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**CONFIDENTIAL**

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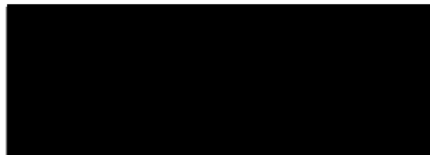
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**PM**

**Caveat**

02

00



**Prepared By**

**Number of Sheets**

12

54

Note: See coding sheet for Protective Marking (PM), Caveat and Prepared By codes.

CINO OH01 TO CINO OH15

1 DARK SHEET



Correspondence on the subject of  
this letter should be addressed to:-

THE UNDER SECRETARY OF STATE,  
AIR MINISTRY,

and should quote the reference:-

C.95567/57/M.A.4 *GMP*

*CINO 0401*

Sir,

*50*

*20194 + 11 X*  
*0401*

1-6, TAVISTOCK SQUARE,

LONDON, W.C.1.

13 OCT 1958

Radiological Safety Precautions  
Persons Selected for Service at Christmas Island

I am directed to refer to Air Ministry letter C.95567/57/D.D.Av.Med.  
dated 23rd September, 1958.

2. In order that all personnel proceeding to Christmas Island may be covered  
by this letter the preamble thereto is to be amended from "Medical Examination  
of Personnel posted to Christmas Island" to read "Medical Examination of  
Personnel posted or attached to Christmas Island".

3. I am to say with reference to paragraph 2 of the above Air Ministry letter  
that the reservation therein, "provided that they are required to work in the  
controlled area" has now been clarified and in future the posting or attachment  
notices of all personnel required to work in this area will be annotated to the  
effect that they are to be examined in accordance with Air Ministry letter  
C.95567/57/D.D.Av.Med. dated 23rd September, 1958.

4. I am to point out that the above arrangement will cover the cases of service  
and civilian personnel with the exception of certain flying and ground members  
of operational squadrons ordered to Christmas Island as units directly from their  
parent stations. All such personnel will require examination and arrangements  
for this are to be made at Command level.

5. Blood examinations and Chest X-Rays, (where the latter will not be  
routinely carried out at Personnel Holding Unit when it is known that an  
individual will not be passing through such a unit) are to be arranged at Service  
Medical establishments in all possible cases. In cases remote from Service  
Medical facilities every effort is to be made to ascertain the costs of civilian  
examination and such costs will only be entertained when the cost of transport  
to the nearest Service facility plus the pay of the individual concerned (to  
the nearest day) exceeds them.

6. Form Med. 42 is to be raised in respect of all service personnel examined.  
Air Ministry form 1928 is similarly to be raised for civilians.

I am, Sir,

Your obedient servant  


Wing Commander  
for Director of Hygiene and Research

All Principal Medical Officers,  
At Home and Overseas.

Senior Medical Officer,  
90 Group  
A.H.Q. Malta

UNCLASSIFIED

/Copy to:-

G.10582/EG/10/58/50



**UNCLASSIFIED**

Copy to:-

I.P.T.M.

Air Log O,  
Task Force Grapple (Rear).

A.W.R.E. (S.S.P.T.),  
Aldermaston.

The Secretary,  
Admiralty,  
(M.D.G.),  
London, S.W.1.

Secretary of State,  
War Office,  
(M.D.),  
Whitehall, S.W.1.

Ministry of Supply,  
(D.A.W.T.),  
St. Giles Court,  
W.C.2.

Folder G.10/M.A.5

████████  
████████  
████████

CWO 0402

c.c. 76 Squadron,  
Royal Air Force.

UNCLASSIFIED

STAFF IN

CONFIDENCE

822

Integrated Radiation Dose

With reference to S.R.H.P. letter ref. W6/HP/7006 dated 3 September 1958, [REDACTED] is stated to have incurred a dose of 10.05 roentgens. At this level the accuracy of measurement is such that this may be regarded as 10.0 roentgens. This officer should therefore not be subjected to further radiation until 27 April 1959, rather than 2 September 1961 as originally stated.

A.W.R.E.  
J.O.C.  
26 September 1958

c.c. Task Force Commander  
S.A.S.O.

[REDACTED]

[REDACTED]

[REDACTED]

From: [redacted] Health Physics Controller, A.W.R.E., J.O.C. (Ext [redacted])

To: O.C 76 Squadron, Royal Air Force

Copies to:- Task Force Commander  
S.A.S.O.

[redacted]  
[redacted]  
[redacted]  
[redacted]  
[redacted]  
File

Date: 24th September 1958

Ref: WG/HP/7006

Integrated Dose

The following persons having incurred a gamma radiation dose of 3 r or over since the beginning of Grapple-2, should not be subjected to further radiation until the date given below:-

<u>Name</u>	<u>Dose incurred</u> <u>23rd Sept.</u>	<u>Integrated Dose</u> <u>for trial</u>	<u>Date</u> <u>Unrestricted</u>
[redacted]	8.2	14.4	22.8.61
[redacted]	6.6	13.6	22.8.61
[redacted]	7.0	13.5	22.0.61
[redacted]	7.8	7.8	24.3.59
[redacted]	9.4	9.4	28.4.59
[redacted]	10.0	10.0	12.5.59
[redacted]	9.4	9.4	28.4.59
[redacted]	6.9	6.9	3.3.59
[redacted]	7.0	7.0	3.3.59

Exposure on this or a subsequent trial will require the personal permission of the Scientific Superintendent in accordance with RSRC/58(2) para 3.1.1 (c).



29/9

CIND 0404

0194 XXIX ①

EXT 2

819

UNCLASSIFIED

Tel. EUSTon 5040  
Extn. 162

Correspondence on the subject of  
this letter should be addressed to:-  
THE UNDER SECRETARY OF STATE,  
AIR MINISTRY, D.D.Av.Med.  
and should quote the reference:-  
C.95567/57/D.D.Av.Med.

AIR MINISTRY,  
1-6 TAVISTOCK SQ.,  
LONDON, W.C.1

23 September, 1958

Sir,

Radiological Safety Precautions at Christmas Island -  
Medical Examination of Personnel posted to Christmas Island from the U.K.

I am directed to state that the question as to whether a medical examination, in accordance with the provisions laid down in the "Factories (Ionising Radiations) Special Regulations", at present in preliminary draft form, should be complied with by the Services in respect of personnel taking part in Operation GRAPPLE and subsequent nuclear tests, has been under discussion within the Service departments.

2. It has been decided that, in future, all personnel posted to Christmas Island should be examined in U.K., as in the Regulations Part III Para. 21, provided that they are required to work in the controlled area there.

3. I am therefore to ask that arrangements be made for such medical examinations to be carried out.

4. The Factories (Ionising Radiations) Special Regulations require:-

- (a) A blood examination which shall include a total red blood measurement and a white cell count, with a differential white cell count; estimation of haemoglobin in grammes per hundred cubic centimetres of whole blood; and a search for and record of abnormal cells seen.
- (b) An x-ray examination of the chest, within two months of employment.
- (c) A medical examination subsequent to the examination referred to in sub-paragraphs (a) and (b).

I am, Sir,  
Your obedient Servant,

[Redacted signature]

Director of Hygiene and Research

All Principal Medical Officers,  
At Home and Overseas.

UNCLASSIFIED

/Copy to:

[Redacted]

Copy to: M.A.2.

I.P.T.M.

Air Log O,  
Task Force Grapple (Rear).

A.W.R.E. (S.S.P.T.),  
Aldermaston.

The Secretary,  
Admiralty,  
(M.D.G.),  
London, S.W.1.

Secretary of State,  
War Office,  
(M.D.),  
Whitehall, S.W.1.

Ministry of Supply,  
(D.A.W.T.),  
St. Giles Court,  
W.C.2.

Folder G.10/M.A.5.

UNCLASSIFIED

Tel. EUSTon 5040  
Extn. 162

CINO  
0404

Correspondence on the subject of  
this letter should be addressed to:-  
THE UNDER SECRETARY OF STATE,  
AIR MINISTRY, D.D.Av.Med.  
and should quote the reference:-  
C.95567/57/D.D.Av.Med.



20194  
0404  
K21A

AIR MINISTRY,

1-6 TAVISTOCK SQ.,

LONDON, W.C.1

23 September, 1958

GRAP

51

Sir,

Radiological Safety Precautions at Christmas Island -  
Medical Examination of Personnel posted to Christmas Island from the U.K.

I am directed to state that the question as to whether a medical examination, in accordance with the provisions laid down in the "Factories (Ionising Radiations) Special Regulations", at present in preliminary draft form, should be complied with by the Services in respect of personnel taking part in Operation GRAPPLE and subsequent nuclear tests, has been under discussion within the Service departments.

2. It has been decided that, in future, all personnel posted to Christmas Island should be examined in U.K., as in the Regulations Part III Para. 21, provided that they are required to work in the controlled area there.

3. I am therefore to ask that arrangements be made for such medical examinations to be carried out.

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- (a) A blood examination which shall include a total red blood measurement and a white cell count, with a differential white cell count; estimation of haemoglobin in grammes per hundred cubic centimetres of whole blood; and a search for and record of abnormal cells seen.
- (b) An x-ray examination of the chest, within two months of employment.
- (c) A medical examination subsequent to the examination referred to in sub-paragraphs (a) and (b).

I am, Sir,  
Your obedient Servant,



Director of Hygiene and Research

All Principal Medical Officers,  
At Home and Overseas.

UNCLASSIFIED

/Copy to:





SECRET

UNCLASSIFIED

-2-

Copy to: M.A.2.

I.P.T.M.

Air Log O,  
Task Force Grapple (Rear).

A.W.R.E. (S.S.P.T.),  
Aldermaston.

The Secretary,  
Admiralty,  
(M.D.G.);  
London, S.W.1.

Secretary of State,  
War Office,  
(M.D.),  
Whitehall, S.W.1.

Ministry of Supply,  
(D.A.W.T.),  
St. Giles Court,  
W.C.2.

Folder G.10/M.A.5.

UNCLASSIFIED

UNCLASSIFIED

222

815'

CIND O405

(P)

From: [redacted] (Ext [redacted])

To: OC 76 Squadron R.A.F.

Copies to:- Task Force Commander  
S.A.S.O.

