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THE INVOLVEMENT OF THE
ROYAL NEW ZEALAND NAVY IN THE BRITISH NUCLEAR
TESTING PROGRAMMES OF 1957 AND 1958

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GLOSSARY

Absorbed dose: Some of the energy of ionising radiation is transferred to the matter through which it passes. The absorbed dose is the amount of energy transferred to a unit mass of material (1 gray (q.v.) = 1 joule per kilogram).

Activation: Some of the neutrons released in fission are captured by atoms in the surrounding materials, e.g. soils, structural materials or atmospheric gases. Many of the resulting atoms are radioactive and are known as activation products. This process of producing radioactive materials is known as activation, producing 'induced radioactivity' (q.v.).

Air burst: A nuclear explosion at such a height that the expanding fireball does not touch the earth's surface.

Alpha radiation: Some radioactive elements, particularly those with a high atomic number decay by emitting a positively charged particle, the alpha particle, which is identical with the nucleus of a helium atom. Alpha radiation has very little penetrating power, but it may present a serious hazard if alpha emitters are inhaled or ingested.

Background radiation: The naturally occurring radioactive isotopes in the surroundings and in biological tissue produce a background radiation. Cosmic rays also contribute to the background radiation.

Background reading on instruments: Unavoidable reading on any instrument measuring radiation, usually caused by background radiation and instrumental effects.

Beta radiation: Some radioactive elements emit from the nucleus charged particles of low mass called beta particles, which are identical to the electrons in the atom. Fission products generally emit negative beta particles. Beta particles have a penetrating power intermediate between that of alpha and gamma radiation.

Contamination: The deposit of radioactive material on or within structures, land, people or animals following dispersal of the radioactive material, e.g. by a nuclear explosion or dust raising activities.

Decontamination: The removal or reduction of contaminating radioactive material from persons, equipment, structures or areas.

Dose: The amount of energy delivered to a mass of material by ionising radiation passing through it.

Fallout: The descent to the earth's surface of particles contaminated with radioactivity, following the dispersion of radioactive material into the atmosphere by a nuclear explosion. The term is applied both to the process and, in a collective sense, to the particulate matter. The early fallout consists of the particles which reach the earth's surface within

24 hours. The delayed fall-out consists of smaller particles which may be carried by wind to great distances and even completely around the earth many times before descent.

Fast neutron: Neutrons produced by neutron reactions or resulting from fission of fissile materials but which have lost relatively little of their initial energy as a result of collisions with atoms.

Film badge: A plastic holder containing a piece of film usually the size of a dental X-ray film. The film is subsequently developed and the degree of darkening is a measure of the radiation dose received. The film holder usually contains various metal filters to provide some discrimination for different types and energies of radiation.

Fireball: Almost immediately after a nuclear explosion the residues and surrounding materials form an intensely hot and luminous mass, the fireball. This expands and rises rapidly, cooling in the process.

Fission: The process whereby the nucleus of a heavy element, e.g. uranium or plutonium, splits into two nuclei of lighter elements (fission products: q.v.) accompanied by the release of substantial amounts of energy.

Fission products: The complex mixture of substances produced in the process of nuclear fission. The primary fragments produced in fission are themselves radioactive, and decay through a succession of radioactive isotopes until a stable form is reached.

Fusion: The process in which the nuclei of light elements, in particular the isotopes of hydrogen, deuterium and tritium, combine to form a nucleus of a heavier element accompanied by the release of substantial amounts of energy. Fusion reactions can only be initiated by very high temperatures in excess of about ten million degrees Celsius; in thermonuclear or 'hydrogen' weapons such temperatures are provided by a boosted fission explosion.

Gamma radiation: Most radioactive elements emit from the nucleus electromagnetic radiation called gamma rays. Gamma radiation is penetrating and can cause radiation exposure many tens of metres from external sources. It is also the radiation that is most readily measured by monitoring equipment such as film badges and dosimeters.

Gray: The SI unit of absorbed dose (q.v.). The gray replaced the rad (q.v.) as the unit of absorbed dose (1 gray = 100 rad).

Ground zero: The point on the ground surface at, or directly below, the initiating point of a nuclear explosion.

Induced radioactivity: The radioactivity of nuclides produced from naturally stable nuclides, as the result of nuclear reactions with neutrons. Radioactivity is induced in materials close to a nuclear explosion by the absorption of the neutrons given off by the explosion.

Milliroentgen: The one-thousandth part of a roentgen.

Rad: The former unit of absorbed dose (q.v.). It was defined as the absorption of 100 ergs per gram and is equivalent to 1/100 of 1 gray.

Roentgen: The old unit exposure to X-rays or gamma radiation. It is defined as the quantity of radiation that will produce 2.58×10^{-4} coulombs per kilogram of dry air. An exposure of 1 roentgen is roughly (equivalent to an absorbed dose of 1 rad (q.v.), or 0.01 gray (q.v.), in soft tissue.

Thermonuclear: The process of fusion of light nuclei at a very high temperature, such as occurs in hydrogen bombs.

X-radiation: Electromagnetic radiations of energy between that of ultraviolet and gamma rays. Much of the initial release of energy from a nuclear explosion is in the form of thermal and X-radiation which is dissipated in the immediately surrounding media as heat to generate the fireball.

Yield: The effective energy released immediately in a nuclear explosion. The residual nuclear radiation associated with the fission products, which amounts to about 10 per cent of the total fission energy, is not included in the yield. Yield is usually expressed as TNT equivalent - the quantity of TNT that would release the same amount of energy if exploded. Yield is usually given in kilotons or megatons, one kiloton of TNT being defined arbitrarily as 4.18×10^{12} joules.

CHAPTER I : INTRODUCTION

In order to understand how the Royal New Zealand Navy came to play a small but significant part in the United Kingdom's nuclear testing programme in the Pacific during 1957 and 1958, it is necessary to appreciate the extent to which New Zealand's foreign and defence policies then centred on the Commonwealth¹. The New Zealand Government supported the production and testing of atomic and thermonuclear weapons by the United Kingdom because it believed that this would materially enhance the security of New Zealand and the rest of the Commonwealth². It was therefore hardly surprising that the New Zealand Government should direct the Armed Forces to assist in the British nuclear testing programme, indeed the RNZN contribution to the programme was simply a somewhat unusual facet of the close Commonwealth defence relationship which dominated much of the Armed Forces' plans and activities³.

The threatening state of international affairs during the late 1940s and 1950s made the development of atomic and later thermonuclear weapons by the United Kingdom a matter of vital national policy⁴. Central to the success of the atomic weapons programme was access to suitable test sites. In 1952, after considering various options, the British Government reached agreement with Australia for the use of the Monte Bello Islands

off the north west Australian coast, as the site for Britain's first atomic weapon test⁵, which was successfully conducted on the 3rd of October 1952⁶.

The Royal New Zealand Air Force played a minor part in monitoring radioactive fallout from this test, which was known as Operation Hurricane. Three aircraft based at Whenuapai made flights to the north and south of Auckland while another aircraft made a return flight to Suva. Apparently all but one of these aircraft "collected significant radioactivity"⁷. The Royal Commission into British Nuclear Tests in Australia, however, concluded that "the air sampling operations out of Townsville [by the Royal Australian Air Force] and New Zealand collected filter samples having a level of radioactivity which would produce very low radiation exposures for the aircrew; aircraft contamination levels were well below permissible levels"⁸.

Operation Hurricane was followed by further tests at the Monte Bello Islands in 1956 and in South Australia at Emu Field in 1953 and at Maralinga in 1956 and 1957⁹. Five New Zealand officers were members of the Indoctrinee Force which took part in the atomic tests at Maralinga in 1956 known as Operation Buffalo¹⁰. During the following year two New Zealand officers observed the Operation Antler tests at Maralinga¹¹.

During 1954 the British Government made a formal decision to develop thermonuclear weapons¹². Once this step had been taken the search began for a suitable site to test the new weapons. Because the atomic testing agreement between the United Kingdom and Australia ruled out the testing of thermonuclear weapons in Australia a new test site had to be found¹³. The British Air Ministry's Trials Planning Section which was charged with organising the thermonuclear weapons tests considered a variety of possible test sites around the world. Eventually they concluded that "the most promising site" was New Zealand's Kermadec Islands, which lie 965 kilometres north east of Auckland. In mid-May 1955 Sir Anthony Eden, the British Prime Minister sent his New Zealand counterpart, Sydney Holland, a personal message asking the New Zealand Government to approve in principle the use of the Kermadec Islands for thermonuclear tests. Eden stressed the apparent suitability of the islands and expressed the earnest "hope that, in the interests of our common defence effort and the importance of the deterrent for Commonwealth strategy, you will find it possible to agree". The British planned to conduct their first test in the Kermadecs in early 1957. The thermonuclear device was to be mounted on a tower on one of the islands or on a ship anchored near the shore (the method used for the first British atomic test).¹⁴

Although the British Prime Minister emphasized that the location of the Kermadecs "in relation to other land, their weather and winds, suggest that here would be a completely safe site" to

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conduct the tests, Holland was, it appears, from the outset rather disturbed by the British proposal. He obtained background information on the Kermadec Islands from the Minister of Defence,¹⁵ and consulted Dr Ernest Marsden, a physicist and a former head of the Department of Industrial and Scientific Research about the use of the Kermadecs as a test site.

Marsden reported to the Prime Minister during July 1955 that both Raoul and Macauley Islands were probably suitable for use as thermonuclear test sites. He estimated that New Zealand would not be able to use the weather station on Raoul Island for up to a year after a test and that the vegetation on the island used for the test would recover from damage within a few years. Even though Marsden had what now seems an overly optimistic view of the likely effects of the tests, he questioned the advisability of allowing them to take place in the Kermadecs. In his view, "the sacrifice and difficulties" entailed in using the islands as a test site and the public opposition to such a course of action outweighed other factors, such as New Zealand's desire to assist with Commonwealth defence preparations. As an alternative, Marsden suggested that Auckland Island would provide a safe site for the tests, although it was in some respects not as convenient as the Kermadecs.¹⁶

Holland shared Marsden's reservations. Early in 1955, during Commonwealth defence discussions in London, Sir Winston Churchill

spoke about thermonuclear weapons and left Holland with "the impression that it was not possible to exaggerate the terrifying magnitude of an H-bomb explosion".¹⁷ The unfavourable public response to reports in early 1955 that the United Kingdom intended testing thermonuclear weapons in Antarctica suggested to Holland that there would be a "howl" if tests were conducted in the Pacific. The New Zealand Prime Minister seems to have considered urging the United Kingdom to approach the United States about using their testing facilities.¹⁸

It appears that late in August 1955, Holland verbally informed Sir Geoffrey Scoones, the British High Commissioner in Wellington, that New Zealand was not able to agree to the use of the Kermadec Islands for thermonuclear tests because of "political and other problems". After learning of New Zealand's decision, Eden wrote to Holland expressing his disappointment "that you did not feel able to help us". He then explained that the United Kingdom was:

now considering the possibility of using some other less suitable site in the central Pacific. The practical difficulties are however likely to be serious and if we fail to find an acceptable alternative I may be compelled to ask you whether you would reconsider the matter.

Eden went on to ask if the Royal New Zealand Navy's survey ship HMNZS LACHLAN could carry out a survey of some of the islands being

considered as test sites.¹⁹ New Zealand was happy to provide this assistance and during January and February 1956 the LACHLAN surveyed the Northern and Southern Line Islands. On board for the survey were Commander J. Paton RN and Captain P.S. Wadsworth RE, who were members of the team responsible for planning the thermonuclear tests, which were code-named Operation Grapple.²⁰

After the conclusion of the survey, and an aerial reconnaissance by the Royal Air Force, the Trials Planning Section concluded that Christmas Island, one of the Northern Line Islands in the Pacific just to the south of the Equator, was the best available base for the testing programme²¹. It was decided to conduct the first test series at Malden Island situated about 700 kilometres south east of Christmas Island. At this time both Christmas Island and Malden Island were administered by the United Kingdom, whereas they now form part of the Republic of Kiribati²². They were selected primarily because of their isolation; Christmas Island, for instance is more than a 1000 kilometres from the nearest inhabited island. The fact that Malden Island was uninhabited and that Christmas Island had only a small native population were also significant considerations²³.

