Public Health England

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# Assessment of the Documentation and Measurements Submitted in Support of the RSRL Harwell Site De-licensing

## B353 Area

# About Public Health England

Public Health England's mission is to protect and improve the nation's health and to address inequalities through working with national and local government, the NHS, industry and the voluntary and community sector. PHE is an operationally autonomous executive agency of the Department of Health.

Public Health England
133–155 Waterloo Road
Wellington House
London SE1 8UG

www.gov.uk/phe
@PHE_uk

Any questions relating to this document should be addressed to

Press and Information
Centre for Radiation, Chemical and Environmental Hazards
Public Health England
Chilton, Didcot
Oxfordshire OX11 0RQ
E: rad.met@phe.gov.uk

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[redacted]

## ABSTRACT

A request for variation of the Nuclear Site Licence was made by Research Sites Restoration Limited (RSRL), formerly United Kingdom Atomic Energy Authority (UKAEA) Harwell, to the Office of Nuclear Regulation (ONR) with respect to part of the Harwell site, referred to as the B353 Area.

On behalf of the ONR, Public Health England (PHE) undertook an assessment of the measurements performed by RSRL Harwell to justify their request. The reports issued with respect to the variation were studied and a survey and sampling regime was undertaken to verify the results reported by RSRL Harwell. Assessments were made against the radiological criteria adopted by RSRL Harwell that any remaining levels of radioactivity will be below the exemption levels given in the International Atomic Energy Authority (IAEA) Safety Guide on Exclusion, Exemption and Clearance, RS-G-1.7.

The primary radiological basis for establishing values of activity concentration for the exemption of bulk amounts of material and for clearance contained within RS-G-1.7 is that the effective doses to individuals should be of the order of 10 μSv or less in a year.

The ONR states that the delicensing criterion of a risk of death from ionising radiation of one in a million corresponds to ‘no danger’criterion. Since the values within RS-G-1.7 are not exceeded, the level of effective dose for a member of the public is less than 10 μSv per annum. The HSE is of the view that this dose criterion broadly equates to the 1 in a million per year ‘no danger’ criterion they have specified for delicensing of nuclear sites.

# EXECUTIVE SUMMARY

A request for variation of the Nuclear Site Licence was made by Research Sites Restoration Limited (RSRL), formerly United Kingdom Atomic Energy Authority (UKAEA) Harwell, to the Office of Nuclear Regulation (ONR) with respect to part of the Harwell site, referred to as the B353 area.

On behalf of the ONR, Public Health England (PHE) undertook an assessment of the measurements performed by RSRL Harwell to justify their request. The reports issued with respect to the variation were studied and a survey and sampling regime was undertaken to verify the results reported by RSRL Harwell. Any areas with enhanced levels of radioactivity were identified and investigated. No areas were identified with levels of radioactivity above the typical values for the Harwell site. Assessments were made against the radiological criteria adopted by RSRL Harwell that any remaining levels of radioactivity will be below the exemption levels given in the International Atomic Energy Authority (IAEA) Safety Guide on Exclusion, Exemption and Clearance, RS-G-1.7.

The primary radiological basis for establishing values of activity concentration for the exemption of bulk amounts of material and for clearance contained within RS-G-1.7 is that the effective doses to individuals should be of the order of 10 μSv or less in a year.

Overall the measurements performed by PHE-CRCE and RSRL indicate that the B353 area has only one area, the 5.4 m section of Old Main Active Drain (OMAD), situated under the 353 services access point, that contains levels of contamination by manmade radioactivity in excess of the values contained within IAEA RS-G-1.7. RSRL have performed a dose assessment to determine the risk associated with the removal of this section of OMAD and concluded that any exposure will be less than 0.1 μSv.

The ONR states that the delicensing criterion of a risk of death from ionising radiation of one in a million corresponds to ‘no danger’criterion. Since the values within RS-G-1.7 are not exceeded, the level of effective dose for a member of the public is less than 10 μSv per annum. The HSE is of the view that this dose criterion broadly equates to the 1 in a million per year ‘no danger’ criterion they have specified for delicensing of nuclear sites. This criterion is met.

