



Ministry of Defence

Our Ref: FOI2018/12320

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[REDACTED]
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Dear [REDACTED]

25 October 2019

Further to our letter dated 27 September 2019, we are writing to provide a response to your email dated 5 October 2018 and apologise for the delay in doing so.

You requested the following information:

"Under the Freedom of Information Act 2000 I would like to request a copy of the full document entitled 'Operation Grapple Y - interim report' partially released under FOI request 2018/06695 and, if the full document is not available, then in particular the 11-page section titled 'part 7 - radiological measurements' reference GY7/RM."

Your correspondence has been treated as a request for information under the Freedom of Information Act (FOI Act) 2000. We can confirm that the Ministry of Defence holds information in scope of your request. We attach a copy of:

- Grapple Y Interim Report, Part 7, Radiological Measurements, dated June 1958, reference GY7/RM. This consists of 16 pages (cover page, 11 numbered pages and 4 pages table and graphs. The latter 3 pages were not included with the response to FOI2018/06695 as they were out of scope of that request.
- Contents page of the full Grapple Y Interim Report dated June 1958.

However, as notified in previous correspondence, some of the information you requested falls within the scope of qualified exemptions Section 24 (National Security) and Section 26 (Defence) provided for within the Act. A public interest test has been conducted and, while the presumption within the Act towards disclosure whenever possible has been considered, it is assessed that the greater interest lies in withholding some of the information requested. Some information has also been redacted under absolute exemption Section 40 (Personal Information).

Section 24(1) (National Security) has been applied to some of the information requested because it includes scientific data about nuclear warhead performance from which details of weapon design and materials could be determined. It is judged that the disclosure of all the information would be prejudicial to both the safeguarding of the UK's national security and our obligations and interests in the non-proliferation of nuclear weapons. Section 24(1) is therefore engaged, and the balance of public interest has been found to lie in favour of withholding some of the information.

Section 26(1) (Defence) has also been applied to elements of the documents as disclosure of some of the information relates to how the UK's strategic deterrent works thereby providing a potential adversary with the ability to undermine its effectiveness. Furthermore, this information could be used by an adversary or third-party state to develop their own device, which would undermine the defence of the UK. Section 26(1) is therefore engaged, and the balance of public interest has been found to lie in favour of withholding some of the information. We have set the level of prejudice against release of the exempted information at the higher level of 'would' rather than 'would be likely to'.

The full Grapple Y Interim Report consists of 19 parts and has well over 100 pages. We have attached the list of contents so you will be able to refine your request and select the areas of most interest to you should you wish to forward a further FOI request. It is highly likely, however, that redactions would be necessary to this information also.

If you have any queries regarding the content of this letter, please contact this office in the first instance. Please remember to quote the reference number above in any future correspondence.

If you wish to complain about the handling of your request, or the content of this response, you can request an independent internal review by contacting the Information Rights Compliance team, Ground Floor, MOD Main Building, Whitehall, SW1A 2HB (e-mail CIO-FOI-IR@mod.gov.uk). Please note that any request for an internal review should be made within 40 working days of the date of this response.

If you remain dissatisfied following an internal review, you may raise your complaint directly to the Information Commissioner under the provisions of Section 50 of the Act. Please note that the Information Commissioner will not normally investigate your case until the MOD internal review process has been completed. The Information Commissioner can be contacted at: Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF. Further details of the role and powers of the Information Commissioner can be found on the Commissioner's website at <https://ico.org.uk/>.

Yours sincerely,

Defence Nuclear Organisation Secretariat

OPERATION GRAPPLE-Y - INTERIM REPORTPART 7. RADIOLOGICAL MEASUREMENTS1. Statement of Group Tasks

RM1 To measure the integrated gamma dose/distance relationship, and the variation of dose rate with time for the initial gamma radiation.

RM2 To measure the variation of integrated neutron flux with distance.

RM3 To measure fallout contamination at points close to Ground Zero.

RM4 To measure fallout at surrounding islands.

RM5 To measure the gamma dose in cloud sampling aircraft.

RM6 To advise on health physics and radiological control.

