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**Visits by
Nuclear-powered Warships
to Australian Ports**

Report on Radiation Monitoring During 1992

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**Canberra, Australia
September 1993**

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

Report on Radiation Monitoring During 1992

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CONTENTS**SUMMARY**

- PART I - GENERAL**
The Radiation Monitoring Program
Program Implementation
- PART II - NUCLEAR-POWERED WARSHIP VISITS IN 1992**
- PART III - MARINE ENVIRONMENTAL MONITORING**
- PART IV - CONCLUSIONS**

SUMMARY

Visits were made by seven nuclear-powered warships (NPW) of the United States Navy to Australian ports in 1992 as follows:

Port	Ship	Dates
Brisbane	USS PUFFER	20 - 25 February
	USS CHICAGO	6 - 11 May
	USS OMAHA	14 - 17 December
Townsville	USS CHICAGO	13 - 18 May
	USS DRUM	3 - 7 August
Melbourne	USS OMAHA	2 - 5 December
HMAS STIRLING Western Australia	USS TOPEKA	29 December 1992 - 2 January 1993

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 1992 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.

PART I — GENERAL

INTRODUCTION

1. Visits were made by seven NPW of the United States Navy to Australian ports in 1992. 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 1992 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. Portable 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 experienced in the port environs following an accidental release of airborne radioactivity, a number of thermoluminescent dosimeters (TLD) are placed at selected locations. The TLD 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 TLD 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 TLD exposed in the field. Field and control TLD 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 0.01S $\mu\text{v/h}$ to 100 m Sv/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 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 Health, Housing, Local Government and Community Services 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 may be 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 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.

¹ In practice, quarterly generally means 14 days either side of the end of the quarter. Should pre- or post-visit samples fall 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.

PART II — NUCLEAR-POWERED WARSHIP VISITS IN 1992

BRISBANE QUEENSLAND

VISIT BY USS PUFFER

1. USS PUFFER, a nuclear-powered Sturgeon class attack submarine of the US Navy, visited Brisbane during the period 20–25 February 1992, berthing at No 1 Wharf, Fisherman Islands.

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 located in a State Emergency Services caravan which was located on the Grain Wharf, approximately 150 metres from USS PUFFER and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dosimeters in the areas around the vessel which were accessible to personnel on the wharf.

Results

3. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.1 to 0.15 $\mu\text{Sv h}$, indicating no significant variations above the natural background level.

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

VISIT BY USS CHICAGO

5. USS CHICAGO, a nuclear-powered Los Angeles class attack submarine of the US Navy, visited Brisbane during the period 6–11 May 1992, berthing at No 1 Wharf, Fisherman Islands outboard of the submarine tender USS PROTEUS.

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 located in a State Emergency Services caravan which was located at the western end of the wharf, approximately 50 metres from USS CHICAGO and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dosimeters in the areas around the vessel which were accessible to personnel on the wharf.

Results

7. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.04 to 0.15 $\mu\text{Sv h}$, indicating no significant variations above the natural background level. It was established that USS PROTEUS created a shielding effect and action was taken to preclude future berthing arrangements which affect the efficiency of monitoring equipment.

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

VISIT BY USS OMAHA

9. USS OMAHA, a nuclear-powered Los Angeles class attack submarine of the US Navy, visited Brisbane during the period 14-17 December 1992, berthing at No 1 Wharf, Fisherman Islands.

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 located in a State Emergency Services caravan which was located on the wharf, approximately 100 metres from USS OMAHA, and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dosimeters in the areas around the vessel which were accessible to personnel on the wharf.

Results

11. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.1 to 0.15 $\mu\text{Sv/h}$, indicating no significant variations above the natural background level.

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

TOWNSVILLE QUEENSLAND

VISIT BY USS CHICAGO

13. USS CHICAGO, a nuclear-powered Los Angeles class attack submarine of the US Navy, visited Townsville during the period 13-18 May 1992, berthing at No 2 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 located in a State Emergency Services caravan which was located on the wharf, approximately 100 metres from USS CHICAGO and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dosimeters in the areas around the vessel which were accessible to personnel on the wharf.

Results

15. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.05 to 0.2 $\mu\text{Sv/h}$, indicating no significant variation above the natural background level.

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

VISIT BY USS DRUM

17. USS DRUM, a nuclear-powered Sturgeon class attack submarine of the US Navy, visited Townsville during the period 3-7 August 1992, berthing at No 2 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 located in a State Emergency Services caravan which was located on the wharf, approximately 100 metres from USS DRUM and which was manned continuously. In addition, measurements of gamma radiation levels were taken using hand-held dosimeters in the areas around the vessel which were accessible to personnel on the wharf.

Results

19. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit were in the range 0.12 to 0.2 $\mu\text{Sv h}$, indicating no significant variation above background level.

20. TLD were exposed at seven designated locations during the visit. Control TLD were held in Townsville and at ARL. The range of dose-rate measurements from the TLD for the visit showed no obvious increase above the normal range of background levels.

MELBOURNE VICTORIA

VISIT BY USS OMAHA

21. USS OMAHA, a nuclear-powered Los Angeles class attack submarine of the US Navy, visited Melbourne during the period 2-5 December 1992, anchoring at the approved anchorage in Port Phillip Bay and 4.2 kilometres south of Point Gellibrand.

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 on the bridge of AM(T) WALLAROO anchored 400 metres from USS OMAHA and which was manned continuously.

Results

23. The gamma radiation dose rates measured by both fixed and portable monitoring equipment during the visit averaged 0.08 $\mu\text{Sv h}$, indicating no significant variation above the natural background level.

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

HMAS STIRLING, GARDEN ISLAND, WESTERN AUSTRALIA

VISIT BY USS TOPEKA

25. USS TOPEKA, a nuclear-powered Los Angeles class attack submarine of the US Navy, visited HMAS STIRLING during the period 29 December 1992-2 January 1993, berthing at the Escort 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 HMAS ADELAIDE berthed at the Escort Wharf and which was manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand-held doseimeters 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 $0.07 \mu\text{Sv}\cdot\text{h}$ indicating that there was no observable increase in the external gamma radiation level above background.

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

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 Brisbane, Townsville and Melbourne were collected according to the agreed sampling program. A dysfunction in the sampling program for HMAS STIRLING resulted in no pre-visit sampling being collected, and only post-visit shellfish and sediment samples being collected. The matter has been resolved and remedial action taken.

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 NPW during 1992 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.*