(1) RADIATION SAFETY REGULATIONS PARTS I & II

(2) INTERNATIONAL COMMISSION RECOMMENDATIONS - RADIOLOGICAL UNITS

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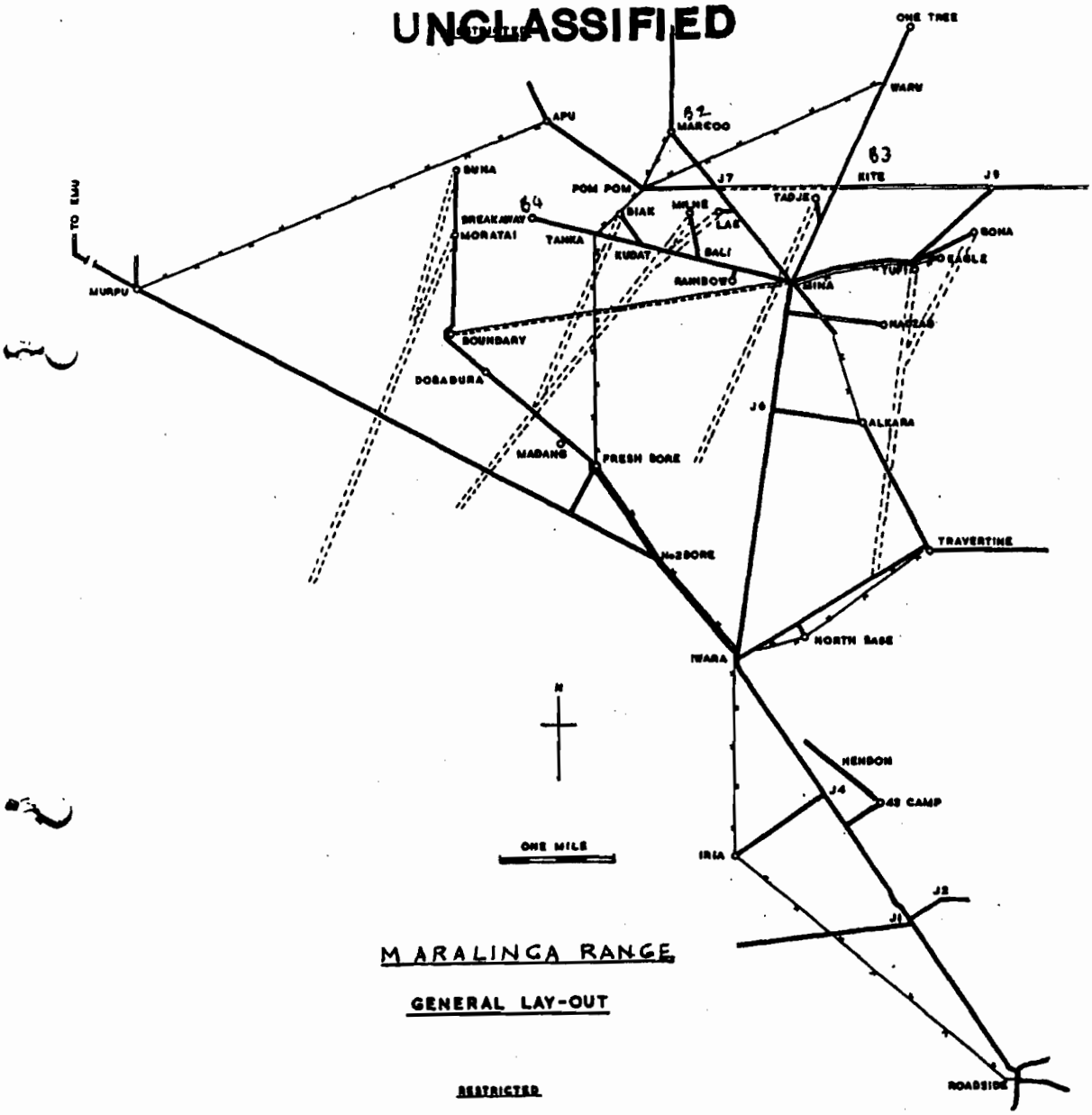


