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Rolls-Royce Submarines Limited

Register of Techniques for the Analysis of Radioactive Waste Materials at the Raynesway Nuclear Licenced Sites

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Rolls-Royce Submarines Limited

Register of Techniques for the Analysis of Radioactive Waste Materials at the Raynesway Nuclear Licenced Sites

Executive Summary

For the Raynesway Nuclear Licenced Sites, Rolls-Royce Submarines Limited (RRSL) holds two Permits for the Disposal of Radioactive Waste (the Permits) issued by the Environment Agency (EA) under the Environmental Permitting Regulations 2016 as amended (EPR16). It is a condition of the permits that RRSL inform the EA of any techniques being employed to determine the activity of radioactive waste and of any modification to those techniques. This register lists the assay techniques applied to meet this condition and gives a description of each technique.

The register covers radioactive liquid and gaseous waste discharged directly into the environment and radioactive solid and non-aqueous waste sent for off-site treatment or disposal. In the case of the Neptune Reactor Raynesway permitted site (NRR) it also covers the assay of waste being transferred to the Nuclear Fuel Production Plant permitted site (NFPP) for onward disposal.

No technique may be used to consign waste off either site unless it is detailed in this register and has been submitted to the EA.

Record of Change

Date	Version Number	Reason for Change
01/2019	Issue 1	New document covering both Raynesway sites. This document wholly replaces • EDNS9701737105 – Rolls-Royce Marine Power Operations Limited Neptune Reactor Raynesway Register of Techniques for the Analysis of Radioactive Waste Materials • RRMP22606 – Register of Techniques for Analysis of Radioactive Waste Materials – RRMPOL NFPP Site
09/2020	Issue 2	UP-issue of document to incorporate: • Addition of Liquid Effluent Analysis by ICP-MS • Minor amendments to smear and probe technique
07/2021	Issue 3	• Update to beta counter and triathler types • Removed references to obsolete WIs • Incorporated temporary arrangements for NRR effluent sampling • Revision to liquid scintillation sample preparation • Removal of the LRGS technique • Demotion of the physical modelling technique to be a backup to the HRGS technique.
11/2021	Issue 4	• Removal of reference to WI 2249 due to being amalgamated with WI 2430.
06/2022	Issue 5	• Addition of back calculation method to recover from abnormal situations for the gaseous waste assay method. • Removal of redundant procedures from the Dose to Activity Conversion section and removal of physical modelling as a technique within this section. • Clarification that the ICP-MS method for aqueous liquid waste cannot be used for final discharge monitoring. • Minor updates to references, abbreviations and text. • Addition of extended stack sample periodicity for NFPP at Christmas.
02/2024	Issue 6	• RCF aqueous effluent sampling arrangements updated to reflect current temporary arrangements. • Referencing of WI 3604 in table 3.

Contents

Tables

1 Introduction

1.1 Requirement for Register of Techniques

1.1.1 This register of techniques lists the techniques and procedures by which RRSL meets its responsibility to define and document techniques being employed to determine the activity of radioactive waste disposals.

1.1.2 The responsibility is defined in the Permit for the Disposal of Radioactive Waste from the Neptune Reactor, Raynesway site (NRR) (1) and the Permit for the Disposal of Radioactive Waste from the Nuclear Fuel Production Plan site (NFPP) (2). The permits are issued to RRSL by the EA under the Environmental Permitting Regulations 2016 (as amended) (EPR16) (3) & (4).

1.1.3 The Permits impose a condition to inform the EA, in writing, in advance of modifications to the approved techniques that have the potential to change the results. No timeframe is specified in the permits for this notification but RRSL will submit technique modifications allowing a reasonable time for review of the modification. This will normally be 14 days, but this could be subject to variation depending upon the circumstances of the modification and in discussion with the relevant EA inspector.

1.2 Techniques & Instruments

1.2.1 This register gives a synopsis of each technique used for the assay of radioactive waste on the NRR and NFPP sites and lists the detailed procedures used to implement these techniques.

1.2.2 The techniques utilised are appropriate to the types of materials present on the sites and to the final disposal routes. Instruments used for detection of radioactive material in the various waste streams are specified in the relevant procedures. Instruments and counting equipment are calibrated using sources traceable to national and / or international standards and periodically tested in accordance with RRSL procedures.