# CONTENTS

# 1 INTRODUCTION

This report details the results of surveys and analyses performed under contract to the Office of Nuclear Regulation (ONR) regarding the request for variation under section 3(6) of the Nuclear Installations Act, 1965 to the Nuclear Site Licence operated by RSRL Harwell. The objective of the project was for PHE to undertake a review of the documentation submitted by RSRL Harwell[1] in support of their application and to perform a survey and sampling regime to validate the report submitted by RSRL Harwell as providing their basis for variation. RSRL Harwell's justification for their application was based upon the following statements:

Demonstrating that no installations as given in Schedule 1 of the Nuclear Site Licence are currently operating or plan to be operated by RSRL in the foreseeable future.

Demonstrating, by means of surveying and sampling, that the levels of radioactive contamination and radiation are consistent with the Office of Nuclear Regulation (ONR)) interpretation of 'no danger from ionising radiation'.

The radiological criteria set by RSRL Harwell were:

a. Any residual radioactivity, above background radioactivity, which remains on the site, which may or may not have arisen from licensable activities, will lead to a risk of death to an individual using the site for any reasonable foreseeable purpose, of no greater than 1 in a million per year[2].

b. Levels of radioactivity will be below the exemption levels given in the International Atomic Energy Authority (IAEA) Safety Guide on Exclusion, Exemption and Clearance[3].

# 2 B353 DELICENSING CHARACTERISATION STRATEGY

## 2.1 Potential areas of concern

The B353 is a complex part of the Harwell site, RSRL determined a strategy to address the history of the area based on three key areas of possible concern.

The characterisation study performed by RSRL Harwell addressed the following areas.

- Buildings
- Drains
- Open land

## 2.2 Buildings in the B353 area

RSRL's review of the history, gap analysis and further investigation appears comprehensive. The following points require further explanation.

B345: What was the surface level obstruction that lead to the trial pit being excavated twice?

B347.1: Contamination found on the floor of room 4 although room 4's location was unknown. Has the base slab been removed? Investigations appear to target drains and there is no mention of whether the base slab is present or not.

## 2.3 Drains

Five categories of drain exist, or existed in the B353 area. These are

**a.** Old Main Active Drain (OMAD)

**b.** New Main Active Drain (NMAD)

**c.** Trade Waste Drain (TWD)

**d.** Foul Drain

**e.** Surface Water Drain (SWD)

### 2.3.1 Old Main Active Drain

RSRL's approach is sound and no results connected to the removal of the OMAD give cause for concern in terms of the values contained within RS-G-1.7. The 5.4 m section of drain left in situ between MH25/1 and MH25/2 has been subject to a dose assessment. This was performed in relation to the TWD and the assumptions and methodology judged as appropriate by PHE [4]. The radionuclide fingerprint for the samples taken from the OMAD grout is similar to that used for the TWD of 67% alpha and 33% beta/gamma, although if the actual values for the OMAD are used, a slightly lower dose estimate results. Hence a fingerprint of 67% alpha and 33% beta/gamma is conservative.

### 2.3.2 New Main Active Drain

RSRL's approach is sound and no results connected to the removal or remaining lengths of the NMAD give cause for concern in terms of the values contained within RS-G-1.7.

### 2.3.3 Trade Waste drain

RSRL's approach is sound regarding the process for assessing the levels of manmade radioactivity present in remaining lengths of the TWD. Overall there are no areas which give cause for concern in terms of the values contained within RS-G-1.7. However the section MH16B – MH16C states that since *the sections removed at either end contained the readings that exceeded the action level, the section of drain remaining meets the delicensing criteria.* It is stated that of the 8 data points on this run, 4 exceed the action level. Were these 4 points at either end of the run? If so why was all the drain going to be removed, what is the mechanism that lead to either end of the drain being contaminated but not the length in the middle?

### 2.3.4 Foul Drain

RSRL's approach is sound and no results connected with the remaining lengths of the foul drain give cause for concern in terms of the values contained within RS-G-1.7.

### 2.3.5 Surface Water Drainage System

RSRL's approach is sound and no results connected with the surface water drainage system give cause for concern in terms of the values contained within RS-G-1.7.

## 2.4 Overall land quality

All historical and subsequent validation sampling performed between 2001 and 2012 show results that satisfy the requirements of RS-G-1.7.

### 2.4.1 Validation Sampling

RSRL sampled at 188 locations which included 52 trial pits. All radiochemical analytical results show levels of potential contamination well below the values contained within RS-G-1.7 and are consistent with the Harwell site background.

