AWE NUCLEAR SECURITY TECHNOLOGIES

Ref: EIR2025-038

[redacted]

27th February 2026

Dear [redacted]

Your Request

We are writing in response to your email/letter of the 17th September 2025, in which you asked for an internal review (IR) of AWE's processing of your request for information made under the Environmental Information Regulations 2004. The purpose of this review is to consider whether the requirements of the legislation have been fulfilled. We apologise for the delay in responding to you.

Your request is set out directly below for ease of reference:

> *Thank you for your letter dated 22 August 2025, which responds to our request for disclosure of the "review of environmental monitoring data for Christmas Island (CI) 1957-1958" by D.P Whithorn, C. Wilson (the* ***Information Requested****).*
>
> *You state that you have been unable to locate the Information Requested. Please could you confirm that you have searched all the relevant servers, including for example 'Sharepoint'?*
>
> *Please could you also confirm whether you have searched for any 'draft' documents, with the same title as the Information Requested?*
>
> *Further, please could you confirm (i) whether you previously held the Information Requested; (ii) who now holds the Information Requested; and (iii) whether the Information Requested was deleted from your system?*
>
> *We make these further requests under the Freedom of Information Act 2000.*

Handling of your Request

Please note this request has been handled as a request for an internal review of EiR25-038 under the Environmental Information Regulations 2004 (the "**EIR**") as it concerns environmental information.

Our Response

Reasonable and proportionate searches were carried out in July 2025 to locate a finalised report with the title '*Review of environmental monitoring data for Christmas Island (CI) 1957-1958"* authored *by D.P Whithorn, and C. Wilso*n.

AWE does not hold a formal record copy of the document requested and were therefore unable to locate it. Resulting, in our written response dated 22 August 2025 where the exception in Regulation 12(4)(a) EIR was applied, which allows public authorities to refuse to disclose information if it is not held at the time a request is received.

In your request for an internal review (IR) you helpfully pointed AWE officials to the area where the information in scope may have been held, which is where the draft document was located.

It remains the case that AWE does not possess a formal record copy of the requested document. However, building upon the reasonable and proportionate searches carried out in July 2025, we located draft versions of a document with the same title as the requested document, the attached document is understood to be the last version (the "**Draft**").

The Draft is subject to the exception in Regulation 12(4)(d) EIR, which allows a public authority to refuse disclosure where the request relates to material which is in the course of completion, unfinished documents and incomplete data.

In determining whether to apply the exception in Regulation 12(4)(d) EIR, we assessed whether the public interest in maintaining this exception outweighs the public interest in disclosure. In undertaking this assessment, we took the following matters into account:

1. The exception aims to protect work which is in progress by delaying disclosure until a final or completed version can be made available. The ICO's online guidance notes that the public interest in maintaining this exception will decline once the final version of a document is finished or published. However, as referenced above, the Draft remains unfinished. As such, the public interest in maintaining this exception remains high.

2. Given the Draft was never finalised, disclosure would lead to a misleading or inaccurate impression, distinct from all underlying data already available in the public domain. The ICO's online guidance notes that the exception aims to provide some protection from having to spend time and resources explaining or justifying ideas that are not or may never be final. We would then need to divert our time and resources to explain any issues and engage in public debate in relation to ideas that will never be final.

3. More generally, there is a strong public interest in ensuring that public officials have a safe space in which to work candidly and freely without being concerned that information still under consideration could be released in a form that is potentially misleading. This concern is particularly acute in relation to work that was not peer-reviewed or complete. Disclosure of the Draft could have an adverse effect on the current way in which public officials or consultants record candid views and carry out research, and risks generating fear of premature public scrutiny.

4. Disclosure could negatively affect the parties involved in the development of the Draft, especially if their contributions were made on the understanding that the document was informal, preliminary and yet to be finalised.

We fully respect the rights of individuals to request information from public bodies and we remain committed to our transparency obligations, including under the EIR. Having given the matter careful consideration, it has been determined that the exception in Regulation 12(4)(d) EIR would apply, as public interest in maintaining the exception does outweigh the public interest in the disclosure of the Draft.

Nevertheless, in view of the exceptional amount of interest in this topic and to draw a line under the significant amount of public resource that has been expended in identifying and handling your requests, we have determined that a copy of the Draft will be made available, alongside an explanatory note. This explanatory note provides further context about the circumstances in which the Draft was prepared and aims to reduce the risk of misinterpretation referenced in the list of public interests above. AWE is not in a position to confirm the contents of the Draft, which should be treated as the personal views of the authors.

The approach taken here should be regarded as exceptional, without prejudice to AWE's ability to apply FOIA/EIR exemptions in the usual way to future requests.

Please note we have redacted personal data from the Draft – the name of the two authors. We acknowledge you are aware of the authors' names, but we wish to protect the names of former AWE employees where possible, so we are relying on your discretion to maintain their privacy.

Next Steps

Please quote the reference number at the top of this letter in any future correspondence. If you remain dissatisfied with this position, you can complain to the Information Commissioner's Office (the "**ICO**") within six weeks of the date of this letter. The easiest way to lodge a complaint is through their website: www.ico.org.uk/foicomplaints or by writing to them at Wycliffe House, Water Lane, Wilmslow, SK9 5AF.

Yours sincerely,

AWE Information Requests Team

Annex A – Explanatory Note

AWE NUCLEAR SECURITY TECHNOLOGIES

Explanatory Note - AWE's Response to EIR- 2025-038

This note provides some information about what is known about the circumstances in which the draft document titled: "Review of environmental monitoring data for Christmas Island (CI) 1957-1958" (the Draft) was prepared.

In 2014, AWE was asked by the MOD to assist with a request which it had received under the Freedom of Information Act (FOI) regarding environmental monitoring during nuclear weapons testing at Kiritimati (Christmas Island) in 1957.

The MOD responded to the FOI request on 10 July 2014, noting that all surviving environmental data regarding the Christmas Island tests is summarised in the document: 'Safety Division Technical Note 16/93: Environmental Monitoring at Christmas Island 1957-1958'.

The FOI requester asked the MOD to review its response and the MOD asked AWE to help with work it was conducting as a result. In that context, AWE commenced a review of the report referenced SDTN 16/93, and environmental monitoring information held by AWE for the MOD. AWE sent its analysis in relation to this internal review to the MOD in September 2014.

On 27 January 2015, the MOD replied to the FOI requester with the outcome of the internal review. To assist the requester, the MOD provided a list of documents which were likely to contain the source data used to compile report SDTN 16/93 (some already in the public domain and others which were due to be released through The National Archives) and copies of fish sampling readings which were not included in report SDTN 16/93.

Two AWE employees had continued to review the environmental monitoring data after AWE sent its response to the MOD in September 2014 and it was in this context that they prepared the Draft. This work went further than what AWE had been asked to do by the MOD to support the FOI request. AWE understands the authors of the Draft shared it with the MOD.

The Draft was never finalised. As noted above, it was not a tasked piece of work and was not formally issued and filed as a formal record. It was not located in the AWE archive and was not on the Merlin database and consequently was not located when AWE was responding to an FOI request received in July 2025. In the circumstances, AWE is not in a position to confirm the accuracy of the contents of the Draft, which should be treated as the personal views of the authors.

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Annex B – The Draft

AWE is the trading name of AWE plc. AWE is a Non-Departmental Public Body owned by the Ministry of Defence.
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Review of environmental monitoring data for Christmas Island 1957 - 1958

[redacted]

Executive summary

a) There was a request to the MoD for an internal review relating to the Nuclear Tests at Christmas Island 1957-58 under the Freedom of Information Act (FoIA) in July 2014. AWE has conducted a review of the completeness of the report "Environmental Monitoring at Christmas Island 1957-58", produced by AWE in 1993 and referred variously as SDTN 16/93 or the Clare report. SDTN 16/93 summarises the environmental monitoring programme that was in place during the UK's atmospheric nuclear tests on Christmas Island (CI). SDTN 16/93 is in the public domain and has been referenced by AWE in response to queries under the FoIA.

b) In the AWE review, the original 1957 - 58 records that were used to compile SDTN 16/93 have been identified and compiled into what is assumed to be the original order. SDTN 16/93 has been found to be incomplete and, in some cases, factually inaccurate.

c) An analysis of the records highlighted elevated instrument readings that have neither been discussed in SDTN 16/93, nor in any of the extant documents known to the holder of these records. The measurements were made during the analysis of fish conducted by Royal Navy personnel in a populated area of CI on the evening of the Grapple X test.

d) An analysis of the instrument readings has been performed but it has not been possible to provide an unambiguous interpretation of the data. Two possible interpretations that have been considered are;

1. There was a low-level of fallout at the measurement location due to rain washout from the nuclear-debris cloud;
2. There was a deposition of radon daughters at the measurement location due to rain washout.

