

COMMONWEALTH OF AUSTRALIA



DEPARTMENT OF
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RADIOACTIVE DECONTAMINATION OF THE AERONAUTICAL RESEARCH LABORATORY

LORIMER STREET FISHERMENS BEND

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Abstract

Decontamination of the Aeronautical Research Laboratory (ARL) property was carried out by ANSTO and TNT ECO Services, under the surveillance and guidance of This Laboratory. The \$1.5M operation commenced on 16 July and was completed on 17 October, 1990. It required the removal of approximately 1300 tonnes of radioactive waste and contaminated soil and items. The active materials were sealed in 4210 X 205 litre drums and transported to Lucas Heights for storage. This brought the total number of drums transported from the CSIRO and ARL properties to 9710. The work was carried out efficiently and professionally and used all reasonable radiological safety precautions.

Apart from that underneath Buildings 21 and 74, the ARL property is now clear of the known deposits of radioactivity.

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1. Introduction

In the 1940's, 50's and early 60's, CSIRO carried out, at its Lorimer Street Fishermens Bend property, industrial scale research projects which involved the separation and concentration of radioactive ores.[1] A radiation survey made by This Laboratory [2] discovered substantial deposits of radioactive waste buried on site and contamination in some buildings and drainage systems. It also indicated the presence of contamination on the adjacent Aeronautical Research Laboratory (ARL) property. A CSIRO Task Force on Fishermens Bend [3] and surveys of the CSIRO buildings [4] and of ARL [5] confirmed the findings of the initial survey.

Removal of the radioactivity from both CSIRO and ARL was required prior to the occupation of the CSIRO property by ARL. The objective was to restore the radiation levels in the affected areas to within the normal range of natural background for the general area.

On 8 January, 1990, ANSTO and TNT commenced the extraction, transport and storage, at Lucas Heights, of the contaminated material found on the CSIRO property.[6, 7] The operation, which took 11 weeks to complete, was carried out under the guidance and surveillance of This Laboratory which was under contract to Australian Construction Services to represent the interests of ARL.

On 16 July, 1990, the above decontamination team commenced its operation at the ARL property, once again under the observation of This Laboratory. The following report presents the outcome of this decontamination operation.

2. Methodology

This section briefly describes the methods, equipment and criteria used in the decontamination operation.

2.1 Radioactive waste removal

A mechanical excavator was used to extract contaminated soil and load it into lined 205 litre drums, by use of an hopper. The excavator was also used to remove contaminated drainage pipes and crush them prior to drumming. Hand tools were used in those areas inaccessible to the excavator. Other methods of removal included scrubbing and flushing. An average of approximately 70 drums per day were filled, labelled and transported to Lucas Heights by road (up to 80 drums per load).

2.2 Radiological precautions

The radiological precautions taken during the operation included personal and site air sampling, personal monitoring, protective clothing, safety equipment, security fences and the covering of air inlets in buildings to minimise dust entry. Regular monitoring of the decontamination staff and of areas surrounding the local work site was carried out to ensure the minimal spread of contamination. Continuous air sampling at the main air conditioning inlet in ARL Building 21 was carried out during the entire operation.

2.3 Radioactive waste detection

The affected areas were monitored, both during and after extraction of the radioactivity, by use of an Eberline ESP-1 ratemeter (ARL Serial No. 4923) with an Eberline SPA-3 scintillation probe (ARL Serial No. 4922) attached. This instrument is highly sensitive to gamma radiation and high energy beta radiation and can readily detect small variations in background radiation

levels. This instrument is most appropriate for measuring buried material such as the uranium decay products found at CSIRO and ARL.[2, 5] Identical items of monitoring equipment were used by the decontamination team, thus ensuring consistency between on site and inspectorial monitors.