### 2.4.2 Surface gamma radiation surveys

The Groundhog fusion survey was thorough and 11 points investigating the Land Action Level were investigated further. All spectra from these locations were shown only to contain naturally occurring radionuclides.

The Bushhog survey was thorough and supports the statement that land around the bushes displayed no elevated readings due to contamination by manmade radionuclides.

The High Resolution Gamma Spectroscopy survey shows that $^{241}$Am, $^{60}$Co and $^{137}$Cs were not present at values above the Minimum Detectable Activity, which was well below the values contained in RS-G-1.7.

### 2.4.3 Surface Dose Rate Results

RSRL state that “the surface dose rate survey conducted using an MC71 detector produced an effective dose rate ranging from 0.005 to 0.025 μSv $h^{-1}$. The quantity effective dose cannot be measured by the detector used. The mini 6-80 with a MC 71 detector measures the quantity “air kerma” which has units of Gy. The conversion factor from Gy to ambient dose equivalent H*(10) is 1.20 for $^{137}$Cs. However this still does not give an estimate of effective dose. In order to obtain an estimate of effective dose a conversion co-efficient would need to be applied from air kerma to effective dose. This can range from 0.7 to 0.9 Sv/ Gy depending on whether rotational or isotropic geometry is assumed. Regardless of how the measurement of surface dose rates were treated, these results give no cause for concern and are typical of background dose rates for the Harwell area.

### 2.4.4 Groundwater

The solid geology beneath the Harwell site is chalk, the absence of significant soil cover means that the chalk is vulnerable to contamination. This would enable contamination of the ground water if the land itself was contaminated. RSRL state that the groundwater flow fluctuates between north-east and south-east, with the general direction of the flow being to the east. This is confirmed if the study of chemically contaminated ground water is considered. This clearly shows movement of the contaminated ground water in a plume due east of the site.

Borehole HWS36 lies to the east of the B353 area and any radioactive contamination in the groundwater due to the presence of radionuclides within the B353 area would be observed in the analysis of samples from the borehole.

All reported values for gross alpha, gross beta and tritium were below the World Health Organisations guideline values[5].

# 3 PHE SURVEY

## 3.1 Sampling

52 trial pits were excavated by RSRL and PHE sampled at different depths within five of the individual pits. Samples were collected at depths of 0 - 0.2 m, 0.2 - 1.0 m, 1.0 - 3.0 m. In addition a further three surface samples were taken. All samples were then analysed for $^{40}$K, $^{226}$Ra/$^{214}$Pb, $^{232}$Th/$^{228}$Ac, $^{60}$Co, $^{137}$Cs and $^{241}$Am.

**Table 1. PHE sample results, all activities are reported in Bq g$^{-1}$**

| Identifier | $^{40}$K | $^{226}$Ra/$^{214}$Pb | $^{232}$Th/$^{228}$Ac | $^{137}$Cs | $^{60}$Co | $^{241}$Am |
|---|---|---|---|---|---|---|
| TP8 (0-0.2m) | 0.20 | 0.018 | 0.017 | 0.003 | <0.0003 | <0.0015 |
| TP8 (0.2-1m) | 0.18 | 0.018 | 0.019 | 0.001 | <0.0003 | <0.0015 |
| TP8 (1-2m) | 0.11 | 0.010 | 0.009 | <0.0002 | <0.0002 | <0.0011 |
| TP8 (2.20m) | 0.09 | 0.008 | 0.008 | <0.0002 | <0.0002 | <0.0010 |
| TP17 (0-0.2m) | 0.19 | 0.012 | 0.015 | 0.001 | <0.0002 | <0.0008 |
| TP17 (0.2-1m) | 0.18 | 0.013 | 0.016 | 0.0008 | <0.0002 | <0.0011 |
| TP17 (1-2.70m) | 0.14 | 0.012 | 0.011 | <0.0002 | <0.0002 | <0.0007 |
| TP21A (0-0.2m) | 0.24 | 0.018 | 0.020 | 0.0021 | <0.0002 | <0.0008 |
| TP21A (0.2-1m) | 0.26 | 0.017 | 0.017 | 0.0013 | <0.0002 | <0.0009 |
| TP21A (1-3.4m) | 0.26 | 0.015 | 0.017 | 0.0009 | <0.0002 | <0.0012 |
| TP24 (0-0.2m) | 0.16 | 0.015 | 0.019 | 0.0009 | <0.0002 | <0.0009 |
| TP24 (0.2-1m) | 0.12 | 0.009 | 0.011 | 0.0003 | <0.0002 | <0.0010 |
| TP24 (1-1.6m) | 0.14 | 0.010 | 0.012 | <0.0002 | <0.0002 | <0.0010 |
| TP36 (0-0.2m) | 0.13 | 0.014 | 0.018 | 0.0011 | <0.0002 | <0.0009 |
| TP36 (0.2-1m) | 0.21 | 0.013 | 0.017 | 0.0002 | <0.0002 | <0.0011 |
| TP36 (1-2.5m) | 0.13 | 0.010 | 0.011 | <0.0002 | <0.0002 | <0.0010 |
| Top Soil 5 | 0.26 | 0.029 | 0.027 | 0.010 | 0.00025 | <0.0021 |
| Top Soil 3 | 0.15 | 0.016 | 0.014 | 0.0012 | <0.0002 | <0.0013 |
| Top Soil 8 | 0.18 | 0.013 | 0.016 | 0.0027 | <0.0002 | <0.001 |