No contemporary documents have been found that specifically refer to the data and there are no other measurement records that confirm the presence of either fallout or radon at that time or location.

e) The magnitude of the instrument readings relative to natural background is large (a factor of approximately 3), however the magnitude is small relative to the values that would be expected to give rise to stochastic health effects, e.g. cancer. Therefore it is considered that there would have been no tissue reactions and a low risk of the induction of stochastic health effects for personnel at the measurement location. Scrutiny of the dosimetry records indicates that no personnel at the location were issued with a film badge, and there was no monitoring for the intake of radionuclides.

g) The instrument readings could potentially be used to challenge the validity of statements made by AWE, MoD and HMG regarding the occurrence of fallout on CI.

A briefing note written by AWE for HMG during a case at the ECHR states that, “there was no fallout on Christmas Island” as a result of operation Grapple X. A case brought before Parliament at the time of the trials involved similar statements regarding the lack of fallout; reports regarding this particular case were still being published in the national press in 2008.

h) A group of nuclear test veterans continue to lobby HMG and pursue it through the courts in order to claim financial compensation for their presence at atmospheric weapon tests. A case against the Secretary of State in the War Pensions Tribunal extensively cites SDTN 16/93 in discussion of radiation in the environment at CI; the incompleteness and inaccuracy of SDTN 16/93 and the fish-sampling data could have ramifications for the Secretary of State’s defence in the Tribunal.

i) Following the discovery of the incompleteness and inaccuracies in SDTN 16/93, in the light of the recent AWE review, and the comments made in the judgement by The War Pensions Tribunal, it may be time to update SDTN 16/93 or use an alternate method of presenting the data into the public domain.

1. Introduction

1.1 The Grapple operations were a series of UK atmospheric nuclear weapon tests conducted in the South Pacific between May 1957 and September 1958 in order to demonstrate the UK's ability to design and build an effective hydrogen bomb. The series was sub-divided into 4 operations; Grapple, Grapple X, Grapple Y, and Grapple Z. Information on each test is provided in Table 1.

1.2 Operation Grapple was conducted at Malden Island, around 400 miles South of Christmas Island (see map in Annex K Figure 2). The remaining tests were conducted at the South East point of Christmas Island (see map in Annex K Figure 1).

1.3 During Operation Grapple X there were around 2000 personnel present on Christmas Island, distributed among multiple camps. A description of the location of each inhabited area is given in Annex K Table 1. For Grapple X no inhabited location was closer than 24 km to the point of detonation and the main inhabited areas were around 40 km away.

Table 1: The Grapple series of operations including locations, dates and times

Operation	Location	Date and time (GMT)	Type	Height	Yield
		dd/mm/yy hh:mm		m	
GRAPPLE	Malden Island	15/05/57 19:37	Airburst: Freefall	2200	0.3 Mt
		31/05/57 19:41	Airburst: Freefall	2400	0.7 Mt
		19/06/57 19:40	Airburst: Freefall	2400	0.2 Mt
GRAPPLE X	Christmas Island	08/11/57 17:47	Airburst: Freefall	2200	1.8 Mt
GRAPPLE Y	Christmas Island	28/04/58 19:05	Airburst: Freefall	2500	3.0 Mt
GRAPPLE Z	Christmas Island	22/08/58 18:00	Airburst: Balloon	450	24 kt
		02/09/58 17:24	Airburst: Freefall	2800	1.0 Mt
		11/09/58 17:48	Airburst: Freefall	2600	0.8 Mt
		23/09/58 17:59	Airburst: Balloon	450	25 kt

2. The environmental monitoring data

2.1 As recently as August of this year (2014), the surviving original records of environmental monitoring from Christmas Island were in a disordered state, held in the Nuclear Test Veteran (NTV) dosimetry archive at AWE. The records had been scanned for incorporation into the Merlin (NTV) database; the structure of these records within Merlin is in a similarly disorganised state, hindering any attempt to interpret the data.

2.2 The original records were not a high priority because a summary report, "Environmental Monitoring at Christmas Island 1957-1958" [1] produced by AWE in 1993 was "believed to include all of the surviving data" from the Grapple series of nuclear tests. This report has been used as the primary reference when answering NTV questions relating to environmental monitoring on Christmas Island in the period 1957 - 58.

2.3 In response to a request under the Freedom of Information Act in July 2014, the requestor was provided with Ref. [1], henceforward referred to as SDTN 16/93 or the Clare report. In reply, the requestor invoked his right to an internal review and remarked, "The 1993 document you are basing your replies on is an extrapolated/abstracted from the original 1957 records. It is therefore impossible to know whether accurately or un-tendentiously [sic] is the abstraction. Sight of the original 1957 records would save much time and allay suspicion. No rainwater readings were provided. There were sporadic showers following the detonation. You tell me none were taken but offer no explanation why." [2]

2.4 For the purpose of the internal review, the MoD asked the AWE's Information Request Team (IRT) to confirm what original documentation survives and whether records are held by AWE. In response, the scanned records held on Merlin were forwarded to the MoD for consideration.

2.5 Motivated by the criticism of the Clare report the NTV Subject Matter Expert (SME) re-ordered the original records with the aim of assessing the completeness of the report, and with the longer-term aim of submitting the records to The National Archive (TNA). During this process the data from the records was captured electronically as an aid to its interpretation.

2.6 The surviving EM dataset comprises records of radiological measurements of samples collected in order to assess the extent and geographical disposition of fallout. The sample types are divided into categories; sticky papers (ground deposition); air filters (atmospheric); rainwater (for fallout washed out by precipitation); and fish samples (added primarily as reassurance for indigenous peoples living in the Pacific).

2.7 The samples types along with collection and measurement methodologies are all described in contemporary documentation [3].

2.8 The locations of sampling outstations are listed in contemporary documentation [3] and changed with each trial due to changing availability of resources and logistics.

2.9 Sticky-paper and air-filter samples were collected and analysed at Christmas Island for operations Grapple and Grapple X. Analysis at Christmas Island took place in the radiochemistry facilities at the main airfield (see map in Annex K Figure 1). The same sample types were transported to AWRE (Aldermaston) for analysis for operations Grapple Y and Grapple Z, now with the addition of rainwater samples. Transport of samples was by air and the analysis of such samples would take place at a time some days after collection, typically ranging between 3 and 20 days depending on circumstances.

2.10 Fish samples were collected and analysed locally across the Pacific using AWRE-supplied equipment, the results being returned periodically as raw data or reports to AWRE at Christmas Island. The original methodology (dating to May 1957) for this has been included as Annex L.

2.11 Identified gaps in the data (missing records) can be classified as; a) single sheets from a chronological series; b) single operation from an outstation; c) all data from an outstation. Original laboratory data (log books) from Grapples Y and Z were not found, this dataset comprising contemporary summary tables in reports only.

2.12 It is possible that further searches of the AWE Corporate Memory Archive may reveal missing records however such searches have been conducted several times. Systematic reasons for such data being missing are not known. There is a significant likelihood that some items may have been discarded or destroyed as part of normal business at the time of the trials or thereafter.

3. Completeness of SDTN 16/93 (the Clare report)

3.1 The Clare report focuses on EM data relating to Christmas Island; data for other outstations is only included where a contemporary table containing such data has been pasted into the report.

3.2 Not all of the EM records relating to Christmas Island are included in the Clare report. No fish sampling data is included in the Clare report for any sampling station - including Christmas Island - only a generalisation that, "in no case was reportable activity found on, or in, any fish which were caught at Christmas Island, or elsewhere in the Pacific" (page 8, Ref. [1]). No contemporary record of an in-depth analysis of this data has been found.

3.3 The table of sample types taken during each operation (p23 in Ref. [1]) is incorrect and suggests that only a limited study of the original datasheets was performed at the time of the compilation of SDTN 16/93. Analysis of the original data shows that sample stations are mis-matched with both operations and sample types. An important example is that there is no evidence that rainwater was sampled or analysed at operations Grapple and Grapple X, though the contrary to this is stated in the report. The FoIA request specifically mentions the lack of rainwater data associated with operation Grapple.

3.4 Original errors in contemporary documents (data tables) were not identified and have been copied into SDTN 16/93 without correction.

4. Elevated instrument readings

4.1 During the current checking of the original records, careful examination of contemporary results has revealed elevated instrument readings during background checks. Specifically, this involves the recording of elevated activities on the following dates at Christmas Island;

- the 16th and 31st May 1957 (operation Grapple 1 and 2 - sticky paper, air filter)
- the 8th November 1957 (Grapple X - fish data [4])
- the 22nd August 1958 (Grapple Z1 – fish data).

  These dates correspond to days on or very shortly after shots for the individual tests (see Table 1).

4.2 On other shot days; 19th June 1957 (Grapple 3); 28th April 1958 (Grapple Y); and 2nd, 11th and 23rd September 1958 (Grapple Z2, Z3, Z4) no fish sample measurements were recorded.

4.3 Such elevated readings are found on the two types of detection system in use at the time (scintillator and Geiger-Müller tube). The interpretation of such results indicates that an elevated radiation background was present at the time of measurement.

4.4 In the case of the Grapple data, the detonations took place at Malden Island, some 400 miles distant from Christmas Island. It is improbable that such detonations (Grapples 1, 2) would be responsible for elevated background levels at Christmas Island.

