Maralinga: The Clean-Up of a Nuclear Test Site

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Plutonium and uranium fallout from 15 nuclear tests conducted by the British government between 1961 and 1963 contaminated Aboriginal lands. Although the British government declared the Maralinga site safe following a 1967 cleanup, surveys in the 1980s proved otherwise, prompting a new cleanup project. Conflicts of interest, cost-cutting measures, shallow burials of radioactive waste, and other management "compromises" have left hundreds of square kilometers of Aboriginal lands contaminated and unfit for rehabitation. M&GS 2002;7:77-81.

Claims that the clean-up of Maralinga is not to world's best practice are not well founded." So said Dr. John Loy, CEO of the Australian nuclear regulatory organization, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).[1] This is a bold claim worth comparing with the outcome of the project.

The Cause of the Contamination

Maralinga is a tract of Aboriginal land in the state of South Australia that was commandeered by the Australian government to be used by Britain for the development of atomic bombs. The Australian government had its own aspirations to possess nuclear weapons and perhaps hoped that this would be an avenue for their acquisition.[2, 3]

Seven atomic bombs were exploded at Maralinga; perhaps 25% to 30% of the plutonium in those devices would have been fissioned. The remainder would have been spread around the ground zeroes, or carried into the air to be deposited later as fallout. Many development trials were also conducted at three sites within Maralinga—Taranaki, TM, and Wewak. Those at the two latter sites resulted in plutonium spread over relatively small areas but a series of trials at Taranaki, code-named Vixen B, were much more damaging.

There were 15 Vixen B trials, all conducted in the period from 1961 to 1963. In twelve of the tests, both plutonium and uranium were in the radioactive mix; the other three contained only uranium. In each trial, a nuclear device was placed on a large steel structure known as a featherbed, erected on a concrete firing pad. The device was detonated in a manner that prevented a nuclear explosion. The heat of the explosion melted the plutonium and uranium and shot radioactive debris up to 1,000 meters into the air, where it was caught by the wind and spread far and wide. The featherbeds were severely damaged and contaminated and were buried along with the firing pads.

Following these tests, hundreds of tons of contaminated steel, concrete, and other items were reported to have been buried in 21 shallow pits at Taranaki, and hundreds of

AP is a mechanical and nuclear engineer who, in 1989, developed some 30 options for rehabilitation of the Maralinga atomic bomb test site. In August 1994, he was appointed the Government's Representative to oversee the whole of the cleanup project and was also a member of the government's advisory committee (MARTAC). In December 1997, he was removed from both appointments for questioning the management of the project. Address correspondence to Alan Parkinson, PO Box 415, Hawker, ACT 2614, Australia; e-mail: alanpark@ozemail.com.au.

The Taranaki nuclear test site.
Photo courtesy of Alan Parkinson.

square kilometers of land were contaminated with plutonium and uranium.

In 1967, the British conducted Operation Brumby—a "final" cleanup of the site. The Australian government accepted that, except for some small fenced "islands," the site was clean and absolved Britain of any further responsibility. Surveys in the 1980s by the Australian Radiation Laboratory showed that the site was far from clean and safe and their findings led eventually to the latest cleanup project.[4]

The Planned Cleanup

From its inception, the nuclear industry has had problems with worker and public safety and with environmental degradation. Too often these problems have been caused by ineffective management, cost-cutting measures, or ineffective regulation. The Maralinga project reflects all three of these factors. The public servants responsible for the last years of the project had no background in radiation or project management, as is illustrated by several statements they made on the public record, asking, for example, what was meant by alpha radiation, or how to convert a milliSievert (a unit of radiation dose) to a picoCurie (a unit of radioactivity), or claiming that soda ash is neutralized by limestone.[5-7]

Project records also reveal suggestions by ARPANSA (e.g., encasing the debris in concrete) to which the contractor objected on the grounds that they would be difficult to implement. The recommendations were then dropped[5-7] despite the principle that the regulator should stipulate requirements, not make suggestions. Responsibility for the cleanup was vested in the Commonwealth Department of Primary Industries & Energy (later Industry, Science & Resources). ARPANSA was contracted to the Department, so was not independent—another failing.

The plan was generally along the lines of a scheme that had been developed some years earlier[8] and from the beginning was intended to be a partial cleanup, which was a compromise. The more contaminated soil was to be scraped up and buried and some pits were to be exhumed and the contents buried more securely. The pits at Taranaki were to be treated by a process of in situ vitrification (ISV).

ISV uses electricity to turn the soil and pit contents into a hard, glass-like rock, which contains and immobilizes the plutonium for thousands of years. The process has to be tailored for each site, and the Australian government signed a contract with Geosafe, Inc. in the US to match the technology to the Maralinga geology.