In March 1956, Eden asked New Zealand to allow the establishment during the testing programme of a radio station, radio navigational aids and a weather station on Penrhyn Island, one of the Northern Cook Islands lying about 650 kilometres south east of

Malden Island. He also requested that New Zealand permit the reactivation of the airstrip on Penrhyn and allow Royal Navy ships involved in the test programme to have access to repair facilities at the Royal New Zealand Navy's Devonport base. New Zealand readily agreed to these requests.²⁴

The Royal New Zealand Navy's direct involvement in Operation Grapple was initiated by a letter in late July 1956 from Sir Geoffrey Scoones to the Minister of External Affairs, Mr T.L. MacDonald, asking that two New Zealand frigates be made available to act as weather ships during the British thermonuclear tests being planned for 1957. Scoones explained that New Zealand assistance was being sought because the Royal Navy did not have ships equipped with the type 277Q radar needed for meteorological monitoring readily available in the Pacific. However, the Royal New Zealand Navy's Loch class frigates were fitted with type 277P radar, which could be easily modified to type 277Q standard. Britain offered to provide two Royal Navy frigates to take the place of the New Zealand ships involved in Operation Grapple²⁵. Earlier in the year, the British Government had made a similar request to Australia. The Royal Australian Navy, however, did not have available a ship suitable for weather reporting²⁶. On the 18th of August 1956, the Acting Minister of External Affairs, Mr R.M. Algie, replied positively to Scoones' request by agreeing to provide two frigates on condition that the British authorities met the cost of converting the ships' radar and that Royal Navy frigates

fulfilled the operational programme of the New Zealand frigates. Algie also agreed with a British suggestion that further discussions about New Zealand's role in the nuclear testing programme be conducted on a service to service basis²⁷.

As part of the preparation for Operation Grapple, the United Kingdom wished to set up radio navigation aids on Christmas Island, and Jervis Island which was administered by the United States, as well as on Penryhn Island. In December 1956, the United States informed New Zealand that it wished to use Penrhyn as the base for a United States Air Force team which was to monitor the British thermonuclear tests. The United States, however, claims sovereignty over Penrhyn and the other islands of the Northern Cooks, and was unwilling to compromise this claim by asking New Zealand's permission to use the island. In an aide memoire passed to the New Zealand Department of External Affairs on 5 December, the United States suggested that any difficulties caused by the competing claim to Penrhyn should be circumvented by adopting a procedure already implemented by the United States and Britain over the use of Christmas Island and Malden Island for the testing programme. Both countries claimed these Islands, but had agreed that the tests could proceed without compromising or prejudicing either country's claims. Under this arrangement the United Kingdom notified the United States of its plan to use Christmas Island and Malden Island as test sites. New Zealand believed that the United States claim to Penrhyn "lacked the slightest substance",

and, although willing to assist the Americans felt obliged to reject their aide memoire.²⁸ The United Kingdom attached great importance to maintaining and, wherever possible, improving co-operation with the United States in nuclear questions, and had therefore hoped that New Zealand would accept the United States' suggestion.²⁹ In a letter to the British High Commission in Wellington Alister McIntosh, the Secretary of External Affairs, explained that New Zealand was not able to accept this kind of arrangement because Penrhyn and the other islands of the Northern Cook Group had been administered and occupied by New Zealand for more than 50 years and that no action which gave "the slightest recognition, tacit or otherwise, to the 'baseless' even frivolous" American claims was acceptable to the Government in Wellington.³⁰

The United States Government was, it seems, surprised by the firmness of New Zealand's response on the sovereignty issue, and after some deliberation agreed to withdraw its aide memoire.³¹ Negotiations involving the United States, the United Kingdom and New Zealand to resolve the difficulties over the use of Penrhyn Island were held in London in mid-January 1957. At this meeting it was agreed to avoid the problems associated with the question of sovereignty by arranging for the United States Air Force party to act as an appendage of the British party on the Island, and that the American party would deal with the New Zealand authorities on Penrhyn through the British party.³² The Island Territories Department sent an officer to Penrhyn to supervise the reactivation

of the airstrip and to liaise with the 24 strong British party which arrived in late March 1957 and the slightly smaller American group which flew in early the following month.³³

The United Kingdom's testing programme and New Zealand's role in it attracted some opposition. In Auckland, for instance, a meeting at Auckland University College called for an immediate end to all nuclear tests and for New Zealand to refrain from assisting the United Kingdom with its testing programme.³⁴ In response to such suggestions, the Chief of Naval Staff, Rear Admiral John McBeath stressed the point that New Zealand was in no way endangered by the tests, and that the Government could not withdraw the Royal New Zealand Navy's assistance after first promising it, without drawing the charge of "starting a job and not having the guts to finish it."³⁵ In general, however, the New Zealand public appears to have supported the Government's decision to assist the United Kingdom with its thermonuclear weapons tests.³⁶

In an effort to assure the public that the British thermonuclear tests posed no danger to New Zealand, the Department of External Affairs considered asking Professor Ernest Titterton, the Head of the Australian Atomic Weapons Tests Safety Committee (AWTSC), to record a radio talk on the effects of thermonuclear tests to be broadcast in New Zealand. Nothing seems to have come of these suggestions, although two articles by Titterton in which

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he argued that thermonuclear tests did not pose a hazard to New Zealand appeared in New Zealand newspapers in mid-1957. It appears, however, that the Department of External Affairs did not play a part in arranging for the publication of these articles.³⁷

In Japan there was considerable public concern about nuclear tests in general and the British testing programme in particular. Japanese fishermen feared that the tests might contaminate fish stocks, and plans were made to protest against the tests by sailing ships into the danger zone surrounding the test sites.³⁸ Officials at the Department of External Affairs were troubled by the possibility that the New Zealand frigates might be called upon to apprehend Japanese protest ships in international waters. To avoid the embarrassment that might well result from such an incident, it appears that some consideration was given to placing restrictions on the operations of the New Zealand ships with respect to action against protest vessels.³⁹ Rear Admiral McBeath reacted angrily to the idea of restricting the operations of the New Zealand frigates. He felt that such a course of action, following on New Zealand's decision to withdraw HMNZS ROYALIST from the British Mediterranean fleet during the Suez crisis would lead the Royal Navy "to lose all faith" in its New Zealand counterpart, and would damage the special relationship between the two navies, and between the Royal Air Force and the Royal New Zealand Air Force.⁴⁰ The suggestion that New Zealand place conditions on the use of her frigates was dropped after it became clear that it was

most unlikely that Japanese protest ships would be sent to the test area.⁴¹

After it became public knowledge that Christmas Island was to be used as the base for the United Kingdom's thermonuclear weapons tests, there was widespread unease in the islands of the South Pacific about the possibility that the tests might constitute a danger to health. In May 1956, several members of the Western Samoan Legislative Council presented a petition to the United Nations Trusteeship Council expressing concern about the possible effects of the testing programme.⁴² During discussion of the petition at the Trusteeship Council in New York, the Soviet delegate implied that New Zealand had not paid sufficient attention to the health and well-being of the people of Western Samoa, when it considered the impact of the United Kingdom's tests. The New Zealand representative, Sir Leslie Monroe, forcefully rejected this suggestion, and after some debate, the Trusteeship Council passed a resolution assuring the people of Western Samoa that the United Kingdom would take "all necessary precautions ... to guard against possible danger to persons or property".⁴³ In spite of this assurance, and the efforts of the New Zealand authorities to stress the safety of the tests, there was continuing unease, especially in the Cook Islands. These concerns really only abated after the first test had been conducted off Malden Island without any apparent ill-effects.⁴⁴ However, people in the Cook Islands remained, somewhat uneasy, and when three islanders died of fish poisoning in

late 1957, suspicion fell upon the tests. New Zealand's decision to establish a programme to monitor marine life in the Northern Cook Islands for contamination was, in part, prompted by these fears.⁴⁵

Notes:

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3. See for example Department of External Affairs, Review of Defence Policy 1957, pp. 4-6 and the Report of the New Zealand Naval Board 1957, AJHR 1957, H.5.
4. A J R Groom, British Thinking About Nuclear Weapons, London, 1974, pp. 33-39 and 56-58.
5. J L Symonds, A History of British Atomic Tests in Australia, Canberra, 1985, pp. 5-32.
6. Ibid., pp. 80-92.
7. The Report of the Royal Commission into British Nuclear Tests in Australia, Vol I, Canberra, 1985, p.117.
8. Ibid., pp. 132-133.
9. Ibid., pp. 137-140, 231-233, 273-277 and 349-352.
10. (S) Army Secretary to Minister of Defence 19 Jun 1956, J.S.O. 8/7/2, Weapons and Methods of Warfare, Atomic Tests New Zealand Participation pt 2 and Symonds, pp. 373-376, 402-403 and 407-410.
11. (S) Head of New Zealand Joint Service Liaison Staff Melbourne to Chief of General Staff, 30 Sep 1957, J.S.O. 8/7/2.
12. Peter Malone, The British Nuclear Deterrent, London, 1984, pp. 12-13 and Denys Blakeway and Sue Lloyd-Roberts, Fields of Thunder : Testing Britain's Bomb, London, 1985, p. 144.
13. Evening Post, 24 Dec 1955 and Blakeway, p.144.
14. (TS) Eden to Holland, N.D. but 16 May 1955, PM 121/5/2, International Affairs, Atomic Energy, Military Uses Experiments.
15. Ibid., and 'Brief notes on Kermadec and Pitcairn Groups', enclosure to Office of Minister of Defence to Prime Minister, 10 Jun 1955, PM 121/5/2.
16. Ibid., (TS) Marsden to Holland, 10 Jul 1955.

17. Text of paper to be read to Cabinet by Holland, dated 9 Feb 1955, PM 121/5/1, International Affairs, Atomic Energy, Military Uses, General.
18. Unsigned undated note probably by Holland, above Eden to Holland, 16 May 1955, PM 121/5/2.
19. Ibid, (TS) Eden to Holland, 2 Sep 1955. I have found no evidence that Holland consulted other members of Cabinet about this decision.
20. Ibid., Marginalia on undated covering note above, (TS) Scoones to Holland, 17 Sep 1955, (TS) Eden to Holland, 22 Nov 1955, (TS) Macdonald to Scoones, 7 Dec 1955. HMNZS LACHLAN Report of Proceedings (ROP), 17 Jan - 7 Mar 1956, NA 18/36/75 "L", Acts Regulations Publications & Returns: Letters of Proceedings HMNZS LACHLAN & Survey MLs, 'Operation Grapple 1956-1957', p. 21, enclosed with Leask to AS (P&M), 5 Apr 1988, D3500/1 Operational Equipment Requirements General and Wilfred E Oulton, Christmas Island Cracker : An Account of the Planning and Execution of the British Thermo-Nuclear Bomb Tests 1957, London, 1987, pp. 149, 180 and 252.
21. (TS) Scoones to Holland, 2 Nov 1955, PM 121/5/2 and Blakeway, p. 146.
22. Pacific Islands Year Book : Fifteenth Edition, Ed. John Carter, Sydney, 1984, pp. 257-258.
23. Blakeway, pp. 146-148.
24. (TS) Eden to Holland, 24 Mar 1956 and (TS) Holland to Scoones, 6 Apr 1956, PM 121/5/2.
25. (S) UK High Commissioner Wellington to Minister of External Affairs, 26 Jul 1956, NA 016/8/52, Operations-Training etc : Operation Grapple.
26. Symonds, p. 429.
27. (S) Algie to Scoones 16 Aug 1956, NA 016/8/52. Under the terms of the agreement between the United Kingdom and New Zealand, HMS ST BRIDES BAY served in New Zealand waters between March and June 1957 and HMS CARDIGAN BAY between November 1957 and January 1958. Report of the New Zealand Naval Board 1958, AJHR 1958, H.5, p. 10.
28. (C) Cleary to McIntosh, 30 Nov 1956, (TS) Aide Memoire (copy original returned) 5 Dec 1956 and (C) Secretary of External Affairs to Minister of External Affairs, 4 Dec 1956, PM 121/5/2.
29. Ibid, (C) Cleary to McIntosh, 30 Nov 1956 and Cleary to Laking, 18 Dec 1956.