MARALINGA RANGE

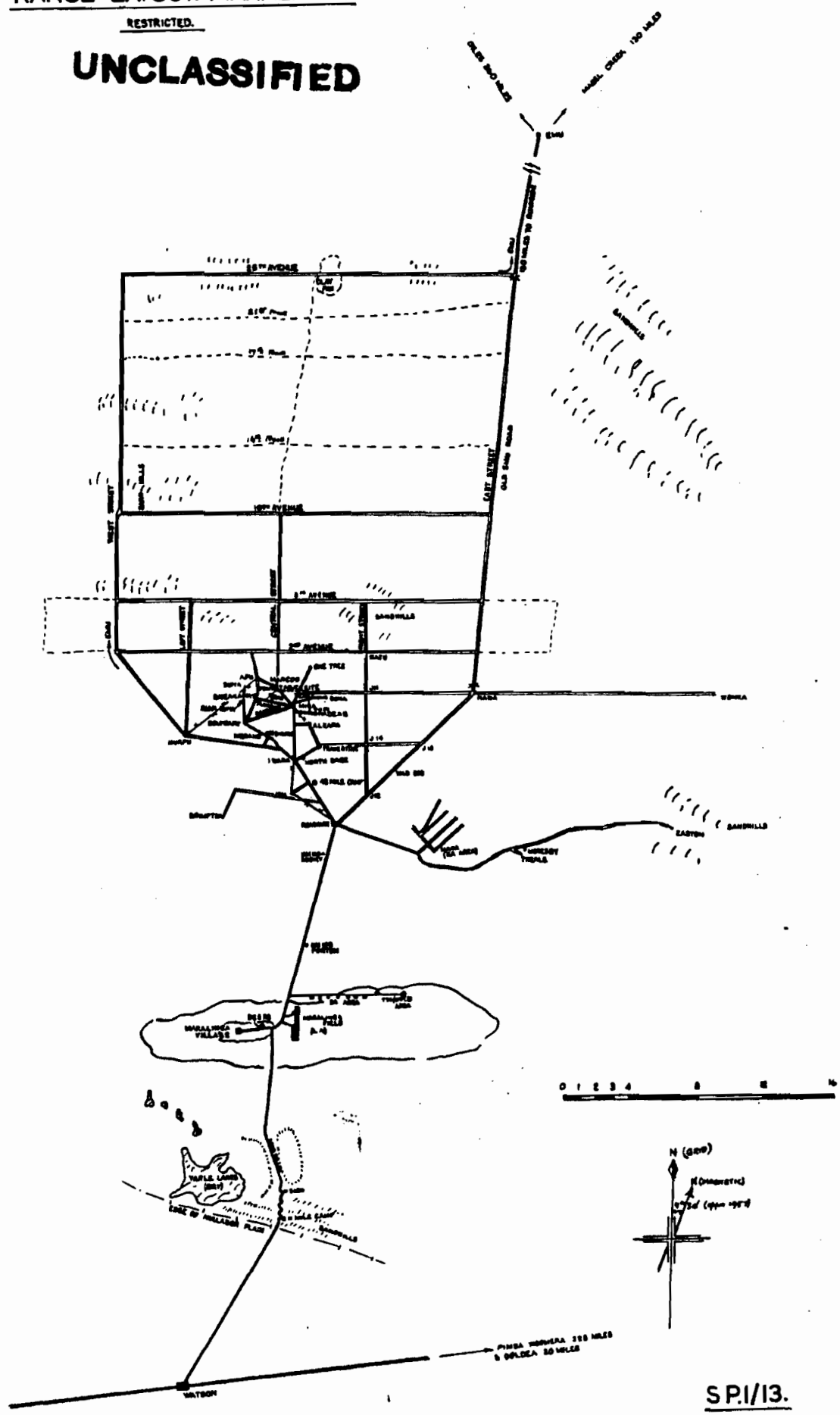
GENERAL LAY-OUT

RESTRICTED

RANGE LAYOUT. MARALINGA.

RESTRICTED.

UNCLASSIFIED



S.P.I/13.

