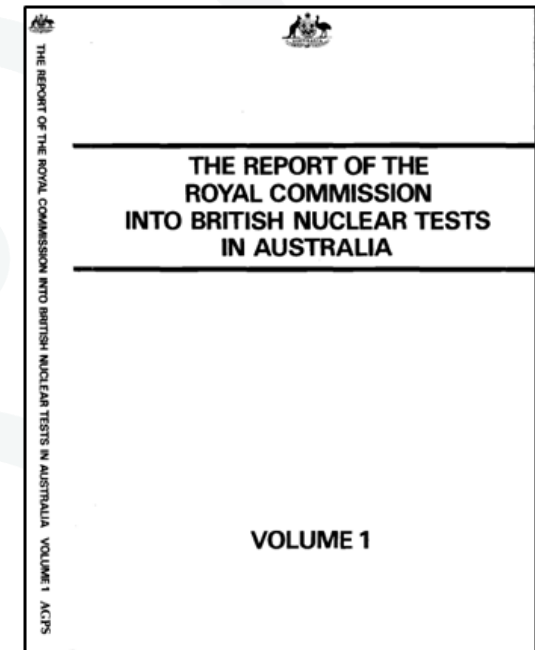


British Clean-up attempts at Maralinga

- Experiments and tests ended in 1963.
- Several British attempts to clean the site:
- Operations Clean-up (1963) and Hercules (1964) – single objective of removing major hazards to enable continued military access without health physics supervision.
- Operation Brumby (1967) clean-up:
 - To allow future pastoral land use of the sites, inhalation hazards to stockmen were only consideration.
 - Did not address plutonium contamination on fragments.
 - Assumed ploughing and other soil mixing techniques would reduce all radiological hazards.
 - Assumed rapid natural revegetation of the area, making it impossible to identify areas used for the tests within a matter of years.
- Criteria Included (Pearce Report, 1968):
 - Removal of general debris and glazing
 - Ploughing of soil and grading around areas of major trial ground zeros
 - Ploughing of soil to a depth of 100mm in minor trial areas of Taranaki, Wewak, TM100 and TM101 (dispersing plutonium through the top few centimetres of surface soil)
 - Covering more highly contaminated areas at Taranaki with 75mm of clean soil
 - Remove highly contaminated soil from Wewak for subsequent burial in the *Marcoo* crater, and
 - Capping debris pits at Taranaki and TMs

After the Tests – the long road to rehabilitation

- **Early 1970's** - after Operation Brumby was complete, the Australian Government accepted the condition of the former test site (without verification measurements) and the UK was released, for the most part, from any future liability for the Maralinga sites.
- **Early 1980's** – increasing concern over the Nuclear Tests and their long-lasting effects for Australia. A number of studies/reports written (Kerr Report 1984).
- **1984-1985** – Australian 'Royal Commission into the British Nuclear Tests in Australia' (McClelland Report).
 - The Royal Commission recommends Maralinga and Emu should be cleaned-up to allow unrestricted habitation by Aboriginal traditional owners.
 - Technical Assessment Group (TAG) established:
 - To report on options and costs for decontamination and rehabilitation
 - Undertook field studies and laboratory research.
 - Comprised of scientists – 2 x British, 2 x Australian and 1 x American.
 - Maralinga Consultative Group (MCG) established:
 - Formed to facilitate stakeholder participation
 - Comprised of representatives of Australian, South Australian, Western Australian (due to early tests at Montebello Islands) and British governments, and the Maralinga Tjarutja traditional owners of the Maralinga/Emu lands