1.3 Scope

1.3.1 The techniques listed in this register apply to the assay of all radioactive waste produced on the NRR and NFPP permitted sites as defined in their relevant permits. It covers techniques for the assay of:

- Gaseous radioactive waste.
- Aqueous liquid radioactive waste.
- Solid and non-aqueous liquid radioactive waste.

1.3.2 Only techniques listed in this register may be used for analysis of radioactive waste. The techniques defined in this register will ensure that the sites comply with the limits and conditions of the Permits.

2 Radioactive Gaseous Waste

2.1 Introduction

2.1.1 Gaseous radioactive waste is discharged from 4 stacks on the NFPP site and 3 discharge points on the NRR site. Discharge points are sampled to allow the total activity discharged through each discharge point to be measured and calculated.

2.2 Sampling

2.2.1 For each stack or discharge point, post-filter/scrubber isokinetic air sampling is carried out by drawing a measured quantity of air through a glass microfiber filter (Whatman GF/A or equivalent). The samples are taken at periods of either a day, a week or a calendar month depending on the radiological risk. Details of the sampling periodicity for individual discharge points are given in Table 2 over leaf.

2.3 Analysis

2.3.1 On the NRR site samples are counted immediately and then after one day. On the NFPP site the initial count is after 48 hours.

2.3.2 Final counts are then made after one week on the NRR site or three weeks on the NFPP site. These counts are normally used to provide the activity assay for the discharge except on the NFPP site where, if the 48-hour count does not show a result statistically significant above background, the 48-hour limit of detection (LoD) is used instead.

2.3.3 For alpha particulate, activity assay is carried out using a single position Harwell Instruments 956012-1 Alpha Drawer Unit connected to a Harwell Instruments SC100 or SC105 scaler. The counter is calibrated for detection efficiency using a traceable natural uranium source on the NFPP site or using a traceable thorium 230 source on the NRR site.

2.3.4 For beta particulate on the NRR site, activity assay is carried out using a single position Harwell Instruments 956025-1 Beta Drawer Unit connected to a Harwell Instruments SC105 scaler. The counter is calibrated for detection efficiency using a traceable cobalt 60 source.

2.3.5 The samples are retained for minimum of 3 months to allow further analysis to be carried out if required.

2.3.6 Flow volume meter and run time readings are taken for all outlets in order to calculate the sample flow rates and total discharge volumes. The stack discharge volume is determined from a 5-yearly flow rate calibration and a time counter.

2.4 Back Calculation

2.4.1 There are occasions when it is necessary to carry out a back calculation of the activity discharged via a particular stack. This usually occurs when there is a fault or other problem with the stack sampler but the stack keeps running. In this scenario there is unmonitored discharge that need to be accounted for.

2.4.2 For the NFPP site the methodology for undertaking the back calculation is detailed within Environmental Advice Note 2022 EAN 006 (5).

2.4.3 For the NRR site would require a bespoke assessment due to longer run times for samples meaning that it is more likely that there will be partial data loss rather than a complete loss of data. To account for this the bespoke assessment shall be made and reported as a Health Physics Advice Note or Waste / Environmental Advice Note.

2.5 Procedures

2.5.1 Stack activity assay and the calculation of the stack discharge from the assay results is carried out in accordance with the work instructions detailed in Table 1.

Site	Work Instructions	Reference
NRR	WI 3627	(6)
NFPP	WI 2430 2022 EAN 006	(7) (5)

Table 1 – Procedures used for Radioactive Gaseous Analysis

Discharge	Sampling Frequency	Counting Equipment Used	Analysis Requirement				
			Immediate	1 Day	48 Hour	1 Week	3 Week
NRR RCF	Weekly	α – SC105 Scaler Counter & 956012-1 Alpha Drawer				x	
		β – SC105 Scaler Counter & 956025-1 Beta Drawer	x	x		x	
NRR RL	Monthly	α – SC105 Scaler Counter & 956012-1 Alpha Drawer β – SC105 Scaler Counter & 956025-1 Beta Drawer	x	x		x	
NRR RH	Monthly	α – SC105 Scaler Counter & 956012-1 Alpha Drawer β – SC105 Scaler Counter & 956025-1 Beta Drawer	x	x		x	
NFPP A2	Daily*	α – SC105 or SC100 Scaler Counter & 956012-1 Alpha Drawer			x		x
NFPP A3	Daily*	α – SC105 or SC100 Scaler Counter & 956012-1 Alpha Drawer			x		x
NFPP A4	Daily*	α – SC105 or SC100 Scaler Counter & 956012-1 Alpha Drawer			x		x
NFPP A6	Daily*	α – SC105 or SC100 Scaler Counter & 956012-1 Alpha Drawer			x		x

Table 2 – Gaseous Discharge Sampling & Assay

*Daily Sampling is undertaken with the exception of Christmas Day. The filter paper installed on Christmas Eve will represent a 48-hour period. Daily Sampling will recommence on Boxing Day.