INTERPRETATION OF INSTRUMENT (1021, 1027, 1257, 1295 and 1320) β/γ COUNT READINGS

1. The Maralinga Range permissible levels of contamination are laid down in Radiological Safety Regulations, Maralinga, R.S.R.M./56(5). This note is to assist interpretation of β/γ counts measured on the 1021, 1027, 1257, 1295 and 1320 instruments, the probes of all of which are essentially similar.

2. The basic conversion will be that the Geiger β/γ probe with the window open gives a count of 15 per second when the contamination is 400 disintegrations per minute per square centimetre, i.e. 2×10^{-4} μc/cm^2 of Fission Products. A useful rough rule is that for γ only 100 counts per second are equivalent to 1.5 milliroentgen per hour.

3. For monitoring of unclothed Personnel, count rates of 16 or more above background disqualify, irrespective of time of measurement.

4. The 1027 hand apertures are adjusted for the R.S.R.M./56(5) tolerance level of 6,000 dis/minute/both sides of one hand, i.e. 2×10^{-4} μc/cm^2. Readings in excess of tolerance will be obtained with the "10 x" range switch.

5. For monitoring of Blue vehicles, count rates of 16 or more above background disqualify, irrespective of the time of measurement.

6. For small objects to be released for use in clean conditions on the Maralinga Range count rates of 16 or more above background disqualify, irrespective of the time of measurement.

7. The following Table shows permitted decay equivalences over twelve weeks for application in specified circumstances to objects being decontaminated:-

Time after firing	Counts/sec on β/γ Probe β Window Open
1 day	< 1,000
2 days	< 1,000
3 days	800
4 days	600
5 days	450
6 days	370
1 week	300
2 weeks	135
3 weeks	80
4 weeks	60
5 weeks	45
6 weeks	37
7 weeks	30
12 weeks	15

In general this Table is of direct application to large objects to be shipped as clean to U.K. ex Maralinga after three weeks.

8. Permitted decay equivalences for smearable activity on large objects to be shipped as clean from Maralinga will be obtained from equating 20 d/m for a 200 square centimetre (roughly 4" diameter) smear taken at 21 days to the day of smearing by direct proportionality according to the number of days.

9. Clothing from the active laundry will be re-usuable at the following levels or less:-

Day	Counts on γ/G probe, β window open
2	100
3	80
4 onwards	60

Where clothing is re-laundered the 60 c.p.s. level applies.

[redacted]

Maralinga,
23rd. August, 1957.

GP. LT.R. HP GROUP

RADIATION SAFETY REGULATIONS

Health Physics Group	Extn. [redacted]
Medical Section	Extn. [redacted]
Ambulance	Extn. [redacted]
Fire	Extn. [redacted]
Police	Extn. [redacted]

RADIATION SAFETY REGULATIONS

PART I

1. INTRODUCTION

1.1 Radiations which may be encountered on the project may be α particles β particles, γ rays, neutrons and X-rays. Under properly controlled conditions work involving exposure to these radiations can be carried on in perfect safety.

Excessive exposure however may result in serious damage to the human body.

The danger is particularly insidious because the effects are not immediately felt and damage may only become apparent 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 and abrasions, or even by absorption through an intact skin.

1.2 The object of these regulations is to ensure complete protection both of workers on the site and of the general public, whilst imposing the minimum interference with the work of the project.

2. MAXIMUM PERMISSIBLE LEVELS

2.1.1 The maximum permissible levels of the various radiations and radioactive substances have been laid down by the Medical Research Council, and these are the levels to be used in the Establishment.

2.1.2 It is emphasized that these are maxima and it is generally agreed that every endeavour should be made to keep the average dose as low as possible.

2.2 EXTERNAL RADIATIONS

For external radiation the maximum permissible levels agreed are:-

(i) X and γ Radiation

0.5 rontgens per week at the surface of the body.

(ii) β Radiation

0.5 rep. per week. A relaxation to 1.5 rep. per week is allowed in the case where the hands only are irradiated

(iii) Neutron Radiation

Fast neutrons in the range 2-20 mev. 30 neutrons/cm^2/sec; at 0.5 mev. 50 neutrons/cm^2/sec, and for slow neutrons 1200 neutrons/cm^2/sec.