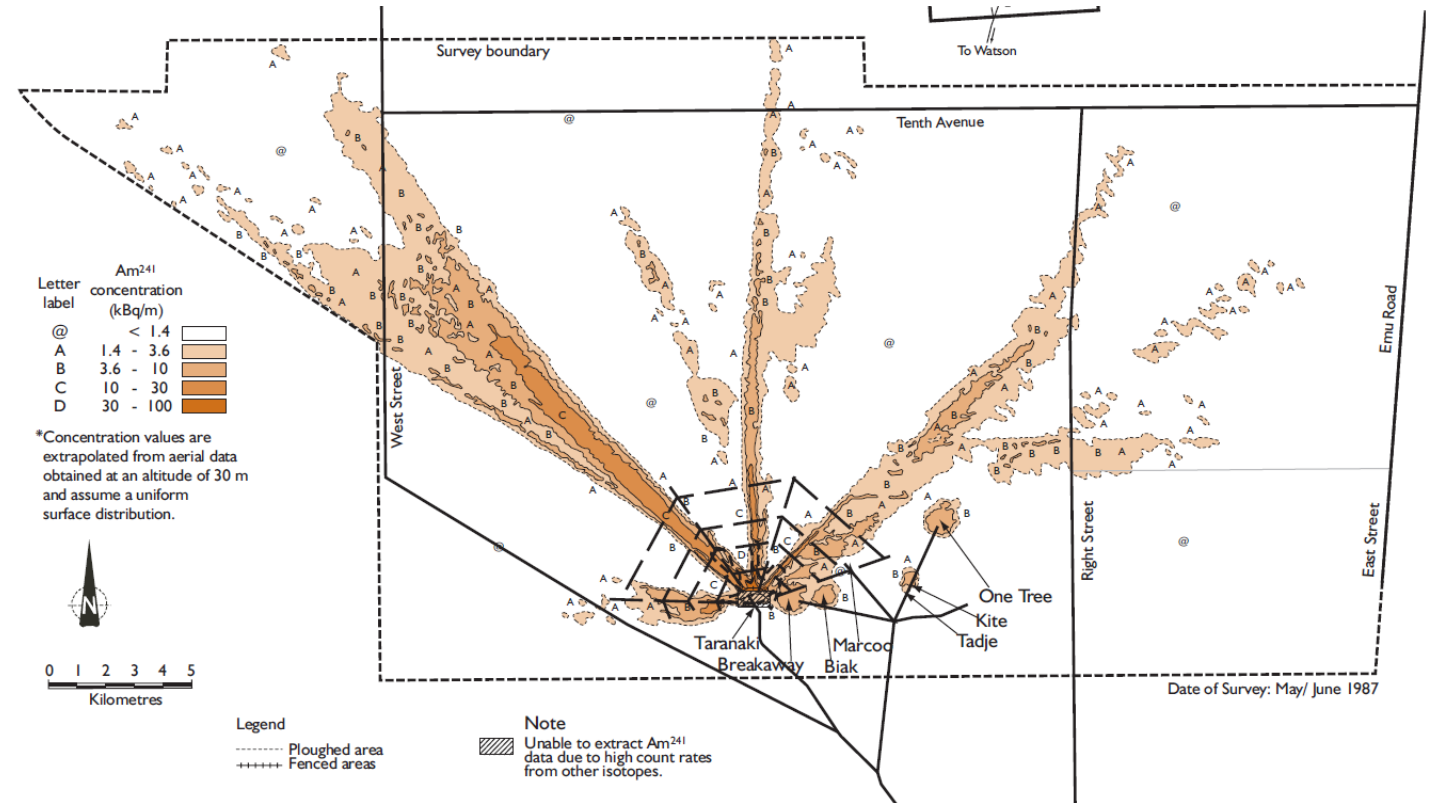
Technical Assessment Group (TAG) – Understand the Issues

- Determine the nature of the hazard - external dose, inhalation, particles.
- Characterise the contamination through field & lab. studies – particle size distribution, dust loadings, radionuclides present, solubilities and chemical properties.
- Effects on the environment - uptake by plants & animals.
- Spatial extent of the contamination - aerial and ground-based surveys.



Technical Assessment Group (TAG) Tasks

- Aerial surveys conducted in 1987 - Am^{241} , Cs^{137} , Co^{60} , U^{238} contamination.



Source term definition

Determine bioavailability

Identify exposure pathways

Dose Assessment

Evaluate uncertainties

- Understand the issue and propose clean-up options and costs for Maralinga.

Role of Maralinga Consultation Group (MCG)

The establishment of this group enabled:

- Involvement of local community and traditional landowners to develop the remediation reference level and the extent of remediation undertaken.
- Open and frank communication using non-technical but clearly understood language.
- Lifestyle (anthropological) studies to inform the modelling of exposure scenarios.
- Understanding of the expectations of the local community for the future rehabilitation actions.
- Ongoing feedback from interested parties on the details of the remediation and rehabilitation.
- Ongoing consultation prior to, during and following the remedial actions.