4.5 A plausible explanation for the elevated background levels following Grapple 1 and 2 is that environmental samples were brought to Christmas Island by aircraft and their subsequent analysis would have taken place in the radiochemistry laboratory situated at the Main Airfield. This laboratory was also in receipt of the highly-active samples collected by cloud-sampling aircraft. Such samples would serve to increase the background radiation levels in their immediate vicinity.

4.6 The above explanation cannot be used for elevated background measurements made at Christmas Island during the routine analysis of fish samples following the detonation of Grapple X. Fish samples caught at sea on shot day were analysed on equipment based at HMS Resolution at Port Camp by members of the Royal Navy. Based on contemporary documents, such measurement equipment would not have been in close proximity to the highly-active cloud samples.

4.7 The RN operator on 8th November 1958 (Grapple X shot day, detonated 17:47 GMT, equivalent to 08:47 local) logged background radiation levels at the start of the day (ca. 09:50), this was approximately one hour following the detonation at which time the operator would have been under mustering orders (on board ship in harbour). The average of two background readings was 43 cpm, which is typical of background measurements made on previous days.

4.8 There are no further data entries for that morning or afternoon; it is likely that during this period the RN "motor fishing vessel" sailed to catch fish off NW Point and returned them for analysis.

4.9 At 19:45 the operator performed additional background measurements prior to counting the fish samples. Three consecutive background measurements made at 19:45, 19:51 and 19:57 gave results of 157 cpm, 110 cpm and 91 cpm, respectively. Despite the elevated background, the operator proceeded with the counting of fish samples; the measurement results continue to be highly elevated relative to the normal background data. It should be noted that the presence of the fish had no effect on the decay pattern. A reproduction of the original record is shown in Figure 1 and the data is reproduced in Table 2.

4.10 On the morning of 9th November 1957 the operator performed background measurements that were similar to those found before shot day. This detailed dataset is unique among the EM records; other data recorded by this operator generally consists of single data points only.

4.11 A cursory analysis of the background and fish sample data indicates that the measured radiation level (following subtraction of background) shows a quasi-exponential decay with an associated half-life of approximately 20 minutes.

Table 2: Fish analysis data extracted from Ref. [4] (see Figure 1 for original)

Date	Time	Fish or Bkgd	Register reading		Duration	Count rate
			start	finish	mins	cnts / min
06/11/57		B(1)	9447	9682	5	47.0
06/11/57		B(2)	9721	9959	5	47.6
06/11/57		Tuna(1)	77	307	5	46.0
06/11/57		Tuna(2)	318	538	5	44.0
06/11/57		Azure(1)	711	947	5	47.2
06/11/57		Azure(2)	1004	1230	5	45.2
08/11/57	09:50	B(1)	2003	2213	5	42.0
08/11/57	09:56	B(2)	2213	2433	5	44.0
08/11/57	19:45	B(3)	3015	3956	6	156.8
08/11/57	19:51	B(4)	3956	4617	6	110.2
08/11/57	19:57	B(5)	4617	5160	6	90.5
08/11/57	20:04	Tuna(1)	5232	5690	5	91.6
08/11/57	20:09	Tuna(2)	5690	6068	5	75.6
08/11/57	20:17	Kingfisher(1)	6269	6651	5	76.4
08/11/57	20:24	Kingfisher(2)	6786	7137	5	70.2
09/11/57	08:50	B(1)	7817	8054	5	47.4

altered from original value (2233) for consistency

Serial No	Date	Background or Fish	Type of Fish	Date Caught	Lat. & Long.	Reg. Reading at Start	Reg Reading on Completion	Duration of Count	Counts per min.	Time.
	8-11-57.	B(i)				9447	9682	5 mins	47.0	
		B(ii)				9721	9959	5 mins	47.6	
13.		F(i)	Tuna	Same	157° 30' 24" W.	0077	0307	5 mins	45.2	
		F(ii)	"	"	002° 03' 12" N.	0318	0538	5 mins	44.0	
14.		F(i)	Azure	"	—— " ——	0711	0947	5 mins	47.2	
		F(ii)	"	"		1004	1230	5 mins	45.2	
	8-11-57	B(i)				2003	2213	5 mins	44.0	0950
		B(ii)				2213	2233	5 mins	44.0	0956
		B(i)				3015	3956	6 mins	156.8	1945
		B(ii)				3956	4617	6 mins	110.2	1951
		B(i)				4617	5160	6 mins	90.5	1957
15.		F(i)	Tuna	Same	157° 29' 24" W.	5232	5690	5 mins	91.6	2004
		F(ii)	"	"	002° 03' 12" N	5690	6068	5 mins	75.6	2009
16.		F(i)	Kingfish	"	—— " ——	6269	6651	5 mins	76.4	2017
		F(ii)	"	"		6786	7137	5 mins	70.2	2024
	9-11-57	B(i)				7817	8054	5 mins	47.2	0850
		B(ii)				8054	8280	5 mins	45.2	0855
	10-11-57.	B(i)				1177	1395	5 mins	43.6	
		B(ii)				1444	1650	5 mins	41.2	
17.		F(i)	Tuna	Same	157° 30' W.	1698	1915	5 mins	43.4	
		F(ii)	"	"	001° 53' N	1958	2178	5 mins	44.0	
18.		F(i)	"	"	—— " ——	2406	2620	5 mins	42.8	
		F(ii)	"	"		2674	2906	5 mins	46.4	

Figure 1: Extract from Ref. [4] showing elevated background readings made during the analysis of fish samples on Grapple X shot day, 8th November 1957

5. Plausible interpretation of elevated instrument readings: Fallout

5.1 Given the date of the elevated instrument readings the possibility of the readings being caused by fallout deposited in the environment at Port Camp has been considered.

5.2 Reference [6] contains contemporary information regarding the potential for fall-out from the Grapple X trial (document dated 19th September 1957). Reproduced extracts from this record are shown in Annex A.

5.3 The extracts acknowledge that, “there is the possibility of washout on Christmas Island” and recommends that there should be no detonation if the wind is in an unfavourable direction and there was a risk of heavy rain falling on Christmas Island within 1-3 hours of detonation. If conditions were favourable for a test, there was a lesser risk at later times (6 hours mentioned) that if the wind was light, contamination could, “loop back to Christmas Island and be washed out”. In this case, “it will not produce a hazardous level of contamination following washout, but it might produce a level of nuisance value to groups using nuclear instruments”.

5.4 An extract from a veteran’s correspondence file (Ref. [7], shown in Annex B) gives details of precipitation on shot day. It is reported that there was a, “trace light shower” at Main Camp 6.5 hours after burst, at approximately 15:17. Rainfall data for Port Camp has not been found.

5.5 Further evidence that low-levels of fallout were considered possible comes from a memo in 1958 regarding fish sample analysis and the behaviour of instrumentation; “The ‘background’ count of the instrument is to be determined daily…It will not vary by more than a few counts from day to day unless artificial radio-activity, e.g. from a nuclear explosion, affects the surroundings.” [8]

6. Plausible interpretation of elevated instrument readings: Radon

6.1 An alternative interpretation of the elevated instrument readings is that there were radon daughter nuclides present in the environment during the fish analysis. The radon decay chain includes several short-lived radionuclides that decay by beta and gamma-ray emission. The two progeny producing the majority of gamma-ray activity are ^{214}Pb and ^{214}Bi, which have half-lives of 26.8 and 19.7 mins, respectively.

6.2 When radon is in equilibrium with its progeny the radioactivity decreases as an exponential function of the radon half-life (3.82 days). If the parent is removed from the equilibrium condition, the progeny decay initially as a complex function due to the interaction between the different isotopes but over a period of a few hours ^{214}Bi dominates the decay function.

6.3 Radon gas propagates freely in the environment but its progeny adhere to aerosol particles and are deposited on surfaces. Equilibrium between parent and daughter nuclides can be broken by ventilation of the air in an enclosed space, or by washout of aerosol particles during rainfall.

6.4 It is possible that the pattern of instrument readings could be reproduced with a radon model however the trend in the readings is quasi-exponential and a simplistic radon model is not adequate to explain the observations.

6.5 Radon has a geological origin and is particularly prevalent in igneous rocks. Christmas Island is a coral atoll; information on the exact geology of the island has not been found but generally a coral atoll consists of layers of coral that have grown on top of a slowly subsiding volcanic feature. It is possible that radon could be produced in the volcanic base of the island and diffuses through the relatively porous coral layers. Coral also contains a small fraction of natural uranium that could produce radon.

6.6 The background radiation level on Christmas Island was measured by the New Zealand Department of Health in 1981 and was found to be 0.58 mSv *per annum*, which is considerably smaller than the UK average. This has led to the assertion by HMG that, "if personnel who served at Christmas Island [at the time of the trials] had been stationed in the UK at an average location, their dose of naturally-occurring ionising radiation would have been *three times greater* than it was at Christmas Island."

6.7 A significant proportion of dose from naturally-occurring ionising radiations is associated with radon exposure. The known low-dose rate on Christmas Island indicates a low-level of radon in the environment.

