

Monitoring of radioactivity in the UK environment: an annotated bibliography of current programmes

A. J. R. Cotter, A. Myatt, G. J. Hunt and C. B. Walters



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1. INTRODUCTION

Since the early development of nuclear programmes and the use of radioactive materials in industry, research and medicine, monitoring of radioactivity in the environment has been generally recognised as a necessary adjunct. In the UK, many organisations carry out regular radioactivity monitoring programmes, and summaries of these programmes have been published in 1983⁽¹⁾ and 1988⁽²⁾. The number of organisations carrying out radioactivity monitoring has increased rapidly in recent years, particularly in the local authority sector. The present report updates the previous summaries in the form of an annotated bibliography, giving synopses of all regular UK programmes whose results are published in report form, and of which we are currently aware. The reader is referred to the published reports themselves for further data. It is not the purpose of this report to endorse any or all of these programmes. It has been produced for reference purposes at the request of the Government's Radioactivity Research and Environmental Monitoring Committee (RADREM).

2. THE ROLE OF ENVIRONMENTAL MONITORING IN THE CONTROL OF RADIOACTIVE WASTE DISPOSAL

No radioactive waste may be disposed of except in accordance with an authorisation under the Radioactive Substances Act 1960⁽³⁾, as amended by the Environmental Protection Act 1990⁽⁴⁾. The authorisations are issued by appropriate Government bodies after a process of detailed application which provides for consultation with local or public authorities. Similar, administrative, arrangements exist for Ministry of Defence sites. The terms of authorisation specify limitations and conditions to disposals. Unless the amount of radioactivity to be disposed of is very small, there is a requirement for the operator to carry out a specified programme of environmental monitoring as a condition of authorisation. This requirement reflects the "Polluter Pays" principle. Operators are required to keep records of their monitoring for scrutiny by authorising bodies, and programmes are reviewed regularly by these bodies to meet changing needs. The Government authorising bodies also carry out their own programmes of environmental monitoring as part of their enforcement responsibilities. Thirdly, local and public organisations carry out monitoring programmes. In this report, programmes are listed under these three categories.

3. THE OBJECTIVES OF ENVIRONMENTAL MONITORING

Regular monitoring programmes in respect of normal disposal operations are usually established to satisfy one or more of the main objectives listed at (a)-(h) below:

- (a) to estimate public radiation exposures, using appropriate additional data and models;
- (b) to comply with regulatory requirements;

⁽¹⁾ *Department of the Environment, 1983. State of the Art Review of Radioactivity Monitoring Programmes in the United Kingdom. DoE, London, Pollution Report (17): 131 pp.*

⁽²⁾ *Her Majesty's Inspectorate of Pollution, 1988. Monitoring of Radioactivity in the UK Environment. HMSO, London, 68 pp.*

⁽³⁾ *Great Britain - Parliament, 1960. Radioactive Substances Act, 1960. HMSO, London, 28 pp.*

⁽⁴⁾ *Great Britain - Parliament, 1990. Environmental Protection Act, 1990. HMSO, London, 235 pp.*

- (c) to ensure that regulatory requirements have been met;
- (d) to check operators' results;
- (e) to provide an independent means of surveillance for inadvertent or unrecorded discharges;
- (f) to provide public reassurance;
- (g) (pre-operationally) to establish background levels;
- (h) to detect any long-term trends.

Usually, several of these objectives apply in the case of any given monitoring programme. It is for each organisation carrying out environmental monitoring to decide on the objectives of its own programme.

In addition, monitoring programmes may also provide information that can be used to quantify radiation exposure pathways and so to confirm the scientific basis of assessments of public radiation exposures.

4. ANNOTATED BIBLIOGRAPHY

The following sub-sections present synopses of monitoring programmes in the three areas: Governmental and Government-funded programmes; site operators' programmes; and local and public authority programmes. Within each section, programmes are listed in alphabetical order of the organisation.

4.1 Government and Government-funded programmes

4.1.1 Department of the Environment (*Digest of Statistics*)

Generic title:	Digest of Environmental Protection and Water Statistics
Published by:	Government Statistical Service (Department of the Environment, Environmental Protection Statistics and Economics Division)
Available from:	DOE, Radioactive Substances Division, Romney House, 43 Marsham Street, London SW1P 3PY
Cost:	£13.50
Frequency:	Annually
First issue:	1983
Scope:	<p>Data abstracted from the results of a number of radioactivity monitoring programmes are presented, including:</p> <ul style="list-style-type: none">Radiation exposure of the UK population: % contribution from various sources to the average effective dose equivalent.Percentage of homes in the UK with radon concentrations above 200 Bq/m³, by county (map).Radioactive atmospheric discharges (annual), by type of radioactivity and type of site.Radioactive liquid discharges (annual), by type of radioactivity and type of site.Concentration of Cs-137 in filtered water from the Irish and North Seas (maps).Annual average concentrations of Sr-90 and Cs-137 in milk from farms near Sellafield, Dounreay, Harwell and Winfrith.Radioactive liquid waste: estimated public radiation exposure, by discharge site.Radioactive solid waste: volume disposed of at Drigg, by source of waste.