[redacted]  
[redacted]  
[redacted]

File

Date: 12th September 1958

Ref: WG/HP/7006

Integrated Dose

1. The following persons having incurred a gamma radiation dose of 3 r or over since the beginning of Grapple Zulu, should not be subjected to further radiation until the date given below:-

<u>Name</u>	<u>Dose (Roentgen)</u>	<u>Date Unrestricted</u>
[redacted]	7.8	12th March 1959
[redacted]	4.5	25th Dec 1958
[redacted]	5.0	8th Jan 1959
[redacted]	8.4	26th Mar. 1959
[redacted]	5.8	22nd Jan. 1959
[redacted]	6.0	29th Jan. 1959
[redacted]	6.2	5th Feb. 1959
[redacted]	5.4	15th Jan. 1959
[redacted]	4.8	1st Jan. 1959

2. The following persons received prior to 11th September the permission of the Scientific Superintendent to receive the higher integrated dose of which the gamma component must not exceed 10 r. Their integrated dose for the trial and the date on which they will unrestricted are given below.

3. It should be pointed out that in their case it seems unlikely that they can perform the same task on round 4 without probably exceeding 10 r. This is particularly so in the case of [redacted]

<u>Name</u>	<u>Dose 11th Sept.</u>	<u>Dose for Trial</u>	<u>Date Unrestricted</u>
[redacted]	4.1	9.1	27th March 1959
[redacted]	3.2	6.9	30th Jan. 1959
[redacted]	3.4	7.0	30th Jan. 1959
[redacted]	3.0	6.5	23rd Jan. 1959

4. Exposure on this trial to further radiation will require the personal permission of the Scientific Superintendent in accordance with RSRC/58(2) para. 3.1.1 (c). In the case of [redacted] however, the personal permission of the Scientific Director should be obtained in accordance with RSRC/58(2) para. 3.1.1 (d).

[redacted]

1

16

UNCLASSIFIED

[REDACTED]

From: [REDACTED] A.W.R.E., J.O.C. (Ext [REDACTED])

To: O.C 76 Squadron R.A.F.

Copies to:- Task Force Commander  
S.A.S.O.

[REDACTED]

File

Date: 3rd September 1958

Ref: WG/HP/7006

Lower Intergrated Dose

1. The following persons having incurred a gamma radiation dose of 3 r or over since the beginning of Grapple Zulu, should not be subjected to further radiation until the date given below:-

	<u>Dose 2 Sept</u> (roentgens)	<u>Dose for trial</u> (roentgens)	<u>Date</u> <u>Unrestricted</u>
[REDACTED]	3.8	5.0	19 Dec 58
[REDACTED]	2.6	3.7	14 Nov 58
[REDACTED]	2.6	3.6	14 Nov 58
[REDACTED]	2.5	3.5	14 Nov 58
[REDACTED]	12.0	12.0	2 Sept 61
[REDACTED]	9.5	9.5	13 Apr 59
[REDACTED]	8.8	8.8	23 Mar 59
[REDACTED]	10.05	10.05	2 Sept 61
[REDACTED]	9.0	9.0	30 Mar 59
[REDACTED]	8.0	8.0	9 Mar 59
[REDACTED]	30.0	30.0	2 Sept 61
[REDACTED]	25.0	25.0	2 Sept 61
[REDACTED]	30.0	30.0	2 Sept 61

2. Exposure on this trial to further radiation will require the personal permission of the Scientific Superintendent in accordance with RSRC/58(2) para. 3.1.1 (c).

[REDACTED]

UNCLASSIFIED

From: [REDACTED], A.W.R.E., J.O.C. (Ext [REDACTED])

To: Task Force Commander  
Deputy Task Force Commander

[REDACTED]

File

Date: 31st August 1958

As the surface contamination and dose rate at all places in the Forward Area are both below the levels for occupational workers the Forward Area is designated CLEAN.

[REDACTED]

C1W0 0406



812

21

Scientific Director.

Control of Sampling Aircraft

Referring to my recommendations about the control of sampling aircraft, [redacted] has since pointed out that I have misunderstood the chief duty of the ground-based Sniff Controller. Apparently he exists primarily in order to take over direction of the sampling operation if the airborne Sniff Boss should be unable to exercise control. For this reason the Sniff Controller cannot, as I recommended, concentrate on safety aspects at the risk of losing touch with the general picture.

However, [redacted] feels that, now that one failure of a Charlie meter has occurred, he (as Sniff Controller) can keep in general touch with the situation and also maintain an adequate watch on the total doses.

I am sorry that I misled you on a point about which I made some effort to be clear.



J.O.C.  
9 September 1958

c.c. [redacted]

2. No 0407

805 16

# UNCLASSIFIED

From: [REDACTED], A.W.R.E., J.O.C. (Ext [REDACTED])

To: O.C 76 Squadron R.A.F.

Copies to:- Task Force Commander  
S.A.S.O.

[REDACTED]  
[REDACTED] ay

Date: 3rd September 1958

Ref: WG/HP/7006

### Lower Intergrated Dose

1. The following persons having incurred a gamma radiation dose of 3 r or over since the beginning of Grapple Zulu, should not be subjected to further radiation until the date given below:-

	<u>Dose 2 Sept</u> (roentgens)	<u>Dose for trial</u> (roentgens)	<u>Date</u> <u>Unrestricted</u>
[REDACTED]	3.8	5.0	19 Dec 58
[REDACTED]	2.6	3.7	14 Nov 58
[REDACTED]	2.6	3.6	14 Nov 58
[REDACTED]	2.5	3.5	14 Nov 58
[REDACTED]	12.0	12.0	2 Sept 61
[REDACTED]	9.5	9.5	13 Apr 59
[REDACTED]	8.8	8.8	23 Mar 59
[REDACTED]	10.05	10.05	2 Sept 61
[REDACTED]	9.0	9.0	30 Mar 59
[REDACTED]	8.0	8.0	9 Mar 59
[REDACTED]	30.0	30.0	2 Sept 61
[REDACTED]	25.0	25.0	2 Sept 61
[REDACTED]	30.0	30.0	2 Sept 61

2. Exposure on this trial to further radiation will require the personal permission of the Scientific Superintendent in accordance with RSRC/58(2) para. 3.1.1 (c).

[REDACTED]

C/NO 0408

UNCLASSIFIED

801 14

From: [REDACTED], A.W.R.E., J.O.C. (Ext [REDACTED])

To: Task Force Commander  
Deputy Task Force Commander

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
file

Date: 31st August 1958

As the surface contamination and dose rate at all places in the Forward Area are both below the levels for occupational workers the Forward Area is designated CLEAN.

[REDACTED]

CIN 8409  
UNCLASSIFIED

GRAP

52

~~RESTRICTED~~

0194 XXIX  
EY 3

798  
13

20194 XXIX  
0409

Office of  
Commander Task Group 333.1  
at Christmas Island.

No. GS.109/7  
The Scientific Director,  
A.W.R.E. Christmas Island.

26th August, 1958.

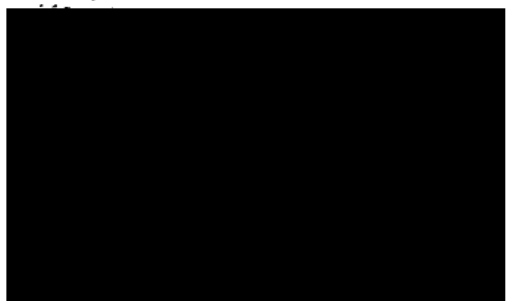
OPERATION GRAPPLE ZULU (PENNANT) - FISH SAMPLING

M.F.V. 630 sailed from Port London at 1300v on 22nd August, 1958 to proceed to the vicinity of point 3A on the attached chart, having on board Captain Grapple Squadron and his A.B.C.D. Staff Officer. At 1630, in the green area in position marked X the craft was stopped and drifted until 1830, at which time she was in position marked Y. At 1830 the craft got under way and returned to Port London, arriving at 2115.

2. Trolling lines were out while under way from clearing the harbour until approaching the reef on return. Whilst drifting, deep fishing lines were used. One barracuda was caught on the return passage in position some 3 miles SW of the Anchorage. This fish gave no reading in excess of background, measured on Type 1413a. Wind, sea and light conditions were such that one would not expect to find fish near the surface. It was for this reason that deep lines were used once the area had been reached.

3. From just before entering the green area until just after leaving it, readings were taken as follows :-

- (a) Type 1413a - Background near water level.
- (b) Type 1320a - Counts per second in water, the probe being wrapped in polythene and hung over the side in the sea. These readings are recorded in Appendix "A". The polythene covering was not, however, robust enough to withstand this treatment in rough seas, and eventually the probe was flooded. No readings were possible on this instrument after this, and it is recommended that for future tests of this kind a fully waterproofed probe be provided. It was also noted that the lead on the probe was not long enough to enable it to be hung over the side without putting the instrument over the side as well. This made it difficult to take readings; there was also a great risk of flooding the instrument. It is considered that the lead should be at least 12 feet long, and waterproof throughout.





UNCLASSIFIED

APPENDIX

0194 XXIX  
EXT 4  
①

FISHES TAKEN ON TYPES 1413a and 1320a DURING FISHING PATROL

<u>Time</u>	<u>Position</u>				<u>1413</u>	<u>1320</u>
1430	1 deg. 50 min. N	157 deg. 33 min. W	--	--		0.5 cps.
1530	1	48	157	31	0.004	0.7
1600	1	46	157	28	0.009	N.R.
1630	1	45	157	27	0.01	2.0
1700	1	45	157	28	0.01	3.0
1730	1	45	157	29	0.007	N.R.
1800	1	45	157	30	0.007	2.5
1830	1	45	157	31	0.0075	1.5
1900	1	47	157	32	0.02	U/S
1930	1	51	157	33	0.004	U/S

C/no. 0410 (PFG)

UNCLASSIFIED

796

From: [redacted] Controller, J.O.C.

To: O.C 76 Squadron R.A.F.  
Group Leader RC Group, A.W.R.E. J.O.C.

Copies to:

Task Force Commander  
S.A.S.O.

[redacted]  
[redacted]  
[redacted]  
[redacted]

File

Date: 25th August 1958

< Ref: WG/HP/7006

Lower Intergrated Dose

1. The following persons having incurred a gamma radiation dose of 3 r or over on 22nd August 1958 should not be subjected to further radiation until the date given below:

2. [redacted] RC Group *	31 Oct 1958	3 r
[redacted] 76 Squadron *	19 Dec 1958	4.9 r
[redacted] 76 Squadron *	7 Nov 1958	3.2 r
[redacted] 76 Squadron *	12 Dec 1958	4.8 r
[redacted], 76 Squadron *	16 Jan 1959	6.4 r
[redacted] 76 Squadron *	19 Dec 1958	5.0 r
[redacted] 76 Squadron *	19 Dec 1958	5.0 r

3. Exposure on this trial to further radiation will require the personal permission of the Scientific Superintendent in accordance with RSRC/58(2) para 3.1.1 (c)

[redacted]

20194 5518

774

Reference

CINC  
0411

792

S.S.P.T.,  
Building

GRAP  
101

### Blood counts and Radiation Hazards

I have read [redacted] letter and [redacted] notes.

