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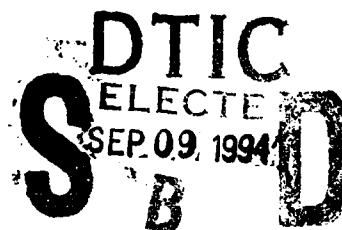


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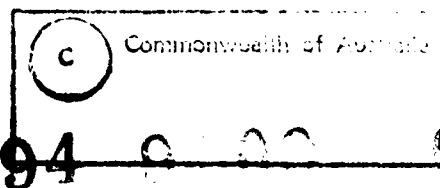
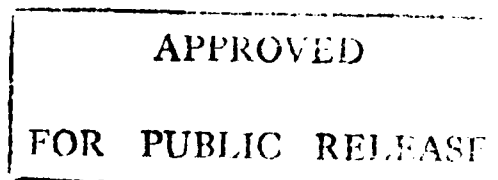
Department of Defence

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**VISITS BY
NUCLEAR POWERED WARSHIPS
TO AUSTRALIAN PORTS**

Report on Radiation Monitoring During 1993



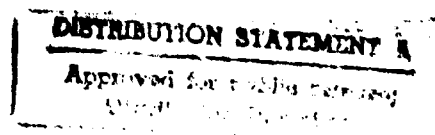
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Canberra, Australia
May 1994

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**VISITS BY
NUCLEAR POWERED WARSHIPS
TO AUSTRALIAN PORTS**

Report on Radiation Monitoring During 1993

**Department of Defence
Canberra, Australia
May 1994**

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SUMMARY

Visits were made by ten Nuclear Powered Warships (NPWs) of the United States Navy and one NPW of the Royal Navy to Australian ports in 1993 as follows:

Port	Ship	Dates
Hobart	USS TOPEKA	6-10 January
	USS NEW YORK CITY	4-8 November
Melbourne	USS TRUXTUN	2-7 March
Darwin	USS HOUSTON	25-31 March
HMAS STIRLING	HMS TRIUMPH	11-31 May
Western Australia	USS BREMERTON	28 May - 2 June
	USS BIRMINGHAM	1-12 July
	USS PASADENA	10-16 November
	USS TUNNY	19-27 December
Fremantle (Gage Roads)	USS ABRAHAM LINCOLN	12-17 November
Brisbane	USS BIRMINGHAM	21-26 July
	USS WILLIAM H. BATES	3-8 August
	USS NEW YORK CITY	24 October

The Commonwealth Government requires that a radiation monitoring program be carried out in association with each visit to detect any release of radioactivity to the ports and their environs.

This report presents a summary of the objectives and requirements of the NPW radiation monitoring program, describes the implementation of the program for the visits during 1993 and records the results of radiation measurements taken in the ports visited.

No releases of radioactive material were detected, nor were any radiation levels recorded in excess of normal background levels of ionising radiation, either during or subsequent to these visits.

Accession For	
NTIS	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail. Codes
A-1	Special

PART I — GENERAL

INTRODUCTION

1. Visits were made by ten Nuclear Powered Warships (NPWs) of the United States Navy and one NPW of the Royal Navy to Australian ports in 1993. The Commonwealth Government requires that a radiation monitoring program be carried out in association with such visits to detect any release of radioactivity to the ports or their environs or any increase in external radiation levels above those due to natural background radiation.
2. This report presents a summary of the objectives and requirements of the NPW radiation monitoring program, describes the implementation of the program for the visits during 1993 and records the results of radiation measurements taken.

THE RADIATION MONITORING PROGRAM

3. The requirements for the monitoring program are laid down in 'Environmental Radiation Monitoring During Visits of Nuclear Powered Warships to Australian Ports — Requirements, Arrangements and Procedures, Department of Defence, May 1988'. These requirements were previously published in the 'Report and Guidelines on Environmental Radiation Monitoring During Visits to Australian Ports by Nuclear Powered Warships, Department of Science and Environment, September 1979'.
4. The monitoring program has two main components:
 - a. environmental monitoring, designed to detect the release of any radioactive material (eg waste) to the environment; and
 - b. direct radiation monitoring, designed to provide warning of any malfunction of the reactor of an NPW while in port, which might lead to a release of radioactivity.