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3 Radioactive Aqueous Liquid Waste

3.1 Introduction

3.1.1 There are three active aqueous waste systems on the Raynesway licenced sites. On the NRR site there is one for Radioactive Component Facility (RCF) and one of the Neptune Reactor Facility (NRF). On the NFPP site there is one system for all of the contact areas. Active effluent is collected in local tanks and sumps and then pumped forward to the relevant system. The sampling methodology is different on the two sites due to design differences in the effluent systems.

3.1.2 There are three techniques of analysis of liquid effluent employed at RRSL, the main two being gross alpha and gross beta counting on the NRR site and liquid scintillation counting on the NFPP site.

3.1.3 The third liquid effluent assay technique is Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) which is used on the NFPP site. This is not directly used to assay the disposal of liquid effluent but is used to determine the uranium content of certain small volume, low activity, aqueous wastes. This in turn is added to the analysis results for the bulk effluent.

3.2 Sampling

3.2.1 NRR Site – RCF Temporary Arrangements

3.2.2 All holding tanks have level indicators and discharge is generally carried out when a full level is reached, or when instructed by the Neptune Controller.

3.2.3 The holding tanks collect effluent, which when requiring discharge, is pumped through a filter into an Intermediate Bulk Container (IBC). A 250 ml sample is then taken from the IBC immediately after transfer.

3.2.4 NRR Site – Neptune Temporary Arrangements

3.2.5 During the upgrade works to the Neptune Facility the old effluent treatment system has been de-planted. A new system will be installed as part of the upgrade but in the intervening time, any liquid waste generated is held in IBCs and manually agitated and sampled.

3.2.6 NFPP Site – Bulk Effluent

3.2.7 Two samples are taken from each batch of effluent, a “B” sample before treatment and an “A” sample after treatment.

3.2.8 In order to take the “B” sample, the acidified neutralising tank is air sparged for a minimum of 20 minutes. The pH is then checked using a clean, dry and calibrated pH meter. If the pH is within the range of 1 to 3 a 200ml dip sample is taken from the tank.

3.2.9 To take the “A” sample the tank is held for at least 12 hours after neutralisation. A 1500ml dip sample is then taken from the tank and 200ml of this dip sample is subsampled into a bottle for uranium analysis.

3.2.10 NFPP Site – ICP-MS Analysis Sampling

3.2.11 The aqueous wastes are typically contained in 45 litre reusable plastic drums. The contents of the drum are agitated for a minimum of 10 minutes by means of a recirculating pump to ensure homogeneity.

3.2.12 Duplicate 30ml samples are taken from the homogenised liquid by means of a valve on the pump.

3.2.13 The small volume, low activity, aqueous liquids are then added into the bulk effluent prior to treatment.

3.3 Gross Alpha and Gross Beta Counting (NRR Site)

3.3.1 After agitating the 250 ml sample, a 10 ml aliquot is transferred to a clean 10 ml volumetric flask. A 60 mm diameter planchet is placed under an infra-red lamp and the aliquot is gradually transferred onto the planchet and evenly distributed over the recessed area. The liquid is allowed to evaporate to dryness under the infra-red lamp. The sample is then allowed to cool for 5 minutes before counting.

3.3.2 A minimum volume (100 ml) from the unused aqueous waste sample is retained for a period of 3 months, so that if required, further analysis may be carried out.

3.3.3 For alpha particulate, the counting is carried out using a single position Harwell Instruments 956012-1 Alpha Drawer Unit connected to a Harwell Instruments SC105 scaler. The counter is calibrated for detection efficiency using a traceable thorium 230 source.

3.3.4 For beta particulate, the counting is carried out using a single position Harwell Instruments 956025-1 Beta Drawer Unit connected to a Harwell Instruments SC105 scaler. The counter is calibrated for detection efficiency using a traceable cobalt 60 source.