It is undoubtedly true and has been recognised for many years that routine blood counts are of no value in detecting small over-dosage of radiation in any individual. It is the practice in all A.E.A. Establishments to do blood counts as part of the basic medical examination and at varying routine intervals, the aim being to exclude for medical reasons, persons showing abnormal blood findings which might weight the effects of subsequent accidental over-exposure or be the bases for litigation. It is not entirely true that routine blood counts have no value since there is one well-known case on record at Harwell in which an over-exposure to a neutron beam showed significant blood changes without any excessive exposure being detected by the monitoring devices.

On the question of pre-employment blood counts. [redacted] arguments are not entirely sound. It seems to most people in this field of medicine that it is reasonable both professionally and meidco-legally, to exclude persons whose blood findings lie outside a wide range of normality or who are showing evidence of disease changes. This view about pre-employment blood examinations will become a statutory requirement under the Factories Act and I have no doubt that Service personnel who are going to be exposed to radiation should be similarly protected. While it is true that the normal pre-employment blood count will do nothing to help a subsequent claim, it is also true that failure to carry our such counts would be considered in Court (especially in the light of the new statutory requirement) to be a failure to take the precautions necessary before exposure. The changes of picking up a leukaemia by this method are obviously very much greater than 1/1000,000 and 1/40,000 might be a truer figure. I agree however, with the economics of it and I have already pointed out, the cost of undertaking pre-employment blood counts would probably be ten times the cost of compensation for a possible case of leukaemia.

Finally, my personal view is that the blood count examination is just as much part of the pre-employment examination as urine analysis, chest x-ray and clinical examination and I have no doubt that sooner or later the Services will get round to this view.

With regard to [redacted] notes. I am certain his facts are accurate and no one has suggested that the 4,000 men at present on Xmas Island should be blood counted. However, I still think it is reasonable to do blood examinations on all replacements before proceeding overseas. In spite of the obviously inadequate medical facilities on Xmas Island, I think it would be reasonable to carry out blood examinations on the small group of people who could be significantly exposed in the forward area.

I would be happy to enlarge on this at our meeting on Tuesday and I have no doubt that you will stress the political angle.

[redacted]

Medical Division,  
Building [redacted] Ext. [redacted],  
11th July, 1958.

CIN0  
0412

GRAP  
77

789

FILM BADGES

~~20194 XXIX~~  
0412

789

1. It is not intended to provide film badges for everyone on Christmas Island. Badges will be issued to all members of A.W.R.E. and to those Service personnel working in active areas. On firing day aircrew employed on sampling and survey duties will also be supplied with badges.
2. The object is first to provide a check on the radiation dose received by individuals in the ordinary course of their employment on trials, which is recorded and controlled as a routine matter for all persons. Secondly in the event of an incident they would give an indication of the doses received by all personnel on the island.
3. Badges for all members of your Group are enclosed. Should anyone not have received a badge, or if you employ servicemen in your group, please let me have their particulars and I will issue them badges.
4. Badges will be changed every 3 to 4 weeks. Since the films are ruined if they become wet they are in polythene envelopes. Pins are provided and the badges should preferably be worn pinned to the clothing or else carried in a pocket. The need to carry them at all times must be brought home to all concerned. Your co-operation in this would be appreciated.
5. As on 'Pied Piper' during Grapple Y a further issue to selected personnel, both A.W.R.E. and Service, will probably be made on firing days. Further details of this issue will be given later.



Health Physics Controller

1st August 1958

Distribution:-

- Scientific Director
- Scientific Superintendent
- C.S.O. (Navy)
- Army Task Group Commander
- S.A.S.O.
- All Group Leaders



CINO  
0412

789

20194 331X

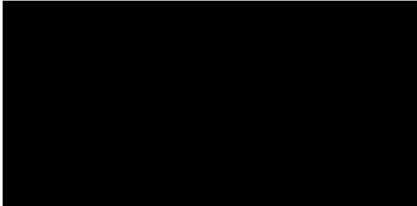
0412

12

GRAP 77/45

FILM BADGES

1. It is not intended to provide film badges for everyone on Christmas Island. Badges will be issued to all members of A.W.R.E. and to those Service personnel working in active areas. On firing day aircrew employed on sampling and survey duties will also be supplied with badges.
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3. Badges for all members of your Group are enclosed. Should anyone not have received a badge, or if you employ servicemen in your group, please let me have their particulars and I will issue them badges.
4. Badges will be changed every 3 to 4 weeks. Since the films are ruined if they become wet they are in polythene envelopes. Pins are provided and the badges should preferably be worn pinned to the clothing or else carried in a pocket. The need to carry them at all times must be brought home to all concerned. Your co-operation in this would be appreciated.
5. As on 'Pied Piper' during Grapple Y a further issue to selected personnel, both A.W.R.E. and Service, will probably be made on firing days. Further details of this issue will be given later.



Health Physics Controller

1st August 1958

Distribution:-

Scientific Director —  
Scientific Superintendent  
C.S.O. (Navy)  
Army Task Group Commander  
S.A.S.O.  
All Group Leaders  
■■■■■■■■■■

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GRAP.....45..... is duplicate of GRAP.....77.....

TITLE .....FILM RANGES.....

CLASSIFICATION .....UIC.....

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G.10/D. of H. & R.

24 July, 1958

Sir,

Radiological Safety Precautions at Christmas Island

I am directed to refer to the Commander Task Force Grapple's letter GRA/104/6/CRS dated 17th July, 1958 addressed to D.C.M.S., Air Ministry with copies to you. The letter records the conclusions reached by the medical representatives of the services with A.W.R.E. and Task Force Grapple staff on the desirability of carrying out preliminary blood examinations on members of the services taking part in weapon trials at Christmas Island.

2. Action is being taken by this Directorate to arrange for the blood examination of the R.A.F. Balloon Unit and Royal Engineer Unit referred to in paragraph 4. It is expected that this will be carried out at Christmas Island by technicians sent there, as a temporary measure, under arrangements made by A.W.R.E. and will be completed by August 22nd, 1958.
3. The question remains however as to whether replacement personnel of the services should in future have blood examinations made before leaving the United Kingdom for Christmas Island.
4. In the Air Ministry view, such examinations are not justified on purely medical grounds for all replacements because -
  - (a) they will not protect the Department concerned against claims for damages
  - (b) periodic fluctuations in white cell counts make the interpretation of a single count in most cases of little value.
5. The occupants of the controlled area on the other hand may, it is stated, be subjected to fall out, and the question arises as to whether it might not be advisable therefore, to adopt a preliminary examination for this group as is intended in the United Kingdom for persons exposed to ionising radiations in their occupation. If the Special (Ionising Radiation) Regulations (Factories Act) now in draft form are to be accepted as a guide it would presumably also be necessary to carry out a chest x-ray examination of each individual.
6. It will be necessary for the Services to agree a common policy and I am, therefore, to ask that the views of your department be communicated as early as possible to this directorate. The matter is now urgent as weapons trials will continue during the autumn but the technicians carrying out blood examinations for A.W.R.E. will leave Christmas Island towards the end of August to return to this country.

I am, Sir,  
Your obedient Servant,

*[Signature]*

Air Commodore  
Director of Hygiene & Research.

The Medical Director General of the Navy,  
Medical Department of the Navy, (Admiralty),  
Queen Anne's Mansions,  
St. James Park, S.W.1.

UNCLASSIFIED

The Director General of Army Medical Services,  
The War Office,  
London, S.W.1.

Copies to: A.W.R.E. (S.S.T.D.), Aldermaston, Ministry of Supply, D.A.W.T.,  
and Commander, Task Force Grapple.

Headquarters Task Force Grapple,  
Air Ministry,  
Whitchall Gans.,  
London S.W. 1

17th July, 1958

GRA/104/6/ORG

Radiological Safety Precautions at Christmas Island

1. The question of instituting blood counts for Service personnel posted to Christmas Island has recently been under consideration by the Task Force and Atomic Weapons Research Establishment. Under present arrangements certain locations at the Base where contamination is a possibility have entry and exit thereto rigidly controlled and those who work in these areas have blood examinations. For the series of tests planned to start next August balloon supported firings will be conducted for the first time at Christmas Island. This introduces a new factor in that rehabilitation of the area contaminated after a balloon firing will be necessary and this work will be done by some 250 R.E. and R.A.F. personnel.

2. In order to determine the correct policy regarding blood counts a meeting was held at A.W.R.E. on 15th July, 1958 with representation as follows:-

- A.W.R.E.
- A.W.R.E.
- A.W.R.E.
- Task Force Grapple
- Task Force Grapple
- R.A.F. Hospital Halton (Consultant in Pe<sup>d</sup> Troic)
- Air Ministry (MA 5)
- H.Q. Bomber Command (Staff of FMO)
- Admiralty (Med Directorate Gen Staff)
- War Office (Medical Directorate Staff)

3. The conclusions reached at this meeting were as follows:-

(a) All medical opinion present agreed single blood counts to be of negligible scientific value.

(b) A.W.R.E., partly anticipating new statutory regulations under the Factories Act (not yet approved) believe that blood counts should be given to all at Christmas Island as a medico-legal safeguard, both to satisfy public opinion and as a "moral" obligation. R.A.F. medical representation at the meeting did not believe blood counts to be a medico-legal safeguard and, as they are scientifically worthless done under Service conditions, considered it "immoral" to do them.

/(c).....

Under Secretary of State,  
Air Ministry (L.G.S.S.)  
Tavistock Sq., W.C.1

Copies to:- A.W.R.E. (S.D.P.T.) ✓  
Aldermaston  
Secretary of the Admiralty,  
Admiralty, (M.D.G.)  
London S.W.1

Ministry of Supply (D.A.S.)  
St Giles Ct., W.C.2  
Secretary of State,  
War Office, (M.D.)  
Whitchall S.W. 1



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(c) After some discussion the meeting concluded that we should institute one blood examination for each of those required to work in the new controlled area.

(d) The meeting agreed that it would be impracticable and valueless to institute blood counts for the remaining personnel at Christmas Island (some 4,500) but that the Services should be invited to determine whether future replacements in all three Services should be subjected to blood examinations prior to posting to Christmas Island.

4. R.A.F. Balloon Unit and Royal Engineer personnel requiring blood counts (para 3 (c)) will total approximately 250 and in view of programme timing blood counts must be completed before 22nd August, 1958. Since no facilities exist at present at Christmas Island for this type of test suitable apparatus and laboratory assistance will be required. It is possible that A.G.R.E. will be able to assist. Will Air Ministry (D.G.M.S.) please now initiate the necessary action for these examinations?