30. Ibid, (C) McIntosh to Cleary, 5 Dec 1956.
31. Ibid, (S) Telegram, New Zealand Ambassador Washington to Minister of External Affairs, No. 284, 19 Dec 1956, (S) Telegram, Minister of External Affairs to New Zealand High Commissioner London, No 1598, 31 Dec 1956 and (S) Laking to New Zealand High Commissioner London, 4 Jan 1957.
32. Ibid, (C) Telegram, New Zealand High Commissioner London to Minister of External Affairs, No. 4, 15 Jan 1957.
33. Ibid, McEwan to Minister of Island Territories, 19 Dec 1956, Reid (NZLO Penrhyn) to Secretary of External Affairs, 5 Feb 1957, Telegram NZLO Penrhyn to Minister of External Affairs, No 22, 28 Mar 1957 and (S) Reid to Secretary of Island Territories, 18 Apr 1957.
34. See for example, Auckland Star, 18 Apr 1957.
35. New Zealand Herald, 20 Apr 1957.
36. See for example Auckland Star, 13 Apr 1957 and Manawatu Evening Standard, 4 May 1957.
37. (C) Telegram Minister of External Affairs to High Commissioner for New Zealand Canberra, No 124, 30 Apr 1957, PM 121/5/2 and Evening Post, 29 Apr and 2 May 1957.
38. (C) J.S. Reid New Zealand Legation Tokyo to Secretary of External Affairs, 27 Feb 1957, PM 121/5/2.
39. Ibid, memorandum initialed R.P. to Scott, Laking and Stanners, 9 Apr 1957.
40. (S) Note for file by Stanners, 26 Apr 57, JSO 8/7/2 also on PM 121/5/2.
41. Memorandum initialed R.P. to Scott, Souter and Stanners, 18 Apr 1957 and marginalia, and (S) J.S. Reid NZ Legation Tokyo to Secretary of External Affairs, 1 May 1957, PM 121/5/2.
42. Ibid, Telegram High Commissioner for Western Samoa to Minister of External Affairs, 8 and 12 May 1956, and Pacific Islands Monthly, Feb 1957.
43. Evening Post, 21 Jun 1956 and Dominion, 21 Jul 1956.
44. Pacific Islands Monthly, Feb, Apr and Jun 1957.
45. Powell to Director of Agriculture Raratonga, 23 Jan 1958, PM 121/5/2. See also pp.41-42.

CHAPTER II : THE 1957 TEST SERIES

Following the Acting Minister of External Affairs' positive reply to the British request for assistance, the New Zealand Naval Board began to prepare for Operation Grapple. The Royal New Zealand Navy's fleet at this time included six Loch class anti-submarine frigates, which had been purchased from the British Government in 1948, HMNZ Ships TAUPO, PUKAKI, KANIERE, HAWEA, ROTOITI and TUTIRA¹. Apparently the Naval Board first considered using HMNZS HAWEA and HMNZS PUKAKI for Operation Grapple, however, at a meeting on the 3rd of October 1956 it decided to place HAWEA in reserve, and to bring ROTOITI out of reserve to take her place².

The HAWEA was placed in reserve on the 15th of February 1957 and the bulk of her crew then transferred to ROTOITI which was recommissioned three days later. Between November 1956 and January 1957 the type 277P radar on ROTOITI and PUKAKI was modified to type 277Q standard, and various other preparations necessary for Operation Grapple were undertaken at HMNZS DOCKYARD at Devonport³.

Much of the Naval Board's work was based on a detailed paper setting out the role of the New Zealand ships and other aspects of the operation, which was received from the Trials

Planning Section in October 1956. The main task of the New Zealand frigates was to be the collection of meteorological information, which was essential for the successful and safe conduct of the nuclear tests. The two weather ships would carry out patrols around the test site, during which they would regularly launch hydrogen filled balloons. The flight of these balloons which were fitted with radar reflectors was to be tracked by radar, and the information about wind patterns and other data was then to be passed to a meteorological centre on Christmas Island. To assist in this work each frigate was to be assigned a specially trained Royal Navy team. Apart from the periods when tests were actually being conducted, the two frigates would alternate on patrol. The secondary tasks given to the New Zealand frigates were air/sea rescue, anti-submarine watch, thermal flash monitoring and water sampling to test for radiation contamination⁴.

The paper also set out the precautions to be taken in respect to the radiation hazards involved in the tests. For the ships taking part in Operation Grapple these measures can be divided into two classes, safeguards incorporated into the way in which the nuclear test programme was to be conducted, and precautions to be taken by individual ships. Within the first category of precautions, the most important step taken to reduce the dangers associated with the Grapple tests was the detonation

of the thermonuclear devices at an altitude of more than 2000 metres. In an air burst explosion of this type the fireball does not touch the surface of the earth and the fission products, which are initially in gaseous form, rise with the fireball to great heights into the stratosphere. When the temperature of the fireball becomes sufficiently low, the radioactive materials form particles through condensation and coagulation. These particles are minute, and because of this their descent is very slow - it may take many months before they come down to the ground - by which time they will have been carried by stratospheric winds round the globe. Under such conditions there is nil, or very little fall-out in the vicinity of the explosion⁵.

The British were confident that their nuclear tests would be true air bursts, but prudence dictated that additional safeguards be taken in case an error or miscalculation led to a surface burst. In a nuclear explosion of this kind the fire-ball touches the surface of the land or sea, vaporizing or sucking up vast amounts of material into the fireball, a process which results in heavy local fallout⁶. To reduce the dangers posed by a surface burst it was planned that ships of the Grapple Squadron would be stationed away from areas likely to be contaminated if a surface burst occurred. In addition, wherever possible, ships were to be stationed up wind of the test site⁷.

The planning for Operation Grapple also emphasized the need for each ship involved in the testing programme to take all practicable precautions to minimize any hazards that might be encountered. There were two main elements to the protective measures taken by each ship:

- a The fitting of a pre-wetting system of hoses and spray heads to wash down the upper surfaces of the ship with water, to prevent fallout from settling and to wash away any fallout that may have settled.

- b The perfection of a closing down procedure for sealing off parts of the ship, in order to form a gas tight citadel, in which the crew could shelter in the event of a serious radiation hazard eventuating.

In addition all ships were to carry equipment for measuring radiation and a quantity of protective clothing⁸. All the radiation measuring equipment and virtually all the protective clothing used by the crews of PUKAKI and ROTOITI during Operation Grapple had to be supplied by the British authorities on Christmas Island, as the Royal New Zealand Navy normally had no requirement for such equipment and stores⁹.

At a meeting on the 11th of February 1957, Cabinet formally approved a range of New Zealand assistance for Operation Grapple.

21.

In addition to providing two frigates to act as weather ships the Royal New Zealand Air Force was to fly scientific equipment and personnel connected with the testing programme between various islands in the South Pacific, and the Meteorological Service was to operate equipment to measure radiation and a microbarograph at some of its stations in the Pacific¹⁰.

On the 14th of March 1957, the PUKAKI and the ROTOITI sailed from Auckland on the first leg of their voyage to Christmas Island. As senior officer the commander of PUKAKI, Cdr Richard T Hale, took the ROTOITI, which was under the command of Lt Cdr William J Brown, under his orders¹¹. It seems that both ships had on board the equivalent of a full war complement, about 150 officers and ratings¹².

After briefly visiting Suva to pick up parties of men from the Royal Fijian Naval Volunteer Reserve, the two frigates parted company on the 19th of March¹³. The PUKAKI sailed directly for Christmas Island, where she arrived on 24 March, after making a brief call at Jervis Island to pick up mail. The ROTOITI visited Rarotonga before arriving at Christmas Island on the 29th of March. During their time at Christmas Island the New Zealand frigates and the other ships of the Grapple Squadron were based at the Port of London, a natural harbour inside the north west arm of the island's lagoon¹⁴. During each of the testing operations

the New Zealand frigates were under the command of the Commodore Grapple Squadron, who controlled all the ships based at Christmas Island. Routine administrative matters, however, continued to be dealt with through the usual Royal New Zealand Navy channels¹⁵.

The party of Fijians left the PUKAKI shortly after she arrived at Christmas Island and on the 25th of March the ship's company were engaged in taking aboard the radiation monitoring and meteorological equipment, protective clothing and a wide variety of other stores¹⁶. The radiation monitoring equipment and associated items issued to each New Zealand ship consisted of:

- 3 Contamination Meters No 1 MK 2 (battery operated)
- 4 Valve Water Sampling Heads
- 1 Water Contamination Calculator MK 1
- 2 Survey Meters No 2, 0-300 rads/hr
- 1 Contamination Meter No 1
- 2 Survey Meters, A.W.R.E. pattern 0-0.3 r/hr
- 25 Quartz Fibre Dosimeters No 1 0-.5 rads
- 50 Quartz Fibre Dosimeters No 2A 0-5 rads
- 5 Quartz Fibre Dosimeters No 3 0-50 rads
- 2 Quartz Fibre Dosimeter Charging Units
- 300 Film Badges, type P.M.1.¹⁷

The contamination meter No 1 MK 2 was designed to measure gamma radiation over the range 0-10 milliroentgens per hour. When used

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in conjunction with the valve water sampling head and the water contamination calculator, the MK 2 contamination meter could be used to measure radiation levels in water. The contamination meter No 1 appears to have had similar functions¹⁸. The Survey Meter No 2 was designed to measure very high doses of beta and gamma radiation in an emergency situation¹⁹. The Atomic Weapons Research Establishment (A.W.R.E.) pattern survey meter like the contamination meter No 1 Mkz, measured the dose of gamma radiation being received at a particular time and the rate per hour. This meter had three reading scales, the highest of which was 0 to 3 rads per hour²⁰. The Quartz Fibre Dosimeters issued to the ships of the Grapple Squadron, and worn by selected personnel, were small pen-like metal chambers which measured the dose of gamma radiation received. The type No 3 Quartz Fibre Dosimeters were designed to measure very high doses of radiation and were only to be issued to selected personnel in the event of a surface burst²¹.

The PM 1 type film badges or photographic dosimeters (similar to those used in hospital radiotherapy departments) measured the total dose of radiation received. It is possible with film badges to measure the dose of gamma, beta and slow neutron radiation which has been received²². Apparently before each nuclear test the crewmen were issued with a new film badge and after the test they would be collected and sent for processing on HMS NARVIK. However, during Operation Grapple most film badges

including those from the New Zealand frigates were not processed, principally because of problems with storing the chemicals needed for processing. The film badges processed were mostly from British personnel stationed near the test site, and indicated very low exposure to radiation. During the first two tests, for instance, film badge analysis indicated exposure of less than 50 milliroentgens²³.

The New Zealand ships were issued with a variety of protective clothing and gear; the PUKAKI and ROTOITI each received:

200	AWRE Coverall Suits
25	Smocks - Foul Weather
25	Trousers - Foul Weather
100	(pairs) Boots for Butchers and Cooks
150	Flight Deck Tinted Goggles
50	(pairs) Rubber Half Wellington Boots
300	(pairs) PVC Gloves
200	(pairs) Anti-Flash Gloves
200	Anti-Flash Hoods
200	A.W.R.E. Over Shoes
400	Surgical Gauze Masks
170	Light Type Respirators
100	Containers Anti-Radiation Dust ²⁴

Different protective clothing outfits for various situations and classes of personnel were specified for Operation Grapple. The outfit generally worn by the crews of the Royal New Zealand Navy ships when observing a test consisted of flash gloves and hoods, No 8 Action Working Dressing (ratings) or white overall combination suits (officers), fully laced shoes with trousers tucked into socks and tinted flight deck goggles²⁵. However, during some Atomic Biological and Chemical Defence (ABCD) exercises and the first Operation Grapple nuclear test series, more elaborate protective clothing was worn. This outfit consisted of A.W.R.E. coverall suit, with overshoes or possibly boots and a respirator or gauze mask. The ship's decontamination teams in addition wore foul weather smocks²⁶.