7. Persons potentially affected

7.1 The exact number of persons present at Christmas Island for operation Grapple X is not known. However The National Radiological Protection Board (NRPB) epidemiological study of Nuclear Test Veterans [9] provides well-researched and generally-accepted data. Relevant extracts of this report are provided in Annex E; this shows that there was a total of 2340 people present at Operation Grapple X.

7.2 As previously stated, it was the policy at the Christmas Island trials that personnel should be issued with personal dosimetry (film badges) only if the individual tasks had been assessed such that personnel would be likely to receive a measurable dose.

7.3 Careful study of the original dose records shows there were 196 film badge issues (some personnel may have received more than one film badge). Of these, 102 went to AWRE (civilians), 83 to RAF and 11 to HM Army; none were issued to Royal Navy personnel.

7.4 Dosemeters recording non-zero doses were those issued to persons expected to receive measurable doses, for example; RAF 76 Sqn and Active Handling Flight (those personnel involved in nuclear cloud-sampling flights and ground crews involved in decontamination); and AWRE and attached service personnel involved in Radiochemistry (RC) and Radiation Metrology (RM) tasks. The RC and RM personnel would have handled radioactive samples and undertaken radiological surveys of the Forward Area, respectively.

7.5 The majority of RN personnel at the Grapple X trial would have been those aboard HM ships. However a proportion of these would have been based at HMS Resolution (a land-based 'stone' Frigate) at Port Camp where the fish sample analysis was undertaken.

7.6 The majority of personnel at Port Camp were with the RN. The majority of AWRE, RAF and HM Army personnel were accommodated and worked at the Main Airfield and Main Camp. It is possible that the physical phenomenon that produced the elevated instrument was widespread and may have affected areas of the island inhabited by civilians and other arms of the Services.

8. Dose reconstruction

8.1 A robust physical model for the phenomenon that produced the elevated instrument readings could not be developed therefore the dose reconstruction is limited by a lack of information on the radionuclides present. An estimate of the dose due to external and internal radiations can be made based on some broad assumptions.

8.2 At the time of the measurement (19:45) the net counts were 2.5 times the average reading due to natural background. Assuming a natural gamma-ray background of 0.1 μSv / hr the additional dose is equivalent to only 0.25 μSv / hr. A surface contamination of 75 kBq / m^2 could produce this external dose rate; at this concentration an intake of fission products would produce a committed effective dose of 0.01 μSv. These doses are not significant in terms of the risk of stochastic health effects or the induction of tissue reactions.

8.3 A conservative dose assessment would need to consider an extrapolation of the dose rate back to 15:17, when washout of radioactive particles may have occurred during rainfall. Assuming a half-life of 20 minutes, the external dose rate would be approximately 2 mSv / hr at 15:17. Using the methodology outlined in Ref. [10] the dose integrated over a 10 day period would be 2.4 mSv. The committed effective dose from internal intakes would be 100 μSv. These doses are also not significant in terms of the risk of stochastic health effects or the induction of tissue reactions.

9. Potential repeat occurrences

9.1 Fish sample analysis was continued following operation Grapple X and comprised part of the total EM programme for operations Grapple Y (April 1958) and Grapple Z (August-September 1958). The original data sheets for this have survived.

9.2 The effect detected on 8th November was not observed on the 9^{h} November, indicating that the effect that was measured had a short half-life and would only have been detected by active radiation detectors (as opposed to passive sampling techniques).

9.3 There are no records showing that equivalent fish measurements were made on 28th April 1958 (Grapple Y), 2nd September 1958 (Grapple Z2), 11th September 1958 (Grapple Z3) and 23rd September 1958 (Grapple Z4). However, for the first round of Grapple Z (GZ1 – Pennant) on 22nd August 1958, there is a record (see Annex F).

9.4 For the Grapple Z trials, the 1257c detectors had been replaced with 1314 dose-rate-meters giving a direct measurement in mR / hr. The measurement record for GZ1 indicates that the natural background derived from the measurements taken before and after shot day, was 0.001 mR / hr (0.1 μSv / hr). The measurements made on shot day gave results of 0.0025 mR / hr (0.25 μSv / hr). In this case there was only a single background measurement followed by a single fish measurement with no indication of the time of measurement. The data for the sample is higher than the background by a factor of 2.5, similar to that observed during measurements after Grapple X.

9.5 The Tribunal notes (in paragraph 107.2.3) that local fallout occurred as a result of GZ1 but that there was, “no reading at the inhabited Port London”. The elevated fish measurement could be interpreted as a signal from fallout at that location.

10. Public interest and information in the public domain

10.1 There is public interest in Operation Grapple X due to the death, from leukaemia, of Sapper William B. Morris (Royal Engineers) shortly after returning to Britain from Christmas Island in 1958 (see Annex I). At the time, a Tribunal took place to determine whether the death could be attributed to Sapper Morris' presence at the Grapple X trial.

10.2 The contemporary document, "Operation Grapple X – Gamma Dose to Civilian and Service Personnel" [11], extracts of which are available in Annex D, outlines the precautions taken: The document states that, "gamma dose could either be measured, when exposure was unavoidable, or precluded by careful control". Exposure to fallout was mitigated by restrictions on access to forward areas, which were surveyed by Health Physics prior to re-entry. A survey by helicopter the day after detonation, "failed to reveal any contamination on the island". Also, measurements were taken of ground and air contamination in the base area and "none of these samples detected activity in excess of background".

10.3 Other documents apparently written as evidence to the Tribunal assert that, "fall-out and air contamination apparatus has been in continuous routine operation on Christmas Island since April 1957…no fall-out has been recorded" [12]. In addition, an AWRE memo states that, "the general level of radiation on this Island did not increase measurably above the natural background throughout the trial" [13]. Both references are reproduced in Annex J.

10.4 More recently (1997), AWE provided a briefing note [14] to the Foreign and Commonwealth Office for a hearing at the European Court of Human Rights (McGinley & Egan vs UK). The briefing note states that during Operation Grapple X, "there was no fallout on Christmas Island". The ECHR found in favour of the FCO.

10.5 NTV radiation reports (as provided to Veterans UK) include a summary for a participant at Grapple X, a typical example of which is: "If an assessment of dose was made, it would be based on the information from environmental monitoring records and other dosimetry measurements. (Refer to Safety Division Technical Note 16/93 'Environmental Monitoring at Christmas Island 1957 – 1958', copies of which have been supplied to the SP&VA for other test veteran cases.) Subsequent to the original monitoring programme, a number of further environmental surveys of the island took place in 1964, 1975 and 1978. Data from the later surveys were used in SDTN 16/93. This information would lead AWE to conclude that any dose assessed for Mr xxx from his period of service at Christmas Island would not be distinguishable from natural background levels."

10.6 There is an active lobby group campaigning for an NTV benevolent fund; the Prime Minister was approached in April 2014 and is considering the case. The information contained in the original EM records casts doubt on the effectiveness of the EM programme and refutes claims made by AWE, and by extension, HMG in the public domain.

11. Recent litigation

11.1 There have been a number of appeals to the War Pensions and Armed Forces Compensation Chamber from Nuclear Test Veterans (NTVs) claiming that they suffered detrimental effects due to their presence at the trials.

11.2 The history of these claims will not be discussed exhaustively but the current context is important. In 2009 multiple individual claims brought by NTVs were amalgamated into a single test case, known as the Ionising Radiations appeals. It is believed that the outcome of the appeals could affect around 1,000 claimants.

11.3 The First Tier Tribunal sat in 2012 – 2013 to hear the case brought against the Secretary of State and reached a decision in May 2013. In the decision of the Tribunal SDTN 16/93 is frequently cited and it is clear that this is one of the principle references in this case. The criticism of the Clare report included here undermines its reliability as evidence and therefore this information may have a bearing on judicial proceedings.

11.4 In the Tribunal it is made clear that, "to succeed the appellants have only to show on the basis of raising a reasonable doubt based on reliable evidence that their claims should succeed" [15]. In essence, for their claim to succeed the claimants must only show that they were exposed to ionising radiation above the level of natural background; the fish-sampling data included in this report provides reliable evidence, and raises a reasonable doubt.

12 Conclusions

12.1 There is substantial public interest in the UK atmospheric nuclear trials. Adversarial explanations regarding causation of health effects in test participants is focussed on there being elevated levels of external radiation or unrecorded intakes of radionuclides. A common claim is that fallout occurred across a wide area resulting in potential contamination and unrecorded radiation dose to personnel that were not issued with personal dosimetry. The majority of participants at the Grapple trials were not issued with personal dosimetry because it was issued on the basis of risk and most routine tasks did not require it.

12.2 If the elevated instrument background measurements in the EM data occurred as a result of fallout on an inhabited part of Christmas Island, the information would potentially overturn the accepted and previously reported information provided by HMG in judicial proceedings. It should be noted that the data does not constitute proof of the occurrence of fallout, but does support this interpretation.

12.3 There is an ongoing case being considered in an upper Tribunal concerning adverse health effects of nuclear test veterans; an outcome is expected imminently. There is an active lobby group campaigning for an NTV benevolent fund; the Prime Minister was approached in April 2014 and is considering the case. The information contained in the original EM records casts doubt on the effectiveness of the EM programme and refutes claims made by AWE, and by extension, HMG in the public domain.