5. Will Air Ministry (D.G.M.S.) please initiate action with the Admiralty and War Office to determine an agreed and acceptable policy with regard to the blood counting of future Service replacement personnel posted to Christmas Island prior to departure from U.K., bearing in mind the likelihood of the statutory requirement referred to at para 3 (b). For planning purposes, population figures are as follows:-

Royal Air Force	-	2475
Army	-	1800
Royal Navy	-	<u>225</u>
Total	-	<u>4500</u>

Commander,  
Task Force Grapple

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Minutes of a Meeting held at A.W.R.E.  
on 15th July, 1958 to discuss  
Radiological Safety Precautions at  
Christmas Island

Present

[Redacted Name]

(Chairman)

- Task Force Grapple
- A.W.R.E.
- Task Force Grapple
- R.A.F. Hospital Malton
- Air Ministry
- A.W.R.E.
- A.W.R.E.
- Headquarters Bomber Command
- Admiralty
- War Office
- Task Force Grapple

1. The Chairman opened the meeting by outlining the matter for discussion. This was whether or not Service personnel at Christmas Island should be subjected to blood examinations. This matter had been under consideration both by the Task Force and A.W.R.E. for some time past but it was now a more pressing problem than heretofore because the tests of balloon supported nuclear devices would necessitate a number of people entering and rehabilitating the contaminated area after the first burst. He continued by saying that there were two points of view, the purely medical and the medico-legal. He had been advised that from a purely medical aspect there was little or nothing to be gained by subjecting Service personnel at Christmas Island to blood counts. A.W.R.E. on the other hand considered that from the medico-legal aspect blood counts were necessary. He concluded by saying that as A.W.R.E. insisted on blood counts for their own personnel a compromise might be acceptable. This was to arrange blood counts for those who would be working in the forward area during Grapple "Z" and for all future replacements for Christmas Island. It was clearly impossible at this stage to arrange for all Service personnel at Christmas Island during Grapple "Z", a total of over 4,500, to be given blood counts.

2. [Redacted Name] considered that no compromise was necessary as he thought that the proposal to give blood examinations was unsound.

3. [Redacted Name] then asked A.W.R.E. to give their reasons for advising the Task Force Commander that a blood count should be taken.

4. [Redacted Name] replied that he would not argue the case for single blood counts on purely medical grounds but he felt that the matter must be regarded from the medico-legal angle. He said that people with counts habitually above or below normal or those with any blood abnormality must be excluded from the possibility of radiation. For this reason it was an integral part of the medical examination given to all A.W.R.E. personnel. Furthermore, a statutory requirement under the Factories Act was shortly to become law which stated that blood counts were to be given to all civilians working under conditions in which they were exposed to radiation in the normal course of their duties. Finally, he stated that A.W.R.E. were concerned about the political repercussions which might ensue if charges of negligence, however unfounded, could be proved. He agreed that it would not be a feasible proposition to carry out blood counts on Service personnel already at Christmas Island, however, he felt that personnel working in the forward area and future replacements for Christmas Island should receive blood counts.

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5. [REDACTED] then stated that his objection was based on the grounds that he was not convinced that a blood count was of any use whatever and he suggested that if a person was examined and found to be normal before posting to Christmas Island and who later developed leukaemia, it might be difficult to refute the allegation that this was due to radiation received at Christmas Island.

6. [REDACTED] is convinced on the other hand that a blood count was of value by not exposing to radiation people of poor health. He considered that it would prejudice the case if no blood count was taken and a person became ill later.

6. [REDACTED] then stated that the compromise he had proposed and, which was supported by [REDACTED], seemed the logical one and after considerable discussion the following decisions were reached:-

(a) All personnel likely to be employed during Grapple "Z" in the forward area where they might be subject to radiation hazards should be given blood counts before the commencement of the tests.

(b) The question of whether all Service replacement personnel posted to Christmas Island should be given blood counts, regardless of their duties or place of work, was to be referred to the Air Ministry for decision in consultation with the other two Services.

H.Q. Task Force Grapple  
17 July 1958

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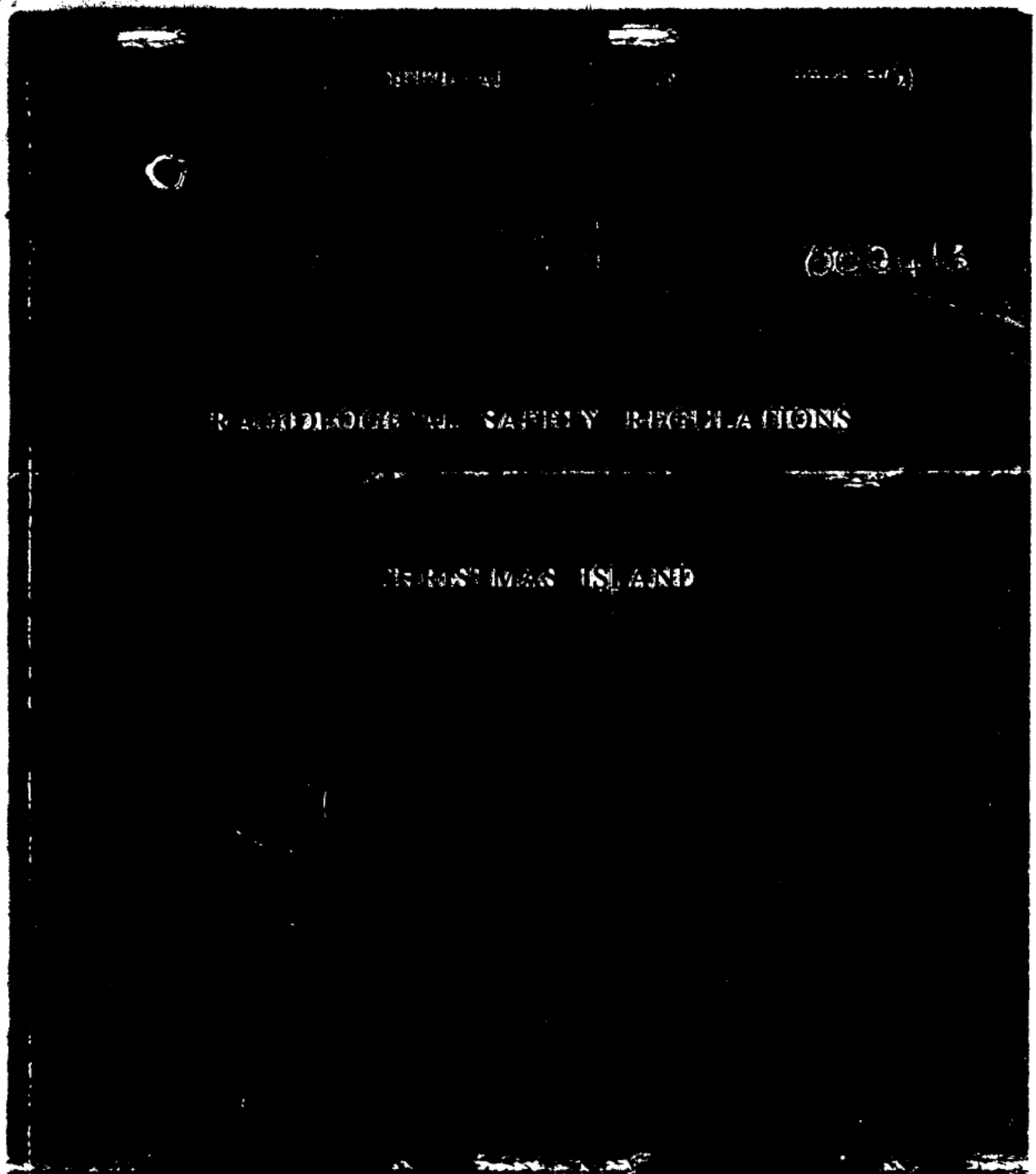
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RADIOLOGICAL SAFETY REGULATIONS

CHRISTMAS ISLAND

The Radiological Safety Regulations, Christmas Island, are issued by the Director, Atomic Weapons Research Establishment, on behalf of the Minister of Supply and have been agreed by the United Kingdom authorities concerned.

Enforcement of these regulations will be the overall responsibility of the Commander, Task Force Grapple.

July, 1958.

It is the responsibility of the recipient to ensure that all amendments to these Regulations are inserted immediately they are received.

Amendment Number	By Whom Amended	Date of Insertion	Paragraph(s) Amended

RADIOLOGICAL SAFETY REGULATIONS

CHRISTMAS ISLAND

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## RADIOLOGICAL SAFETY REGULATIONS

## CHRISTMAS ISLAND

## 1. Introduction

1.1 Radiation which may be encountered during a trial may be  $\alpha$  particles,  $\beta$  particles,  $\gamma$  rays or neutrons. Under properly controlled conditions, work involving exposure to these radiations can be carried on in perfect safety.

Excessive exposure, however, results in damage to the human body.

The danger is insidious because the effects are not immediately felt and damage may become apparent only after a period of years. Damage may arise not only from external exposure but from irradiation of internal organs as a result of ingestion, inhalation, injection into the bloodstream through cuts or abrasions, or even by absorption through an intact skin.

1.2 The maximum permissible levels of the various radiations and radioactive substances are based on the recommendations of the International Commission on Radiological Protection and of the International Commission on Radiological Units, and have been approved by the UKAEA and other Authorities concerned. These are the levels to be used throughout a trial.

1.3 The object of the regulations is to ensure complete protection both of staff and of the general public, whilst imposing the minimum interference with work. To this end, the

ulations will, at all times, apply to all who are concerned with the Christmas Island Trials, both servicemen and civilians never stationed.

1.4 Advice on the applicability and interpretation of these regulations will be prepared by the Health Physics Adviser for the Scientific Director, who is responsible for advising the Commander, Task Force Grapple, on whom rests overall responsibility for all matters of radiological safety. For implementation, a Health Physics Controller will be appointed by DAWRE to work under control of the Scientific Director.

If necessary, a Health Physics Representative will be provided by AWRE during inter-trials periods.

#### Classification of Areas

2.1 Each part of the Test Area will be classified according to the nature of the work which may be done in that particular part.

2.2 The system of classification and nomenclature which will be used is as follows:-

2.2.1 **Controlled Areas:** are those where the levels laid down in Section 3 are exceeded and where precautions appropriate to the degree of risk must be taken.