As part of their training for Operation Grapple a party of 19 from PUKAKI, led by Cdr Hale and consisting of all but one of the other officers and a selection of senior ratings, took part in a one day course conducted by the Grapple Squadron ABCD Officer on HMS WARRIOR, the light aircraft carrier which was the squadron's flagship. The programme for the type of course attended by the personnel from PUKAKI covered a number of topics:

<u>Time</u>	<u>Subject</u>
0900 - 0930	Introduction to Operation Grapple.
0930 - 1000	Ship Collective Protection.
1010 - 1100	Draw and wear protective clothing.

1315 - 1550 Cleansing and monitoring exercises on the flight deck of WARRIOR, working in protective clothing.

Cdr Hale considered that the course was "good value and assisted considerably in providing much needed information for our ABC organisation."²⁷

After embarking its Royal Navy meteorological team PUKAKI sailed from Christmas Island on the 31st of March for her first weather patrol. The PUKAKI adopted the pattern generally followed by the New Zealand frigates during their weather patrols throughout Operation Grapple. Each day meteorological balloons were released at regular intervals and their flight paths tracked by radar. This data and other meteorological information were then transmitted to the weather centre on Christmas Island²⁸. Additional balloons were released before and after each nuclear test and when requested by the weather centre²⁹. Some balloons were tracked to very high altitudes, for instance on the 3rd of April 1957 a balloon from the PUKAKI was plotted at 100,400 feet³⁰. The PUKAKI returned to the Port of London, Christmas Island, on the 8th of April after completing her first weather patrol off Malden Island³¹.

After her arrival on the 29th of March the party of Fijian naval reservists left the ROTOITI, and in their place a Royal Navy meteorological team consisting of one instructor Lieutenant and three ratings was embarked. Specialist equipment and stores for

Operation Grapple were also taken aboard³². In accordance with the instructions laid down for Operation Grapple the ROTOITI sailed from Christmas Island on the 5th of April, in order to take PUKAKI's place on weather patrol. During this patrol, which lasted until the 11th of April, the various items of specialised equipment carried by the ROTOITI functioned satisfactorily, and she was able to carry out successfully her weather reporting duties³³.

Shortly before the ROTOITI returned to Christmas Island on the 11th of April, the PUKAKI sailed to replace her on weather patrol. During this patrol the PUKAKI, in addition to her normal weather monitoring duties, conducted two extensive ABCD exercises. The first of these took place on the 16th of April, and involved closing the ship down, the setting up and operation of the ship's pre-wetting equipment and exercising the PUKAKI's radiation monitoring teams. Conditions when the ship was closed down became rather hot and unpleasant for the crew who were all wearing their protective clothing and in addition, at least in some cases, gas masks. In the engine room where temperatures were highest, three men collapsed because of the heat and humidity³⁴. After visiting the New Zealand possession of Penrhyn Island, one of the Cook Group, between the 18th and 22nd of April, the PUKAKI conducted an even more intensive ABCD exercise on the 26th of April during which the whole routine for the day of the first nuclear test was rehearsed. The PUKAKI's

radiation monitoring, decontamination and cleansing parties were all thoroughly exercised during the day's programme. For instance, the cleansing party, who were responsible for washing men contaminated by fall-out, established a cleansing station in the ship's company's bathroom, through which all personnel who entered the ship's gas tight citadel had to pass. Very high temperatures (up to 118⁰ fahrenheit in the engine room) and humidity were again experienced after the ship had been closed down. As during earlier exercises conditions were made much worse by the need to wear protective clothing and gas masks outside the ship's citadel³⁵.

The PUKAKI spent from the 2nd until the 4th of May at Christmas Island before departing on her last patrol before the first nuclear test. As with her earlier patrols she divided her time between weather monitoring and ABCD exercises³⁶.

Before leaving New Zealand, and during the voyage to Christmas Island, the PUKAKI and ROTOITI conducted lectures on ABCD subjects and carried out pre-wetting exercises and closing down trials³⁷. These initial efforts were hampered by a lack of up to date ABCD information available in New Zealand. However, this problem was remedied after the ships joined the Grapple Squadron, where they were able to acquire more information and conduct intensive exercises³⁸. By the time of the first nuclear test both New Zealand frigates had very effective ABCD organisations and procedures³⁹. This was an especially

noteworthy achievement as the Loch class frigate was a World War II design which, unlike modern warships, was not designed from the outset to meet the requirements of atomic or nuclear defence.

The ROTOITI's activities during this period closely matched those of her sister ship. After sailing from the Port of London, Christmas Island, on the 15th of April, the ROTOITI carried out a weather patrol off Malden Island before visiting Penrhyn Island between the 25th and 28th of April⁴⁰. Later, during the voyage back to Christmas Island, the ROTOITI carried out a range of closing down, pre-wetting and decontamination exercises. Further lectures on ABCD matters were also given to the ship's company⁴¹.

Following her return to Christmas Island on the 5th of May, the ROTOITI took on stores and three Royal New Zealand Navy ratings from HMS SALVICTOR, which had recently rejoined the Grapple Squadron after a short refit at HMNZ DOCKYARD⁴². On the 8th of May the ROTOITI sailed from Christmas Island to join the PUKAKI on patrol off Malden Island, in preparation for the first test of Operation Grapple⁴³.

Early in the morning of the 15th of May 1957 the ROTOITI and PUKAKI took up positions off Malden Island. By 0900 PUKAKI had assumed ABCD state One Alpha, all distillation of fresh water had been stopped, the pre-wetting gear set up and the crew had donned protective clothing⁴⁴. Half an hour later "hands were piped to

their burst stations". At 0950 the crew's protective clothing was checked and dark goggles fitted. It appears that virtually the whole ship's company, except for those who had to remain at their stations below deck, then sat down on the upper deck facing aft, away from the test site, which was one and a half miles south of Malden Island. Because the PUKAKI could pick up communications between the Valiant bomber carrying the thermonuclear bomb, and the forward control ship HMS NARVIK, it was possible to give the ship's company a running commentary of the events leading up to the test. Just after 1038 the bomb which had been dropped by the Valiant from nearly 14,000 metres exploded 2400 metres above the ocean off Malden Island. The PUKAKI was positioned approximately 50 nautical miles from surface zero, the point on the ocean's surface above which the bomb detonated. Even members of her crew who had their hands over their eyes as well as their eyes closed and goggles on, experienced "the intense brilliance of the flash" caused by the explosion⁴⁵.

After 15 seconds the crew of the PUKAKI were ordered to "open your eyes, stand up and face the burst". They also removed their goggles and anti-flash helmets at this time. The spectacle presented by Britain's first thermonuclear explosion made a great impression upon the crew. Cdr Hale included a detailed description of what he saw in the PUKAKI's Report of Proceedings:

The fire ball just starting to grow in size was easily visible well above the horizon. During plus 2 and plus 3 minutes the blast wave was distinctly noticeable by a double wave of pressure on the ear drums followed closely by a double rumble - the explosion. For those first two or three minutes the fire ball grew in size shaped like a round fire [sic] and turbulent cauliflower changing from an angry deep red streaked with grey to a larger smouldering ball of cloud with a glowing centre, evidence of the intense heat remaining visible for 7 to 8 minutes. Between the 2nd and 3rd minutes the terrific up draught of air and cloud soon became apparent by what appeared to be a strikingly white water spout being drawn into the centre of the fire ball, this rising mass increased in volume until the more familiar but equally fantastic shape of the mushroom was evident to everyone. After 6 to 7 minutes the upper winds started to offset the evenly shaped top of the mushroom cloud by blowing it flat, soon afterwards the stalk started to fall away and was lost to sight. As the higher level winds started to play havoc with the cloud a small speck of blue was soon in its midst between minutes 11 and 12. From then on the cloud opened out like a massive smoke ring and continued to do so until after 1600 when there was only the faintest trace of cirro cumulus clouds almost completely around the heavens slowly fading towards the horizon⁴⁶.

Following the explosion the various pieces of scientific equipment carried by the PUKAKI were either secured or stowed away, and a meteorological balloon was launched. During the afternoon of the 15th of May the PUKAKI closed with WARRIOR to transfer the data collected by her scientific instruments, and to pick up supplies of fuel and hydrogen. While sailing towards WARRIOR, with whom she rendezvoused at 1700, the PUKAKI passed "within 6 [nautical] miles of surface zero". In spite of being so close to where the test had taken place, "no notable [radiation] readings were received either from the atmosphere or the water by the geiger counter"⁴⁷. The crew of the PUKAKI remained in their protective clothing (minus anti-flash helmets) until 1645, when orders were received that the Grapple Task Force could go to ABCD

state Three Charlie⁴⁸. After visiting the islands of Manihaki and Rakahanga, outlying members of the Cook Islands, on the 18th and 19th of May, PUKAKI returned to Christmas Island⁴⁹.

Although the ROTOITI's viewing position was 150 nautical miles from surface zero, her commander decided to implement the full range of ABCD precautions and by 0925 the frigate had assumed ABCD state One Alpha. All members of the crew were wearing "full No 8 clothing, anti-flash gear and blue goggles". The ship's pre-wetting gear was also rigged up and made ready for use. Apparently the members of ROTOITI's crew who observed the test could see very little of the bomb's effects. Lt Cdr Brown noted in the ship's Report of Proceedings that:

The horizon at the time of the burst was obscured by considerable fair-weather cumulus cloud, but a faint glow beyond was apparent from this ship. Little else was seen until about six minutes later when an appearance of precipitation was observed about 3 degrees above the horizon over a horizontal arc of approximately 30 degrees.

Thirteen minutes after the burst a series of three rumbles was distinctly heard.

Gradually an anvil-shaped cloud of cirro-stratus formed beyond the foreground of fair weather cumulus.

The crew of the ROTOITI were disappointed that a change in the arrangements for the test meant that their ship had to be stationed so far away from the test⁵⁰. Later on the 15th May the ROTOITI completed her weather monitoring and sailed for Penrhyn Island where she arrived on the 17th of May⁵¹.

New Zealand also sent three official observers to Britain's first thermonuclear test, in response to an invitation received in early 1957. The New Zealand observers were Cdr L B Carey, Maj D J Aitkin and Mr H J Yeabsley, the Deputy Director of the Health Department's Dominion X-Ray and Radium Laboratory (now the National Radiation Laboratory)⁵². Along with observers from Australia, Canada and the United States, the New Zealanders had arrived on Christmas Island on the 13th of May and then transferred to HMS ALERT from which they watched the test⁵³.

Immediately after the test the observers returned to New Zealand and Mr Yeabsley reported to the Prime Minister and the other Ministers involved in the testing programme. In his report Yeabsley outlined discussions he had, before the first test, with Dr William Cook, the scientific director of Operation Grapple, about arrangements for the testing programme and the safety precautions being taken. After the test, when he and the other observers returned to Christmas Island, Yeabsley had further discussions with members of the British scientific team. They informed him that the Valiant aircraft which had dropped the bomb was not contaminated, but that the two Canberras which had taken samples from the test cloud were "hot" and required decontamination. He was also told that the radioactive cloud travelled up into the stratosphere, and that they expected little if any fallout to be detected on nearby islands. The British scientists also informed Yeabsley that an hour after the test the

dose rate on Malden Island was 0.2 rads per hour. The New Zealand scientist was impressed by the way the tests were being conducted, and concluded in his report that the tests "were being made in such a fashion that the possibility of highly active local fall-out was reduced to a minimum and that no person under the care of the New Zealand Government was liable to suffer radiation damage from the operation". In a radio address on the 23rd of May, which was intended to allay concerns about the safety of the British tests, Mr Holland commented that Yeabsley's "report reinforces the assurances the Government has received from Britain that the tests are being conducted with the utmost care and regard for the safety of human life"⁵⁴.