As none of the samples display activities at levels that would exceed the levels quoted in RSG1.7 no further isotopic analysis has been deemed necessary. Further analysis was performed on the $^{137}Cs$ values obtained by PHE and RSRL. PHE mean value was 0.0015 ± 0.0022 Bq $g^{-1}$ with RSRL's 95$^{th}$ percentile value being 0.003 Bq $g^{-1}$; which is not statistically significant different to the PHE values and both being well below the value contained within RS-G-1.7.

## 3.2 Surface radiation gamma survey

The B353 area was surveyed at a slow walking pace with the one to two metre strip, sine wave motion employed the majority of the time. This survey technique was not suitable for monitoring beneath the trees and in shrub areas and measurements were only performed where reasonably accessible. The count rate from the detector was continuously monitored using the visual and audio outputs and any changes were investigated. Where there was a significant difference in count rates, typically an increase of 50% or more, an Exploranium GR-130 or an Exploranium GR-135 was used to obtain a gamma spectrum of the location. The spectrum was then stored for later interpretation.

A total of 26,300 measurements were made and analysed. No measurement exceeded the mean by more than three standard deviations. The PHE survey results are consistent with RSRL's reported findings that gamma dose rates within the B353 area are typical of Harwell site background.

# 4 CONCLUSION

The aim of this project was for PHE-CRCE to provide independent and authoritative advice to the HSE, ONR. This was performed by validation of the documentation, measurements and assessments made by RSRL with respect to their application for variation of the RSRL, Harwell Site License. In addition the PHE performed an independent radiological survey of the area.

RSRL's justification for their application was based upon the following statements:

The area is not being used for purposes for which a nuclear site licence is required and that the area presents no danger from ionising radiations.

The radiological criteria set by HSE were that it should be demonstrated that: there has ceased to be any danger from ionising radiations from anything on the site, or the part of the site, under consideration for delicensing. The HSE policy statement states:

"On the basis of existing, published guidance, HSE considers that an additional risk of death to an individual of one in a million per year is 'broadly acceptable' to society. Applying this to nuclear licensed sites, any residual radioactivity, above average natural background, which can be satisfactorily demonstrated to pose a risk less than one in a million per year, would be 'broadly acceptable'.

Further HSE criterion states:

"Annex 1 of the Basic Safety Standards Directorate (Euratom 96/29) allows member states to exempt a practice where appropriate and without further consideration if doses to members of the public are of the order of 10 microsieverts per year. HSE is of the view that this dose limit broadly equates to the 1 in a million per year 'no danger' criterion as well as being consistent with other legislation and international advice relating to regulatory protection of the public".

In addition to demonstration of meeting the 'no danger' criteria, the delicensing results were compared to limits specified in other relevant legislation and guidance including:

**a.** Health and Safety at Work Act 1974 (HSWA) and Ionising Radiations Regulations 1999 (IRR99) requirement that operators reduce risk to levels that are "As Low As Reasonably Practicable" (ALARP)

**b.** Assessment of any residual radioactivity, above background, will be compared to those contained within the International Atomic Energy Authority (IAEA) RS-G-1.7 safety Guide. Where the primary radiological basis for establishing values of activity concentration for the exemption of bulk amounts of material and for clearance contained within RS-G-1.7 is that the effective doses to individuals should be of the order of 10 μSv or less in a year.