(iv) α Radiation

α particles present no external hazard as they are unable to penetrate the outer layers of the skin.

2.3 INTERNAL RADIATIONS

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

They will be given in detail in the appropriate parts of the regulations.

2.4 Contamination Levels

Contamination can be fixed or "smearable".

2.4.1 Fixed contamination is defined in the case of benches, clothing, etc., as that which will not rub off in a smear test and in the case of hands, as that which remains after washings in accordance with the instructions laid down in Appendix A.

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

β - γ	Microcuries/cm^2
6,000 disintegrations/min on both sides of one hand	1×10^{-5}
400 disintegrations/min/cm^2, clothing, benches, etc.	2×10^{-4}
400 disintegrations/min/cm^2, fume cupboards	2×10^{-4}
≤	
300 disintegrations/min on both sides of one hand	5×10^{-7}
20 disintegrations/min/cm^2, clothing, benches, etc.	10^{-5}
400 disintegrations/min/cm^2, fume cupboards	2×10^{-4}

2.4.3 No amount however small can be tolerated if it is shown to rub off in a "smear" test.

A smear test is done by wiping 12 square inches of surface with two square inches of blotting or filter paper.

3. NOMENCLATURE

3.1 All parts of the site will be classified according to the nature of the work which may be done in that particular part.

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

3.2.1 Non-Active Areas

Those in which there may be some radiation risk and where precautions appropriate to the degree of risk must be taken. There will be three categories of Active Areas, viz:-

(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, injestion, and injection. Protective clothing (e.g. Laboratory coats, gloves etc.,) will be worn in accordance with H.P.C. recommendations for the particular area.

(c) Purple Area

Risk of penetrating radiation and of a serious inhalation, ingestion and injection. Fully protective clothing with air supply (e.g. Frog-Suit) will be worn.

3.2.3 The classification of an Area will be laid down by H.P.G. who will be informed of any proposed change in the work which might affect the classification.

3.2.4 Signs showing the classification and having a patch of the appropriate colour will be placed at all entrances to any active area (e.g. gate of an enclosed area, door of changing room, etc.,) entrance to F/M Shower, change from Red to Purple.

All areas not classified in this way will be Non-Active areas and these will not have any special marking.

3.3.1 No person will be allowed to enter an Active Area without permission of the Scientist in Charge.

Building and Engineering work in Active Areas will normally be carried out by S.P.E. If it be necessary to employ any other personnel S.P.E. will first obtain a clearance certificate (White Certificate) from H.P.G.

3.3.2 All personnel entering an Active area of any classification will wear a Personal Monitoring Film at all times whilst in the area.

4. PROTECTIVE CLOTHING

4.1 (a) All radiation protective clothing will be white. Laboratory coats will be distinguished by red epaulettes.

(b) The wearing of clothing as specified in the appropriate parts of the regulations is compulsory.

(c) To assist the rigid enforcement of these rules under no circumstances will radiation protective clothing be issued for other purposes.

4.2 Degree of protection

(a) Workers in BLUE areas

(i) No special protective clothing necessary.

(b) Workers in RED areas

(i) Non-Industrial Staff

High necked Lab. coats
Rubber gloves
Shoes.

(ii) Industrial Staff

Overall (or Lab. coat and trousers)
Rubber gloves
Shoes.

(iii) Visitors

Lab. coats
Overshoes (canvas type)

The above is general for all Red Areas but in certain special cases additional clothing will be specified by H.P.G.

(c) Workers in PURPLE areas

Frogsuits
Underclothing
Socks

4.3 Scales of Issue

Sufficient stocks of protective clothing to meet all requirements will be maintained by Superintendents. Lab. coats, overalls, shoes, shirts, trousers and face masks will be a personal issue to all regular users. In all other cases items will be issued as required.

4.4 Laundering and Disposal

4.4.1 Once an article becomes unserviceable it will not be returned to stores but will be written off by the Superintendent and disposed of as contaminated waste.

4.4.2 Protective clothing will be sent only to the special laundry provided and will be dealt with according to Part V of the regulations.