RM7 To provide a dose measuring service.

RM8 To provide nuclear instrumentation.

RM9 To radiograph and monitor the neutron output of weapon components.

RM10 To carry out a radiological survey and the analysis of a sea water sample from surface zero.

RM11 To make radiological survey in an emergency.

RM12 To arrange for fish monitoring.

2. Results of Measurement Tasks2.1 Task RM1 Integrated Gamma Dose/Distance Measurements

The integrated initial gamma dose was measured at a number of points varying from 11000 ft. to 24200 ft from point of burst. The measuring devices used were phosphate glass dosimeters (range 10 - 10⁴r), condenser ion chambers (ranges 0 - 0.5r, 0 - 5r, 0 - 50r, 0 - 300r and 0 - 1000r) and film phosphor dosimeters (range 5 x 10⁻³ - 2.5r). In addition three gamma integrators designed to measure the gamma dose to 30 seconds after firing on one channel and from 5 to 30 seconds after firing on a second channel, were installed.

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Results from the ion chambers and film phosphor dosimeters were first plotted and a curve drawn. The phosphate glass dosimeters were read at Aldermaston and the values were added to the graphs as shown in Figure 1 (RM). The data plotted are the measured values of dose considered most reliable at any given distance and usually represent the average of several values for the ion chambers and two values for the film phosphor dosimeters. Results from the gamma integrators are shown below:-

Results from the Gamma Integrators

<u>Distance from point of burst (ft)</u>	<u>Total Dose to 30 seconds after firing (mr)</u>	<u>Dose from 5 to 30 seconds after firing</u>
19400		
22050		
24200		

2.2 Task RM1 Variation of Initial Gamma Dose Rate With Time

At two sites 15400 ft and 19400 ft from point of burst, instruments for recording gamma dose-rate were installed. These consisted of an ionisation chamber, a pulse generator with output pulse frequency proportional to ionisation current from the chamber and consequently to dose-rate, and a tape recorder to record the pulses. The variation in dose-rate with time from one of these instruments, obtained by counting the number of pulses per second of tape run, is shown in Figure 2 (RM). The scattered points prior to time of burst are thought to represent instrumental background.

The method of analysing the tape recording available on Christmas Island does not give the best time resolution of which the equipment should be capable. The tape recording will be re-analysed at Aldermaston using more refined techniques.

The record equipment failed to produce a record showing more than background effects.

2.3 Task RM2 Integrated Neutron Flux-Distance Measurements

Sulphur and gold detectors were exposed at distances from point of burst varying from 11000 ft to 13750 ft in an attempt to measure integrated neutron flux of energies greater than 3 MeV (sulphur) and of thermal neutrons (gold) by the activity induced in the detectors. The gold detectors are exposed in pairs, one enclosed in a cadmium shield and the other not. The difference in induced activity in the detectors is a measure of the total number of thermal neutrons.

Gold foil discs and sulphur tablets of about 2 cm diameter have been used previously, and have been calibrated by exposure in a reactor (for thermal neutrons) or to neutrons from a Po-Be

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source (for fast neutrons). It was considered on the basis of experience on previous Grapple trials that these might be insufficiently sensitive at the distances at which they must be placed. Four sets of larger detectors were therefore made up comprising two 6 in. square gold foils, one enclosed in a cadmium can, and an aluminium tube containing sulphur. The gold foils could be counted in counters intended for sticky paper fallout collectors, and the radioactive phosphorus - 32 separated chemically from the remaining sulphur and counted. No calibration had been carried out on these detectors.

The only satisfactory activity decay curves obtained for the small gold detectors were for the pair sited closest to point of burst. All four pairs of large gold detectors gave satisfactory decay curves. No activation of the small sulphur samples was detected and the large ones are to be analysed at Aldermaston.

One pair of large gold detectors was sited alongside the small pair giving the satisfactory decay curves. A calibration was thus afforded for the large detectors and the results so obtained are shown in Figure 3 (RM).

2.4 Task RM4 Fallout at Points Close to Ground Zero

Sticky paper fallout trays were exposed after the blast wave had passed at nine sites on the island. A tenth tray was exposed near D Site at H + 5 hours. The results expressed in terms of 1-hour fission products, employing a $t^{-1.2}$ law, are given in Table 1 (RM).