3.4 Liquid Scintillation Counting (NFPP Site)

3.4.1 Two samples are prepared for analysis. For each sample 10ml of effluent, 0.5ml of 10% HNO3 and 1ml of scintillation cocktail (6 g TOPO to 100 ml maxilight) are placed in to a clean 20ml glass scintillation vial. The vial is then shaken vigorously and left to stand until the scintillant layer is clear and distinguishable.

3.4.2 The sample is then assayed using a HIDEX Triathler liquid scintillation counter type 425-004 or 425-034. The counter is calibrated for detection efficiency using a standard liquid solution of uranium. The sample activity is calculated by taking the mean of the results from the two samples.

3.4.3 Coloured effluents, or those containing organics, may show a quenching effect using standard parameters. In practice, the result will appear to be partially outside the standard counting window. Any result displaying this effect is referred to a suitably qualified and experienced person (SQEP) for advice. To ensure a representative count is obtained, and if deemed appropriate by the SQEP, the instrument parameters may be temporarily changed, or a higher dilution of sample may be used. Details of any temporary change to either the settings or to the dilution are recorded on the record sheet for the particular effluent batch.

3.5 ICP-MS Analysis

3.5.1 This method may only be used for the assessment of low volume feeds into the effluent system. It is not a recognised technique in the RRSL permits for the analysis of effluent prior to discharge. The Approved techniques for discharge analysis in the permits must be followed.

3.5.2 Sample are prepared by acidification with concentrated nitric acid and 1ml of hydrofluoric acid, added in 100µL aliquots.

3.5.3 The assay samples are then made, by sub-sampling the bulk acidified liquor and dilution with ultrapure water in clean bottles.

3.5.4 Samples are assayed on NexION Inductively Coupled Plasma Mass Spectrometer equipment, with data managed on Syngistix software in accordance with WI 4242.

3.5.5 For any liquids that may not be in full dissolution in the tank, the ICP-MS activity is added to the “before treatment” activity calculated (section 3.2.6) for the bulk effluent.

3.6 Procedures

3.6.1 Aqueous liquid waste assay and aqueous liquid discharge sampling, assay and the calculation of the aqueous discharge from the assay results is carried out in accordance with the work instructions detailed in Table 3.

Site	Work Instructions	Reference
NRR	WI 3628, WI 3604	(8) and (9)
NFPP	WI 1842, WI 3116 & WI 4242	(10), (11) and (12)

Table 3 – Procedures used for Liquid Effluent Analysis

4 Radioactive Solid and Non-Aqueous Liquid Waste

4.1 Introduction

4.1.1 All radioactive solid and non-aqueous liquid waste is segregated, packaged and monitored in accordance with the RRSL management arrangements for solid and non-aqueous liquid radioactive low level waste on the Raynesway sites (13) and the subsidiary procedures and work instructions.

4.1.2 There are several techniques for the assay of solid and non-aqueous liquid waste. Each technique may cover several work instructions that detail the application of the technique to a specific waste type. Specific waste types including details of packaging, assay and disposal are given in the Rolls-Royce Submarines Waste Product Specification Sheets (WPSS) (14).

4.1.3 The subsections in section 4 give a synopsis of each of these assay techniques.

4.2 Direct Probe and Smear Survey

4.2.1 This method is to be used where it can be demonstrated from the history of the waste and/or from process knowledge that the activity is on the accessible surface of the waste. Work instructions using this technique are listed in Table 4.

4.2.2 The surface will be monitored using an approved α and/or β probe (according to location) and by smear. The readings in cps will be recorded along with the dimensions of the item as specified on the relevant Waste Tracking Note (WTN).

4.2.3 An average α and/or β reading for an item weighted by the percentages of the area with particular α and/or β readings will be calculated for both fixed and removable activity. The weighted average α and/or β reading in cps from the monitoring will then be used to calculate the area specific activity of the item using the formulas given in the work instructions for fixed or removable activity.

4.2.4 The results will be multiplied by the total surface area of the item in square centimetres to give the total activity with a conversion factor applied to convert to megabecquerels (MBq).

$$A_t = \frac{S_f \times a}{1\times10^6} + \frac{S_r \times a}{1\times10^6}$$

Where,
A_t = total activity (MBq)
S_f = area specific activity (fixed) (Bq/cm^2)
S_r = area specific activity (removable) (Bq/cm^2)
a = area (cm^2)

4.2.5 Table 4 lists the procedures that are used to carry out assay of solid and non-aqueous waste using the direct probe and smear technique.