4.4.3 Gloves and shoes will be cleaned by the users and not sent to the laundry.

5. USE AND STORAGE OF RADIOACTIVE MATERIALS

5.1.1 In order to allow normal chemical work the following materials may be used in non-active chemical laboratories with the precautions normal to such work.

Natural Uranium and its compounds
Natural Potassium and its compounds
Natural Rubidium and its compounds
Natural Samarium and its compounds
Natural Lutecium and its compounds
Natural Rhenium and its compounds.

For work other than of a normal chemical nature Regulations Part II will apply.

5.1.2 No other radioactive material whatever will be used in non-active areas.

5.2 Materials which are completely sealed so as to prevent any escape of active materials may be used, or stored in any active area. Adequate precautions must be taken to ensure that the dose received by workers in that area is within the limits laid down and to prevent the dose-rate at any point outside the active area from exceeding one tenth of the maximum permissible.

5.3.1 Use or storage of radioactive materials other than as stated above is permitted only in Red or Purple areas.

5.3.2 (a) Quantities greater than 1 millicurie will be used only in approved hot boxes.

(b) Quantities less than 1 millicurie may be used in fume cupboards.

(c) Quantities less than 100 microcuiries may be temporarily removed from fume cupboards for counting purposes only.

5.3.3 Except as provided for in (c) above no radio active material will be exposed to the air of the Laboratory.

5.4 Details of special precautions required for particular materials and areas will be laid down in the appropriate parts of the regulations.

6. TRANSIT OF RADIOACTIVE MATERIALS

6.1 Transit of radioactive materials through a Non-Active area is permitted, provided they are properly designed and sealed containers which will effectively prevent escape of the material and which are themselves externally clean. The transit should be uninterrupted and adequate precautions must be taken to ensure that the Y-ray dose does not exceed 200 milliroentgens/hour at the surface, or 10 milliroentgens/hour at one metre, and the neutron dose rate does not exceed 40 neutrons/cm^2/sec. at the surface. Transit of containers where the dose rate exceeds any one of these limits will be permitted only with prior approval of H.P.G.

7. LABORATORY WASTE

7.1 All waste will be segregated into the following three categories:

(i) Active waste Non-combustible
(ii) Active W ste Combustible
(iii) Used Paper Towels.

Bins suitably labelled will be kept in all laboratories and workrooms where this waste is likely to arise. 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.

7.2 All waste will be assembled by the Health Physics Surveyor prior to collection for disposal.

8. MONITORING

8.1 The object of radiation monitoring is to ensure the protection of workers and to prevent interference with scientific work due to contamination.

H.P.G. will provide complete monitoring facilities for personal use.

A Health Physics Surveyor will be available in all "active" buildings to advise and assist where called upon to do so.

8.2 PERSONAL MONITORING

8.2.1 Personal monitoring must primarily be the individuals responsibility.

8.2.2 Gamma-Rays dosage will be measured by means of film badges which will be worn by all persons in active areas.

8.2.3 All persons, before leaving an active area will monitor themselves by means of the instruments provided to ensure that the contamination levels laid down are not exceeded.

8.2.4 In the case of workers subject to an inhalation, ingestion or injection risk, regul r analysis of urine samples will be made.

8.2.4 For special operations, where high dose-rates are anticipated personal ionization chambers will be worn.

8.3 Area Monitoring

8.3.1 Air sampling will be carried out in all laboratories and work rooms where there is normally a potential inhalation risk. For special operations where an unusual inhalation risk is anticipated samples will be taken by means of portable equipment.

8.3.2. Neutron and gamma-ray levels will be measured by fixed instruments installed where necessary.

8.3.3. Individuals will make day to day contamination checks to ensure that levels of activity are below the maximum values laid down.

In addition periodic surveys will be made by Health Physics Surveyors.

8.4 Monitoring of Active Waste

8.4.1 Solid waste containers will be monitored before being taken from an active area.

8.4.2 Air effluent from active areas will be regularly monitored at stack discharge points.

8.4.3. All liquid effluent from active areas will be monitored before release from the Establishment.

8.5. Monitoring of Equipment

All equipment will be monitored and Decontaminated if necessary before being taken out of an active area.