The historical investigation was detailed and there were no reported levels of activity that do not meet the delicensing criteria as defined by the HSE. There are a number of areas where further clarification or documentation should be sought. These are:

**1.** B345: What was the surface level obstruction that lead to the trial pit being excavated twice?

**2.** B347.1: Contamination found on the floor of room 4 although room 4's location unknown. Has the base slab been removed? *"There are no records of the demolition process, such as the removal of the base slab."* Investigations appear to target drains and there is no mention of whether the base slab is present or not.

**3.** MH16B – MH16C states that since *the sections removed at either end contained the readings that exceeded the action level the section of drain remaining meets the delicensing criteria.* It is stated that of the 8 data points on this run 4 exceed the action level, were these 4 points at either end of the run? If so why was all the drain going to be removed, what is the mechanism that leads to either end of a drain being contaminated but not the length in the middle?

**4.** What is the Land Action Level and how was it derived?

**5.** In the report BOSS/REP/003/13 section 6.2, "*Surface Dose Rate Results*" states effective dose rates were measured using a 6-80 with a MC71 probe. How were these figures obtained? Was a conversion co-efficient applied to convert from air kerma (Gy) to effective dose (Sv), if so which irradiation geometry was assumed or was it measured and the value reported directly, in which case it is a measurement of air kerma and should be reported in Gy, or was it converted to ambient dose equivalent which has a conversion coefficient of 1.2 Sv/Gy and is then reported in Sv?

Overall the measurements examined and performed by PHE - CRCE and RSRL indicate there is no residual contamination with activity above the radiological criteria set by the HSE.

# 5 RSRL RESPONSE TO PHE QUESTIONS

**B345: What was the surface level obstruction that lead to the trial pit being excavated twice?**

The obstruction was a hedgerow. The excavation was carried out on both sides of the hedge and this was sufficient to fulfil the trial pit investigation purpose.

**B347.1: Contamination found on the floor of room 4 although room 4's location unknown. Has the base slab been removed? "There are no records of the demolition process, such as the removal of the base slab." Investigations appear to target drains and there is no mention of whether the base slab is present or not.**

Yes the base slab to B347.1 has been removed, which site works have proven. Trial pits 47 and 49 were designed to investigate the active re-designated foul drain and the base slab as a secondary outcome. Trial pit 49 dissected the building footprint and did not encounter the base slab – please refer to Figure 5.8 of the B353 Delicensing Case. Trial pit 47 was not excavated as TP49 extended through the footprint of TP47. In addition, the removal of B353T1 & 2 portakabins required some minor ground works and no historical slab was encountered. These portakabin removal works were not fully described in the delicensing case historical review (Appendix III). The works comprised the removal of the concrete pads that the portakabins were placed. These were not large or deep structures, and were not placed on top of an existing slab or foundation.

**MH16B – MH16C states that since the sections removed at either end contained the readings that exceeded the action level the section of drain remaining meets the delicensing criteria. It is stated that of the 8 data points on this run 4 exceed the action level, were these 4 points at either end of the run? If so why was all the drain going to be removed, what is the mechanism that leads to either end of a drain being contaminated but not the length in the middle?**

The sections of drain with the 8 data points that exceeded the action level were removed. It should be noted that the work at MH16/B to MH16/C was carried before the revised Trade Waste Drain data assessment process was implemented (described in BOSS/TN/010/13: "Harwell TWD Decommissioning: Overview of Data Assessment Processes"). As a result the section of drain was removed based on the original 'action levels' for vitrified clay drain which have been demonstrated to be conservative.

Regarding the original survey data, the 4 elevated (i.e. >110cps) readings were as below:

• From MH16/B: 0-1.8m downstream =210 cps, 150cps, 150cps

• From MH16/C: 0.8m upstream= 210 cps

When it was found that there were high readings at either end of the 8m pipe section, the default option was to excavate the entire section in one trench. This is because it is more practical from a health and safety and cost point of view to continue with one excavation rather than using 2 different excavations at each end. The extra ~ 4m of 100mm vitrified clay pipe that would have been excavated would not have been a significant extra volume of material to

assess and segregate appropriately. The pipe was excavated at each end (MH16/B to 3m downstream from MH16/B and MH16/C to 1m upstream from MH16/C) due to the presence of unexpected services over the middle of the drain (where there were no elevated readings). It was decided that as there were no elevated readings in the middle section of pipe the additional industrial hazard associated with moving the services could not be justified and hence the middle section of the pipe was left in-situ.