4.1.2 Department of the Environment for Northern Ireland

- Generic title:** Report of the Chief Alkali Inspector
- Published by:** HMSO, Belfast, on behalf of the Department of Environment for Northern Ireland
- Available from:** HMSO, Belfast
- Cost:** £3.60
- Frequency:** Every 2 years
- First issue:** Not stated
- Scope:** The report covers all of the activities of the Alkali and Radiochemical Inspectorate of which responsibilities connected with radioactivity are only a part. Monitoring activities include:
- (i) Collection quarterly of seaweed from the Ards Peninsula and Portrush. Species include *Fucus vesiculosus* and *Rhodomenia palmata*. Analytes are total beta, gamma spectrometry and transuranics.
 - (ii) Collection quarterly of whiting, herring, dogfish, cod, *Nephrops* and winkles landed at Ardglass, Kilkeel or Portavogie. Analytes as (i).
 - (iii) Shoreline gamma dose rates at selected sites quarterly.
 - (iv) Collection every 6 months of sediments from 6 coastal sites. Analytes as (i).
- Samples are sent to MAFF Lowestoft for analysis, and published in the MAFF report entitled "Radioactivity in Surface and Coastal Waters of the British Isles" (see sub-section 4.1.5). A selection of the results is published by the Chief Alkali Inspector. They can also be found in the "Northern Ireland Abstract of Statistics", published by HMSO, Belfast.
- Other information:** The report also summarises any special research or investigations into radioactivity, along with other responsibilities of the Chief Alkali Inspector.

4.1.3 Her Majesty's Industrial Pollution Inspectorate for Scotland (HMIPI)

- Generic title:** Statistical Bulletin: Environmental Monitoring for Radioactivity in Scotland [year]
- Published by:** HMIPI
- Available from:** Her Majesty's Industrial Pollution Inspectorate for Scotland, 27 Perth Street, Edinburgh EH3 5RB
- Cost:** £1
- Frequency:** Not stated
- First issue:** 1980-83 (published 1984)
- Scope:** The bulletin contains a summary of the environmental monitoring for radioactivity carried out in Scotland as part of the statutory procedure for ensuring the safety of radioactive waste disposals from nuclear facilities. It presents summarised results obtained by the nuclear operator together with 'check' monitoring undertaken by HMIPI for environmental media other than water. The aquatic environment is monitored by the Directorate of Fisheries Research, MAFF. Summaries of its results are also presented. (Both DFR and the operators publish their own reports of data; these are referenced elsewhere in this bibliography.) Nuclear sites covered include Chapelcross, Dounreay, Hunterston, Torness, Clyde Submarine Base, Holy Loch, Rosyth, as well as the effects on the Scottish coast of Sellafield in England. The HMIPI 'check' monitoring includes milk, thyroid glands from sheep, and soil and grass from farms situated around the nuclear site. These are analysed for selected fission products and transuranics. 'Check' monitoring also includes the use of dry cloth airborne dust collectors, as well as marine samples such as seaweed, shellfish, sediment, fish and seawater dealt with by the DFR.
- Other information:** The report includes a useful review of standards for radiation control.

4.1.4 Her Majesty's Inspectorate of Pollution (HMIP)

Generic title: HMIP's Monitoring Programme: Radioactive Substances Report for [year]

Published by: Her Majesty's Inspectorate of Pollution

Available from: HMIP, Romney House, 43 Marsham Street, London SW1P 3PY

Cost: No charge

Frequency: Intended annually

First issue: For 1988 (published January 1991)

Scope: The monitoring programme concentrates on monitoring activity levels in environmental materials which might result in radiation exposure of the public from non-food pathways such as might arise from the occupation of beaches, river banks or other areas for leisure purposes. It is intended to complement similar annual reports published by MAFF (see elsewhere), and acts as a check on site operator's returns. The programme consists of a survey of radiation levels and radiochemical and gamma spectrometric analysis of samples collected in the vicinity of BNFL sites at Sellafield, Drigg, Springfields, Capenhurst; 10 nuclear power stations in England and Wales; UKAEA sites at Harwell and Winfrith; Amersham International PLC sites at Amersham and Cardiff; the MOD site at Aldermaston; at two non-nuclear factory sites registered under the Radioactive Substances Act 1960⁽¹⁾; and at several landfill sites receiving low-level solid radioactive wastes.

Environmental materials sampled include water and sediments from ponds, lakes, streams and rivers in areas used by the public. Also, surface waters which are sources of drinking water. Direct instrumental monitoring is applied to beaches and river banks.