2.2.2 There will be three categories:-

- (a) **BLUE Area** - Risk of penetrating radiation but not of inhalation, ingestion or injection. No special clothing.
- (b) **RED Area** - Risk of penetrating radiation and of slight inhalation, ingestion or injection. Clothing as specified by the Health Physics Controller will be worn.
- (c) **YELLOW Area** - Risk of a serious inhalation, ingestion, injection, or penetrating radiation hazard. Fully protective clothing must be worn.

2.2.3 The classification of an Area will be laid down by the Health Physics Adviser who must be informed prior to any proposed change in the work which might affect the classification. He will review the classifications periodically.

2.2.4 Signs showing the classification and having a patch of the appropriate colour will be displayed at all entrances to any Controlled Area.

2.3 No person will be allowed to enter RED or BLUE areas without permission of the scientist, or other officer, in charge of the Area concerned. No person will be allowed to enter a YELLOW area without permission of the Health Physics Control Officer in charge.

When it is necessary to carry out building, engineering or other maintenance work in any Controlled Area,



Permit To Work Certificate must first be obtained from the Health Physics Adviser or Representative.

### Specification of Maximum Permissible Levels

It is emphasized that these levels are maxima and every effort must be made to keep all exposures as low as possible.

The levels are based on the Recommendations of the International Commission of Radiological Protection for 'Occupational Workers'. For non-occupational workers the levels should be reduced to 1/10th of those quoted.

#### 3.1 External Radiations

For external radiation the maximum permissible levels will be :-

##### 3.1.1 $\beta$ and $\gamma$ Radiation

(a) A normal working rate as defined in the current 'Recommendations of the International Commission on Radiological Protection'.

1.5 rep/week of which the  $\gamma$  radiation component must not exceed 0.3 r/week.

The dose to the eyes must not exceed 0.3 rep/week.

(b) A lower integrated dose of up to 15 rep of which the  $\gamma$  radiation components must not exceed 3r.

This dose will be allowed only with the express permission of the Health Physics Controller which will be given only when he regards it as necessary for the smooth running of the Operation.

Except as provided for under (c) or (d) below, personnel who have received this dose will not be subjected to further exposure until their average exposure is below 1.5 rep/week of which the  $\gamma$  component shall not exceed 0.3r/week.

(c) A higher integrated dose of up to 50 rep of which the  $\gamma$  radiation component must not exceed 10r.

This dose will be allowed only where it is necessary in order to recover important records and information which might otherwise be lost, and will require the personal permission of the Scientific Superintendent after consultation with the Health Physics Adviser and Medical Adviser.

Except as provided for under (d) below, personnel who have received this dose will

not be subjected to further exposure until their average exposure is below the level given in (b).

Personnel who, having been given permission to receive up to 10r, accidentally exceed this figure, will not be permitted to receive further exposure within 3 years except under the conditions of (d) below.

(d) A special higher integrated dose of up to 75 rep of which the  $\gamma$  radiation component must not exceed 25r.

This dose will be allowed only if essential to the success of the trial, and only to personnel who are not normally exposed to radiation, and then only with the personal permission of the Scientific Director after consultation with the Health Physics Adviser and the Medical Adviser.

(e) Personnel who have received over 10r but not more than 25r will not be subjected to further exposure during a period of three years except under the condition of (d) above.

(f) No person will be allowed to receive more than 50r before age 30, his full radiation history being taken into account.

(g) If doses are received larger than authorised for the individual, a special enquiry into the circumstances must be held by the Scientific Director.

### 3.1.2 Neutron Radiation

The maximum permissible levels will be as defined in the current recommendations of the 'International Commission on Radiological Protection'.

The dose to the tissue 2 cm below the skin surface must be less than 30 millirads/week. This figure, for a 40 hour week, is given by the neutron fluxes below:-

Neutrons of energy	0.25	eV	2000	neutrons/cm <sup>2</sup> /sec		
"	"	"	10	eV	2000	neutrons/cm <sup>2</sup> /sec
"	"	"	10	keV	1000	neutrons/cm <sup>2</sup> /sec
"	"	"	0.1	MeV	200	neutrons/cm <sup>2</sup> /sec
"	"	"	0.5	MeV	80	neutrons/cm <sup>2</sup> /sec
"	"	"	1	MeV	60	neutrons/cm <sup>2</sup> /sec
"	"	"	2	MeV	40	neutrons/cm <sup>2</sup> /sec
"	"	"	3-10	MeV	30	neutrons/cm <sup>2</sup> /sec

### 3.1.3 $\alpha$ Radiation

$\alpha$  particles present no external hazard as they are unable to penetrate the outer layers of undamaged skin.

### 3.2 Internal Radiations

The maximum permissible levels of ingestion, inhalation and injection are based on the equivalent doses to tissue, but are dependent on biological factors which vary with the material.

#### 3.2.1 The Maximum Permissible Levels for Inhalation and Ingestion will be:-

(a) For individual isotopes, or mixtures of isotopes except weapon debris

The concentrations shall be those in Appendix 1 for the materials concerned.

(b) For Weapon Debris

(i) In Water	$\mu\text{C}/\text{cc}$
(a) $\alpha$ emitters	$1 \times 10^{-7}$
(b) $\beta$ - $\gamma$ emitters for debris of age less than one month	$6 \times 10^{-4}$

$\beta$ - $\gamma$  emitters for debris of age greater than one month  
(t = age in months)  $6 \times 10^{-4} \times t^{-1.2}$

$\beta$ - $\gamma$  emitters of unknown age  $1 \times 10^{-6}$

#### (ii) In Air

(a)  $\alpha$  emitters. The concentration shall be that in Appendix 1 for the most hazardous material likely to be found.

(b)  $\beta$ - $\gamma$  emitters age up to 384 hours  
(t = age in hours)  $3 \times 10^{-6} \times t^{-1.2}$

$\beta$ - $\gamma$  emitters for debris of age greater than 16 days or of unknown age  $2.4 \times 10^{-9}$

The maximum permissible levels applicable to inhalation hazards are based on a regular exposure of 56 hours/week. If these hours are not applicable the levels should be varied in inverse proportion to the duration of exposure.

## 3 Contamination Levels

## 3.3.1 Buildings and Equipment

In the case of buildings and equipment the restriction of contamination is dictated not only by health considerations but also the need to ensure that background radiation does not interfere with the operation of sensitive measuring equipment. The levels quoted apply to the most obnoxious radioactive materials likely to be found in such areas.

Contamination can be fixed or loose.

In the case of benches, clothing, etc., contamination can be regarded as fixed when a smear test (see Appendix 2) gives values below the maximum permissible levels. In the case of hands and body it is defined as that which remains after washing in accordance with the instructions laid down in Appendix 3.

The maximum permissible levels of fixed surface contamination will be as follows:-

	$\mu\text{C}/\text{cm}^2$
Hands	$3 \times 10^{-6}$
Benches, equipment, etc.	$1 \times 10^{-3}$

 $\beta$ - $\gamma$ 

Hands

Benches, equipment, etc.

The maximum permissible levels for loose contamination on benches etc. will be:-

 $\alpha$  smear $\beta$ - $\gamma$  smear $\mu\text{C}/\text{cm}^2$  $1 \times 10^{-4}$  $4 \times 10^{-3}$  $3 \times 10^{-6}$  $1 \times 10^{-4}$ 

## 3.3.2 Fall-out Areas

The maximum permissible level of contamination by fall-out of fission products in uncontrolled areas depends upon its physical state, (whether it is soluble or insoluble, finely divided or in pellet form), and upon the age of the products.

The Health Physics Controller will determine the boundaries of the Controlled Area according to the circumstances.

Insoluble Products

MPL for products of any age

 $\mu\text{C}/\text{cm}^2$  $4.3 \times 10^{-2}$

**Soluble Products**

MPL for products aged up to  $4\frac{1}{2}$  months  $4.3 \times 10^{-2}$

MPL for products aged  $4\frac{1}{2}$  months to 12 years  $2.7 \times 10^{-1} \times t^{-1.2}$   
(t = age in months)

MPL for products of age unknown or greater than 12 years  $7 \times 10^{-4}$

**Pellets  $\mu\text{c}/\text{pellet}$** 

MPL for insoluble pellets of any age 5

MPL for soluble pellets up to age 1 month 5

MPL for soluble pellets aged 1 month to 12 years  $5 \times t^{-1.2}$   
(t = age in months)

MPL for soluble pellets of age unknown or over 12 years  $1.3 \times 10^{-2}$

Note:  $4.3 \times 10^{-2} \mu\text{c}/\text{cm}^2 \sim 2 \text{ mr}/\text{h}$  measured at 1 metre above the surface.

3.3.3 When contamination levels exceed those given in paras 3.3.1 and 3.3.2 the Health Physics Controller will lay down the conditions under which work may proceed in the areas affected.

**4. Film Badges**

All personnel who have duties in a Controlled Area will wear a Personal Monitoring Film at all times.

**5. Protective Clothing****5.1 Wearing of Clothing**

5.1.1 The type of radiation protective clothing required in Controlled Areas depends upon the degree of hazard prevailing and will be specified by the Health Physics Controller accordingly.

5.1.2 All protective clothing will be white and will be distinguished by red epaulettes or a red triangle as appropriate.

5.1.3 The wearing of the approved protective clothing with film badges and dosimeters, as specified in the appropriate parts of the regulations, is compulsory.

5.1.4 To assist the rigorous enforcement of these rules, radiation protective clothing will not be issued for other purposes.

**5.2 Laundering and Disposal**

5.2.1 An article of clothing may be re-used after laundering so long as the fixed contamination does not exceed  $10^{-5} \mu\text{c}/\text{cm}^2(\alpha)$  or  $10^{-4} \mu\text{c}/\text{cm}^2(\beta)$ . If after repeated laundering the contamination is not reduced to these levels the article will be disposed of as contaminated waste.

5.2.2 Protective clothing will be sent only to the special laundry provided. Rubber gloves from RED areas will not be sent to the laundry but will be cleaned by the users.

### Use and Storage of Radioactive Materials

6.1 No radioactive material will be used outside Controlled Areas. Sealed sources of radiation may be used in carrying out calibrations provided the Health Physics organization has been informed and BLUE Area warning signs have been erected.

6.2 Materials which are completely sealed so as to prevent any escape of active materials may be used, or stored, in any Controlled Area. Adequate precautions must be taken to ensure that the dose received by workers in that area is within the limits laid down.

6.3 Use or storage of radioactive materials other than stated above is permitted only in RED or YELLOW areas.

6.4 In RED Areas no radioactive material will be exposed unnecessarily to the air of the laboratory.

6.5 Details of special precautions required for particular materials and areas will be laid down as appropriate by the Health Physics Controller, who will maintain a record of all radioactive sources and materials in use or in store.