Equipment will not be moved from PURPLE to RED, or RED to BLUE areas unless it is Decontaminated.

9. MEDICAL SURVEILLANCE

The Medical Section will provide a complete service of X-ray examination, blood counts, and medical examinations for all people engaged on the project and should be consulted on all medical aspects.

10 RESPONSIBILITIES

10.1 The individuals:

Anyone engaged in work on radioactive materials is responsible for complying with the regulations as they affect him personally

10.2 The Scientist in charge of the section is responsible:

10.2.1 That these regulations together with additional requirements for his section 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.

10.2.2. That these regulations are rigorously adhered to.

10.2.3. That H.P.G. and the Medical Officer is informed in advance of any proposed changes in work being done which may affect the safety arrangements in any way.

10.2.4 That any accidents or abnormal circumstances are reported immediately to his Superintendent, H.P.G., and the Medical Officer.

10.3 H.P.G. is responsible for:

10.3.1. Installation, inspection and maintenance of all monitoring equipment.

10.3.2 Collections, decontamination if necessary, and arrangements for laundering of all contaminated clothing.

10.3.3 Prompt investigation of all accidents and abnormal circumstances reported to him.

10.3.4 Advice on all aspects of radiation safety

11. ACCIDENTS AND FIRST AID

11.1 If anyone thinks he may have inhaled, ingested, or had injected, any radioactive material he must report to his Superintendent, H.P.G. and the Medical Officer and take emergency action.

11.2.1 If the skin is accidentally cut or scratched during work, the cut should be placed 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.

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

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

11.3 If anyone spills any radioactive material he must.

(i) Ask all staff to vacate the area
(ii) Limit the spread of contamination
(iii) Report immediately to H.P.G.

12. STORAGE AND USE OF PERSONAL EFFECTS

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

APPENDIX I

TECHNIQUE FOR RUBBER GLOVES

1. **Putting on**

(a) The gloves are picked up inside out as they have been laid down previously and pushed through leaving a generous amount of cuff. Care should be taken to hold only the surface which has been in contact with the hands. Compressed air may be used to blow the fingers out.

(b) Before putting on the cuffs should remain turned down on the outside and if necessary, powder applied to the hands.

(c) The left glove is picked up in the right hand, grasping it by the turned down edge. During this operation, the right hand does not touch the outside surface of the glove.

(d) The glove is pulled on the left hand without changing the grasping position: The cuff is left turned down.

(e) The right glove is picked up by sliding all fingers on the left hand (now covered by the left glove) under the turned down cuff.

(f) The right glove is then pulled on without changing the position of the left hand.

(g) Cuffs of both gloves should be then turned up.

2. **Taking Off**

(a) The same precautions must be taken to avoid touching the outside to the inside surface.

(b) The gloves are stripped off by turning inside out.

APPENDIX II

DECONTAMINATION OF HANDS

(1) For outine washing, wash thoroughly with soap and water for two or three minutes, using a nail-brush around finger-nails and suspected areas.

(2) If a routine wash is not sufficient to remove all dirt and contamination continue scrubbing with soap and water for at least eight minutes. Scrubbing should be thorough and systematic, dealing with one hand at a time, going from thumb to fingers paying special attention to the webs between fingers, thence to palm to back of hand, and finally to the nails and cuticles. Water should be tepid and should be changed at least three times during the process.

(3) If soap and water alone proves inadequate Duckham's jelly should be applied over the entire surface of the hands. Rinse off and all dirt and contamination should come away with it.

(4) As a last resort, rinse thoroughly in 24 per cent sodium citrate. Apply potassium permanganate crystals and work up with water, covering the entire surface. Rinse off and remove any stain with sodium bisulphite (5 per cent) $NaHSO_3$) and water. Rinse the hands thoroughly.

(5) After decontamination as in (4), a hand cream should be applied to keep the hands from chapping forming cracks through which active material might be absorbed.

RADIATION SAFETY REGULATIONS

Part II

Please amend 4.2 to:-

4.2 The only means of determining the amount of uranium taken into the body is by urine analysis. Regular urine tests will be carried out by the Medical Division.