The efficiency of the counter is such that the minimum detectable activity at the time of counting is approximately $2 \times 10^{-4} \mu\text{c}/\text{m}^2$. The efficiency of the counter had deteriorated radically since Grapple-X.

The level of activity at which an area is declared active is approximately $430 \mu\text{c}/\text{m}^2$ on the ground at the time of measurement. The maximum fallout was $300 \mu\text{c}/\text{m}^2$ of 1-hour fission products.

2.5 Tasks RM4 and 12 Outlying Sampling Stations

These stations were all restocked and operated satisfactorily from 17th April, 1958. The counting is done in the UK. ~~██████████~~ A.W.R.E., will act as liaison officer between the stations and S.R.H.P. in the inter-trial period.

2.6 Task RM5 Measurement of Gamma Dose in Cloud Sampling Aircraft

Both integrating and dose-rate instruments were supplied for use in the cloud sampling aircraft and these appear to have functioned satisfactorily.

It had been intended to instal a gamma dose-rate recorder in the cabins of the high altitude Scorpion Canberras to ascertain how the dose-rate varies with time but this measurement was eliminated as the high altitude aircraft were not used for sampling.

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2.7 Task RM9 Radiography and Neutron Monitoring of Weapon Components

Radiography and a check on the neutron output of two weapon components were carried out. The results are available in separate correspondence.

2.8 Task RM 10 Radiological Survey

Four gamma dose-rate meters with an overall range of 0 - 10 r/h and switched ranges were prepared for installation in Shackleton aircraft, arrangements having been made for these to be operated by crew members.

Data on the gamma dose-rate background levels in the area around Christmas Island were obtained at the desired survey altitude of 300 ft on various operational sorties. These data varied between about 10 and 25 $\mu\text{r/h}$.

On D-day an area, shown in Figure 1 (TP), was declared by TP Group to be the area where fallout was most probably, and this was surveyed in five E-W or W-E runs at about 300 ft altitude. The dose rates recorded on this sortie were above 100 $\mu\text{r/h}$ after the first 15 minutes of flight, with a maximum of about 185 $\mu\text{r/h}$. On return to Christmas Island the aircraft was found to be contaminated and it would appear that at least 120 $\mu\text{r/h}$ of the high readings was due to this contamination. The dose readings are thus ambiguous, the dose probably being received sometimes from contamination of the aircraft, from fallout on the sea and from radioactive material still in the air. Further analysis of the data may provide some useful information on fallout.

A further search of the same area was carried out starting at about 1400 hours on D + 1 using a different aircraft and survey meter. The dose-rates observed were consistently between 23 and 26 $\mu\text{r/h}$. On return this aircraft was also found to be somewhat contaminated. It is considered that no dose-rates on this sortie significantly exceed background levels and that the aircraft had in fact been contaminated on D-day. From the readings on this survey, concentrations of fallout in the sea in the area surveyed, were not greater than the maximum permissible of $6 \times 10^{-5} \mu\text{c/cm}^3$ recommended by [REDACTED]

2.9 Task RM10 Analysis of a Sea Water sample, from Surface Zero, for Radioactivity

A search by helicopter, using a portable radiation monitor, was made in the region of surface zero some 2 hours after firing, to locate the highest level of sea contamination. A sample of sea water was taken at the point of maximum monitor reading.

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Page No. 5 of 11 Pages

The water sample was analysed by a method based on Windscale Method WSL/M.425, which was used on Grapple-X. In this method fission product activity is precipitated from the sea water with ammonium oxalate. The remaining solution should contain the principal neutron induced activity.

It was found that the activity (/cc of sea water) referred to time of collection of the solution after the precipitation process was indistinguishable from that of the sea water. Both activities decayed with a half life of about 13 hours which can be attributed to sodium - 24 (half life 14.9 hours). The concentration of Na-24 at time of collection was 1.5×10^{-4} $\mu\text{c}/\text{cc}$ which is substantially less than the maximum permissible level for drinking of 8×10^{-3} $\mu\text{c}/\text{cc}$. Some slight activity was found on the precipitate which might be attributable to bomb debris but at time of collection the concentration in sea water would be about 3×10^{-6} (less than the maximum permissible concentration for drinking of 6×10^{-4} $\mu\text{c}/\text{cc}$).