Environmental Monitoring

5. The environmental radiation monitoring program is intended to provide assurance that there has been no infringement of Australian public health standards because of the release of radioactive material from the waste control and retention systems of a visiting NPW.
6. The relevant Australian public health standards are those endorsed by the National Health and Medical Research Council in 1980 ('Recommended Radiation Protection Standards for Individuals Exposed to Ionising Radiation', AGPS, 1981). These standards relate to permissible ionising radiation doses received by individuals from both external radiation sources and from the intake of radionuclides in air, water and foodstuffs.
7. **Internal radiation.** Internal radiation exposure of individuals could follow consumption of seafoods should these become contaminated with radioactive waste material. Accordingly, a marine environmental monitoring program is implemented to take samples of the surface layer of the bottom sediment and selected seafoods or seaweed (where available) from the vicinity of approved berths and anchorages.
8. These samples are analysed for evidence of cobalt-60 and other artificial gamma ray emitting radionuclides known to characterise the radioactive waste likely to be held in an NPW.

9. **External radiation.** When an NPW is at an alongside berth, gamma radiation surveys are undertaken at the wharf in those areas in the vicinity of the vessel designated as free for access by the public or by port employees. Surveys are made initially on the vessel's arrival and periodically thereafter for the duration of the visit using portable dose rate meters capable of measuring ionising radiation dose rates down to 0.01 $\mu\text{Sv/h}$.

10. **Thermoluminescent dosimeters.** In order to record the accumulated ionising radiation doses that might be received in the port environs following an accidental release of airborne radioactivity, a number of thermoluminescent dosimeters (TLDs) are placed at selected locations. The TLDs remain in position during the period that an NPW is in port or, in the event of an accident, would remain in position until the termination of the accident. Control TLDs are exposed at the Australian Radiation Laboratory (ARL) in Melbourne and also in the port being visited, but remote from the NPW to provide a comparison with the TLDs exposed in the field. Field and control TLDs are returned to the ARL for measurement.

Direct Radiation Monitoring

11. In order to provide early warning of an NPW reactor malfunction at an alongside berth, fixed radiation detectors are located in the vicinity of the vessel to provide continuous monitoring of gamma radiation levels. The detectors cover the range 0.01 $\mu\text{Sv/h}$ to 100 mSv/h with an audible alarm set to trigger at a level of 1 $\mu\text{Sv/h}$. A significant release of radioactivity into the interior of the vessel from the reactor would be detected and initiate an alarm.

PROGRAM IMPLEMENTATION

The Monitoring Program

12. Groups which consist of members from the Australian Nuclear Science and Technology Organisation (ANSTO), the Health and Environmental authorities of the host State or Territory and the Royal Australian Navy (RAN) undertake the external radiation monitoring program. The composition of the groups varies in different ports; however, the Leader of the Radiation Monitoring Group is always a radiation protection officer from ANSTO.

13. The marine environmental monitoring program is a joint undertaking by the Australian Radiation Laboratory (ARL) of the Commonwealth Department of Human Services and Health and either the State concerned or, where the berth is in a naval establishment, the RAN. The collection of samples of sediment and seafood or seaweed is carried out by State authorities or by the RAN, nominally at quarterly¹ intervals at approved berths and anchorages. Samples are also taken prior to and immediately after each visit. The analysis and measurement of samples is undertaken by ARL. Details of the measurement method and detection capability are presented in Part III.

14. The routine sampling program maybe discontinued at NPW berths and anchorages which are visited infrequently or where an adequate database has been established. When an NPW subsequently visits such a berth, samples are taken prior to and immediately after the visit and a further set of samples taken three months later.

Contingency Arrangements

15. Port safety organisations have been established at all ports approved for NPW visits and arrangements made so that in the event of a reactor accident they would be activated immediately. Simultaneously, radiation surveys would be initiated by Commonwealth officers in order to identify any radiation hazards. Prior to each visit, the Port Safety Organisation is brought to a state of

1 In practice, quarterly generally means 14 days either side of the end of the quarter. Should pre- or post-visit samples * be within two weeks of the due date for routine sampling, then the same set of samples will suffice for the routine and either pre- or post-visit samples. Authorities occasionally have difficulty in obtaining samples within these time scales.

readiness and briefings are conducted to familiarise key participants with the operational procedures and the tasks required of them in the event of an accident. Normally, an exercise is conducted prior to an NPW visit involving key members of the Port Safety Organisation.

PART II — NUCLEAR POWERED WARSHIP VISITS IN 1993

HOBART TASMANIA

VISIT BY USS TOPEKA

1. USS TOPEKA, a nuclear powered Los Angeles class attack submarine of the US Navy, visited Hobart during the period 6–10 January 1993, anchoring at the approved designated anchorage in the Derwent River.

Radiation Monitoring

2. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located on the bridge of AM(T) WALLAROO anchored 300 metres from USS TOPEKA and which was manned continuously.

Results

3. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.05 $\mu\text{Sv h}$, indicating no significant variation above the natural background level.

4. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Hobart and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS NEW YORK CITY

5. USS NEW YORK CITY, a nuclear powered Los Angeles class attack submarine of the US Navy, visited Hobart during the period 4–8 November 1993, anchoring at the approved designated anchorage in the Derwent River.

Radiation Monitoring

6. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located on the bridge of AM(T) WALLAROO anchored 300 metres from USS NEW YORK CITY and which was manned continuously.

Results

7. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.05 $\mu\text{Sv/h}$, indicating no significant variation above the natural background level.

8. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Hobart and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

MELBOURNE VICTORIA

VISIT BY USS TRUXTUN

9. USS TRUXTUN, a nuclear powered Truxtun class cruiser of the US Navy, visited Melbourne during the period 2-7 March 1993, berthing at the approved berth on Breakwater Pier at Williamstown.

Radiation Monitoring

10. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Port of Melbourne Authority building on Breakwater Pier 150 metres from USS TRUXTUN and which was manned continuously.

Results

11. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.10 $\mu\text{Sv h}$, indicating no significant variation above the natural background level.

12. TLDs were exposed at seven designated locations during the visit. Control TLDs were held in Melbourne and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

DARWIN NORTHERN TERRITORY

VISIT BY USS HOUSTON

13. USS HOUSTON, a nuclear powered Los Angeles class attack submarine of the US Navy, visited Darwin during the period 25-31 March 1993, berthing at the approved designated position, No. 5 Naval Buoy off Stokes Hill Wharf.

Radiation Monitoring

14. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located on the bridge of AM(T) TAMMAR anchored 300 metres from USS HOUSTON and which was manned continuously.

Results

15. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.05 $\mu\text{Sv h}$, indicating no significant variation above the natural background level.

16. TLDs were exposed at eight designated locations during the visit. Control TLDs were held in Darwin and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

HMAS STIRLING, GARDEN ISLAND, WESTERN AUSTRALIA

VISIT BY HMS TRIUMPH

17. HMS TRIUMPH, a nuclear powered Trafalgar class attack submarine of the Royal Navy, visited HMAS STIRLING during the period 11-31 May 1993, berthing at the Destroyer Wharf.

Radiation Monitoring

18. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Guardhouse and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand-held dose rate meters in the areas around the vessel which were accessible to personnel on the base.

Results

19. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.12 $\mu\text{Sv/h}$ indicating that there was no observable increase in the external gamma radiation level above background.

20. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS BREMERTON

21. USS BREMERTON, a nuclear powered Los Angeles class attack submarine of the US Navy, visited HMAS STIRLING during the period 28 May - 2 June 1993, berthing at the Submarine Wharf.

Radiation Monitoring

22. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Guardhouse and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand-held dose rate meters in the areas around the vessel which were accessible to personnel on the base.

Results

23. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.12 $\mu\text{Sv/h}$ indicating that there was no observable increase in the external gamma radiation level above background.

24. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS BIRMINGHAM

25. USS BIRMINGHAM, a nuclear powered Los Angeles class attack submarine of the US Navy, visited HMAS STIRLING during the period 1-12 July 1993, berthing at the Submarine Wharf.

Radiation Monitoring

26. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Guardhouse and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand-held nuclear powered dose rate meters in the areas around the vessel which were accessible to personnel on the base.

Results

27. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.12 $\mu\text{Sv h}$ indicating that there was no observable increase in the external gamma radiation level above background.

28. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS PASADENA

29. USS PASADENA, a nuclear powered Los Angeles class attack submarine of the US Navy, visited HMAS STIRLING during the period 10-16 November 1993, berthing at the Submarine Wharf.

Radiation Monitoring

30. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Guardhouse and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand held dose rate meters in the areas around the vessel which were accessible to personnel on the base.

Results

31. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.12 $\mu\text{Sv h}$ indicating that there was no observable increase in the external gamma radiation level above background.

32. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS TUNNY

33. USS TUNNY, a nuclear powered Los Angeles class attack submarine of the US Navy, visited HMAS STIRLING during the period 19-27 December 1993, berthing at the Submarine Wharf.

Radiation Monitoring

34. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located in the Guardhouse and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand held dose rate meters in the areas around the vessel which were accessible to personnel on the base.

Results

35. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.12 $\mu\text{Sv/h}$ indicating that there was no observable increase in the external gamma radiation level above background.

36. TLDs were exposed at six designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

FREMANTLE (GAGE ROADS)

VISIT BY USS ABRAHAM LINCOLN

37. USS ABRAHAM LINCOLN, a nuclear powered Nimitz class aircraft carrier of the US Navy, visited Fremantle during the period 12-17 November 1993, anchoring at the approved designated anchorage in Gage Roads.

Radiation Monitoring

38. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment which was located on the bridge of TRV TAILOR which was anchored 500 metres from USS ABRAHAM LINCOLN and which was manned continuously.