2.4 Range of natural background levels

The range of count rates due to natural background was established for the Eberline instrument from measurements made using the same instrument settings which were maintained throughout the decontamination operation. A minimum background count rate of 85 c.s^{-1} (counts per second) was found at the front nature strip adjacent to Lorimer Street. Maximum count rates of up to 260 c.s^{-1} were found next to any external brick wall on the property. The elevated count rates found near brick walls were due to the naturally occurring radioactivity in brick clay. Count rates which were well in excess of 300 c.s^{-1} were almost exclusively found at radioactive deposits which did not occur on the property naturally. For the Eberline monitor, most of the outdoor measurements of natural background were in the range of 100 to 300 c.s^{-1} .

2.5 Acceptable level of decontamination

The decontamination of an area was considered acceptable to all interested parties when the levels were brought down to within the normal range of natural background. The following criteria was used throughout the decontamination operation.

- (a) A value of 200 c.s^{-1} was the target limit when using the Eberline instrument. This was approximately mid way in the natural background range for that instrument.
- (b) In areas where the count rate may have been affected significantly by

an adjacent brick wall, count rates of up to 300 c.s^{-1} were considered acceptable.

- (d) The acceptability of a decontaminated area was adjudged on inspection by This Laboratory.

2.6 Air sampling measurements

The air sampler filters from Building 21 were measured by use of an high resolution solid state detector, which was connected to a computerized data acquisition and spectral analysis system. This instrument is capable of measuring accurately the radioactive content in samples taken from the natural environment.

3. Radioactivity Removed

Significant levels of radioactivity were detected at various sites on the property.[5] On excavation, the true extent of these finds was revealed. The site positions, numbered in the same order as in the survey report [5], and the areas of the excavations are shown on the property diagram, see Annex 1.

3.1 Site 1

This site was to the north-east of Building 21 and was adjacent to the CSIRO car park.[2, 5] The material removed from this site appeared to be an extension of that found in the CSIRO car park. The material extended along both the northern and eastern sides of Building 21. Apart from the contamination underneath Building 21 [5], this site is now clear of all known contamination.

3.2 Site 2

This site, which was the largest and most difficult of those decontaminated

in this operation, was in the area between Buildings 15, 21, 21 Ext. and 74. The area had recently been disturbed by electrical contractors while laying high voltage cables. The radioactivity had been dispersed and mixed with uncontaminated soil over many years due to the introduction of a large number of services, including gas, water, storm water drainage, sewerage, electrical power and the like. The amount of material removed from this site was considerably larger than expected due to the need to remove the soil contaminated by mixing. A large proportion of the material required removal by use of hand tools and this was particularly time consuming.

Contamination was found below the water table level, but this was only in those areas where the service excavations had been made below that level. There was not any indication of the contamination moving with the ground water flow. The material was evidently incorporated in backfill for the numerous service trenches. It is useful to note that chemical tests, made at This Laboratory on soil samples taken from the site, indicated that the material was not water soluble. This insolubility is why the contamination had not migrated with the ground water flow.

In order to remove contamination, there was a need to support and relocate heavy high voltage equipment from the substations adjacent to Building 74. This necessary work was difficult, time consuming and required considerable expertise. The TNT and ANSTO site team, in particular Richard Horsington and David Penny demonstrated considerable ingenuity in the methods used to support the heavy equipment.

Contamination was found in and around a moulded concrete channel between Buildings 15 and 74. The channel carried asbestos lagged water pipes to the buildings, apparently from a boiler room in Building 76, for heating purposes. All reasonable safety precautions were taken in the removal of

the asbestos, in addition to those precautions already taken for the radioactivity. Asbestos was removed only from those areas where it was necessary for the removal of the radioactivity. The asbestos was drummed and sent to ANSTO for storage.

This site, which joined Site 4 and also extended along the nature-strip adjacent to Building 76, is now clear of all known radioactive contamination apart from a deposit of low level material underneath the footings of Building 74, below the electrical substation on the south-west corner of the building. This material could not be removed completely without compromising the structural integrity of the building.