2.10 Task RM11 Radiological Survey in an Emergency

No emergency occurred which required aerial radiological survey.

3. Discussion and Conclusions on Measurement Tasks

3.1 Gamma Dose/Distance Measurement

The curve through data points obtained with condenser ion chambers in Figure 1 (RM) is very nearly parallel to the dose-distance curve of Grapple-X, the gamma output (read at 16000 ft) being [REDACTED] times that for Grapple-X. Using scaling factors graphed in "Capabilities of Atomic Weapons", and a value of [REDACTED] for the yield of Grapple-X, we arrive at a yield of [REDACTED] for Grapple-Y. The analysis of gamma dose/distance data is however far from complete and this figure is only provisional.

The measurements obtained with the film phosphor dosimeters are not in agreement with the data from ion chambers, but this has also been observed on other trials.

The results from the gamma integrators are not satisfactory although they operated more successfully than similar devices on earlier trials.

3.2 Variation of Initial Gamma Dose Rate with Time

The value of the one record obtained can be decided only after further analysis.

3.3 Integrated Neutron Flux/Distance Measurements

More data have been obtained on integrated neutron flux than on Grapple-X, but for the type of firing and the yield of the weapons used on X and Y, more work on more sensitive detectors such as those used experimentally on this trial seems desirable.

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3.4 Fallout

There is some doubt as to whether the D-day sortie will yield any information on either sea or air contamination levels, but the D + 1 sortie provided useful negative data by showing that radiation levels were consistent with pre-shot levels.

The sticky paper fallout sampling on Christmas Island indicates a very real fallout at the Decca Master Site on South West Point of the island and this was confirmed by survey on foot. The levels were, however, within those laid down for an uncontrolled area. It is not known whether the contamination was the result of dry fallout or rain-out in a light shower.

3.5 Outlying Sampling Stations

The programme was originally undertaken by various individuals and organisations on a short term basis. Some are finding the work irksome. This mainly applies to fish sampling which they find difficult to organise, lengthy to operate and sometimes the cause of concern to the local fishermen.

The air sampling pumps do not appear to be standing up to continuous running in the Pacific.

4. Nuclear Instrumentation (Task RM8)

A wide variety of nuclear instruments has been supplied and serviced for RC, DC and RM Groups, for installation in aircraft and for the monitoring programme for the emergency plan "Pied Piper".

5. Health Physics - General (Tasks RM 6 and 7)

5.1 Film Badge - Service and Radiation Doses

5.1.1 AWRE A total of 160 film badges were issued. So far (3rd May 1958) no member of AWRE has received a dose in excess of 3.0 roentgens. A number of badges still remains to be developed.

5.1.2 Services Film badges were issued to service personnel attached to AWRE groups, and were included in the AWRE total.

Nine RAF crew received more than 3.0 roentgens. Particulars are given below:-

<u>Name</u>	<u>Dose received</u> (r)	<u>Date further exposure may</u> <u>commence without special</u> <u>authority</u>
[REDACTED]	10.75	} 28.4.61
[REDACTED]	13.0	
[REDACTED]	10.75	
[REDACTED]	13.0	
[REDACTED]	10.5	

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Page No. 7 of 11 Pages

<u>Name</u>	<u>Dose received</u> (r)	<u>Date further exposure may</u> <u>commence without special</u> <u>authority</u>
[REDACTED]	10.0	15.12.58
[REDACTED]	7.5	20.10.58
[REDACTED]	5.0	25. 8.58
[REDACTED]	5.5	6. 9.58

5.2 Operation Pied Piper

RM Group was called upon to provide considerable instrumentation for Op. Pied Piper. The group was in a position to supply film badges for the majority of A and B category personnel but for only 1/3 of C category. There are not enough personal dose meters. The communications provided for the Health Physics controller both within JOC and between himself and outlying surveyors were not wholly satisfactory. A wireless net is essential in an operation of this nature.