4.2.6 Note: By agreement with a RRSL RWA, a suitable probe or counter other than those listed in the work instruction shown in Table 4 may be used for surface activity measurements.

Site	Work Instructions	Reference
NRR & NFPP	WI 3621	(15)

Table 4 – Direct Probe and Smear Survey Procedures

4.3 Sample & Analyse

4.3.1 This method is to be used where the activity either is or is suspected to be distributed through the structure of the waste material.

4.3.2 The waste material is sampled and the mass specific activity of a key nuclide in determined by appropriate laboratory analysis.

4.3.3 The total specific activity will be calculated by scaling the key nuclide specific activity according to the appropriate radiological fingerprint. If there are positive detects for multiple nuclides in the results, the positive detects should be added in separately.

4.3.4 The total activity is determined by multiplying the total mass of the waste in grams by the total specific activity.

$$A_t = S_m \times \frac{100}{n} \times M$$

Where,
A_t = total activity (MBq)
S_m = key nuclide mass specific activity (Bq/g)
n = key nuclide abundance (%)
M = total mass (g)

4.3.5 Table 5 lists the procedures that are used to carry out assay of solid and non-aqueous waste using the Sample and Analyse technique.

Site	Work Instructions	Reference
NRR & NFPP	WI 4213	(16)

Table 5 – Sample and Analyse Procedures

4.4 Dose to Activity Conversion

4.4.1 Dose to activity conversion uses a known relationship between radiation doses measured on the waste item to the total activity of the waste item. There are two methods for establishing the dose to activity relationship, physical modelling or computational modelling. Physical modelling is no longer used at RRSL.

4.4.2 Computational Modelling

4.4.3 At RRSL computational models are created using specialist gamma ray modelling software such as Microshield, Mercurad or Rankern. The software predicts the gamma dose rate that would be expected to be measured for a known level of activity within the modelled material. This then allows the actual activity to be scaled from the actual measured dose rate.

4.4.4 Individual models used for activity assessment are documented in technical reports prior to use and subject to peer review.

4.4.5 Table 6 lists the procedures that are used to carry out assay of solid and non-aqueous waste using the Dose to Activity Conversion by Computational Modelling technique.

Site	Type of Material	Work Instructions	Reference
No current procedures in use			

Table 6 – Dose to Activity Conversion by Computational Modelling Procedures

4.5 High Resolution Gamma Spectrometry

4.5.1 High resolution gamma spectrometry (HRGS) measures the amount of activity of individual gamma emitting nuclides in a package of waste by automatically combining the output of a computational model with physical measurements taken by a specialist detector. This measured activity is then scaled to the known fingerprint of the waste to give the total activity. Individual models used for activity assessment are documented in technical reports prior to use and subject to peer review.

4.5.2 RRSL use both contract HRGS services and in-house systems.

4.5.3 Table 7 lists the procedures that are used to carry out HRGS assay of solid and non-aqueous waste.

Site	Type of Material	Work Instructions	Reference
NRR & NFPP	All	WI 4234	(17)

Table 7 – HRGS Assay Procedures

4.6 Mass Balance

4.6.1 Mass balance calculations are used to calculate the activity of filter cake produced by the RRSL NFPP active effluent treatment plant. The activity in a batch of filter cake is the difference in the before and after total activity of tanks of effluent during their treatment. The tank total activities are measured in accordance with the relevant parts of section 3 of this document.

4.6.2 The before treatment activity figure is the sum of the activities calculated for the bulk effluent activity using the liquid scintillation technique (3.4) and the activity for any added small volume, low activity, aqueous wastes calculated using the ICP-MS technique (3.5).

4.6.3 The activity assigned to any batch of filter cake is therefore calculated according to the following formula:

$$\text{Activity} = \Sigma_B - \Sigma_A$$

Where,
$\sum_B$ is the sum of effluent tank before treatment activities for the filter cake batch.
$\sum_A$ is the sum of effluent tank after treatment activities for the filter cake batch.

4.6.4 Table 8 lists the procedures that are used to carry out Mass Balance assay of solid and non-aqueous waste.

Site	Type of Material	Work Instructions	Reference
NFPP	Filter Cake	WI 1842	(10)

Table 8 – Mass Balance Assay Procedures

4.7 Spent Radioactive Sources

4.7.1 The activity of all test sources is recorded on the date when they are delivered and accepted into the source accountancy system. On disposal, a calculation of the source activity on the disposal date is made according to the following formula:

$$A = A_0 \, e^{-\lambda t}$$

Where,
A = current source activity
A_0 = original source activity on receipt into accountancy system
λ = source decay coefficient for nuclide in question
t = decay time between source receipt on accountancy system and disposal date.