New Zealand also received a summary of Dr Cook's report on fallout after the first test from the British High Commission in Wellington. In his report Cook set out the main features of the test operation, and the results of the radiation monitoring programme. As part of Operation Grapple monitoring stations had been established on Christmas, Canton and Penrhyn Islands and at Apia in Western Samoa. These stations had equipment to measure "the amount of active material deposited on the ground, and ... the amount suspended in the air." The data collected by the stations in the week preceding and the two weeks following the first test showed no appreciable change. The differences in radiation levels were "within the errors of measurements and in any case do not exceed a few percent of the natural background".

The monitoring of fish caught near the monitoring stations and by ships of the Grapple Squadron also revealed no differences in radiation levels, although figures from only some of the stations were available to Cook when he prepared his report. In addition, "samples of water taken in the area of the burst three hours after the explosion were examined for fallout activity and none could be detected"⁵⁵. Later, New Zealand received more detailed data about the levels of radiation recorded by each of the monitoring stations and ships⁵⁶.

In preparation for the second nuclear test, PUKAKI carried out a weather patrol between the 26th and 31st of May during which technical problems were experienced with the type 277Q radar. Before the test, the PUKAKI received a new water probe and radiation monitoring unit from WARRIOR to replace items which had become defective⁵⁷.

At 0750 on the 31st of May 1957 the PUKAKI reached her observation position for the second nuclear test and by 0900 she had assumed ABCD state One Alpha⁵⁸. The positions of the New Zealand frigates for the second test appear to have been similar to those adopted for the first test, with PUKAKI about 50 nautical miles from surface zero, and ROTOITI 150 nautical miles distant⁵⁹. The routine followed during this test was identical to that of the 15th of May. On this occasion, however, the PUKAKI's crew was disappointed by their view of the explosion

"as very thick cloud and rain passed between us and the target area when the weapon was dropped"⁶⁰. After the test the PUKAKI sailed north to transfer scientific records to WARRIOR, then returned to Christmas Island on the 2nd of June⁶¹.

After the second test New Zealand was again passed a summary of Dr Cook's report on fallout. Cook noted that of the monitoring stations, the Canton Island installation had recorded the highest level of radiation associated with the test. On the 1st of June 1957 an air sample taken there measured "7x10x10.5 microcuries per cubic metre". This reading Cook calculated meant "that breathing this active air as it passed through the area would only add one thousandth part of a year's dose received by the lungs from radiation in the normal environment." Nine days later the ground test at the Canton Island station recorded activity equivalent to "22x10.2 microcuries per square metre." A level of radiation which "would add less than 1/20 to radiation received in a year from natural causes in a normal environment"⁶².

The PUKAKI and ROTOITI were at Christmas Island for only two or three days before they departed to make a four day visit to Papeete⁶³. The PUKAKI resumed her weather monitoring duties off Malden Island on the 14th of June, and the ROTOITI began her patrol about a day later⁶⁴. For the last test of the first Grapple series on the 19th of June 1957 the New Zealand frigates reversed their observation positions, which meant that the ROTOITI

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took the close in position, probably about 50 nautical miles from the test site, and PUKAKI the more distant position 150 nautical miles off⁶⁵.

Once again many members of the PUKAKI's crew observed the test from the deck, but it appears that because the ship was so far away, they dispensed with protective clothing except for the dark goggles. Weather conditions for watching the test were very good with little cloud in evidence. The bomb was detonated at about 1038, and although the explosion occurred below the horizon, the flash was clearly visible from the PUKAKI. After the flash a towering mushroom cloud appeared on the horizon. About 20 minutes after the test Cdr Hale and other members of the crew felt the pressure wave and heard the explosion⁶⁶.

During their Operation Grapple weather patrols the PUKAKI and ROTOITI caught fish to monitor for radiation, although in the case of the PUKAKI these efforts seem to have met with little success⁶⁷. The fish monitoring work undertaken by the New Zealand frigates was part of a programme involving a number of Grapple Squadron ships. It appears that during the first Grapple series no evidence of radioactive contamination of fish was found⁶⁸. During the first test series there was only one recorded incidence of the Grapple Squadron encountering radioactive contamination, when a weather balloon radar reflector was recovered from the sea⁶⁹.

The report by the Atomic Weapons Research Establishment (AWRE) on fallout from the first Grapple series was passed to New Zealand in October 1957. The report revealed that very little fallout had been recorded; for instance, at Apia the fallout due to the tests amounted to 7% of the dose due to natural background radiation in one year⁷⁰.

The PUKAKI and the ROTOITI returned to Christmas Island two days after the test, and spent the next few days off-loading the specialist equipment and stores carried for the operation⁷¹. After embarking the party of Fijian naval reservists, both frigates sailed from Christmas Island on the 25th of June 1957 for their return voyage to New Zealand. They visited various islands during the voyage and did not arrive in Auckland until the 16th of July 1957⁷².

Shortly after the third test on the 19th of June, the British authorities responsible for the test programme decided to conduct an additional test late in 1957. This decision was apparently prompted by the unsatisfactory yields developed by the first three British thermonuclear bombs and by concerns that an international agreement to halt atmospheric nuclear tests might be reached before further tests planned by the United Kingdom could be conducted⁷³.

The new test was to be conducted off Christmas Island rather than off Malden Island. It has been suggested that the use of the new test site was the result of a desire to reduce the complexity of the testing operation, and of a belief that the first tests had shown that clean air bursts could be safely conducted near populated areas⁷⁴. However, Air Vice Marshal Wilfred Oulton, who was Commander of the Grapple Task Force in 1957, seems to suggest in his recently published book Christmas Island Cracker, that the precipitating factor was that an aircraft carrier, which would be needed if tests were to be conducted at Malden Island, would not be available in late 1957. Shifting the tests to Christmas Island removed the need for an aircraft carrier to take part in the operation⁷⁵.

Late in June 1957 AVM Oulton made a visit to Wellington. In discussions with the Prime Minister and the Chiefs of Staff Committee Oulton praised the work of the New Zealand Armed Forces and thanked the Government for its assistance. During his meeting with the Chiefs of Staff Committee Oulton replied to questions about the safety of the nuclear tests by stressing the extensive safety precautions which were taken and the advantages of air burst tests⁷⁶.

During August 1957 the British authorities made arrangements with the New Zealand Naval Board for the use of PUKAKI and ROTOITI as weather ships during the additional test, which was code-named

Grapple X⁷⁷. The United Kingdom's request did not present the Naval Board with any significant problems, as the PUKAKI and ROTOITI had remained in the Auckland area after their return from Christmas Island⁷⁸.

The ROTOITI and PUKAKI sailed from Auckland in early October and arrived at Christmas Island on the 21st and 22nd of October respectively. Their duties during Grapple X were practically identical to those of the first test series⁷⁹. Both frigates had new commanders: on the PUKAKI Lt Cdr William B. Elliott had replaced Cdr Hale, and Lt Cdr Lionel E. Hodge had replaced Lt Cdr Brown on the ROTOITI⁸⁰.

The New Zealand frigates alternated on weather patrol after their arrival at Christmas Island until the 5th of November when the PUKAKI joined the ROTOITI on patrol in preparation for the Grapple X test. Early on the 8th of November ROTOITI and PUKAKI took up their viewing position for the test⁸¹. At 0850 the thermonuclear bomb which had been dropped from a Valiant exploded 2250 metres above surface zero about two and a half kilometres off the south-eastern tip of Christmas Island⁸². The crew of the ROTOITI, which was 60 nautical miles to the north east of surface zero, had an "excellent view" of the "awe inspiring spectacle" of the explosion⁸³. An hour before the test the ROTOITI had stopped distilling water and had gone to 30 minutes notice to assume ABCD state One Alpha. It appears that the ship's company

did not wear any protective clothing apart from goggles⁸⁴. The PUKAKI observed the test from 132 nautical miles to the south east of surface zero. The flash of the explosion was hardly noticeable from the PUKAKI, but the fireball was clearly visible. As on the ROTOITI, the only item of protective gear worn by the crew of PUKAKI were goggles⁸⁵. Following the Grapple X test New Zealand was informed that the test had resulted in "no significant contamination on Christmas Island or adjacent sea"⁸⁶.

The New Zealand frigates continued their weather reporting duties before returning to Christmas Island on the morning of the 10th of November. During the following three days parties from the PUKAKI and ROTOITI went ashore to inspect the installations on the island and to swim and play cricket⁸⁷. On the 14th of November the New Zealand ships along with other ships of the Grapple Squadron took part in exercises near the island. At the end of the day the ROTOITI returned to Christmas Island while the PUKAKI began her return voyage to Auckland via Apia⁸⁸. The ROTOITI sailed from Christmas Island on the 16th of November and arrived in Auckland ten days later, in company with the PUKAKI⁸⁹. The commanders of both ships noted that the health and morale of their men had been good throughout Operation Grapple X-Ray⁹⁰.

Shortly after the end of the first series of tests Ronald Powell, the Cook Islands Administration's Fisheries Officer,

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prepared a report expressing concern about the possibility of radioactive contamination of marine life in the vicinity of the Northern Cook Islands⁹¹. Powell's report was passed by the Department of Island Territories to the Health Department. The Director of the Dominion X-Ray and Radium Laboratory concluded, after considering Powell's report, and other data about the effect of thermonuclear explosion, that it would be useful to set up a programme to sample marine life around Penrhyn Island⁹². Late in 1957 the Island Territories Department in conjunction with the Dominion X-Ray and Radium Laboratory established a programme to sample fish, birds and plankton to check for contamination. It appears that no traces of contamination were found in the period up to late 1958⁹³.

Notes

1. Report of the New Zealand Naval Board 1949, AJHR 1949, H. 5, pp. 2 and 6 and Report of the New Zealand Naval Board 1950, AJHR 1950, H.5, p. 2.
2. Extract from NA 06/46/10, 3 Oct 1956, NB 140/30/6/3, Ships, Loch Class Frigates, Movements and Programmes (HMNZS HAWEA), Vol 4, and (S) Secretary to the Admiralty to Navy Secretary, 14 Dec 1956, NA 016/8/52.
3. (S) Navy Secretary to NOCA, 11 Oct 1956, NA 016/8/52, HAWEA programme for 15 Feb 1957 and 18 Feb 1957 NB 140/30/6/3, and Report of the New Zealand Naval Board 1957, AJHR H.5, pp. 9-10 and 21.
4. (S) GRA/415/SEA, Requirements and Information concerning HMNZ Ships taking part in Operation Grapple, 27 Sep 1956, NA 016/8/52, and Cdr Hale to Commodore Grapple Squadron (CGS), 19 Jul 1957, NA 06/1/33, Ships and Repairs, HM Ships - Administration NBCD Collective Protection Policy, pt 2.
5. (S) Appendix F to GRA/415/SEA, NA 016/8/52, and Joseph Rotblat, Nuclear Radiation in Warfare, London 1981, p. 73 and pp. 12-14 and 94-97. Air burst and other kinds of nuclear explosions also result in induced radiation in substances near the explosion, see Rotblat, p. 59.
6. Rotblat, p. 12.
7. (S) Appendix F to GRA/415/SEA, NA 016/8/52.
8. Ibid. The radiation measuring equipment and protective clothing carried by the New Zealand ships is detailed on pp. 22-25.
9. Ibid and (S) Navy Secretary to NOCA, 11 Oct 1956, NA 016/8/52
10. (S) Cabinet Minute (M(57))5, 12 Feb 1957, NA 016/8/52, and various papers, AIR 222/2/4, Scientific Research, Experiment, "Operation Grapple" Christmas Island (Survey).
11. PUKAKI ROP, 14 Mar 1957, NA 18/36/75 "Q", Returns, Letters of Proceedings HMNZS KANIERE and HMNZS PUKAKI, pt 3. Because the logs of ROTOITI and PUKAKI for 1957-58 and ROTOITI'S ROPs for late May-June 1957 have been lost it is not possible to be exact about their movements.