5.3 Health Control Centre at Site C

The present building is quite suitable for future operations on the lines of Grapple-Y. The building is not secure as regards the storage of attractive items, but under the present conditions this is acceptable. A better sump needs to be made further from the building and also an access track clear of the rest of Site C in case contamination is ever encountered.

5.4 Active Buildings

The following buildings and areas are expected to be active after Grapple-Y.

JOC B2 1 RC 'Blockhouse' - RED

" B2 Plumbing and fume cupboard ducting should be regarded as RED.

WA Area: EP RA store - BLUE

DC Area: All buildings there are either RED or BLUE.

5.5 HP Representative

[REDACTED] AWRE, will carry out any Health Physics tasks required on behalf of SRHP in the inter-trial period.

6. Health Physics Control - Decontamination Area

6.1 Initial Preparations

The Active Handling Flight (A.H.F.) comprised two medical officers, two R.A.F. Regiment officers and a senior A.W.R.E. decontamination adviser and 33 N.C.O.s and airmen of mixed Canberra servicing trades. All had received initial instruction

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Page No. 8 of 11 Pages

in the U.K. on general Health Physics principles. Further instruction was given on their arrival in the specific duties on which they would be employed. All lectures were backed by practical demonstrations.

A programme of lectures and demonstrations was drawn up for the Canberra sampling squadrons, but Shackleton squadron was not included. These indoctrination lectures included the use of all Health Physics instruments to be carried in the aircraft both fixed and hand-held. Visits to the decontamination area were organised so that the drill and purpose of a decontamination control was fully understood.

6.2 Decontamination Area

Six new soakaways plus the necessary pumps had been installed to deal with contaminated effluent from aircraft and laundry. A 'dirty' aircrew change tent was set up to supplement the small control building (P14).

Instruments, fixed and hand, were installed at the rate of 50% excess to meet unserviceability (Types 1320, 1257, 1021 and one 1404).

All persons, other than visitors, were provided with film badges (P.M.I.) and dosimeters (0.5 or 5.0r).

6.3 Practice

Several practices were organised with No. 76 Squadron Canberras to familiarise aircrew with the drill of passing through the D.C. Area. Two full official practices were held one of which included 'Pied Piper'. Certain small difficulties were encountered but the normal accepted drill was altered in no way. On aircrew extraction the introduction of a new type door shield cut the time for this operation from 2 minutes approx to less than 30 seconds.

6.4 D-Day

Prior to leaving the area all buildings and tents were vented and instruments were cached in two old bomb shelters in the D.C. area to meet the possible destruction of B14 (this building was damaged on Grapple-X).

Arrival and handling of the sampling Canberras (5) followed accepted practice, all being received within 3 hours of burst. Details of the doses received by the aircraft are as follows:-

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Page No. 9 of 11 Pages

A/c	Stbd. Tank r/h	Stbd. Eng. r/h	Nose Wheel r/h	Crews Door r/h	Port Eng. r/h	Port Tank r/h	Charlie r	Time	Code
980	5	5	1	1	4.5	5	14	11.00	Sniff 2
757	2	2	0.4	0.4	2	2.8	10	11.45	Sniff 1
976	Did not sample							11.53	Sniff 3
754	0	.02	0.01	0.01	0.02	0	1.8	12.43	Sniff Bo
978	0.6	0.6	0.2	0.1	0.6	0.8	0.7	12.47	Sniff 4

Burst time 10.05. Charlie = Integrating Dosimeter. Sniff = code for sampler aircraft.

At approximately 1930 hours the radiological survey Shackleton aircraft was admitted into the D.C. Area having become contaminated during the course of its operational sortie. Smearable activity off-scale on a 1320 was recorded from many points on the skin of the aircraft and smearable activity was detected in the cabin. The crew were passed through the decontamination building and it was necessary to remove aircrew clothing and kit from certain members of the crew. The somewhat apprehensive crew were reassured.

All Canberras were refueled without incident.