4.8 Records

4.8.1 The records to be kept along with the duration and conditions of storage are specified in each procedure and in compliance with the RRSL EPR16 Permits (1) & (2).

5 New and Modified Techniques

5.1.1 New techniques and modifications to equipment and procedures must only be made in accordance with the Rolls-Royce Quality Management System. An RWA shall be consulted on any new or changed equipment or procedures used for the disposal of radioactive waste. Procedures will be written, checked and reviewed by suitably qualified and experienced persons (SQEP). Any new or modified techniques or requirement for new equipment will be carried out in accordance with the arrangements for installation and modification.

5.1.2 In accordance with the permits, any new or modified technique that has the potential to change results must be notified to the EA, in writing, in advance of modifications being carried out. Although no time frame is specified in the permits for this notification RRSL have committed to that the notification will normally be at least 14 days prior to the modification but this may be subject to variation depending upon the circumstances of the modification and in discussion with the relevant EA inspector.

6 Abbreviations and Acronyms

Acronym	Definition
Bq	Becquerel
EA	The Environment Agency
EPR16	The Environmental Protection Regulations 2016 as amended
GF/A	Glass Fibre Absolute Air Sample Filter
HEPA	High Efficiency Particulate Air (Arresting) Filter
HNO3	Nitric Acid
HP	Health Physics
HRGS	High Resolution Gamma Spectrometry
IBC	Intermediate Bulk Container
ICP-MS	Inductively Coupled Plasma Mass Spectrometer
LoD	Limit of Detection
MBq	Megabecquerel
NFPP	Nuclear Fuel Production Plant
NRF	Neptune Reactor Facility
NRR	Neptune Reactor Raynesway
RCF	Radioactive Components Facility
RRMPOL	Rolls-Royce Marine Power Operations Limited (previous name of RRSL)
RRSL	Rolls-Royce Submarines Limited
RWA	Radioactive Waste Adviser appointed under the terms of EPR16
SC100 and SC105	Harwell Instruments Scaler-Counter 100 or Scaler-Counter 105
SQEP	Suitably Qualified and Experienced Person
WI	Work Instruction
WPSS	Waste Product Specification Sheet
WTN	Waste Tracking Note

7 References

If specific issues/versions of documents listed are not included, the latest full issue/version is to be used.