12. List of War Complement for Loch Class Frigates, 1 Oct 1958, NA 66/10/3, Personnel : Manning : Loch Class Frigates Complement, pt 1, and ROTOITI Quarterly Medical Report 1 July 1957, NB 0140/30/6, Loch Class Frigates : Movements & Programmes.
13. PUKAKI ROP, 18-19 Mar 1957, NA 18/36/75 "Q".
14. PUKAKI ROP, 20-24, 29 Mar 1957, NA 18/36/75 "Q", and ROTOITI ROP, 22 and 29 March 1957, NA 18/36/75 "P", Returns, Letters of Proceedings, HMNZS TUTIRA and HMNZS ROTOITI.
15. (S) GRA/415/SEA, NA 016/8/52.
16. PUKAKI ROP, 25 Mar 1957, NA 18/36/75 "Q".
17. (S) Appendix 2 to Enclosure 'A' to 173/95. 100/6 of 17 Oct 1957, Statement of Protective Gear and Radiac Instruments Being Supplied from RN Sources, NA 016/8/52.
18. Ibid, (S) Enclosure A to 173/95. 100/6 of 17 Oct 1957 and Admiralty, Radiac Instruments Handbook 1959, B.R. 2053, Chapter 3.
19. Ibid, (S) Appendix 3 to Enclosure A to 173/95. 100/6 of 17 Oct 1957 and Royal Commission, I, p. 31.
20. Ibid, (S) Enclosure A to 173/95. 100/6 of 17 Oct 1957. During Operation Grapple it was stipulated that personnel should be withdrawn to a safe area if they had received 0.3 rads per week.
21. Ibid, (S) Appendix 2 to Enclosure A to 173/95. 100/6 of 17 Oct 1957.
22. Ibid, and Royal Commission, I, pp. 35-36.
23. (C) Cable London to Wellington 00533 of 25 Jan 1988, 00569, 26 Jan 1988, Def 12/1/1, Weapons and Methods of Warfare General.
24. (S) Appendix 2 to Enclosure A to 173/95. 100/6 of 17 Oct 1957, NA 016/8/52,
25. Ibid, (S) Enclosure A to 173/95, 100/6 of 17 Oct 1957 and see for example HMNZS PUKAKI First Lieutenant's Temporary Memorandum No 39, 1 Sep 1958, (copy provided by Mr K.J. Lewis), D12/1/1.
26. Lt Cdr Brown to CGS 17 Jun 1957, Cdr Hale to CGS, 19 Jun 1957, NA 06/1/33, PUKAKI ROP, 17 Jul 1957, NA 18/36/75 "Q" and Grant Howard, The Navy in New Zealand : An Illustrated History, Wellington, 1981, p. 129.

27. PUKAKI ROP, 29 Mar 1957, NA 18/36/75 "Q", and (S) Annex 1 to Enclosure A 173/GS. 100/6 of 17 Oct 57, NA 016/18/52.
28. See for example PUKAKI ROP, 25 and 31 Mar, 1-2 Apr, 1-2 Nov 1957, NA 18/36/75 "Q", and ROTOITI ROP, 15 Apr and 14 May 1957, NA 18/36/75 "P".
29. PUKAKI ROP, 23 Sep 1958, NA 72/3/6, Reports and Returns, Reports of Proceeding : HMNZS PUKAKI pt 1.
30. PUKAKI ROP, 3 Apr 1957, NA 18/36/75 "Q".
31. Ibid, 8 Apr 1957.
32. ROTOITI ROP, 29 Mar - 5 Apr 1957, NA 18/36/75 "P".
33. Ibid, 5-11 Apr 1957.
34. PUKAKI ROP, 11-16 Apr 1957, NA 18/36/75 "Q".
35. Ibid, 18-26 Apr 1957.
36. Ibid, 2-11 May 1957.
37. (S) Lt Cdr W J Brown to NOCA, 2 Apr 1957, NA 016/8/52, PUKAKI ROP, 20, 21 and 23 Mar 1957, NA 18/36/75 "Q", and Lt Cdr W J Brown to CGS, 17 Jun 1957 and Cdr R T Hale to CGS, 19 Jun 1957, NA 06/1/33.
38. PUKAKI ROP, 31 May 1957, NA 18/36/75 "Q", Lt Cdr W J Brown to CGS, 17 Jun 1957, NA 06/1/33 and ROTOITI ROP, 11 May 1957, NA 18/36/75 "P".
39. Lt Cdr W J Brown to CGS, 17 Jun 1957, NA 06/1/33, and (S) Paras 8 and 12 Enclosure A to 173/95. 100/6 of 17 Oct 1957, NA 016/18/52
40. ROTOITI ROP, 15-28 Apr 1957, NA 18/36/75 "P".
41. Ibid, 1-3 May 1957.
42. Ibid, 5-7 May 1957 and 1957 RNZN Report, p 12.
43. ROTOITI ROP, 8-14 May 1957, NA 18/36/75 "P".
44. One Alpha was the highest ABCD state, 2B and 3C were lower states of readiness involving extensive ABCD precautions but not the complete closing down of the ship. Lt Cdr W.J. Brown to CGS, 17 Jun 1957 and Cdr R.T. Hale to CGS 10 Jun 1957, NA 06/1/33.

45. PUKAKI ROP, 15 May 1957, NA 18/36/75 "Q". The positions of the RNZN ships during each test are set out in Appendix I.
46. Ibid, 15 and 18 May 1957, Kenneth Hubbard and Michael Simmons, Operation Grapple : Testing Britain's First H-Bomb, London, 1985 p. 78 and Oulton pp. 320-321 and 328.
47. PUKAKI ROP, 15 May 1957, NA 18/36/75 "Q".
48. Ibid.
49. PUKAKI ROP, 18-22 May 1957, NA 38/36/75 "Q".
50. ROTOITI ROP, 15 May 1957, NA 18/36/75 "P".
51. Ibid, 15-17 May 1957.
52. (S) Minutes of Meeting of Chiefs of Staff Committee, 29 and 31 Jan 1957, CAS to Minister of Defence, 28 Mar 1957, Secretary of External Affairs to Minister of External Affairs 6 May 1957 and Confidential Annex to Minutes of Meeting of Principal Personnel Officers Committee, 9 May 1957, NA 016/8/52.
53. Oulton p. 308.
54. (TS) 'Confidential Report on the Observation of the British H-Bomb Test in the Pacific on 15 May 1957' by H.J. Yeabsley (a record of a verbal report given to the Prime Minister, Minister of External Affairs and Minister of Health on 21 May 1957), ND, PM 121/5/2, (this paper is filed out of date order in part 2 of PM 121/5/2) Oulton, P. 334 and EAR, May 1957, p. 17.
55. (C) Summary of Dr Cook's Report, enclosed with (C) Cleary to Laking, 21 Jun 1957, PM 121/5/2.
56. Ibid, (C) Craw to Director-General of Health, 28 Jun 1957.
57. PUKAKI ROP, 26-31 May 1957, NA 18/36/75 "Q".
58. Ibid, 31 May 1957.
59. Ibid, 17 May and 19 Jun 1957.
60. Ibid, 31 May 1957.
61. Ibid, 31 May - 2 Jun 1957.
62. (C) Commonwealth Relations Office Memorandum, 3 Jul 1957, enclosed with (C) Cleary to Laking, 4 Jul 1957, PM 121/5/2.

63. Ibid, 4 Jun - 12 Jun 1957.
64. Ibid, 4 Jun and 13-14 Jun 1957.
65. Ibid., 17 May and 19 Jun 1957.
66. Ibid, 19 Jun 1957.
67. Ibid, 13-21 Jun 1957 and Laurie G Ross to RO(Hist) ND (received Jan 1988), Def 1350/9 Operation Grapple - Personnel Vol 1.
68. Oulton, p. 329.
69. Enclosure A to 173/GS. 100/6 17 Oct 1957, paras 87 and 88, NA 016/18/52.
70. (C) Atomic Weapons Research Establishment, Aldermaston, Fall Out from Operation Grapple, 22 Aug 1957, enclosed with (C) Cleary to Scott, 16 Oct 1957, PM 121/5/2.
71. PUKAKI ROP, 21-25 Jun 1957, NA 18/36/75 "Q".
72. Ibid, 25 Jun - 16 Jul 1957.
73. (TS) MacMillan to Holland, 27 Jul 1957, PM 121/5/2, Oulton, op. cit., pp. 356-357 and Blakeway, op. cit., p. 158. For an account of moves during this period to end atmospheric nuclear testing see Robert A Divine, Blowing on the Wind : the nuclear test ban debate 1954-1960, New York, 1978.
74. Blakeway, pp. 158-159.
75. Oulton, p. 357.
76. (S) Minutes of Meeting of the Chiefs of Staff Committee, 24 Jun 1957 and Secretary of Chiefs of Staff Committee to Chiefs of Staff, 2 Jul 1957, NA 016/18/52.
77. (TS) RNZNLO London to NZNB, No 581, 11 Aug 1957, Admiralty to UKSLA Wellington, 12 Aug 1957 and (TS) NZNB to NOCA, 142251Z, NA 0016/8/52.
78. 1958 RNZN Report, pp. 9-10 and 23.
79. Ibid, p. 8, (S) Operation Grapple Ship Movement Schedule 11 Nov 1957, NA 016/18/52 and PUKAKI ROP, 10-30 Oct 1957, NA 18/36/75 "Q".
80. PUKAKI ROP 21 Sep 1957, NA 18/36/75 "Q", and Letters of Proceeding HMNZS TUTIRA and ROTOITI pt 2. ROTOITI ROP, 30 Oct - 20 Dec 1957, NA 18/36/75 "P".

81. Ibid, 8 Nov 1957.
82. Hubbard, pp. 108-110 and Oulton, pp. 357 and 403.
83. ROTOITI ROP, 8 Nov 1957, NA 18/36/75 "P".
84. Operation Grapple "X" Ray - D. Day Routine (ROTOITI), enclosed with Lawson to Gair 17 Oct 1987 enclosed with Gair to Minister of Defence, 23 Oct 1987, Def 12/8/1 Nuclear Weapons General.
85. PUKAKI ROP, 8 Nov 1957, NA 18/36/75 "Q".
86. (S) Cleary to McIntosh, 13 Nov 1957, PM 121/5/2.
87. Ibid, 10-12 Nov 1957 and ROTOITI ROP, 10-12 Nov 1957, NA 18/36/75 "P".
88. Ibid, 14 Nov 1957 and PUKAKI ROP, 14-15 Nov 1957, NA 18/36/75 "Q".
89. Ibid, 16-26 Nov 1957 and ROTOITI ROP, 16-26 Nov 1957, NA 18/36/75 "P".
90. Ibid, p. 3 para 25 and PUKAKI ROP, 28 Nov - 1 Dec 1957, NA 18/36/75 "Q".
91. 'Report on Inquiries into the possible contamination of Marine Life in the Northern Cook Islands following the H-Bomb Tests' by R. Powell, N.D., enclosed with (C) Wright to Secretary of External Affairs, 31 Aug 1957, PM 121/5/2.
92. Ibid, (TS) Holyoake to MacMillan, 4 Oct 1957, Roth to Secretary of Island Territories, 11 Sep and 25 Oct 1957. H 108/11.
93. Roth to Powell, 23 Dec 1957, Powell to Director of Agriculture Rarotonga, 23 Jan 1958, D.S. Reid to Official Secretary Cook Islands Administration and enclosure, 24 Jun 1958 and Roth to Secretary of Island Territories, 8 Aug 1958, PM 121/5/2. I have only examined file PM 121/5/2 up to the end of 1958 and have not established when the sampling programme was terminated and what the results of sampling after August 1958 were.