Setting Cleanup Standards

The criteria to be met after the contaminated soil was removed were set at a meeting of half of the Maralinga Rehabilitation Technical Advisory Committee (MARTAC), which was established to advise the Minister on the project. Each member of the Committee was contracted to the Department. At Taranaki, the criteria were to remove soil until the surface reading was less than 3kBq (Am-241) per m^2. Variations in the ratio of plutonium to americium led to slightly different criteria for the other sites. There were also criteria for the removal of contaminated fragments and particles of plutonium, thereafter referred to by ARPANSA as MARTAC criteria.

MARTAC also prepared some draft criteria for the ISV product, but these were not incorporated into the contract with Geosafe.

Removal and Burial of Contaminated Soil

The removal and burial of soil was a simple civil engineering exercise with an overlay of health physics to protect the workers. Contaminated soil was collected by large scrapers and placed in trenches up to 16 meters deep. The top of the contaminated soil was no higher than three meters below the ground surface and was then covered by at least five meters of clean soil. Dust was a major problem and its suppression at Taranaki was not satisfactory, with the result that thousands of tons of contaminated soil simply blew away. With a change of approach, dust suppression during soil removal at the other two sites was excellent.

Nineteen of the 21 pits at Taranaki were reported to have been covered by concrete caps. As the soil was removed, however, a huge amount of plutonium-contaminated debris was uncovered outside the pits. Much of the debris was covered by only a few cen-

timeters of soil. One cap was about one fifth of the required size and another was several meters away from the pit. The impact of this discovery was that the ISV project would have to be expanded so that all the debris could be treated, at increased cost.

Change of Management Structure

The project management structure was changed in mid 1997. The company that had been awarded the contract to manage the earlier parts of the project was purchased by another company (GHD) that had not made the final six considered for the project management contract. Before the end of 1997, GHD persuaded the Department that it should manage the whole of the project, not just the part that it had purchased. Three meetings were held in secret between GHD and the Department to discuss this takeover. The participants at these meetings were two people from the Department whose only knowledge of ISV was one half-hour visit to see some of the equipment, and two people from GHD who did not have even that meager knowledge. The Commonwealth's Representative overseeing the whole project was excluded. The most expensive and most complex part of the whole project was decided by four people who were totally ignorant of what was involved. There are no notes of these meetings on record.

The outcome was that GHD was appointed both Project Manager and Project Authority even though the company was not qualified for either position. At the same time, the Commonwealth's Representative was removed from the project. So the Department had no one in either its own ranks or on the project manager's team with any knowledge of ISV. This was a recipe for disaster.

Treatment of Contaminated Debris

All of the Taranaki pits were to have been treated by ISV and a contract for this work was placed with Geosafe. Initially the 21 pits would have required 26 "melts" but, with the discovery of the large amount of debris outside the pits, the whole project would require 40 melts. The ISV equipment was built and tested and was transported to site at the beginning of 1998. Treatment of pits started in May of that year.

At that point, the absence of ISV expertise within both the Department and GHD became even more apparent. Into this vacuum stepped the Minister's advisory committee MARTAC, which met only three or four times a year. This committee had expectations and requirements that were not contractual and were constantly changing. Moreover, the government at this time was seeking ways to reduce the cost of the project and adopted a hybrid scheme in which eight pits would be exhumed and the contents sorted. Some debris would be vitrified in a specially prepared "pod" and the remainder simply buried. The strange thing was that sorting was done by size, not level of radioactivity, so highly radioactive particles would be buried while slightly contaminated debris would be vitrified.

Another peculiar aspect of the ISV part of the project was that ten melts had been completed before agreement was reached on any acceptance criteria, and even then the criteria were rather impractical since some could not be confirmed.

It was quite clear in early 1998 that problems were looming for the project. This was relayed to the then Minister, Senator Parer, but no action was taken.[9] As treatment of Pit 17 (the eleventh melt of the series) was nearing completion, there was an explosion within the melt that severely damaged the equipment and spewed molten glass some 50 meters from the pit. The Department used this incident as an excuse to cancel the ISV contract after having spent 40% of the project budget on the scheme. This decision was taken long before the investigation of the incident was complete. The Department claimed that it could not be sure that the cause of the accident was not due to the process,[10] but both the report of the investigation and the audit of that report agreed that the cause was something in the pit, not the process.[11]

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Although the government claims that the project was conducted in full consultation with the South Australian Government and the Maralinga Tjarutja, this decision and other key decisions were made without any consultation.[12]

Once vitrification had been abandoned, all debris from the pits that had not been treated was placed in a shallow trench, covered with the solidified vitrified material and then covered with only two meters of soil to grade, with a further three meters of soil above grade. There is no reliable record of what has been buried. Nine firing pads reported by Carter[13] to be contaminated with up to 1 kg of plutonium are not mentioned in the report of burials.[14]

The Department has claimed that burial is a safe disposal method consistent with "the Code."[15] This was the first time that the Code had been mentioned in relation to the

project. When three of the five authors said that it was not applicable (the other two were Commonwealth public servants and would not comment), the Department claimed that it did not have to follow the Code but had chosen to do so.[16] It made this statement despite the fact that not a single requirement of that Code was satisfied.