The elevated readings in the drain were near the manholes. Review of the site wide Trade Waste Drain survey data does not indicate 'patterns' in survey data for slightly elevated readings, as in the case for between MH16/B and MH16/C. With more significant activity than recorded here (e.g 300-1000cps), it is common to observe a 'tailing off' in readings downstream from where the effluent entered the system (e.g. at a junction or manhole) for up to approximately 10 metres.

The data presented in the delicensing case for the TWD in the B353 Area is based on the revised TWD assessment process and site specific clearance levels. The assessment for this section of drain involved using the gamma survey dataset with the readings from the removed sections excluded. The remaining section of drain meets the revised TWD assessment criteria.

**What is the Land Action Level and how was it derived?**

The Land Action Level is a site specific threshold developed between RSRL and the contractor Nuvia. The threshold is an indicative level where counts below this threshold are within normal background levels for the Harwell site. The level was derived from a statistical review of all historical Harwell survey data – between 1997 and 2011. The Land Action Level was calculated using Currie method (background + 2.33 x Background Standard Deviation). Full details are given in report 'Defining Groundhog Features for Land Surveys' by M Davies, 2012, reference 87245/TR/037[6].
This reference was examined and the methodology considered sound. The Land Action Level of 328 cps is appropriate and the 6 measurements recorded which exceeded this value are to be expected since 5% of values which belong to a background distribution would be above this value.

**In the report BOSS/REP/004/13 section 6.1.2 states effective dose rates were measured using a 6-80 with a MC71 probe. How were these figures obtained? Was a conversion co-efficient applied to convert from air kerma (Gy) to effective dose (Sv), if so which irradiation geometry was assumed or was it measured and the value reported directly, in which case it is a measurement of air kerma and should be reported in Gy, or was it converted to ambient dose equivalent which has a conversion coefficient of 1.2 Sv/Gy and is then reported in Sv?**

The contractors (in this case Nuvia) use the $^{137}$Cs conversion coefficient (16 cps/ µGy h$^{-1}$) which gives a more conservative result than applying the $^{226}$Ra conversion coefficient (18 cps/ µGy h$^{-1}$). In the context of measuring 'background' radiation the geometry would be Isotropic. Nuvia do not use a unique instrument calibration coefficient - the instrument is calibrated yearly and the calibration coefficient checked – Nuvia use the manufacturers quoted factor. The conversion factor for Isotropic dose is 0.87 Sv/Gy. The contractor's methodology is

available in report ‘Use of the 6-80 Meter with GM Tube Type MC-71 – Issue E’ by A Stannett, 2012[7].

This reference was examined and the methodology considered sound. The conversion factor from counts per second to Grey is conservative and the conversion factor from air kerma to effective dose of 0.87 is the most appropriate.

# 6 REFERENCES


1 Barnett M, Holdroyd S, Crook M, Bartlett A, Roworth ,Request for Variation to the RSRL Harwell Nuclear Site Licence No. 99 'B353 Area', BOSS/REP/003/13 Issue 2

2 HSE criterion for delicensing nuclear sites. HSE, May 2005

3 International Atomic Energy Agency (2004) Application of the Concepts of Exclusion, Exemption and Clearance Safety Guidance. RS-G-1.7.

4 McClure J, Assessment of the Documentation and Measurements Submitted Relating to the Determination of Background Activity Levels in the Harwell Trade Waste Drainage System. CRCE-OPD-015-2010

5 World Health Organisation (2004) Guidelines for Drinking Water quality. 3rd edition, Volume 1, recommendations.

6 M Davies. Defining Groundhog Features for Land Surveys' 2012, reference 87245/TR/037 Issue 1, DOC006366

7 A Stannett. Use of the 6-80 Meter with GM Tube Type MC-71 – Issue E' 2012

# APPENDIX A Guidance on the 'no danger' criteria

In 1996 the Council of the European Union published their Basic safety Standards Directive (BSSD) (Council Directive Euratom 96/29, 1996)[1] laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. Article 5 of BSSD specifies the requirements for the release of radioactive materials from regulatory control for operations involving clearance, for disposal, recycling or reuse. This states that wastes may be cleared from the requirement for prior authorisation for disposal, recycling or reuse '*provided they comply with clearance levels established by national competent authorities. These clearance levels shall follow the basic criteria used in Annex I and shall take into account any other technical guidance provided by the Community'*. The dose criteria in Annex 1, for the application of exemptions for practices, are:

*'(a) the radiological risks to individuals caused by the exempted practice are sufficiently low as to be of no regulatory concern; and*

*(b) the collective radiological impact of the exempted practice is sufficiently low as to be of no regulatory concern under the prevailing circumstances; and*

*(c) the exempted practice is inherently without radiological significance, with no appreciable likelihood of scenarios that could lead to a failure to meet the criteria in (a) and (b).'*

Annex 1 also specifies the following dose criteria for exemption without further consideration:

*(a) the effective dose expected to be incurred by any member of the public due to the exempted practice is of the order of 10 μSv or less in a year;*

*and*

*(b) either the collective effective dose committed during one year of performance of the practice is no more than about 1 man x Sv or an assessment of the optimization of protection shows that exemption is the optimum option.'*

These dose criteria for exemption are the same as those specified in IAEA guidance given in Safety Series 89 (IAEA, 1989) [2].

In connection with Article 5 of BSSD, the European Commission published radionuclide specific clearance levels for the disposal, recycling and reuse of wastes from authorised practices (Radiation Protection 122: Part 1)(EC, 2000) [3]. This document contains the recommendations of the Group of Experts established under the terms of Article 31 of the Euratom Treaty. The clearance levels were developed by modelling a set of scenarios and determining the mass specific activity which resulted in an annual dose of 10 μSv to the most exposed group.

The International Atomic Energy Agency (IAEA) has also published Safety Standards (Safety Series 115) (IAEA,1996) [4], containing guidance on radiation practices, and sources within practices, which may be exempted from the requirements of the IAEA

Safety Standards. The exemption criteria are contained within Schedule 1, namely: *'The effective dose expected to be incurred by any member of the public due to the exempted practice or source is of the order of 10 μSv or less in a year'*.

Further guidance on exclusion, clearance and exemption of materials was published by IAEA in 2004, in IAEA safety guide RS-G-1.7 (IAEA,2004) [5]. This report used modelling of scenarios to define activity concentration levels that correspond to annual doses of about 10 μSv to the most exposed groups. Although the dose criteria are the same as those used in RP122 part 1, the scenarios and parameter values are slightly different, leading to some differences in the derived activity concentration levels.

The Health and Safety Executive (HSE) defined their criteria for delicensing nuclear sites in 2005 (HSE, 2005) [6]. Their document refers to the exemption criteria in Annex 1 of the BSSD (Euratom 96/29, 1996) that allows member states to exempt a practice without further consideration if doses to members of the public are of the order of 10 μSv or less per year. The document also states that the HSE is of the view that this dose criterion broadly equates to the 1 in a million per year 'no danger' criterion they have specified for delicensing of nuclear sites.

HSE have further stated in their guidance document, (HSE, 2008) [7], that their preferred position is that land should be cleared to the values given in RS-G-1.7 to demonstrate achievement of the policy criterion of the residual risk of death being one in a million per year, which broadly equates to the no danger criterion.

Whilst the HSE recommend the use of the values contained within RS-G-1.7 since these are radionuclide specific clearance levels that correspond to the 10 μSv per year dose criterion, it is useful to consider other clearance levels that also meet the 10 μSv per year dose criterion, and hence the HSE delicensing criterion of a risk of one in a million that corresponds to 'no danger'. Hence it is also useful to consider the EC guidance on clearance levels contained in Radiation Protection 114.

| Nuclide | IAEA Safety Guide on the Application of the Concept of Exclusion, Exemption and Clearance. RS-G-1.7 | European Commission Radiation Protection 114 Definition of clearance levels for the release of radioactively contaminated buildings and building rubble. |
|---|---|---|
| Cs-137 | 0.1 Bq/g | 12 Bq/cm$^2$ |
| Pu- 239 | 0.1 Bq/g | 2.3 Bq/cm$^2$ |

When commenting on whether or not the delicensing criterion has been met, all conclusions are based on a comparison of the levels of any residual radioactivity, above background, that remains on site with the most restrictive of the values contained within the above table. Situations involving more than one radionuclide were assessed using the summation rule described in Annex 1 of BSSD.