12.4 The EM data identified in this report is in the Merlin database and could be interpreted by adversarial lawyers. In addition, the information is subject to the Freedom of Information Act and may be requested at any time.

12.5 If the importance of this data is identified by others, there is potential for substantial detriment to the reputation of AWE, MoD and HMG.

13 Recommendations

13.1 AWE manages the nuclear test veteran archives on behalf of the customer (SRD line 8884) and provides subject matter expertise in this area. The data and its interpretation have the potential to cause detriment to the reputation of AWE, MoD and HMG. It is recommended that the customer be approached through appropriate channels and made aware of the data and the historical context in which it sits so that an assessment of the impact can be made and appropriate action can be taken.

14 References

1. Clare, P., *et al.*, "*Environmental Monitoring at Christmas Island 1957 – 1958*", AWE Safety Division Technical Note 16/93 (1993)
2. Extract from the website, *"What do they know?"*
3. AWRE R.M. Group, "*Operation Grapple, Scientific Plan*", Merlin Ref. 034572.pdf
4. "*Operation Grapple - 1957 - Fallout Measurements Including Fish Sampling*", Merlin Ref. 04000382.pdf
5. Glasstone, S. and Dolan, P. J., "*The effects of nuclear weapons*", The US DoD and DoE (third edition, 1977)
6. Hicks, E. P., Document 69/57/SWP, Merlin Ref. ES010626.pdf
7. Butcher, W. A., Veterans Correspondence, Merlin Ref. 05000481.pdf
8. MacDougall, W., Major, Memo regarding fish sampling, Merlin Ref. 05001305.pdf
9. "*Mortality and Cancer Incidence 1952-1998 in UK Participants in the UK Atmospheric Nuclear Weapons Test and Experimental Programmes*", NRPB Report NRPB-W27, C.R.Muirhead et al., February 2003
10. Carter, M. *et al.*, "*Australian participants in British nuclear tests in Australia*", Australian Veterans' Affairs (2006)
11. "*Operation Grapple X – Gamma Dose to Civilian and Service Personnel"*, Merlin Ref. 05000235.pdf
12. A.W.R.E memo, "*Re: Appeal to Ministry of Pensions and National Insurance*", AWRE (August 20th 1959)
13. A.W.R.E memo, "*Sapper W. B. Morris*", AWRE (24th June 1959)
14. Woodville, A. C., *"ECHR briefing note: Safety at the Grapple series of operations, Christmas Island and Malden Island 1957 – 1958",* AWE (17th February 1997)
15. Reserved decision of the War Pensions and Armed Forces Compensation Chamber, Ionising Radiations Appeals, (HMG 2013)

Annex A: Prediction of fallout

Reference [6] contains contemporary information regarding the potential for fall-out from the Grapple X trial (document dated 19th September 1957):

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69/57/SWP

Fallout Predictions at Grapple-X

There are two quite distinct problems involved, first the planned air-burst, and secondly a low yield accidental surface burst.

The Planned Airburst

Experience at Grapple confirmed our prior expectation that true fallout from the planned airbursts would be negligibly small and certainly well below the extremely safe tolerance levels A and A'. We thus conclude that it is unnecessary to consider the possible hazards of true fallout from the Grapple-X planned airbursts.

We cannot in the same way dismiss from consideration the hazards caused by rain washout of contamination. This problem has been considered on several occasions, most recently in my memo 57/57/SWP of 19.7.57 to Mr. Adams, a copy of which is appended. The conclusion is that a combination of unfavourable circumstances can cause an unpleasantly high level of ground contamination, which I assessed as a few times level B' at a distance of 170 nautical miles from the burst. I think that the reasonable conclusion is that, at distances of this order, it is extremely unlikely that the washout contamination hazard would be sufficiently high to necessitate temporary evacuation of affected islands, and the possibility of actual danger is utterly remote. We cannot however ignore the possibility that washout will cause a level of ground activity which has unfortunate political repercussions.

Finally, there is the possibility of washout on Christmas Island itself. It would be desirable that all constant level trajectories up to the maximum rain level should proceed away from the island, but this might prove too severe a firing restriction. If active material were allowed to drift over Christmas Island and were deposited locally by heavy rain, the possibility of a very hazardous contamination level cannot be excluded (cf. para. 15 of 57/57/SWP). It must therefore be a firm requirement that no rain shall fall

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on Christmas Island until the activity up to rain level has drifted clear of the island, for example, until say 1-3 hours after the explosion unless the winds are very light. One would presume that this is not much of a firing restriction except during the wet season. There is of course the possibility, particularly with light winds, that a trajectory will loop back to Christmas Island and be washed out at a much later time. It is difficult to be quantitative, but one could reasonably expect that the level of deposition would be greatly reduced by such contortions. I would suggest that if the looped trajectory does not return until more than say 6 hours after the burst, it will not produce a hazardous level of contamination following washout, but it might produce a level of nuisance value to groups using nuclear instruments.

Annex B: Report of rainfall on Christmas Island

The following extract is taken from a veterans correspondence file [7] and provides evidence of rainfall on Christmas Island on 8th November 1957, Grapple X shot day.

1. The information available and reviewed here up to now shows that:-

a. On the day of detonation of a megaton-range nuclear explosive device, 8 November 1957, at Operation Grapple X at Christmas Island, light showers occurred at the site of the Main Camp, leading to a measured precipitation of 0.1mm in the period between 2½ hours and ¾ hour before the moment of burst.
A trace light shower occurred 6½ hours after the moment of burst and a shower leading to a measured precipitation of 4.2mm at the Main Camp between 22 and 23 hours after the moment of burst, that is in the early morning of 9 November 1957. No rain fell on 10 November and only a trace light shower on 11 November.
Should there have been any deposition as a result of rainfall of early/local residual radioactive materials (fallout) it would have been during the early morning period on the day following the detonation of the megaton-range nuclear explosive device. During the period from the moment of burst to that time wind directions at heights of and above the fireball from the detonation varied from South West to North and back to South West carrying the cloud of atomic nuclear debris in a direction from North East to South away from the point of detonation, the Main Camp site being located to the North West of the point of detonation. In other words the actual upper air winds during the period from the moment of burst to the time of the shower on the morning of the day following the burst carried the cloud of atomic nuclear debris well away from the site of the Main Camp and Christmas Island generally.

b. On the day of detonation predictions based on the meteorological forecasts indicated that no deposition of early/local residual radioactive materials (fallout) were to be expected over the occupied sites at Christmas Island. Measurements made showed that the predictions were correct and that the levels of radioactivity from solid material collected by continuous air sampling apparatus and by adherance to sticky papers at five sites at Christmas Island, including the Main Camp, did not rise above the minimal measurable levels of contamination (7.8×10^{-13} μCi/cc in air and 5.4×10^{-8} μCi/cm^2 at the surface; in current SI units, 3×10^{-2} becquerel per cubic metre and 20 bequerel per square metre respectively). These levels are extremely low and do not and did not sensibly differ from normal background levels.

2. It is thus clear that although rain fell about 22 hours after the detonation of the nuclear explosive device at Operation Grapple X in measurable quantity, the meteorological forecast and predictions were correct in that the cloud of atomic nuclear debris was carried away from the occupied areas; measurements of the dispersal of any fallout in occupied areas confirmed that the levels of airborne and surface radioactive materials did not sensibly differ from the normal background levels.

Annex C: Enhanced EM programme for Grapple X

The following extracts are taken from Ref. [3] and demonstrate the enhancement of the EM programme ahead of Grapple X, due to the move to Christmas Island.

OPERATION GRAPPLE-X

SCIENTIFIC PLAN

PART 9. RADIOLOGICAL MEASUREMENTS GROUP

(R.M. GROUP)

1.3 RM 3 Measurement of Fall-Out Contamination at Points Close to Ground Zero

Sticky paper fall-out samplers will be placed at about ten sites on Christmas Island. The location will be governed by ease of access to the sites.

1.4 RM 4 Measurement of Fall-Out and Air Sampling at Surrounding Islands

Sticky paper fall-out samplers and air samplers which trap the dust from a known volume of air on a filter will be operated at the following places:-

Malden	Aitutaki	Brisbane
Fanning	Canton	Penrhyn
Kwajalein	Samoa	Christmas
Honolulu	Fiji	

Annex D: Current interpretation of radiation exposure during Grapple X

The following extracts are taken from Ref. [11], which is believed to have been written as part of an inquiry into the death by leukaemia of Sapper Morris RE, shortly after returning from Christmas Island to the UK in 1958.

20.7.84

Operation Grapple X - Gamma dose to Civilian and Service Personnel

No attempt was made to provide film-badge dosimeters for all personnel on Xmas Island at the time of Operation Grapple X, since large numbers of personnel were involved and the gamma dose could either be measured, when exposure was unavoidable, or precluded by careful control. In deciding upon the required

(i) Gamma-flash from detonation of the weapon. The integrated dose resulting from gamma flash was calculated to be well below the minimum level of detection of the most sensitive dosimeter at the closest point of approach of personnel to the explosion. Subsequent measurements confirmed that the gamma dose at main camp did not exceed 10 μr. A system of personal reporting ensured that no person approached closer than 'C' site to the point of detonation.