Maralinga Remediation Criteria

- Extensive consultation with Maralinga Tjarutja community to fully understand lifestyle and culture within criteria considerations.
- Local community placed higher importance on the impact of a very dusty environment for children at play, adult hunting and recreation pursuits and in sleeping and cooking quarters, than for the consumption of 'bush tucker'.
- Criteria set at 5mSv/y - based on the risk of acquiring a fatal cancer following uptake of contamination, this likelihood should not exceed 1 in 10,000 by the fiftieth year.
- Inhalation of plutonium was the major hazard remaining at Maralinga, soil removal required in most contaminated areas, i.e. Taranaki, TM100/101, Wewak.
- Dust raising and particle-sizing studies showed: expected annual dose by inhalation for 100% occupancy to the critical group (Aboriginal children living a semi-traditional lifestyle) does not exceed 5 mSv/y for soil activity below 3 kBq/m² of ²⁴¹Am averaged over 3 km²



Agreement on Rehabilitation Process and Criteria by Maralinga Tjarutja

- Maralinga Tjarutja wanted to avoid complete removal of vegetation and soil due to environmental damage.
- Only the highest levels of contamination were to be treated by soil removal at Taranaki, Wewak and TM 100/101 sites.
- Acceptance that the 120 km² area around Taranaki/Vixen B test site was contaminated to the extent that it may exceed the 5 mSv/y criterion for 100% occupancy.
- Agreement that the 120 km² area around Taranaki will remain restricted for permanent habitation and marked at close intervals with signs (in local language) to indicate that the area is suitable for hunting but not for camping.



Post-remediation Rehabilitation and Consultations

- Maralinga site maintained by onsite Caretaker since end of project (2003 onwards)
 - Employed directly by Maralinga Tjarutja
- The Maralinga Land and Environment Management Plan (MLEMP) in place.
- Implemented by the Maralinga Land and Environment Management Committee (MLEMC), membership includes:
 - Commonwealth Government
 - South Australian Government
 - Maralinga Tjarutja representatives
 - Others by invitation
- Tourism business now in place at Maralinga
 - Managed by Maralinga Tjarutja
- MLEMP Provides:
 - Institutional management responsible for the oversight and implementation of the plan.
 - Records management related to the site.
 - Maintenance of hazard reduction measures.
 - **Radiological safety assessment**
 - Conservation management
 - Revegetation of soil removal areas
 - Auditing to ensure compliance with the Plan
 - Contingency planning to monitor and manage unanticipated events

Ongoing Radiological Monitoring

- Every 3 years, measurements at 9 locations in remnant plumes
 - Compare with previous measurements
 - Report to Maralinga Land and Environment Management Committee
- Review of radiation safety measures if
 - the Committee becomes aware of any failure of the remediation controls; or
 - there are any significant proposed or observed changes in land use.
 - Or in 2035
- Review to incorporate up to date information and re-assess
 - The TAG dose estimates;
 - The Clearance Criteria developed by MARTAC; and
 - The radiation safety measures implemented during the Maralinga Rehabilitation Project.



Continued Stakeholder Engagement by ARPANSA

Current

- ARPANSA provides radiological advice to MLEMC.
- Attends MLEMC meetings by invitation from Maralinga Tjarutja and Department responsible for the site.
- Undertakes radiation monitoring every 3 years as determined by MLEMP.
- Provides additional input to MLEMC meetings as required.



Future

- Continue regular monitoring visits even if radiological risk reduces - provides independent assessment and increases public confidence.
- Commence additional onsite visits to Maralinga between monitoring trips – increase interaction with traditional owners.
- Increase knowledge transfer of test sites and their radiological condition to Maralinga Tjarutja community in cooperation with Oak Valley Rangers.
- Support Oak Valley Ranger/Maralinga Tjarutja proposition to designate the Maralinga Test site an Indigenous Protected Area.

Lessons Learned – Stakeholder Engagement

- Continue stakeholder engagement after remediation is complete:
 - To counter misinformation.
 - Provides continuing knowledge of the sites.
 - Provide continuing trust between stakeholders.
 - Provide one ‘source of truth’, avoiding miscommunication/misunderstanding if information is distributed through , 2nd, 3rd or 4th parties.
 - Continues to provide reliable source of information in regard to radiological safety queries of the site.
 - Continues regular appreciation of traditional owners lifestyle, culture and beliefs.





Thank you

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