## 7 Transit of Radioactive Materials

7.1 Transit of radioactive materials outside Controlled Areas is permitted, provided they are in properly designed and sealed containers which will effectively prevent escape of the material and which are themselves externally clean, and that the Health Physics organization has been informed previously. The transit should be uninterrupted and adequate precautions must be taken to ensure that the  $\gamma$ -ray dose rate does not exceed 200 mr/h at the surface and 10 mr/h at one metre, and the neutron dose rate does not exceed 30 neutrons/cm<sup>2</sup>/sec at the surface. Transit of containers where the dose rate exceeds any one of these limits will be permitted only with prior Health Physics approval.

7.2 Transit of radioactive materials to and from the Test Area is governed by any International UK and Australian Government Regulations currently in force, by the Regulations of any other Government concerned, and by any Instructions, currently in force, issued by DAWRE, RAF/AWRE, the Health Physics Adviser (See Appendix 4), or the Scientific Director.

## 8. Laboratory Waste

8.1 All solid waste will be segregated into the following four categories:-

- (i) Highly active waste, i.e., above one millicurie.
- (ii) Low activity waste non-combustible.

(iii) Low activity waste combustible.

(iv) Used paper towels.

Category (i) waste must be sealed in rigid containers and retained by the originator until proper arrangements have been made for its disposal. The contents and the approximate levels of activity must be marked on the outside.

Bins suitably labelled will be kept in all laboratories and workrooms where categories (ii), (iii), and (iv) are likely to arise. Low activity articles too large to be placed in the bins will be wrapped in impervious material in such a way as to prevent the escape of active material, and will have their contents and approximate levels of activity marked on the outside.

### Monitoring

9.1 The object of radiation monitoring is to ensure protection of personnel and to prevent interference with scientific work due to contamination.

The Health Physics organisation will provide complete monitoring facilities for personal use.

A representative of Health Physics will be available in all Controlled Areas to advise and assist when called upon.

### 9.2 Personal Monitoring

9.2.1 It is the responsibility of each individual to ensure that he is monitored before leaving a Controlled Area. Instruments will be provided for this.

9.2.2  $\gamma$ -ray dosage will be measured by means of film badges which will be worn as laid down in section 4.

9.2.3 For special operations, where high dose rates are anticipated, personal ionization chambers will be worn. Special film badges will be worn when required by the Health Physics organization.

### 9.3 Area Monitoring

9.3.1 Air sampling will be carried out in all laboratories and workrooms where there is normally a potential inhalation risk. For special operations or where an unusual inhalation risk is anticipated additional samples will be taken.

9.3.2 The Officer-in-Charge will ensure that regular contamination checks are made, to ensure that levels of activity are below the maximum values laid down.

In addition periodic surveys will be made by the Health Physics organization.

### 9.4 Monitoring of Active Waste

Solid waste containers will be monitored and decontaminated if necessary before being taken from a Controlled Area.

### 9.5 Monitoring of Vehicles and Equipment

All equipment and vehicles, including ships and aircraft, will be monitored and decontaminated, if necessary, before being taken out of a Controlled Area. Special arrangements have been made for the movement from and to Australia of aircraft which have undertaken sampling duties and may, therefore, be contaminated, and this section does not apply to such aircraft.

Equipment will not be moved into a less active area unless it is monitored, decontaminated, if necessary, and given a Health Physics Clearance Certificate. Articles will not be moved into a BLUE or a non-controlled area if there is any detectable loose activity. Again, this section does not apply to sampling aircraft for which special arrangements are made.

### Medical Surveillance

The Medical Officer must be consulted in all medical aspects of Radiation Safety.

No person will be allowed to work in a Controlled Area, with radioactive materials, who has not previously been prepared for such work by a special medical examination either immediately prior to the Trial, or immediately prior to his first exposure during the Trial.

### Accidents and First Aid

11.1 If anyone thinks he may have inhaled, ingested or otherwise absorbed (e.g., through cuts, etc.) any radioactive material he must at once:-

- (i) Take emergency action (See 11.2 below).
- (ii) Report to the Health Physics Controller and the Medical Officer (through his Officer-in-Charge if the accident occurs on duty).

11.2 If the skin is accidentally cut, or scratched, during work in a Controlled Area the cut should be placed, if possible, under running water within 15 seconds and held there whilst the whole wound area is scrubbed with a soaped brush for at least five minutes. The flow of blood should be encouraged by mild pressure above the wound. The surrounding skin should be monitored and washing continued until this is inactive.

A sterile dressing, not a strip of dressing of the Elastoplast type, may be used as a temporary cover until qualified medical attention has been received.

The object causing the wound will be kept and tested for contamination.

11.3 If anyone spills any radioactive material he must, unless in a YELLOW area:-

- (i) Ask all staff to vacate the area.
- (ii) Limit the spread of contamination.
- (iii) Report immediately to the Health Physics organization.



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In a YELLOW area he must mark the boundaries of the spill and report to the Health Physics organization.

### Storage and Use of Personal Effects

Eating, smoking, drinking and the storing of food, drink tobacco anywhere in Controlled Areas, other than BLUE areas, is forbidden.

### Hazards from Weapon Debris

13.1 The Health Physics Adviser will obtain from the Radiation Measurements Group, the Theoretical Predictions Group and the Meteorological Service all data required to maintain effective control over the hazards due to fall-out.

13.2 The use of all aircraft, vessels and vehicles, in connection with the Operation will be governed by such instructions as may be issued. Where aircraft, vehicles or personnel are likely to go, into areas which may have been contaminated, all personnel concerned must report at once to a Health Physics representative, who will arrange with the appropriate authority for the checking, decontamination if necessary and the granting of clearances and who will give such advice as may be necessary.

13.3 Advice on other matters concerning Radiological safety outside the Test Area will be called for from the Health Physics Adviser as necessary.

## 14. Responsibilities

### 14.1 The Individuals

Any person coming into contact with radioactive materials or entering active areas is personally responsible for complying with these regulations and other relevant regulations and instructions.

### 14.2 The Officer-in-Charge of any Task is responsible for ensuring:-

(i) That these regulations and other relevant regulations and instructions together with any additional requirements applicable to his task are brought to the notice of all his staff, and that they clearly understand the hazards involved in any work that they have to do.

(ii) That these regulations are rigorously observed.

(iii) That the Health Physics Adviser and the Medical Officer are informed in advance of any proposed work which may affect the Radiological Safety arrangements in any way.

(iv) That any accidents or abnormal circumstances are reported immediately to the Scientific Director, the Health Physics Adviser, the Medical Officer and, where applicable, to Officers Commanding Service Units.

(v) That Health Physics Controller is kept fully informed of all radioactive materials being used by his staff or under his control.

#### 14.3 Officers Commanding Service Units, etc.

The Officers in Command of the various service units, ships, aircraft and detachments and groups involved ensure that these regulations and all other relevant regulations and instructions issued by the Health Physics Adviser with the approval of the Scientific Director, under Task Force Commander's Authority, are enforced and are brought to the notice of all personnel under their command to their visitors.

#### 14.4 The Health Physics Adviser is responsible for:-

(i) Advice to the Scientific Director on radiological safety. Issue of instructions on behalf of the Scientific Director requires the authority of the Commander, Task Force Grapple.

(ii) The activities of the Health Physics Controller (see Section 14.5).

#### 14.5 The Health Physics Controller is responsible to the Health Physics Adviser for:-

(i) Delineation of all Controlled Areas.

(ii) Radiological control of all movements into, out of, and within YELLOW areas and radiological supervision in all other Controlled Areas.

(iii) Maintenance of records of individual radiation doses received by all personnel and location of all radiation sources used in the Test Area.

(iv) Provision of instruments and equipment necessary for Health Physics control.

#### 15. Amendments

DAWRE will issue any amendments necessary to keep these regulations consistent with current Regulations, Instructions and Codes of Practice issued by various Government, International and other organizations concerned.

## APPENDIX 1

## MAXIMUM PERMISSIBLE CONCENTRATIONS

1 The concentrations shown below shall be the maximum permissible levels for the various isotopes mentioned, when used during the Trial. The values are based on recommendations of the International Commission on Radiological Protection and of the International Commission on Radiological Units.

2 When using these levels it must be remembered that the inhalation levels are based on a working week of 56 hours spent in the Active Areas. For differing exposure times the levels will be inversely proportional to the exposure times, e.g., for a 24 hour daily exposure the level in air for Sr<sup>90</sup> will be  $2 \times 10^{-10} \mu\text{c/cc}$ , instead of  $6 \times 10^{-10} \mu\text{c/cc}$ .

## Maximum Permissible Concentrations

Radio Isotopes	Water ( $\mu\text{c/cc}$ )	Air ( $\mu\text{c/cc}$ )
H <sup>3</sup>	$4 \times 10^{-2}$	$6 \times 10^{-8}$
C <sup>14</sup> (CO <sub>2</sub> )	$3 \times 10^{-3}$	$3 \times 10^{-5}$
Na <sup>24</sup>	$8 \times 10^{-3}$	$3 \times 10^{-8}$
A <sup>41</sup>	$5 \times 10^{-4}$	$1.5 \times 10^{-8}$
Ca <sup>45</sup>	$10^{-4}$	$2.4 \times 10^{-8}$
Sr <sup>90</sup>	$7 \times 10^{-5}$	$6 \times 10^{-8}$
Sr <sup>90</sup> + Y <sup>90</sup>	$8 \times 10^{-7}$	$6 \times 10^{-10}$
Y <sup>91</sup>	$3 \times 10^{-4}$	$2.7 \times 10^{-8}$
Ru <sup>106</sup> + Rh <sup>106</sup>	$10^{-4}$	$6 \times 10^{-8}$
I <sup>131</sup>	$6 \times 10^{-5}$	$1.8 \times 10^{-8}$

## Maximum Permissible Concentrations

Radio Isotopes	Water ( $\mu\text{c/cc}$ )	Air ( $\mu\text{c/cc}$ )
Cs <sup>137</sup> + Ba <sup>137</sup>	$2 \times 10^{-3}$	$6 \times 10^{-7}$
Ba <sup>140</sup> + La <sup>140</sup>	$2 \times 10^{-4}$	$5 \times 10^{-8}$
Ce <sup>144</sup> + Pr <sup>144</sup>	$10^{-4}$	$6 \times 10^{-9}$
Po <sup>210</sup>	$3 \times 10^{-8}$	$3 \times 10^{-10}$
Rn <sup>222</sup> (See note a)	-	$3 \times 10^{-7}$
Ra <sup>226</sup> + 55% d.p.	$4 \times 10^{-8}$	$2.4 \times 10^{-11}$
Ac <sup>227</sup> + d.p.	$5 \times 10^{-7}$	$1.2 \times 10^{-11}$
Th Natural (See note b)	$4 \times 10^{-7}$	$9 \times 10^{-11}$
Th <sup>234</sup> + Pa <sup>234</sup>	$2 \times 10^{-4}$	$3 \times 10^{-8}$
U Natural (See note c)	$2 \times 10^{-8}$	$9 \times 10^{-11}$
U <sup>233</sup>	$3 \times 10^{-8}$	$9 \times 10^{-11}$
Pu <sup>239</sup>	$3 \times 10^{-8}$	$6 \times 10^{-12}$
Weapon Debris	See para. 3.2 of Regs.	See para. 3.2 of Regs.
Any fission mixture (except from weapons) and any mixture of $\beta$ - $\gamma$	$10^{-7}$	$3 \times 10^{-9}$ See note d below
A mixture of $\alpha$ emitters	$10^{-7}$ See note d below	$1.5 \times 10^{-11}$ See note d below

ces

) The figures given refer to the parent element. Where there is a daughter element, it is assumed that it reaches equilibrium with the parent after it is taken into the body. However, the figure of  $3 \times 10^{-7} \mu\text{C/cc}$  for radon refers to the parent + daughter products in the inhaled air and is thus an exception to the above rule.