6.5 D-Day + 1

All aircraft were left to allow contamination to decay. A further Shackleton was admitted in a contaminated state following an operational sortie. It was only mildly contaminated in comparison with the previous aircraft contaminated on the radiological sortie.

6.6 Sample Handling

Despite the relatively 'hot' papers recovered from the Mark 3 Ducts (2.2×10^{14} fissions) the officer handling samples received a relatively small amount of radiation dose, it is considered, to new aids. The doses recorded on the special films used in this operation were:-

Left wrist: less than 1r
Right wrist: less than 1r
Head: 0.35r
Body: 0.8r

6.7 Radiation Received by Members of the A.H. Flight

Dosage received by members were extremely low, 0.15r being the highest (P.M.1) recorded. These low rates are considered to have been achieved due to training, the inclusion of a nucleus of airmen who had had previous experience and adequate N.C.O. and officer supervision.

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Page No. 10 of 11 Pages

6.8 Sampling Aircrew Dosage

Five Canberra B6 aircraft were airborne on sampling detail. Of these only four entered the cloud. The initial penetration, a fringe cut, by the sampling controller gave a very low dose-rate yet enabled subsequent control of samplers to be judged very accurately in respect to obtaining the necessary quantity of particulate matter. Two crews received dosages over 10r.

Crew dosages are tabulated below and can be correlated with the table in Section 6.4 above:-

Sniff Boss A/C 754	[REDACTED]	Badge Dose 0.45r [REDACTED]
		0.38r [REDACTED]
		0.34r [REDACTED]
		0.35r [REDACTED]
Sniff 1 A/C 757		13.0r 10.0r 10.5r
Sniff 2 A/C 980		13.0r 10.75r 10.75r
Sniff 3 A/C 976		} Did not sample
Sniff 4 A/C 978		7.5r 5.0r 5.5r

6.9 Decontamination of Aircraft

The cleaning of all aircraft should take about a fortnight and no health hazards are anticipated.

6.10 Summary

No new problems in relation to Health Physics have been encountered. Dosages in the Active Handling Flight were low but it is clear that this will only remain so if supervision is maintained.

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Copy No. of Copies
Page No. 11 of 11 Pages

Table 1 (RM)

Fallout Data from Sites on Christmas Island

<u>Serial</u>	<u>Site</u>	<u>Time Exposed (local time)</u>		<u>Fallout in $\mu\text{C}/\text{m}^2$ of 1-hour fission products</u>
		<u>From</u>	<u>To</u>	
1.	J.C.C.	281030	281900	Below detectable level
		281900	290900	140×10^{-4}
2.	Port	281015	281900	300×10^{-4}
		281930	290900	450×10^{-4}
3.	Main Camp	281030	290900	Below detectable level
4.	Site C	281100	281800	60×10^{-4}
		281800	290900	140×10^{-4}
5.	Airfield	281015	290900	Below detectable level
6.	Site Y	281015	290930	" " "
7.	Decca Monitor	281100	290930	" " "
8.	Decca Slave	281015	291000	" " "
9.	Site D	281600	291600	1000×10^{-4}
10.	Decca Master (Vaukess Bay)	281015	282200	300
		282200	290815	220×10^{-4}