3.3 Site 3

Radioactive material was indicated underneath Building 21 but the amount could not be estimated accurately.[5] It was demonstrated that the material was well contained and did not present an health hazard to any of the occupants. By joint agreement with the interested parties, this area was not disturbed. Decontamination of this site need not be considered until the building has reached its useful lifetime and is finally demolished.

3.4 Site 4

This site is in the driveway to the south of Building 15. On removal of the driveway concrete, low level contamination was found to cover the full area between Buildings 15 and 72. On removal, an old burial site was found underneath the north-west corner of Building 72. No other contamination was indicated underneath the building. This site joined up with Site 2 and extended along the nature strip adjacent to Building 76. The site is now clear of all known radioactive contamination.

3.5 Site 5

This site is to the north of Building 15, in the lawn and garden area surrounded by Buildings 9, 15 and 66 and by Burma Road.[5] Three isolated deposits of activity were found. Two deposits found in the lawn were disposal locations. The other deposit was in the garden at the north-west corner of Building 15 and beside Burma road. This may have been either a disposal location or fill from another area.

This site was decontaminated with little difficulty and is now clear of all known radioactive contamination.

3.6 Site 6

This site was to the north of Building 66, in a small wire enclosure attached to the side of the building.[5] This small active area gave the highest count rate of all the sites. The wire enclosure, which served as a boundary fence with CSIRO, was removed for access in the decontamination operation.

This site is now clear of all known radioactive contamination.

3.7 Site 7

This site is in the lawn area between Buildings 14, 15 and 36, where three isolated locations had been found. These locations consisting of two small areas of garden fill and one of a few small clods of contaminated material, all of which had been excavated and stored prior to this operation. The contamination from this site was included in that transported from the property in this operation.

This site is clear of all known radioactive contamination.

3.8 Site 8

This site is to the east of Burma road, in the garden to the north of the car park adjacent to Building 19 and is adjacent to Building 72.[5] The contamination was of low level and was removed without particular difficulty.

This site is now clear of all known radioactivity.

3.9 Site 9

A radioactive source was found in the concrete base of the Neene test rig in Building 19.[5] On further investigation, by use of spectral analysis techniques, a small radium source was indicated in the concrete at a depth of approximately 4 cm. The removal of this source was carried out under contract with ARL. This source was not considered to be the responsibility of CSIRO.

The precise location of the source was determined by use of the inspection monitor and a diamond tipped concrete coring drill was used to extract a concrete core which contained the source. A water dam was used to collect run off water used to cool the drill bit and appropriate safety equipment was worn by the drill operator. The core was extracted without the release of any contamination. The concrete core was later broken open to reveal a small needle from an instrument dial which contained a radium based luminous compound.

This site is now clear of all known radioactive contamination.

4. Areas That Required Additional Attention

On completion of the previous decontamination operation at the CSIRO property, additional attention was recommended in the following areas [6]:

- (a) the garden outside Building 72;
- (b) the electrical substation attached to Building 74; and
- (c) two small deposits in the roadway and footpath to the north of Building 61.

The areas indicated in (a) and (c) had been addressed prior to the present operation and (b) was included in this operation as a part of Site 2.

Areas (a), (b) and (c) are clear of all known contamination, apart from the small deposit of low level material beneath the footing of Building 74 (see Site 2).

5. Discussion

The decontamination operation removed 4210 X 205 litre drums (approx. 1300 tonnes) of radioactive waste and contaminated material from the ARL and CSIRO properties. Including the previous operation, [6] a total of 9710 drums (approx. 3000 tonnes) has now been removed.