CHAPTER III : THE 1958 TEST SERIES

During September 1957 MacMillan wrote to Holland requesting that New Zealand assist the United Kingdom with a further series of tests which it planned to conduct the following year. In response Holland seems to have verbally informed the British High Commissioner in Wellington that he was prepared to continue New Zealand assistance with the testing programme. In October, Keith Holyoake, who had replaced Holland as Prime Minister, reaffirmed this undertaking¹. The defeat of the National Government in the General Election at the end of November 1957 meant that this agreement had to be discussed with the new Labour administration. As one External Affairs official put it on the 3rd of December:

Are we not duty bound (in view of their expressed views on the question of tests) to bring this commitment [to assist in the 1958 test programme] to the notice of Labour leaders in the near² future. (ie before it leaks out from Navy sources etc) .

Before the election the New Zealand Labour Party had supported a call by the British Labour Party for the postponement of the tests scheduled for 1958. Many Labour supporters now expected the new Government to halt New Zealand's involvement in the British nuclear testing programme. The new Prime Minister, Mr Walter Nash, however, agreed to fulfil the undertaking given

by Holyoake. Although he sanctioned continued New Zealand involvement in the Christmas Island tests, Nash made it clear to the British Prime Minister that his government wished to see an end to nuclear testing.

The United Kingdom decided to delay announcing the new test series for as long as possible because of concern that an early announcement would provide an opportunity for pressure to be exerted on the British Government to stop or postpone its testing programme. Such pressure would be embarrassing for the United Kingdom, and if it did lead to the suspension or cancellation of the planned tests would, in words of the Secretary of State for Commonwealth Relations, represent "a victory for Soviet propoganda which is to neutralize and discredit the deterrent so that Soviet preponderance in conventional armaments will leave Russia dominant in world affairs"³.

The ROTOITI did not take part in the 1958 tests because she had to undergo a refit during the early months of the year and then sailed for South East Asia to replace HMNZS ROYALIST as the Royal New Zealand Navy's contribution to the Far East Strategic Reserve⁴. During the first 1958 series, Grapple Y, the ROTOITI's place was taken by HMS ULYSSES⁵.

After sailing from Auckland on the 14th of March 1958 the PUKAKI visited a number of islands and conducted exercises with

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HMNZS KANIERE and the Royal New Zealand Air Force's No 5 Squadron before arriving at Christmas Island on the 12th of April⁶. A Royal Navy meteorological party and a variety of stores were then embarked by the PUKAKI before she resumed the now familiar task of weather reporting off Christmas Island⁷.

Early on the 28th of April, the day of the only test in the Grapple Y series, PUKAKI's radar picked up a "small firm echo" which Lt Cdr Elliott believed could be a submarine. A search by PUKAKI and two RAF Shackleton aircraft failed to find any trace of the contact and at 0515 the PUKAKI resumed her weather patrol⁸.

Later in the morning the PUKAKI took up her viewing position 80 nautical miles to the east of surface zero. Lt Cdr Elliott ordered that her engines be stopped so that as many as possible of the crew could witness the test. The crew wore no protective clothing, apparently because of the experience gained during previous tests. The only precaution taken was "to face the ship's company away from Ground Zero with eyes closed until 15 seconds after the burst". At 1005 the megaton range weapon which had been dropped from a Valiant exploded, and the crew of the PUKAKI:

had a magnificent view of the burst, from the rising of the fireball to the formation of a symmetrical and spotlessly white mushroom shape, which later deteriorated into an ugly greyish-white cloud shot through with a reddish tinge.

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The cloud from the test "spread and drifted across the whole sky and was still clearly distinguishable overhead at sunset". This situation led Lt Cdr Elliott to comment that "Such was our faith in the scientists ashore that no-one was heard to say, 'I hope it doesn't rain'". Clearly Elliott was well aware of the dangers posed by rain-out, in which radioactive particles produced by a nuclear explosion are brought to earth by rain passing through the explosion's cloud¹⁰.

At 0910 on the following day, during the voyage back to Christmas Island, the PUKAKI passed through surface zero. The ship's monitoring officer, Lt Commons, recalls that at this time he monitored the sea water from the boiler room inlets and detected very low levels of radiation; the only occasion during his involvement on which he detected radiation attributable to the nuclear tests¹¹. After her return to the Port of London, members of PUKAKI's crew took part in a regatta organised by the Grapple Squadron on the 30th April 1958¹². At Christmas Island the PUKAKI discharged her specialist meteorological and other equipment and the Royal Navy party before departing for Auckland on the 2nd of May, where she arrived 16 days later¹³.

During July 1957 Prime Minister Nash apparently responded favourably to a request from the British High Commissioner in Wellington for further New Zealand assistance in a final Operation Grapple series. High Commissioner Mallaby stressed in his letter

the urgent need for the United Kingdom to complete her test programme before an agreement to halt nuclear testing was reached¹⁴.

On the 23rd of July, just a few days after the High Commissioner's request had been received, the PUKAKI departed from Auckland for Christmas Island¹⁵. In addition to her normal crew she carried the Reverend Henry Taylor DSO, OBE, the RNZN's senior chaplain who was to act as Grapple Squadron chaplain during the final series which was codenamed Grapple Z¹⁶. After arriving at Christmas Island Lt Cdr Elliott discussed the operation with the commander of the other weather ship, HMS SCARBOROUGH, a newly commissioned Whitby class anti-submarine frigate¹⁷. Following the by now well established routine, the PUKAKI took on board a variety of specialist stores and a Royal Navy meteorological team before beginning her weather reporting duties. In an effort to relieve overcrowding caused by the presence of an additional relieving meteorological officer, it was decided that the PUKAKI's two Acting Sub-Lieutenants should each spend three weeks on the SCARBOROUGH. The first officer involved in this scheme, Acting Sub-Lieutenant John T. Ford, left the PUKAKI on the 8th of August¹⁸.

Between the 8th and 13th of August the PUKAKI conducted her first weather patrol of Grapple Z and on the 16th she again sailed from Christmas Island to join the SCARBOROUGH on patrol

for the first test of the series. On the 20th of August an Admiralty scientist, a Mr Allwood, was embarked from the Royal Fleet Auxiliary OLNA to operate recording equipment during the first test¹⁹.

At 0900 on the morning of the 22nd of August, the PUKAKI observed the test of a kiloton range atomic advice which was suspended from barrage balloons 450 metres above the south east point of Christmas Island. Because of a faulty starsight the PUKAKI was 28 nautical miles to the east of surface zero, five miles closer than the planned viewing position. All of the ship's company apart from six men required to man the wheelhouse, engine and boiler rooms were mustered on the deck. The crew faced away from the test site until 15 seconds after the blast before turning to see the fireball rising and the mushroom cloud forming. Later in the day Mr Allwood was transferred back to the OLNA²⁰. The PUKAKI continued its weather reporting duties until she returned to Christmas Island on the 25th of August 1958²¹.

After embarking Mr Allwood and a supply of fresh vegetables which had arrived by air from Honolulu, the PUKAKI sailed from Christmas Island on the 30th of August. Three days later at 0826 on the 2nd of September, the New Zealand frigate witnessed the second Grapple Z test from a position 35 nautical miles north east of surface zero. As with all the megaton range air dropped nuclear tests off Christmas Island, the test site was about two

and half kilometres off the south east tip of the island. As this test was much more powerful than the first test of the series, it appears that the PUKAKI assumed ABCD state 1 Alpha an hour before the test and that her crew wore full anti-flash clothing during the test. After the test the PUKAKI returned to the island²².

On Sunday the 7th of September six officers and a party of ratings from the PUKAKI went ashore to compete in a variety of sports against the 59 Squadron, Royal Engineers, and to make a tour around the various installations on the island²³. Early the following morning the PUKAKI took part in a search for a seaman who was missing in a dinghy from his ship in the Port of London. After a short search along the western side of Christmas Island the PUKAKI located the dinghy and took its intoxicated occupant aboard. Later that morning the PUKAKI took Mr Allwood aboard and sailed to join the SCARBOROUGH on weather patrol, in preparation for the next test²⁴.

For the third test of the series, at 0847 on the 11th of September 1958 the PUKAKI's viewing position was 35 nautical miles to the north east of surface zero. It appears probable that the PUKAKI took the same precautions as during the previous test of an air dropped megaton range weapon. The crew wore full anti-flash gear while observing this test. Following the test the New Zealand frigates returned to Christmas Island²⁵. The PUKAKI spent the next four days in port, during which members of her crew competed in another Grapple Squadron regatta²⁶.

Before the PUKAKI sailed on the 16th of September, on what was to be her last weather patrol for Operation Grapple, five ratings left the ship to change places with five men of 38 Squadron, Royal Engineers. The object of this exchange was, it seems, to relieve the monotony of service during the testing programme²⁷. After five days of weather monitoring the PUKAKI rendezvoused with the SCARBOROUGH during the afternoon of 21st of September 1958 and took the Admiralty scientist Mr Allwood on board. The PUKAKI then sailed westward to take up her viewing position for the fourth test, 20 nautical miles east of surface zero, by the morning of the 23rd of September. At 0900 the kiloton range atomic device which was supported by barrage balloons was detonated, 450 metres above the south east tip of Christmas Island. The view from the PUKAKI was obscured by cloud "but glimpses were obtained of a dirty grey stalk and the pink-white mushroom head". Following the test the PUKAKI launched her last weather balloons of Operation Grapple and then returned to Christmas Island during the evening of the 23rd of September 1958²⁸. The following day the Royal Navy meteorological party left the ship and the various items of specialist equipment and stores were put ashore, and on the 25th of September the PUKAKI sailed for Auckland, where she arrived on 9th of October 1958²⁹.

Notes

1. (TS) MacMillan to Holland, 11 Sep 1957, (TS) McIntosh to Cleary, 27 Sep 1957 and (TS) Holyoake to MacMillan, 4 Oct 1957, PM 121/5/2 and (TS) Secretary of External Affairs to Navy Secretary, 19 Dec 1957, NA 0016/8/52.
2. Minute to Scott initialed by K, 3 Dec 1957, PM 121/5/2 and marginalia on Secretary of External Affairs to Navy Secretary, 17 Dec 1957, NA 0016/8/52.
3. (TS) Note to Nash probably by McIntosh, 6 Dec 1957, (TS) Nash to MacMillan, 16 Apr 1958, (S) Telegram Secretary of State for Commonwealth Relations to United Kingdom High Commission Wellington, No 292, 12 Mar 1958, PM 121/5/2, (TS) Secretary of External Affairs to Navy Secretary, 13 Jan 1958, NA 0016/8/52 and Keith Sinclair, Walter Nash, Auckland, 1976, pp. 299 and 334.
4. (S) Secretary of External Affairs to Navy Secretary, 19 Dec 1957, NA 0016/8/52 and 1958 RNZN Report, p. 10. During the 1958 test series the Royal Navy did not have to provide the Royal New Zealand Navy with a replacement ship, as it had during 1957. See (TS) Cleary to Scott, 12 Sep 1957, PM 121/5/2.
5. PUKAKI ROP, 16 and 23 Apr 1958, NA 18/36/75 "Q".
6. Ibid, 16 Mar - 12 Apr 1958.
7. Ibid, 12-20 Apr 1958. However, about 30% of PUKAKI's crew had only recently joined the ship, *ibid.*, general comment p. 6, ROP 1 Mar - 9 Apr 1958.
8. Ibid, 28 Apr 1958.
9. Ibid.
10. Ibid and Rotblat, p. 73. It has been suggested that rain-out may have occurred on and in the vicinity of Christmas Island after the Grapple Y test, see Blakeway, pp. 174-176.
11. PUKAKI ROP, 29 Apr 1958, NA 18/36/75 "Q", and Commons to Secretary of Defence, 28 Jan 1988, Def 12/1/1. Commons was involved in Grapple X and all of the 1958 nuclear tests.
12. PUKAKI ROP, 30 Apr 1958, NA 18/36/75 "Q".
13. Ibid, 30 Apr - 18 May 1958.
14. (TS) Mallaby to Nash, 14 Jul 1958, NA 0016/8/52.