) The curie of natural thorium is considered to correspond to  $3.7 \times 10^{10}$  dis/sec from  $\text{Th}^{232}$  and  $3.7 \times 10^{10}$  dis/sec from  $\text{Th}^{230}$ . It is considered that none of the other daughter products of  $\text{Th}^{232}$  is present at the time of ingestion or inhalation.

) The curie of natural uranium is considered to correspond to  $3.7 \times 10^{10}$  dis/sec from  $\text{U}^{238}$ ,  $3.7 \times 10^{10}$  dis/sec from  $\text{U}^{234}$  and  $9 \times 10^9$  dis/sec from  $\text{U}^{235}$ . It is considered that none of the other daughter products of  $\text{U}^{238}$  is present at the time of ingestion or inhalation.

1) The last two values listed are for "unidentified beta or gamma emitters" and unidentified alpha emitters". They are safe for use over short periods of time (a few months) regardless of the radioactive contaminants. They are safe for indefinite use with the following exceptions:-

- (i)  $10^{-7} \mu\text{C/cc}$  of water is safe for any mixture of beta gamma emitters and all alpha emitters except  $\text{Ra}^{226}$ .
- (ii)  $3 \times 10^{-9} \mu\text{C/cc}$  of air is safe for any mixture of beta gamma emitters except  $\text{Sr}^{90}$ .

- (iii)  $1.5 \times 10^{-11} \mu\text{C/cc}$  of air is safe for any mixture of alpha emitters except  $\text{Pu}^{239}$  and  $\text{Ac}^{227}$ .

## APPENDIX 2

## Method of Making Smear Tests

A Whatman No. 1 (5.5 cm) filter paper is used for this test.

The paper is slightly bent around the second finger by the two adjacent fingers so that a small area in the centre of the paper is brought into contact with the surface. It is then rubbed lightly over the area or object being checked.

## For Flat Surfaces

Rub paper in a circular motion covering an area of approximately six inches diameter, i.e., approximately 180 - 200 cm<sup>2</sup>.

For Irregular Shaped Objects: Door Handles, Telephones, etc.

Lightly rub paper over whole surface (if small enough), otherwise take a series covering the whole surface.

These "smears" are then placed in a standard type alpha or beta/gamma counter and counted.

Results are usually expressed as disintegrations/minute having applied the necessary factors for counter efficiency.

## APPENDIX 3

## Removal of Radioactive Contamination From Hands

In many cases contamination will be removed by a normal washing of the hands in tepid water using a mild soap.

DO NOT RINSE HANDS IN WASHINGS AS THIS IS LIABLE TO BE CONTAMINATED.

If this procedure is not enough to remove contamination then scrubbing is necessary.

For this you should use the special brush provided in active change rooms.

A convenient routine for scrubbing hands is to start by scrubbing one thumb, being sure to brush all surfaces; proceed to the space between the thumb and first finger and similarly to each finger and the webs between the fingers.

Close fingers tightly together and scrub in a downward direction from approximately one inch above the wrist, giving attention to the back and palm of the hand, and finally additional scrubbing of the nails and cuticles.

Rinse hands, as before, in fresh water direct from the tap.

This nail brush is most effective when used lightly; any extra pressure of this brush on the hands will only result in bending the bristles out of shape.

Always scrub in a direction away from the body into the palm. This is to prevent splashing of possibly contaminated liquid on your clothes or the floor.

IN ORDER TO PREVENT THE TRANSFER OF ACTIVITY FROM ONE HAND TO ANOTHER, THE BRUSH SHOULD BE WASHED IN CLEAN WATER AND FRESH SOAP APPLIED AT LEAST THREE TIMES DURING SCRUBBING OF EACH HAND.

If the above procedure is not successful, then it should be repeated.

It is advisable to rub a small quantity of ROSALEX No. 4 cream on the hands after a vigorous scrubbing to soften the hands and prevent chapping.

DO NOT USE THIS CREAM BEFORE YOU HAVE SATISFIED YOURSELF THAT YOUR HANDS ARE FREE FROM CONTAMINATION.

It will probably not be necessary to use any more than the above scrubbing, but if contamination is very persistent more advanced techniques are available.

Whether these are used should be decided jointly by the Medical Officer and the Health Controller.

## APPENDIX 4

## Carriage of Radioactive Material

**A4.1** The only published regulations in the United Kingdom governing the carriage of Radioactive material are those made by the Ministry of Transport and Civil Aviation, which are in close agreement with the International recommendations. Regulations governing other forms of transport have not yet been made. Codes of Practice recommended by AERE Harwell have, however, been adopted by the authorities concerned in the United Kingdom. All regulations and Codes of Practice extant in the United Kingdom are given in A4.3 below. Health Physics must be consulted about the arrangements for each consignment and will issue any necessary certificates.

**A4.2** Where consignments do not comply with the regulations or Codes of Practice, special arrangements must be made with the carrier concerned. Such consignments invariably require one or two escorts. The Health Physics authorities at the Establishment originating the consignment must be consulted about the arrangements for all such consignments, and will, in consultation with the consignor and the carrier, issue written instructions governing the carriage of the particular items.

**A4.3 (i) Transport of Radioactive Materials by Rail (Code of Practice)**

The basic requirement for rail transport is that the radiation at any point on the outer surface of the

Container may not exceed certain limits; as an interim measure, the railways are accepting packages which fall into two classes:

**Class I.** Radiation at any point on the surface not greater than 10 milliroentgens per 24 hours.

**Class II.** Radiation at any point on the surface greater than 10 milliroentgens per 24 hours, but not exceeding 100 milliroentgens per eight hours.

Special labels are used to designate these two classes. A Class I package does not have to be separated from other freight carried in passenger trains, and is treated by the railways as an ordinary package, except that prior notice must be given to the railway authorities at the station from which it is to be consigned.

Class II packages have to be stowed in passenger trains at least 4 feet from any other goods. The label is designed so that this requirement is brought to the notice of all railway officials handling the package. Prior notice must be given to the railways and on some routes at least 48 hours notice is required.

In order that an adequate check may be kept on the transport of these materials they are usually classed as "Insured Goods" under a special rate. Packages are signed for at the consigning station, and should only be sent by direct through routes to their destination.

Arrangements must be made for the immediate collection at the destination and railways will not in any circumstances transport radioactive materials by their own vans. This means that the person to whom the isotopes are consigned should be notified in advance of the time of arrival of the train, and must be able to collect the material at this time from the station.

**(ii) Transport of Radioactive Materials by Road  
(Code of Practice)**

(a) The radiation level at the driver's seat, or at any seat occupied by a passenger, must be below 100 milliroentgens per eight hours ( $12\frac{1}{2}$  mr/h).

(b) The radiation limit at any point on the outside of the car must be below 200 milliroentgens per hour.

(c) A notice should be carried in the car stating that radioactive materials are being transported, and are packed in containers in the luggage compartments (or appropriate wording as applicable). An address and telephone number should be given, in order that the police may contact the owner of the vehicle immediately if there is an accident. As an example, the following is a copy of the notice carried by AERE cars:

**WARNING**

THIS CAR IS CARRYING  
 RADIOACTIVE MATERIAL  
 THE MATERIAL IS PACKED IN SEALED CONTAINERS  
 THE CONTAINERS ARE SAFE TO HANDLE FOR  
 SHORT PERIODS PROVIDED THEY ARE UNDAMAGED  
 IN CASE OF ACCIDENT TO THIS CAR  
 COMMUNICATE AT ONCE WITH

.....

Telephone Number

.....

(iii) **Transport of Radioactive Materials by Sea  
 (Code of Practice)**

(a) Detailed regulations covering the transport of radioactive materials by sea have not yet been published but shipments are permitted subject to the approval of the United Kingdom Ministry of Transport and Civil Aviation and in Australia the Department of Defence Production and the State Government concerned.

Gamma radiation should not exceed 200 milliroentgens per hour at any point on the surface of the outside shipping container and 10 milliroentgens per hour at a distance of 1 yard from the container.

(b) Applications to the Ministry should include the following information:-

(a) Details of radioactive material including half life.

(b) Details of packing used.

(c) Radiation at surface of container in milliroentgens per hour.

(d) Radiation at 1 yard from surface of container in milliroentgens per hour.

(c) Radioactive materials are classified in the United Kingdom as "Category X-Other Dangerous Goods", as defined in the Merchant Shipping (Dangerous Goods) Rules, 1952. The provisions of Statutory Instrument 1952 No. 1977, issued by the United Kingdom Minister of Transport and Civil Aviation make it unlawful for dangerous goods to be taken on board any ship unless the owner or master of the ship has been supplied with a declaration of identity, packing and marking of the goods by the shipper. The use of the following standard form of declaration has been agreed by the United Kingdom Ministry of Transport and Civil Aviation.

"The herein-mentioned hazardous cargo is described and classified as set out in para. 2(1) of the Merchant Shipping (Dangerous Goods) Rules, 1952



and we declare that the marking and packing of the goods are in accordance with paras. 3 and 4 of the Rules," which are reproduced in sub-para. (iii) (d) below.