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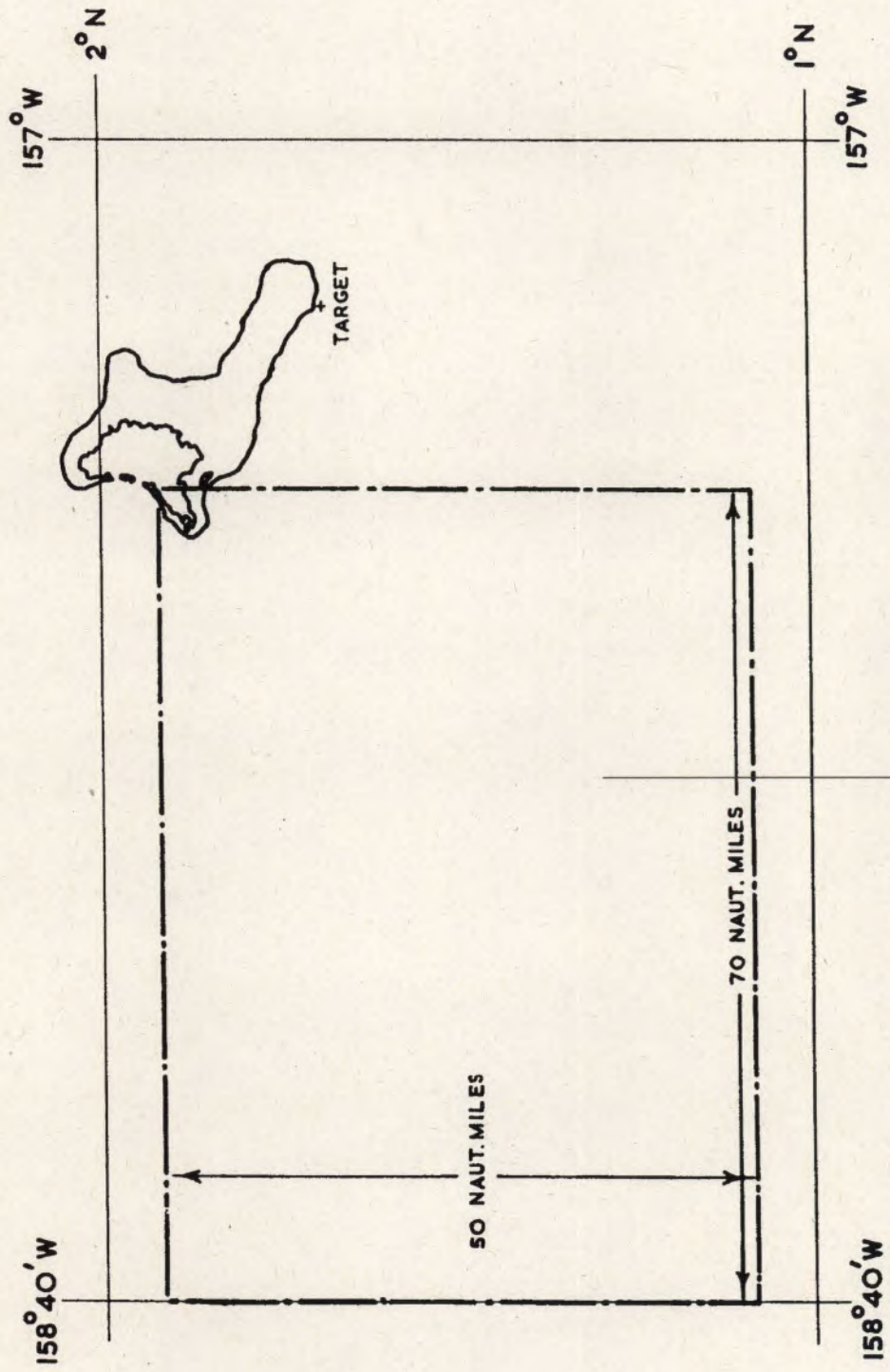


FIGURE I (TP) AREA OF AERIAL RADIOLOGICAL SURVEY

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CONTENTS PAGE ONLY

OPERATION GRAPPLE-Y

INTERIM REPORT

Contents

- Part 1. Air Shock Measurements ✓
- Part 2. Radio Flash Measurements
- Part 3. Thermal Measurements ✓
- Part 4. Nuclear Transients
- Part 5. Photographic Measurements
- Part 6. Radiochemical Analysis
- Part 7. Radiological Measurements
- Part 8. Weapon Functioning
- Part 9. Weapon Instrumentation and Measurements
- Part 10. Meteorological Observations ✓
- Part 11. Aircraft and Armament. ✓
- Part 12. Administration ✓
- Part 13. Air Sampling and Techniques ✓
- Part 14. Control and Communications ✓
- Part 15. Decontamination ✓
- Part 16. Photographic Services ✓
- Part 17. Theoretical Predictions
- Part 18. Explosive Assembly
- Part 19. Burst Position of HE and Live Rounds. ✓

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