This was not put into operation.

(ii) Resulting from fall-out of fission products or from neutron induced activity following detonation of the weapon. To control possible contamination and gamma dose resulting from detonation of the weapon a Health Control Point was established at 'C' site. All authorised re-entry into the area forward of 'C' site was made through Health Control. Health Control was established by the first helicopter lift from J.O.C. All personnel re-entering the area were dressed in full protective clothing and provided with film badge and quartz-fibre dosimeters. Each team leader was equipped with a gamma survey meter and instructed immediately prior to re-entry on its use. Initial re-entry was made by a Health Physics survey team who reported levels of contamination to Health Control point via Operational Control 'C' Site. No detectable γ dose was recorded on any dosimeter carried by any member of any re-entry party. Records indicate that the military party under the command X of Cpt. Cothecole did not include Sapper W. Morris. X A helicopter survey of the forward area on the day after detonation failed to reveal any ground contamination on the island.

Measurements were taken of ground and air contamination in the base area during and after detonation. Sampling sites were situated at the Officers Mess at Main Camp, at Port of London and near JOC. None of these samples detected activity in excess of background.

Annex E: Dosimetry records for Grapple X

The following information is taken from a study by the NRPB on the epidemiology of nuclear test veterans, Ref. [9].

Page 10, Table 2.4: "Numbers of men involved at each operation by Service or employer", gives the following;

Grapple X	**597 – Royal Navy**
	625 – Army
	1011 – RAF
	107 – AWRE
	2340 – TOTAL

Page 11, Table 2.6: "Numbers of men mentioned in Health Physics (HP) records, with and without recorded doses as a percentage of all participants at each operation";

Grapple X	**2340 – Test Participants**
	179 (8%) – mentioned in HP (records)
	53 – mentioned with zero dose
	126 – mentioned with non-zero dose

Annex F: Fish sample data from Grapple Z

FISH REPORT 31st August, 1958

Serial Number	Date	Background of fish	Type of fish	Date caught	Where caught	Reading in Millircentgens per hour.
246	18.8.58	B1 F1	Barracuda	Same	Spal	.001 .001
247	18.8.58	B2 F2	Barracuda	Same	Spal	.001 .001
248	19.8.58	B1 F1	Wahoo	Same	Spal	35 counts per 38 " mil
249	19.8.58	B2 F2	Wahoo	Same	Spal	35 " " 37 " "
	20.8.58 21.8.58		NO CATCH			
250	22.8.58	B1 F1	Barracuda	Same	Spal	.0025 .0025
	23.8.58		NO FISHING			
251	24.8.58	B1 F1	Allure	Same	S.W. Point	.001 .001
252	25.8.58	B1 F1	Wahoo	Same	S.W. Point	.001 .001
253	25.8.58	B2 F2	Wahoo	Same	S.W. Point	.001 .001
254	25.8.58	B3 F3	Wahoo	Same	VASKERS BAY	.001 .001

Annex G:

An extract from Ref. [8]

6. The 'background' count of the instrument is to be determined daily. This is a function of the natural surroundings and the instrument itself. It will not vary by more than a few counts from day to day unless artifical radioactivity - e.g. from a nuclear explosion, affects the surrounding atmosphere. Two separate counts of five minutes are to be made, care being taken to avoid close proximity to artifical radioactivity, e.g. luminous watches or compasses. The background count is to be averaged over the whole ten minutes and expressed in counts per minute. It will be termed the daily background count or 'background'. The counts and 'background' are to be recorded.

An extract from Merlin Ref: Grapples21_003.pdf

21st. April, 1958.

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Major MacDougall
A.W.R.E.
Joint Operations Centre.

RADIOACTIVITY - BACKGROUND LEVEL

On Saturday 19th. April, during a routine background count preparatory to testing fish for radioactivity, a much higher reading than usual was observed in H.M.S. RESOLUTION.

2. Normal counts per minute on this machine are between 28 and 30; on this occasion two separate counts gave 47.2 and 46.8 respectively, an increase of ~~nearly~~ 50 per cent.

3. High readings for background count were also reported on 19th. April by H.M.S. ULYSSES, at anchor in Port London. This report was quite independent of that from RESOLUTION. Figures are not available from Ulysses.

Lieutenant Commander,
A.B.C.D. Officer.

Annex H: Changes to the Christmas Island EM programme

I1. An enhancement to the EM programme was planned ahead of the Grapple X test, given that it was planned to take place at Christmas Island. Extracts from the scientific plan [3] are provided in Annex D and demonstrate that the EM programme for Grapple X was similar to that for operation Grapple in philosophy, but with a greater number of sampling locations.

I2. The Grapple EM programme consisted of daily sticky papers, air filters and fish samples from Christmas Island and distant outstations across the Pacific. The first two sample types were analysed sometime after collection and transportation to Christmas Island. The sampling-to-analysis time was of the order of days, limiting the use of such a technique to the detection of relatively long-lived radionuclides. For Grapple X the scientific plan states that additional, “sticky paper fall-out samplers at about 10 sites” would be placed. Such samples, if analysed quickly following detonation (hours), would have the potential to detect short-lived radionuclides.

I3. Fish sampling across the Pacific continued as per operation Grapple as the equipment was already based at Christmas Island and other outstations. No contamination had been found to date and none was expected.

I4. The information in Annex D states that additional sticky paper and air filter samplers had indeed been placed at locations across Christmas Island. No measureable activity was found. Locations for some of these samples are given (Main Camp (Officers Mess), Joint Operation Centre and Port Camp), however the times between sampling and analysis are not. No mention of these samples is given in SDTN 16/93 nor have such measurement results been found in the surviving contemporary laboratory record. However, it is probable that such measurements did take place and results were recorded elsewhere. The results as presented are of limited use because it is not clear that measurements were corrected for the delay between sampling and analysis.

I5. There is no evidence in the contemporary documentation that there were any concerns regarding the data from EM samples (including fish, using the prescribed methodology) following Grapple X. The test criteria used for fish sample analysis would not have classified the fish samples analysed on 8th November 1957 as contaminated despite the readings being well above the known natural background.

I6. Following Grapple X, a new more extensive EM programme for Grapple Y was introduced which involved:

a. The sticky paper and air filter samples from Pacific outstations were no longer sent to Christmas Island for daily analysis, but transported back to AWRE Aldermaston resulting in sampling-to-analysis times increasing from 10 to 20 days. The resources freed (within

Radiological Measurements group) by this change on Christmas Island enabled these personnel to be utilised elsewhere. The acknowledged transportation time (10-20 days) for samples transported to the UK would have meant short-lived radionuclides could not be measured.

b. On Christmas Island itself, the ten 10 new sampling stations outlined in the Grapple X Scientific Plan were set up around the island (SDTN 16/93 details these locations). The new system was referred to as the 'Local Monitoring Programme' operated by the Radiological Measurements group (RM4). Sticky papers, air filters and rainwater collectors (see 6.5.3) would be placed soon after detonation and collected up within hours for analysis on Christmas Island. The more rapid methodology was capable of measuring short-lived radionuclides if the collection and analysis time was reduced to hours.

c. In addition to the sticky paper collectors, rainwater collection at new 'Local' stations and all other Pacific outstations commenced. This was as a result of previous operation difficulties. It had been found that sticky paper collectors could only be used in dry conditions, being potentially ruined if made wet. Rainwater collectors would then be used if rain should fall, an operator making the appropriate switch as necessary.

I7. The results from the EM programme (as reported in SDTN 16/93 and elsewhere) indicate that fallout was detected on Christmas Island at one sampling station for each of operations Grapple Y and Grapple Z. Both of these were on the south coast of the island in non-inhabited areas. Given the nominal Easterly direction of the prevailing wind at Christmas Island, early-time depositions at these locations might be expected to have occurred. SDTN 16/93 also provides details of a dose reconstruction based on such depositions.

Annex I: Modern newspaper report on Sapper Morris RE

'JUST ADMIT HOW OUR BILLY DIED'

Billy Morris was the first to die - a strapping young man reduced to skin and bone only weeks after he was exposed to the atom bomb tests.

In the years that followed, 17,000 other servicemen were condemned to an early death after being ordered to watch a series of atomic explosions.

Now the family, who watched Billy's agony in 1958, have joined the Sunday Mirror's campaign for justice.

His sister Rachel Morris said: "I remember him in his uniform - he was so handsome and such a lovely boy. He was never sick a day of his life. He was sent to Christmas Island on National Service and a few months after he came back he wasted away to nothing and died."

Billy, from Swansea, was one of 20,000 British servicemen who witnessed hundreds of test blasts set off by Government scientists at the height of the Cold War. A sapper in the Royal Engineers, he was declared "A1 fit" and had blood tests when his National Service began.