References

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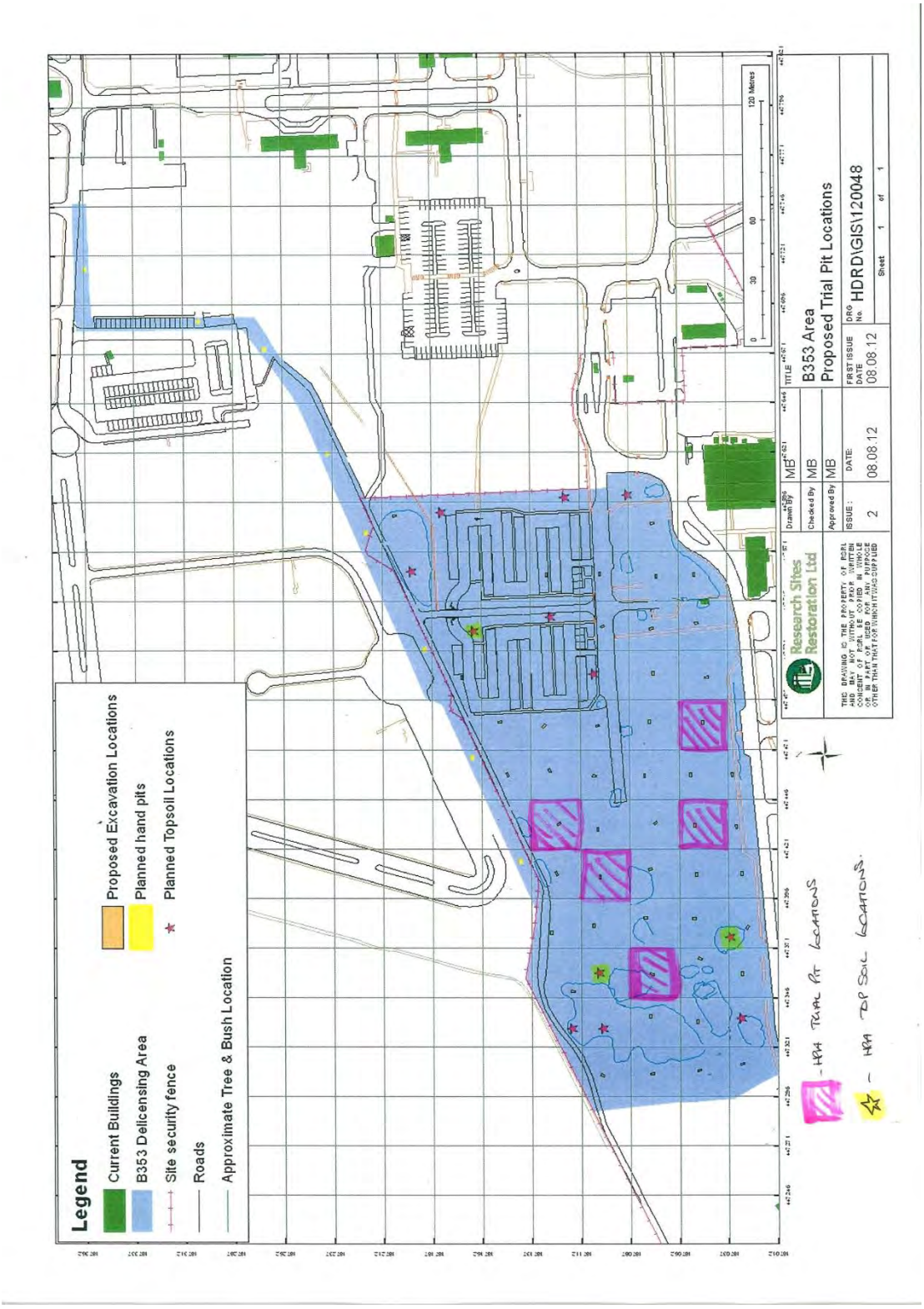
# APPENDIX B PHE Sample locations



## APPENDIX C Rad App gamma survey

## APPENDIX D Documents reviewed by PHE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