Results

39. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.05 $\mu\text{Sv/h}$ indicating that there was no observable increase in the external gamma radiation level above background.

40. TLDs were exposed at five designated locations during the visit. Control TLDs were held in Perth and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

BRISBANE QUEENSLAND

VISIT BY USS BIRMINGHAM

41. USS BIRMINGHAM, a nuclear powered Los Angeles class attack submarine of the US Navy, visited Brisbane during the period 21-26 July 1993, berthing at No. 1 Wharf, Fisherman Islands.

Radiation Monitoring

42. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment located in a State Emergency Services caravan which was located on the Grain Wharf, approximately 50 metres from USS BIRMINGHAM and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dose rate meters in the areas around the vessel which were accessible to personnel on the wharf.

Results

43. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.14 $\mu\text{Sv/h}$, indicating no significant variations above the natural background level.

44. TLDs were exposed at eight designated locations during the visit. Control TLDs were held in Brisbane and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS WILLIAM H. BATES

45. USS WILLIAM H. BATES, a nuclear powered Sturgeon class attack submarine of the US Navy, visited Brisbane during the period 3-8 August 1993, berthing at No. 1 Wharf, Fisherman Islands.

Radiation Monitoring

46. Throughout the visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before the vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment located in a State Emergency Services caravan which was located at the western end of the wharf, approximately 50 metres from USS WILLIAM H. BATES and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dose rate meters in the areas around the vessel which were accessible to personnel on the wharf.

Results

47. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.14 $\mu\text{Sv/h}$, indicating no significant variations above the natural background level.

48. TLDs were exposed at eight designated locations during the visit. Control TLDs were held in Brisbane and at ARL. The range of dose measurements from the TLDs for the visit showed no obvious increase above the normal range of background levels.

VISIT BY USS NEW YORK CITY

49. USS NEW YORK CITY, a nuclear powered Los Angeles class attack submarine of the US Navy, visited Moreton Bay on 24 October 1993, to rendezvous with a boat from HMAS MORETON to land two US Navy personnel and embark three RAN personnel and stores in preparation for Exercise LUNGFISH. USS NEW YORK CITY entered Moreton Bay at 1100, carried out the transfer off Tangalooma Point at 1330 and left the bay at 1600.

50. The Port of Brisbane Port Safety Plan for nuclear powered warship visits was placed on standby for the period that USS NEW YORK CITY was within Moreton Bay. The emergency response team, and a C130 aircraft to convey the team and equipment, were placed on three hours notice to react at the Research Laboratory at Lucas Heights and the RAAF Base at Richmond respectively, for the period.

51. No radiation monitoring or marine environmental sampling was appropriate in the circumstances.

PART III — MARINE ENVIRONMENTAL SAMPLING

Measurement Method

1. Each sample is measured for at least 10 000 seconds, in a standard geometry, in a low background gamma ray spectrometer with a hyperpure germanium detector. Each gamma ray spectrum is scrutinised over the energy range of 50 to 1500 KeV for evidence of cobalt-60 and other artificial gamma ray emitting radionuclides.

Detection Capability

2. The measurement method used has sufficient sensitivity to detect concentrations of gamma ray emitting radionuclides in shellfish which, based upon typical intakes of shellfish, would result in no more than one per cent of the annual limits for members of the public as given in the **1990 Recommendations of the International Commission on Radiological Protection (ICRP Publication 60)** which are currently in the process of being adopted for Australia by the National Health and Medical Research Council.

3. For surface layer of bottom sediment, the measurement method used has sufficient sensitivity to detect artificial gamma ray emitting radionuclides at concentrations at least as low as 40 millibecquerels per gram of sediment.

Marine Environmental Monitoring

4. Marine environmental samples appropriate to each berth visited in Hobart, Melbourne, Darwin, HMAS STIRLING, Gage Roads (Fremantle) and Brisbane were collected according to the agreed sampling program, except for the visit of USS NEW YORK CITY to Moreton Bay on 24 October 1993. Such sampling was inappropriate in the circumstances because of the location and brevity of the visit.

5. All samples were analysed at ARL. Certificates of analysis issued by ARL showed that no radionuclide was detected that would be characteristic of the radioactive waste associated with NPW operations.

PART IV — CONCLUSIONS

1. The program of radiation monitoring and marine environmental sampling implemented for visiting NPWs during 1993 was consistent with the Commonwealth Government's requirements.
2. There was no indication of any infringement of Australian public health standards. Radiation monitoring did not detect any release of radioactive materials, nor did radiation measurements indicate any value in excess of background levels of ionising radiation either during or subsequent to these visits.