**(d) Paras. 2, 3 and 4 of the Merchant Shipping (Dangerous Goods) Rules**

2. - (1) It shall be unlawful for dangerous goods to be taken on board any ship to which this Rule applies for carriage in the ship unless the shipper of the goods has furnished the owner or master of the ship with a statement in writing of the identity of the goods and of the nature of the danger to which the goods give rise, indicating to which of the following categories the goods belong:-

- (i) Explosives.
- (ii) Compressed, liquified and dissolved gases.
- (iii) Corrosives.
- (iv) Poisons.
- (v) Substances giving off inflammable vapours.
- (vi) Substances which become dangerous by interaction with water or air.
- (vii) Strong oxidising agents.

- (viii) Substances which are liable to spontaneous combustion.
- (ix) Laboratory chemicals and medicinal preparations in limited quantities.
- (x) Other dangerous goods.

For the purposes of these Rules a laboratory chemical or medicinal preparation shall be treated as being in a limited quantity if and only if the quantity of that chemical or preparation is a limited quantity for the purposes of Section 10 of the Report of the Department Committee appointed by the Minister of Transport to consider the Existing Rules relating to the Carriage of Dangerous Goods and Explosives in Ships, dated 13th November, 1951.

(2) The master of the ship shall cause a list to be carried in the ship setting forth, in accordance with the information furnished under the foregoing provisions of this Rule, the dangerous goods carried in the Ship on the voyage in which she is currently engaged.

**Marking**

3. It shall be unlawful for dangerous goods, being goods contained in a vehicle, receptacle

or package, to be taken on board a ship to which this Rule applies for carriage in that ship unless the vehicle, receptacle or package in which the goods are contained, is clearly marked with a distinctive label or stencil purporting to indicate the nature of the danger to which the goods give rise, and if the goods are taken on board the ship at any port in the United Kingdom or within the territorial waters of the United Kingdom a label or stencil purporting to indicate the identity of the goods.

Where goods are taken on board a ship together with the vehicle in which they are contained, or where goods are taken on board a ship together with the receptacle in which they are contained, being a receptacle which is an additional body for a vehicle and is constructed or adapted for the purpose of being taken on or off the vehicle with goods contained therein, nothing in the foregoing provisions of this Rule shall be taken to require any such receptacle or any package in which the goods in the vehicle may be contained, or, as the case may be, any package in which the goods in the receptacle may be contained, to be also marked.

#### Packing and Carriage in Bulk

4. - (1) It shall be unlawful for dangerous goods being goods which are not loaded in bulk, to be taken on board any ship to which this Rule applies for carriage in that ship if the owner of the ship or any of his servants or agents knows or ought to know that the goods are not packed in a manner adequate to withstand the ordinary risks of handling and transport by sea having regard to their nature:

Provided that in any proceedings against an owner or master in respect of a failure to comply with the provisions of this paragraph, it shall be a good defence to prove that before the goods were taken on board the ship:

(a) The owner or master was furnished with a statement in writing by the shipper to the effect that the goods were packed in accordance with the requirements of this paragraph and

(b) neither the owner nor any of his servants or agents knew that the goods were not so packed.

(2) It shall be unlawful for dangerous goods to be loaded in bulk into any ship to which this Rule applies for carriage in that ship if the owner of the ship or any of his servants or agents know or ought to know that the goods cannot safely be carried in bulk to the destination to which they are consigned.

iv) **Transport of Radioactive Materials by Air -  
Ministry of Transport and Civil Aviation  
Regulations**

The following conditions have been adopted by the United Kingdom to govern the carriage of radioactive materials in aircraft. These conditions are basically the same as the conditions recommended by the International Air Transport Association and adopted by the majority of airline companies. Radioactive materials are not classed as dangerous goods as defined in the Air Navigation Order 1949 unless the amount of radioactivity exceeds the maxima stated in the conditions below.

**Conditions governing carriage of radioactive materials in aircraft**

(a) The carriage of radioactive materials is permitted in any aircraft in or over the United Kingdom and in any aircraft registered in the United Kingdom when flying outside the United Kingdom subject to compliance with the under-mentioned conditions.

(b) Radioactive materials are defined as any material or combination of materials which spontaneously emit ionizing radiation. For the purpose of these conditions, radioactive materials are divided into three groups by the type of radiation emitted at any time during carriage as follows:

- (i) **Group I** radioactive materials are those materials which emit any **gamma radiation**, either alone or with electrically charged particles or corpuscles.
- (ii) **Group II** radioactive materials are those materials which emit **neutrons** and either or both of the types of radiation characteristics of Group I radioactive materials.

(iii) **Group III** radioactive materials are those materials which emit only electrically charged particles or corpuscles (i.e., alpha or beta radiation or both).

(c) A unit of gamma radiation mentioned in these conditions means one milliroentgen per hour at a distance of one metre for "hard gamma" radiation (1 mrhm), i.e., the amount of gamma radiation on which will have the same effect on sensitive photographic film as 1 milliroentgen per hour at a distance of one metre of "hard gamma" radiation of radium filtered through  $\frac{1}{2}$  inch of lead.

(d) The maximum quantity of radioactive materials contained in one package for conveyance by either passenger or cargo aircraft shall be 2000 millicuries and the maximum amount of radiation shall be 10 units. Not more than 40 units of radioactive materials Group I and II shall be carried on any one aircraft, provided that no quantity limitation is prescribed for Group III materials.

(e) All radioactive materials must be packed in sealed inner metal containers. Where the material is liquid it must in addition be packed in tight glass, earthenware, or other suitable inside containers surrounded on all sides, and within the shield, by sufficient absorbent material to absorb

the entire contents. The outside shipping container must be a strong, rigid container having a minimum dimension of 4 inches on any one side, and of such design that the gamma radiation will not exceed 200 milliroentgens per hour or equivalent at any point of readily accessible surface.

(f) Radioactive material consignments must be shielded in such a manner that the shield will maintain its efficiency under conditions normally incident to carriage as follows:

(i) **Group I.** The shield must be lead or other suitable material of such thicknesses that at all times gamma radiation at 1 metre does not exceed 10 milliroentgens per hour and must also be sufficient to prevent the escape of primary corpuscular radiation to the exterior of the outside shipping container.

(ii) **Group II.** The shield must be such that at all times the radiation measured at right angles to any point on the long axis of the shipping container shall not exceed 10 mrhm of gamma radiation, or its physical equivalent in electrically charged corpuscular radiation, or neutron radiation, or neutron radiation which is

the physical equivalent of 2 mrhm of gamma radiation. Where more than one type of radiation is present their total must not exceed the above limits.

(iii) Group III. The shield must be such as to prevent the escape of primary corpuscular radiation to the exterior of the container, and secondary radiation at the surface of the container must not exceed 10 milliroentgens per 24 hours, at any time during carriage.

) The following statement signed by the shipper his authorised agent must accompany each package radioactive material:

"This is to certify that the contents of this package are properly described by name and are packed and marked and are in proper conditions for carriage by air according to the regulations relating to the carriage of radioactive material published by ..... carrier(s) .....and otherwise comply with such regulations. This consignment is within the limitations prescribed for passenger-carrying aircraft."

h) All packages of radioactive materials in Groups and II shall have attached a label worded as follows:

"Do not place undeveloped film within 15 feet of this container. Radioactive material. Group I or II.

No person shall remain within 3 feet of this container unnecessarily.

Principal radioactive content .....

Activity of contents ..... millicuries

Radiation units in this package .....

Not more than 40 units shall be loaded in one aircraft or held at one location or point."

(j) The label may be varied in respect of consignments of Group I material handled solely by either the British Overseas Airways Corporation or the British European Airways Corporation where the total number of units carried in one aircraft does not exceed four\*. In these circumstances, where the number of units is one or under, the words "15 feet", "3 feet" and "40 units" may be replaced by "5 feet", "1 foot" and "1 unit" respectively. Where the number of units is over one but does not exceed four, the

\*Note: In Australia aircraft of the internal airlines may carry a maximum of two packets containing R.A. materials.

words "15 feet", "3 feet" and "40 units" may be replaced by "10 feet", "2 feet" and "4 units" respectively.

(k) All packages of radioactive materials in Group III shall have attached a label worded as follows:

"Handle carefully  
Radioactive material  
Group III  
Contents .....  
Emitting corpuscular rays only."

#### Wing tip Service

Limited amounts of gamma emitting radioactive materials can be transported without lead shielding, in the wing tips of DC4 aircraft operated by South African Airways to South Africa, and in Argonaut aircraft operated by British Overseas Airways Corporation to the Near East, Middle East, Far East and South America. The maximum amount of radioactivity permitted depends upon the intensity of gamma radiation and flying time involved; but in no case can it exceed 300 millicuries. A standard size cylindrical wing-tip container, 1.7 inches diameter and 5.2 inches length, is in use which automatically restricts the physical quantities of materials which can be transported in this manner. Nevertheless, small amounts of radioactive materials can be transported long distances by wing-tip service at a lower cost than that involving the orthodox use of lead pots and wooden boxes.

Special handling procedures are used in the wing-tip service. Aircraft are loaded and unloaded by the airlines or their agents, but users must possess a suitable shielding container into which the wing-tip cylinder containing the radioactive material can be loaded at airport of arrival and transported safely to its final destination.

#### (v) Postal Transport of Radioactive Materials (Code of Practice)

(i) The packages used must have been approved by the G.P.O. Engineering Section.

(ii) That the radiation at any point on the surface of the package is not greater than 10 milliroentgens per 24 hours.

## Reference Works

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- A.E.R.E. Harwell, Berks.
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- H.M.S.O., London.
- A5.1.3 The Carriage of Dangerous Goods and Explosives in Ships (The Blue Book).  
- Ministry of Transport and Civil Aviation, London.
- A5.1.4 Conditions Governing the Carriage of Radioactive Materials in Aircraft.  
- Ministry of Transport and Civil Aviation, London.
- A5.1.5 Recommendations of the International Commission on Radiological Protection (Revised December, 1954) - Published in the British Journal of Radiology, Supplement No. 6, 1955.  
- British Institute of Radiology, London.

## A5.2 Published in Australia

- A5.2.1 Technical Communication No. 58 of the Commonwealth X-Ray and Radium Laboratory.  
- CX and RL, Melbourne.
- A5.2.2 Air Navigation Order, Part 33.  
- Department of Civil Aviation, Melbourne.
- A5.2.3 Instructions for the Storage and Handling of Radioactive Sources.  
- Defence Standards Laboratory, Melbourne.

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- A5.3.1 Ensuring Public Safety in Continental Weapons Tests (13th Semi-Annual Report of the United States Atomic Energy Commission).
- A5.3.2 The Effects of Nuclear Weapons.  
- USAEC, June, 1957.