The operation was carried out efficiently and professionally and used all reasonable safety precautions for the on-site personnel and for those in the surrounding area. It can be demonstrated that ARL staff members were not, as a result of any stage of the operation, exposed to radiation levels in excess of the normal range of natural background. The principle hazards from radioactivity are due to external exposure, inhalation and ingestion. Measurements indicated that the external exposure levels outside the immediate work-sites and at the boundary fence between ARL and CSIRO, either due to exposed material or material stock piled in drums, were not significant above background. The principle mode of transport of contamination from the work-site into the body is by air. Although dust was raised, independent air sampling measurements carried out by ANSTO and by This Laboratory did not detect the presence of airborne contamination

above that normally found. The contamination was found to be of a particle size and form which was unsuitable for air suspension. Laboratory tests indicated that the material was in an insoluble form and therefore had a small biological uptake fraction. The probability of any harmful effects due to inhalation or ingestion were therefore negligible. The heavy consistency of the material, which retards the release of radon gas, and the ample natural ventilation rate, explains the normal radon levels found on the property even when the material was disturbed.[5]

There is one comment which can be made that may be useful to government organisations responsible for future work of this type. Decontamination operations, due to the large number of unknowns involved, must be flexible and open ended. The phrase "excavation by Eberline" which was coined by members of the decontamination team, aptly describes the appropriate approach. If rigid schedules are prepared and enforced remotely from off site, disruptions inevitably occur which reduce the efficiency of the operation. It is advisable to remember that the decontamination team is always in the best position to make the decisions that effect the day to day continuity of the operation. The role of those off site is to ensure total support of those on site.

6. Future Property Management

Now that the ARL and CSIRO properties are clear of the radioactive contamination which was both known and accessible, there is a need to address the problems of:

- (a) possible undetected contamination; and
- (b) the inaccessible contamination.

Undetected contamination is that which may still exist underground but at a depth where it can't be monitored from the ground surface, due to the shielding effects of the covering material. Inaccessible contamination

includes that known to be underneath Buildings 21 and 74. As contamination could be revealed in the future, a long term strategy is required for the management of these properties.

In previous reports [2, 5 & 6] recommendations were made regarding future property management and these are that:

- (a) permanent records, in the form of caveats in the deeds of title, file records and fixed metal plaques, indicate the presence of the inaccessible contamination;
- (b) radiation monitoring be carried out in any future excavations of significant size where long term exposure could occur; and
- (c) if significant contamination is discovered, the matter should be referred, without delay, to This Laboratory or another recognised expert organization capable of assessing the safety implications.

Provided the above recommendations are followed, there should not be any concern regarding the safety issue.

One final comment should be made regarding future responsibility. CSIRO was clearly responsible for depositing the radioactive contamination on the Fishermens Bend property and rightly took responsibility for its removal. All reasonable efforts should be made to ensure that if additional contamination is revealed in the future, the responsibility to remove it should remain with CSIRO irrespective of any future transfer of property ownership.

7. Acknowledgements

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8. References

- [1] Commonwealth Scientific and Industrial Research Organization (CSIRO), Sixth Annual Report (for the year ending 30 June 1954).

- [2] Owen J. Wilson, "Radiation Survey of the CSIRO Applied Organic Chemistry Division, Lorimer Street, Fishermen's Bend", Australian Radiation Laboratory, March 31, 1989, under contract to The Australian Construction Services.

- [3] Minutes of the CSIRO Task Force on Fishermens Bend Radioactivity, held at the CSIRO Division of Mineral Products, Port Melbourne, 22 June, 1989.

- [4] P. Wright, J. Sykes, B. O'Brien and G. Collings, "Radiation Survey of the CSIRO Applied Organic Chemistry Division, Lorimer Street, Fishermen's Bend, Melbourne", ANSTO, May, 1989, under contract to CSIRO.

- [5] Owen J. Wilson, "Radiation Survey of the Aeronautical Research Laboratory, Lorimer Street, Fishermen's Bend (CSIRO waste only)", Australian Radiation Laboratory, 9 June, 1989, under contract to The Australian Construction Services.

- [6] Owen J. Wilson, "Radioactive Decontamination of the Former CSIRO Applied Organic Chemistry Division Lorimer Street Fishermens Bend", Australian Radiation Laboratory, 29 March, 1990, under contract to The Australian Construction Services.

- [7] "Removal of Radioactive Contaminated Materials - CSIRO Fishermens Bend Site, Melbourne", ANSTO Project Report, May 1990.

Annex 1: Property Diagram