On November 8, 1957, in just shorts and boots, Billy was ordered, with 2,500 others, to stand in the open while a bomb code-named Short Granite was detonated in the skies off the Pacific island.

He carried on living and working on Christmas Island, but on January 1, 1958, reported sick with swellings in his neck and nosebleeds.

He was diagnosed with leukaemia and evacuated home to Swansea.
He lost weight and was admitted to hospital, where he died on June 14 while his girlfriend Sylvia was pregnant with his child.

Rachel said: "The Royal British Legion wanted to use Billy as a test case for compensation. But his girlfriend lost the baby and my mother found it all too upsetting, so we decided to pull out."

She added: "We don't care about compensation - the most important thing is that the Government admits what it did to our Billy."

Sunday Mirror 26/8/2008 – S.Boniface

Annex J: AWRE memos regarding Sapper Morris

Building F6.1,

Ref: C2.45/Misc/386(C.2)
GRA/5.619/SP.1

20th August 1959

23290242 Sapper W.B. Morris (deceased)
Appeal to Ministry of Pensions and National Insurance

A copy of a letter, bearing the above references and dated 12 August 1959 from Mr. R.G. Abraham to The Commander, Task Force Grapple, had been sent to A.W.R.E. Answers to the four questions raised in the Ministry of Pensions and National Insurance letter to Abraham (dated 6th August) are given below.

1. The Tribunal may be informed that prior to 8th November 1957 no nuclear devices of any kind were exploded in the proximity of Christmas Island.

2. Air sampling and fall-out detection apparatus has been in continuous routine operation on Christmas Island since April 1957. During this period no fall-out has been recorded. Hence the statement on levels quoted under 2 in Abraham's letter 45/Misc/386(C.2) of 16th July 1959 applies throughout this period.

3. It is presumed that Dr. Levitt's term 'flash' refers to thermal and visible radiation. These are, of course, detectable at ranges much greater than those to which neutron and gamma radiation extend. Hence it does not follow that personnel exposed at distances where thermal flash protection would be required would necessarily also be exposed to neutron and gamma radiation. In fact, no thermal flash protective clothing was necessary at the Main Camp nor was any worn. For comments on neutron and gamma radiation, see 4 below.

4. The Tribunal may be told that the November 1957 explosion was of a nuclear device in the megaton range. Instruments used to measure neutron and gamma radiation from nuclear explosions demonstrated that even at only 10 miles from the November 1957 explosion the radiation dose was appreciably less than that which is received in a few seconds from natural causes in any part of the world. Clearly, therefore, at distances greater than 25 miles the question of radiation dose to an individual does not arise.

P.W.B. Brooking

for Director

The Commander,
Task Force Grapple,
Room 0082,
Air Ministry,
Whitehall Gardens,
London, S.W.1.

A.W.R.E. ALDERMASTON
20 AUG 1959

c.c. The Controller,
Ministry of Pensions and National Insurance,
Thames House South,
Millbank,
London, S.W.1.

AID

Sapper W. B. Morris

1. The general level of radiation on this Island did not increase measurably above the natural background throughout the trial.

The only measurable increase was that expected in the Forward Area, i.e. the scientific measurement area, at the instant after explosion; the increase measured there was such that the corresponding increase at the Camp Area must have been quite insignificant. This was confirmed by the negative results of measurements in the Camp Area itself.

2. Before the explosion all personnel were withdrawn from the Forward Area and all were properly accounted for and known to be in their allocated positions. The Main Camp was 28 miles from the point of the explosion.

3. Re-entry into the Forward Area immediately after the explosion was routed through a Health Control post and all personnel re-entering then wore protective clothing and carried film badge and other dosemeters. No radiation was recorded on any of these dosemeters.

4. The meteorological conditions were such that no fall-out was expected to reach the island and indeed measurements showed that this was the case. Sticky paper and air samples from five sites (Main Camp, Port of London, N.E. Point, Cape Manning and C Site) all indicated no fall-out. This means that the upper limits of ground and air contamination were $5.4 \times 10^{-8} \mu c/cm^2$ and $7.8 \times 10^{-3} \mu c/cc$ respectively.

5. Film dosemeters in the Main Camp Area throughout the trial gave no indication of radiation dosage, i.e. the dose delivered in this area did not exceed the minimum detectable, namely 0.05r.

6. There were certain areas, such as the scientific laboratories and the part of the airfield where the cloud sampling aircraft were serviced, where it was possible to receive doses of radiation.

These areas were clearly marked and entry to them was controlled.

All personnel with duties in these areas were issued with film-badge dosemeters.

7. Sapper Morris was not among those whose duties were such as to render them liable to measurable doses of radiation above the natural background. He was therefore never issued with a film badge or other dosemeter.

He could have received a radiation dose only through unauthorised entry into certain areas, disregarding warning notices and deliberately and stealthily avoiding control points.

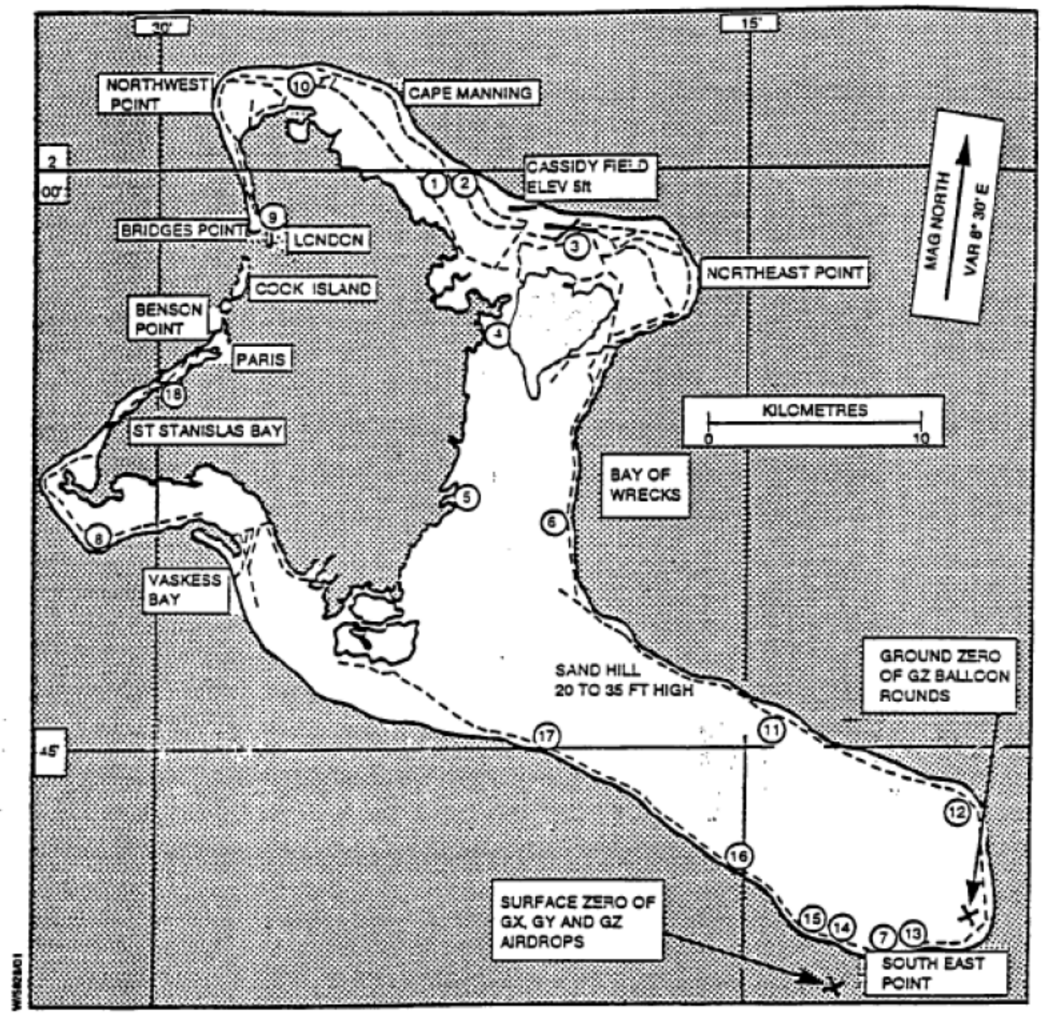
8. 270 film badge dosemeters were issued. Of these only 20 received measurable radiation doses above natural background. They had been worn exclusively by A.W.R.E. personnel and R.A.F. personnel concerned with the cloud sampling programme.

J. A. T. Dawson.

Building A2.2.
A.W.R.E.,
Aldermaston.
24th June, 1958.