The government claimed that cost played no part in the decision to opt for burial of the debris. Senator Minchin said: "Can I refute the scurrilous suggestion which I see floating around in the media that suggests that this decision was made on cost grounds."[16] This is at odds with the statement: "The recent consideration of alternative treatments for ISV for these outer pits has arisen as a result of the revised estimate for ISV being considerably above the project budget."[17]

The Department also claimed that ISV was abandoned because the amount of plutonium in the pits was less than expected. In fact it was very close to what was assessed at the MARTAC meeting of November 1995,[18] seven months before the contract for ISV was signed.[19,20] This and many other misleading or incorrect statements by the Minister and his Department were exposed.[21]

Had the plutonium debris been returned to Britain, the authorities would not have allowed disposal to be undertaken in the same way as was done at Maralinga; the contaminated material would have been placed in a concrete-lined vault.

Since the explosion at Maralinga, the world license for the technology has been purchased by the very large engineering firm Amec, which has been awarded contracts by the US Department of Energy to treat pits containing plutonium debris. There is also keen interest in the technology in several European countries and in Australia.

Cost of the Cleanup

The budget for the cleanup was $Aust 104.4 million (1994 dollars), of which about half was an *ex gratia* payment by Britain. The British contribution was a mere pittance compared with what it cost to spread the contamination in the first place. If an oil tanker runs aground and its contents are spilled, the owners face huge fines and are required to pay for the cleanup. In the case of the oil tanker, the contamination is accidental. In the case of Maralinga, the contamination was deliberate. Moreover, had the plutonium debris been returned to Britain, the authorities would not have allowed disposal to be undertaken in the same way as was done at Maralinga; the contaminated material would have been placed in a concrete-lined vault.

The Outcome

Dr. Loy was incorrect in saying that the Maralinga cleanup project represented the "world's best practice." The project was a compromise from the beginning and was never intended to be a total cleanup. There are still hundreds of square kilometers of land contaminated with plutonium. The government says that all but 120 km^2 are now safe, but this is misleading. What they mean is that 120 km^2 of land are still contaminated above 3 kBq Am-241/m^2. At that level, an Aboriginal living a semi-traditional lifestyle would receive an effective dose of 5 mSv/a (five times that allowed for a member of the public). Within the 120 km^2, the effective dose would be up to 13 times greater.

The plutonium-contaminated debris is buried in a bare hole in the ground in limestone and dolomite which exhibits many cracks and fissures, with only two meters of cover to grade. Even burial at a greater depth would be an improvement. At least one member of MARTAC and the regulator at ARPANSA have admitted that encasement in concrete would be an improvement. And every member of MARTAC has agreed that vitrification is a far superior solution.[22]

What has been done at Maralinga in the burial of long-lived, plutonium-contaminated debris can be compared with the government's plans for the disposal of other radioactive waste. After several years searching for a site with suitable geology, the government recently selected one for the disposal of short-lived, low-level waste and the storage of short-lived, medium-level waste. The low-level waste is to be packaged in drums and placed in a disposal facility with a solid base and then covered by several impervious layers. If such precautions are necessary for short-lived wastes, the disposal of long-lived wastes in a bare hole in the ground in totally unsuitable geology at Maralinga cannot possibly be "world's best practice."

In July 2001, the Department issued a discussion paper[23] addressing the safe storage of radioactive waste. In two places in that paper, the Department states that long-lived low- and intermediate-level waste is not suitable for near-surface disposal, and yet that is exactly what they have done at Maralinga.

Concluding Comment

The Aboriginals wish to return to the land, provided it is safe to do so. They have been advised that some of the land is not suitable for permanent occupation and 450 km^2 is encircled by boundary markers to remind them that this is so. The boundary markers might have a life of 50 years, but half of the plutonium will still be there in 24,000 years.

Whoever accepts responsibility for the site should recognize that they will have to rely for several thousand years on assurances from a government that has not kept to agreements made only ten years ago.

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Additional Resources

International Physicians for the Prevention of Nuclear War (IPPNW) and the Institute for Energy and Environmental Research (IEER) have published three books on the health and environmental effects of nuclear weapons testing and the contamination of nuclear test sites. They are Radioactive Heaven and Earth (1991); Plutonium Deadly Gold of the Nuclear Age (1992); and Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects. For more information, contact IPPNW or visit www.ippnw.org.