1. **Environment Agency.** *Permit with Introductory Note, Neptune Reactor, Raynesway.* London : Environment Agency, 2019. EPR/NB3430DM/V003.
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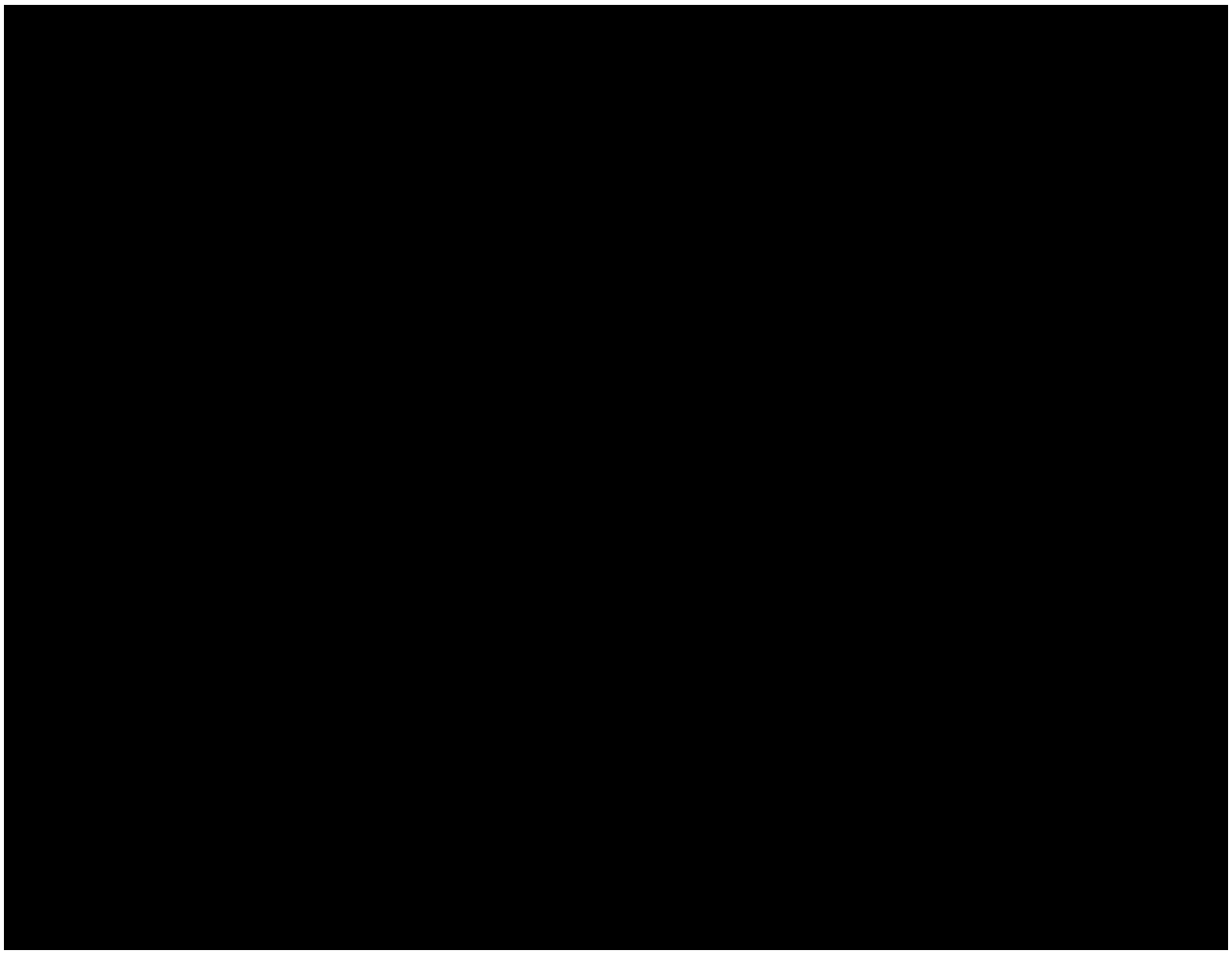
3. **UK Statutory Instrument.** *The Environmental Permitting (England and Wales) Regulations 2016.* London : HMSO, 2016. S.I. 2016 No. 1154.
4. —. *The Environmental Permitting (England and Wales) (Amendment) (No.2) Regulations 2018.* London : HMSO, 2018. SI 2018 No. 428.
5. **Rolls-Royce Submarines Limited.** *How to Carry Out Gaseous and Aqueous Super User (Supervisor) Tasks in Salus - a FAQs.* Derby : Rolls-Royce Submarines Limited, 2022. 2022 EAN 006.
6. —. *Gaseous Waste Discharges to the Environment.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 3627.
7. —. *Preparation, Assessment and Storage of Stack Sample Filter Paper.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 2430.
8. —. *Aqueous Waste Discharges to the Sewers of Severn Trent.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 3628.
9. —. *Active Liquid Effluent System Operation.* Derby : Rolls-Royce Submarines Limited, Lastest Issue. WI 3604.
10. —. *Operation of Effluent Plant and Treatment of Liquid Waste.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 1842.
11. —. *Analysis of Effluent Samples for Uranium Content using the Triathler Liquid Scintillation Counter.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 3116.
12. —. *Low Uranium Analysis by Inductively Coupled Plasma Mass Spectrometer (ICP-MS).* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 4242.
13. —. *Arrangements for the Management of Solid and Non-Aqueous Liquid Radioactive Low Level Waste at the Raynesway Nuclear Licenced Sites.* Derby : Rolls-Royce Submarines Limited, Latest Issue. EDNS9701834915.
14. —. *RRSL Core Manufacture Waste Product Specification Sheets for Radioactive Waste.* Derby : Rolls-Royce Submarines Limited, Latest Issue. EDNS9701836492.
15. —. *Radiation and Contamination Monitoring.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 3621.
16. —. *Radiological Characterisation of Material or Waste.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 4213.
17. —. *Waste Assay by High Resolution Gamma Spectrometry.* Derby : Rolls-Royce Submarines Limited, Latest Issue. WI 4234.



Record of Approval

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