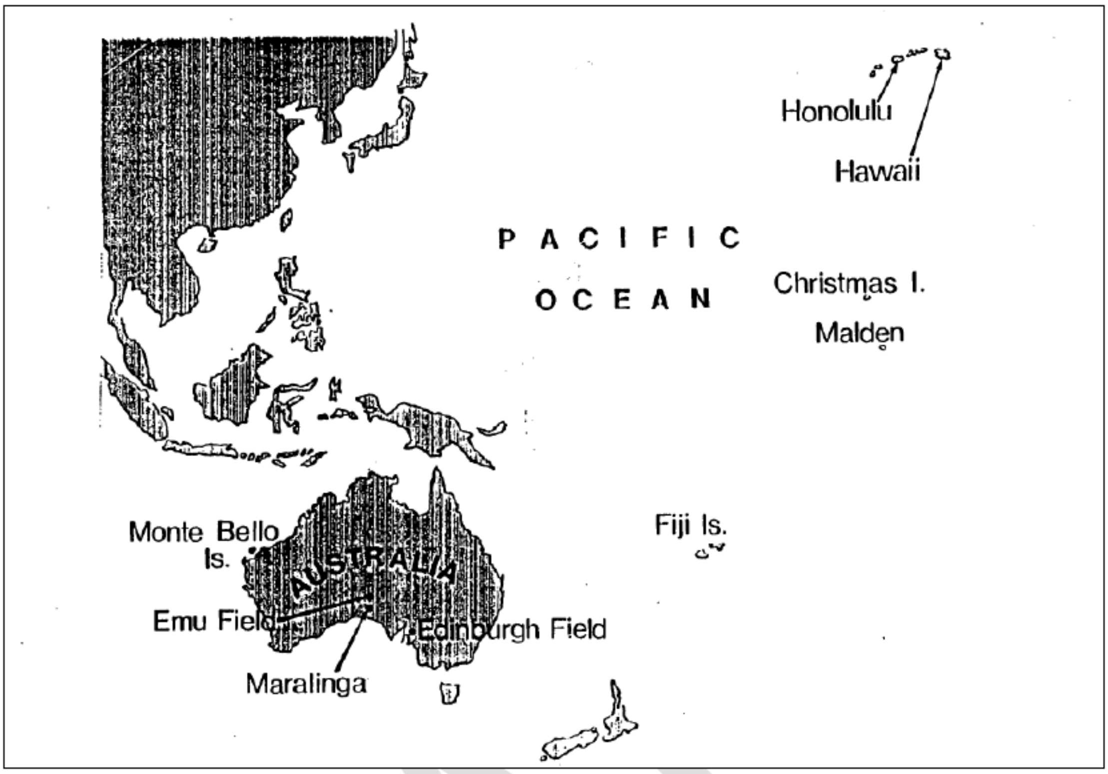
ANNEX K: Geographical information for the Grapple operations

The following maps and data are taken from SDTN 16/93[1]



1	JOINT OPERATIONS CENTRE	11	SITE A
2	MAIN CAMP	12	SITE B
3	AIRFIELD	13	RMF
4	DECCA SLAVE	14	TARGET MARKER
5	SITE Y	15	RM2
6	SITE C	16	RM17
7	SITE D	17	TRIG POINT 685196
8	DECCA MASTER SITE	18	DECCA (SPAL)
9	PORT		
10	DECCA MONITOR		

Annex K Figure 1: A map of Christmas Island with the locations of the main sites of habitation and operations



Annex K Figure 2: A map of the South Pacific with the locations for the Grapple series of tests

Annex K Table 1: Geographical information for Christmas Island at the time of Operation Grapple X

Point of Detonation	Location at Time of Detonation	Range from Point of Detonation (km)
1.7 km off SE Point	A Site*	12.7
	B Site*	10.5
	C Site	24.6
	E Site	42.4
	X Site	46.8
	Y Site	28.0
	NE Beacon (Decca)	30.8
	SW Point (Decca)	42.0
	Airfield	35.0
	Main Camp	40.0
	JOC	41.0
	Port Camp ('Port London')	43.1
	* No personnel present at time of detonation	

ANNEX L: Methodology of Fish Sampling and Analysis

Annexe 4 to
Appendix F
4 May, 1957
(A.L.5.)

OPERATION GRAPPLE - THE OPERATIONAL PHASE
JOINT OPERATION PLAN PART 5
PRECAUTIONS AGAINST EFFECTS OF THE WEAPON
FISH SAMPLING

Introduction

1. Certain foreign countries have experienced concern that, as a result of Operation Grapple, large numbers of fish will become contaminated. Although it is considered that this risk is being grossly exaggerated, it is necessary to collect data with which to refute any possible claim made by foreign countries subsequent to the Tests.

Sampling to be Undertaken

2. Fish will be sampled as follows :-

(a) From ships within the Grapple Area as detailed.

(b) From Radiation Measurement Stations at Christmas, Apia, Penrhyn and Canton.

Frequency and Extent of Sampling

3. From Ships. As from receipt of this Plan all ships detailed should select samples at random from edible fish caught (tuna whenever possible) and test them for radioactivity. It is desired to obtain information from as many different parts of the Grapple Area as possible and to this end ships are encouraged to fish whenever opportunity appears acceptable. A mean catch of from one to five fish per day per ship would be a reasonable sample.

4. Radiation Measurement Stations. Arrangements are being made to provide suitable instruments to the Radiation Measurement Stations at Apia and Canton and to Penrhyn in order that the Radiation Measurement Operators and the Senior Meteorological Officer at Penrhyn may sample fish. Fish will be obtained by local purchase with money provided by the Task Force. Full instructions to each station are being issued separately.

Method of Carrying out Test in H.M. Ships

5. External Geiger Method - (Ships holding Type 1257 Contamination Meters). The instrument is the A.E.R.E. type 1257C radiation monitor. The beta gamma probe will be used with the beta window shut. The gamma count will be read on the mechanical register.

6. The 'background' count of the instrument is to be determined daily. This is a function of the natural surroundings and the instrument itself. It will not vary by more than a few counts from day to day unless artifical radioactivity - e.g. from a nuclear explosion, affects the surrounding atmosphere. Two separate counts of five minutes are to be made, care being taken to avoid close proximity to artifical radioactivity, e.g. luminous watches or compasses. The background count is to be averaged over the whole ten minutes and expressed in counts per minute. It will be termed the daily background count or 'background'. The counts and 'background' are to be recorded.

7. After establishing 'background' the fish can be checked. The fish should first hang for 15 minutes to drain off surplus water and then will be laid horizontally on a flat contamination free surface. It may be presumed that all surfaces are contamination free until it is known otherwise.

/ The geiger probe should . . .

[redacted] [redacted]

Annexe 4 to
Appendix P
4 May, 1957
(A.L.5.)

OPERATION GRAPPLE - THE OPERATIONAL PHASE
JOINT OPERATION PLAN PART 5
PRECAUTIONS AGAINST EFFECTS OF THE WEAPON
FISH SAMPLING
(Continued)

The geiger probe should be held or mounted four inches above the centre of the fish with the longer axis of the probe parallel with that of the fish. A five minute count is to be taken. The fish should be turned over and a similar second five minute count taken. If the count per minute approaches 1½ times the highest background so far recorded two further checks are to be made by repeating five minute counts, placing the probe four inches above each side of the head and tail. If the average of the six counts is then twice the highest background recorded a report by confidential signal is to be made to 333.4 giving :-

(a) Total count over 30 minutes.

(b) Background on same day in counts per minute.

(c) Highest background in counts per minute.

(d) Type of fish.

(e) Latitude and Longitude of position caught.

8. Ships other than WARRIOR and MESSINA are to forward the appropriate portions given in paragraph 9 below to the nearest disection centre.

The Disection Method

9. Fish registering more than twice the highest background should be subjected to more detailed test. This can be carried out at Christmas, WARRIOR or NARVIK. Approximately one inch cubes from the following positions are required for this test :-

(a) Flesh.

(b) Gut.

(c) Skin.

(d) Fins and tail.

(e) Bone

10. If detailed test cannot be carried out soon after disection, the portions above should be wrapped in a polythene covering and kept in a cool place. It is safe to keep portions so wrapped in Domestic food refrigerators.

11. For detailed test 25 grammes are to be measured out from each category, maccrated and spread evenly over a counting tray and counted in the standard and window Beta counter for 10 minutes each.

12. The maximum count is to be reported by confidential signal to 333.4 giving :-

(a) Total count over 10 minutes.

(b) Average background count on same day in counts per minute.

(c) Type of fish.

(d) Latitude and longitude of position caught.

/ Records . . . .

Annexe 4 to
Appendix F
4 May, 1957
(A.L.5.)

OPERATION GRAPPLE - THE OPERATIONAL PHASE
JOINT OPERATION PLAN PART 5
PRECAUTIONS AGAINST EFFECTS OF THE WEAPON
FISH SAMPLING
(Continued)

Records

13. A written record is to be kept of all observations as follows :-

Example

Date	No. of Samples	Type of Fish	Result	No background for day
4 May, 1957.	4	Sardine	40 cpm.	34
		Tuna	39 "	"
		Stickleback	34 "	"
		Ulna	34 "	"

14. This record is only to be forwarded when called for.

Fishing Methods and Provision of Fishing Tackle

15. A small quantity of fishing tackle and information on the various fishing methods may be obtained on application to the Naval Staff Officer Materials.

Thermos Flasks

16. Distribution of suitable Thermos Flasks for forwarding test samples of fish will be arranged by the Naval Staff Officer Materials.