15. Report of the New Zealand Naval Board 1959, AJHR 1959, H.5, p. 8. This would be the first Operation Grapple for much of the PUKAKI's crew as some 90 ratings had joined the ship during June 1958. See PUKAKI ROP, 13-22 Jun 1958, NA 72/3/6, pt 1, Reports & Returns, Reports of Proceedings HMNZS PUKAKI.
16. Ibid, 23 Jul and 4 Aug 1958.
17. Ibid, and 1959 RNZN Report, p. 12.
18. PUKAKI ROP, 8 Aug 1958, NA 72/3/6. During the first Grapple series a total of 19 RNZN personnel were temporarily attached to HMS WARRIOR and one to HMS MESSINA. In 1958 during Grapple 2 three RNZN personnel served on HMS RESOLUTION, the Royal Navy's base on Christmas Island. See Saxby to Newman, 22 Jan 1988, Def 12/1/1.
19. PUKAKI ROP, 20 and 22 Aug 1958, NA 72/3/6.
20. Ibid and Oulton, p. 403.
21. PUKAKI ROP, 22-25 Aug 1958, NA 72/3/6.
22. Ibid, 30 Aug - 2 Sep 1958, PUKAKI 1st Lt's Temporary Memo No 39, 1 Sep 1958, (copy) D 12/1/1, and Oulton, p. 403.
23. PUKAKI ROP, 7 Sep 1958, NA 72/3/6.
24. Ibid, 8 Sep 1958.
25. Ibid, 11 Sep 1958.
26. Ibid, 12-16 Sep 1958.
27. Ibid, 29 Sep 1958.
28. Ibid, 23 Sep 1958.
29. Ibid, 24 Sep - 9 Oct 1958.

THE POSITIONS OF HMNZS ROFOITI AND HMNZS PUKAKI DURING OPERATION GRAPPLE NUCLEAR TESTS

PUKAKI

Operation & Location	Date & Time (GMT-Z)	Site	Type	Height (metres)	Yield Range	Distance from Surface Zero	AWE Distance Estimate	Bearing (degrees)
Grapple Malden Is.	15 May 57 1937 Z	04 deg. 04' 03" South, 154 deg. 56' 01" West (Offshore, approx 1.7 kms, South of Malden Is.)	Airburst: Freefall	2400	Megaton	50 miles (92.6 kms)	-	-
	31 May 57 1941 Z	04 deg. 04' 03" South, 154 deg. 56' 01" West (Offshore, approx 1.7 kms, South of Malden Is.)	Airburst: Freefall	2300	Megaton	50 miles (92.6 kms)	75 kms	352
Grapple Christmas Is.	19 Jun 57 1940 Z	04 deg. 04' 03" South, 154 deg. 56' 01" West (Offshore, approx 1.7 kms, South of Malden Is.)	Airburst: Freefall	2300	Megaton	150 miles (277.8 kms)	-	-
	8 Nov 57 1747 Z	01 deg. 41' 05" North, 157 deg. 14' 14" West (Off South East Point 2.5 kms from Xmas Is.)	Airburst: Freefall	2250	Megaton	132 miles (244.5 kms)	280 kms	267
Grapple Christmas Is.	28 Apr 58 1905 Z	01 deg. 41' 05" North, 157 deg. 14' 14" West (Off South East Point 2.5 kms from Xmas Is.)	Airburst: Freefall	2350	Megaton	80 miles (148 kms)	160 kms	275
	22 Aug 58 1800 Z	01 deg. 42' 58" North, 157 deg. 10' 38" West (South East Corner)	Airburst: Balloon borne	450	Kiloton	28 miles (52 kms)	60 kms	272
Grapple Christmas Is.	2 Sep 58 1724 Z	01 deg. 41' 05" North, 157 deg. 14' 14" West (Offshore South East Point approx 2.5 kms from land.)	Airburst: Freefall	2850	Megaton	35 miles (64.8 kms)	-	-

PUKAKI

Operation & Location	Date & Time (GMT=Z)	Site	Type	Height (metres)	Yield Range	Distance from Surface Zero	AWE Distance Estimate	Bearing (degrees)
	11 Sep 58 1749 Z	01 deg. 41' 05" North, 157 deg. 14' 14" West (Offshore South East Point approx 2.5 kms from land.)	Airburst: Freefall	2650	Megaton	35 miles (64.8 kms)	75 kms	220
*	23 Sep 58 1800 Z	01 deg. 42' 58" North, 157 deg. 10' 38" West (South East Corner)	Airburst: Balloon borne	450	Kiloton	20 miles (37 kms)	40 kms	272

ROTOITI

Operation & Location	Date & Time (GMT=Z)	Site	Type	Height (metres)	Yield Range	Distance from Surface Zero	AWE Distance Estimate	Bearing (degrees)
Grapple Malden Is.	15 May 57	04 deg. 04' 03" South	Airburst: Freefall	2400	Megaton	150 miles (277.8 kms)	-	-
	1937 Z	154 deg. 56' 01" West (Offshore, approx. 1.7 km south of Malden Is.)						
	31 May 57	04 deg. 04' 03" South	Airburst: Freefall	2300	Megaton	150 miles (277.8 kms)	-	-
	1941 Z	154 deg. 56' 01" West (Offshore, approx. 1.7 km south of Malden Is.)						
	19 Jun 57	04 deg. 04' 03" South	Airburst: Freefall	2300	Megaton	50 miles (92.6 kms)	90 kms	377
	1940 Z	154 deg. 56' 01" West (Offshore, approx. 1.7 km south of Malden Is.)						
Grapple X Christmas Is.	8 Nov 57	01 deg. 41' 05" North	Airburst: Freefall	2250	Megaton	60 miles (111 kms)	115 kms	229
	1905 Z	157 deg. 14' 14" West (Off South East Point approx. 2.5 km from Xmas Is.)						

Note: Tables compiled from the ROPs of PUKAKI and ROTOITI, information provided by the AWE, (C) Cable London to Wellington, No. 310, 15 Jan 1988 and enclosure to Leask to DIMS, 31 Mar 1988, D 12/1/1 and AWE table reproduced in Oulton, p. 403.

APPENDIX II

THE TIME SPENT BY HMNZS ROTOITI AND HMNZS PUKAKI
AT CHRISTMAS ISLAND AFTER THE GRAPPLE X TEST

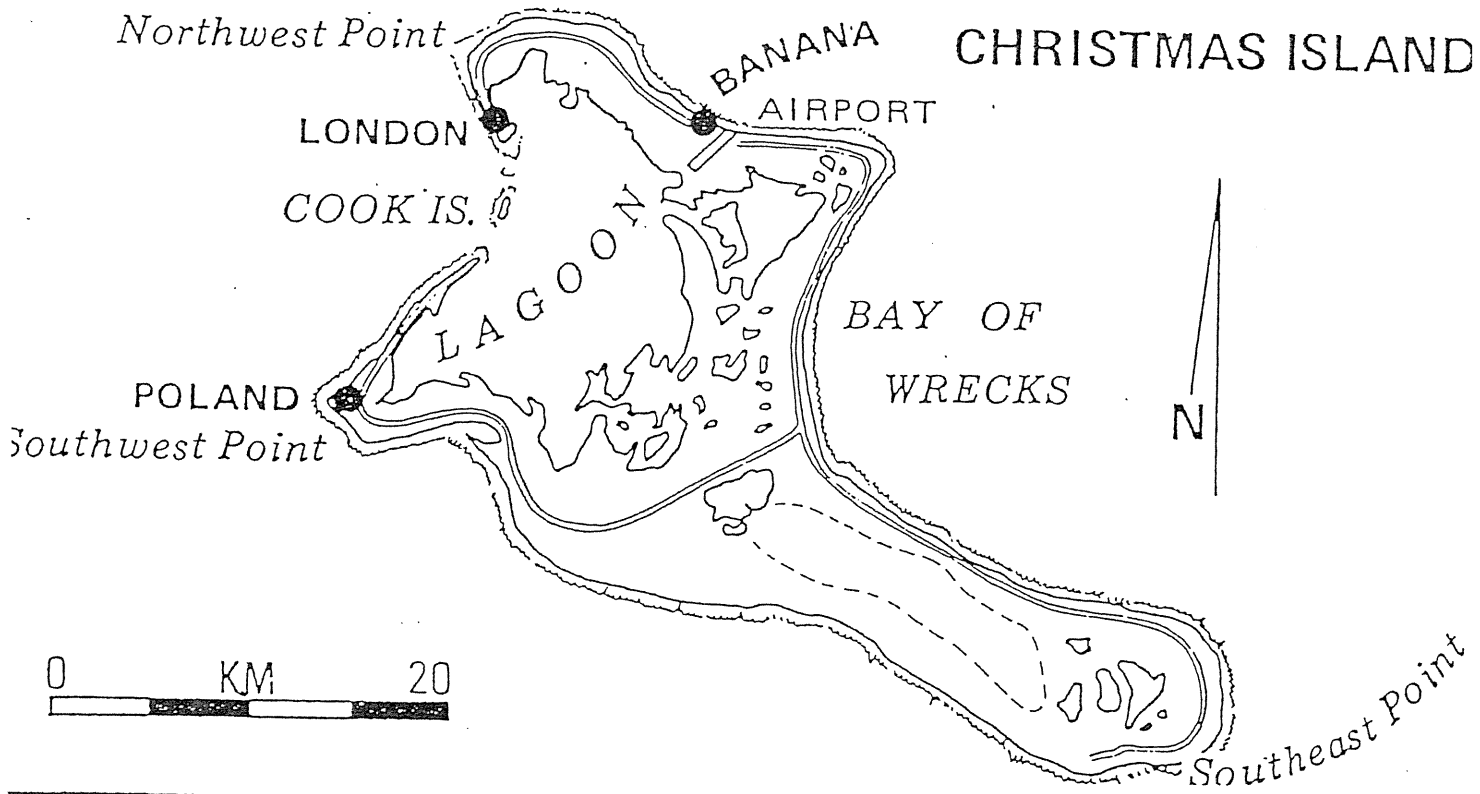
OPERATION	TIME	ROTOITI	PUKAKI
Grapple X		0900/10/11/57	0900/10/11/57
		to	to
		0800/14/11/57	0800/14/11/57
		1700 (est) 14/11/57	
		to	
		1300/16/11/57	
	sub total	5 days 19 hours	3 days 23 hours
Grapple Y			0940/12/4/58
			to
			1245/16/4/58
			1100/21/4/58
			to
			1430/22/4/58
			1200/29/4/58
			to
			1200/2/5/58
	sub total	-	8 days 6 hours 35 minutes
Grapple Z			0900/4/8/58
			to
			1330/8/8/58
			0900/13/8/58
			to
			1400/16/8/58

OPERATION	TIME	ROTOITI	PUKAKI
			1100/25/8/58 to 2015/30/8/58
			1930/2/9/58 to 0145/8/9/58
			0430/8/9/58 to 1140/8/9/58
			1340/11/9/58 to 1320/16/9/58
			1930/23/9/58 to 0830/25/9/58
	sub total		24 days 20 hours 50 minutes
	Total	5 days 19 hours	37 days 2 hours 25 minutes

Note: Table dates compiled from Reports of Proceedings of HMNZ Ships PUKAKI and ROTOITI. The time spent at Christmas Island is calculated from the time of arrival to time of departure or if these are not given from the time of anchoring until the weighing of anchors.

APPENDIX III

CHRISTMAS ISLAND



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Primary Sources

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(held by MoD)
- NA 016/8/52 : Operations - Training etc - Operation Grapple
(held by MoD)
- Note: The unclassified version of this file NA 16/8/52 is missing.
- NA 8/20/62 : Intelligence - Movements of HM Ships,
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- NA 8/20/63 : Intelligence - Movements of HM Ships,
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- NA 18/36/85 "L" : Acts, Regulations, Publications and Returns -
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