Other information: The 1988 report provides a summary of legislation, protection standards, analytical methods, etc.

⁽¹⁾ Great Britain - Parliament, 1960. *Radioactive Substances Act, 1960*. HMSO, London, 28 pp.

4.1.5 *Isle of Man*

- Generic title:* Radioactivity Monitoring on the Isle of Man
- Published by:* Dept of Local Government and the Environment, Isle of Man Government
- Available from:* Government Laboratory, Kingswood Grove, Douglas, Isle of Man
- Cost:* No charge
- Frequency:* Annually; funding secure until 1993
- First issue:* 1989
- Scope:* Original results independent of UK authorities.
- Seawater, rainwater and drinking water; background dose rate and radon gas in buildings; mutton, leafy vegetables and potatoes in Manx farm produce; soil samples; high volume air sampling.
- Fish and shellfish from Isle of Man waters, and mussels, seaweed and silt collected from the shoreline.
- (Not all of this monitoring programme was established in time for the 1989 report).
- Analytes: Gamma spectrometry; total alpha and beta activity. Individual alpha- and beta-emitting radionuclides will be analysed when the methods have been developed and intercalibrated in the Government Laboratory.
- Other information:* The scope, objectives and timetable of the monitoring programme are described in the 1989 report along with analytical methods.

4.1.6 Ministry of Agriculture, Fisheries and Food (Aquatic)

- Generic title:* Radioactivity in Surface and Coastal Waters of the British Isles [year]
- Published by:* Ministry of Agriculture, Fisheries and Food, Directorate of Fisheries Research
- Available from:* The Library, MAFF Fisheries Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 0HT
- Cost:* No charge
- Frequency:* Annually
- First issue:* 1963 (published in 1967. Reports were originally published in the MAFF Fisheries Radiobiological Laboratory Technical Report series; since 1979, published in the MAFF Aquatic Environment Monitoring Report series).
- Scope:* Independent original radioanalytical data are published from monitoring of the following locations, species and analytes.
- Locations:* Monitoring of the aquatic environments around the major nuclear sites in the UK. These include all nuclear power stations, BNFL nuclear establishments, UKAEA sites, naval sites, Amersham International sites and the Channel Islands; monitoring of other UK coastal sea areas, especially the Irish and North Seas; monitoring of selected freshwater sites (since 1986 this has included deposition from Chernobyl). Most detailed information is given for Irish Sea locations.
- Species:* Analyses of numerous aquatic materials, including: sea and freshwater, about 20 species of fish (marine and freshwater), about 15 species of shellfish, seaweeds, freshwater algae and sediments.
- Analytes:* Alpha radionuclides by alpha spectrometry following chemical separation. Beta activity, mainly as total beta, but with specific radionuclides following chemical separation. Gamma radionuclides by gamma spectrometry. About 25 radionuclides are included, about 10 of which are actinides.
- External exposure:* Gamma dose rates over sediments are presented, and contact beta dose rates from fishing gear.
- Other information:* Data are included on liquid discharges from the major UK establishments, estimates of critical group doses and collective doses to the UK and the rest of Europe.

4.1.7 Ministry of Agriculture, Fisheries and Food (Terrestrial)

Generic title: Terrestrial Radioactivity Monitoring Programme (TRAMP): Radioactivity in Food and Agricultural Products in England and Wales

Published by: MAFF Publications, London SE99 7TP

Available from: Food Safety (Radiation) Unit, Ministry of Agriculture, Fisheries and Food, Nobel House, 17 Smith Square, London SW1P 3JR

Cost: £4.95

Frequency: Annually

First issue: 1986 (published in 1988)

Scope: Original radioanalytical data, independent of nuclear site operators, are published from monitoring of the following materials, locations and analytes:

Milk: from 3 to 12 farms around each of 9 Nuclear Electric stations, Harwell, Winfrith, Amersham, Cardiff, Sellafield, Drigg, Capenhurst, and Springfields. As a result of the Chernobyl accident in 1986, additional milk monitoring was carried out in 1989 for 28 dairies around England and Wales, and for 4 farms in the Isle of Man.

Crops (e.g. cabbages, lettuces, cereals and fruit): from fields around 9 Nuclear Electric stations, Sellafield, Drigg and Isle of Man.

Grass and soil: from the vicinity of Capenhurst and Springfields; also herbage (grass) from minor nuclear sites at Ascot, Billingham, Derby, and Risley.

Animal meat and offal: from farms near Sellafield, Drigg, Springfields, and Isle of Man; most samples are from cows or sheep, but other species as well as faecal material may also be collected.

Analytes, depending on location and material: H-3, C-14, S-35, Sr-90, Tc-99, I-125, I-129, I-131, Cs-134, Cs-137, Co-60, Nb-95, Zr-95, Ru-103, Ru-106, Ag-110m, Ce-144, U-234, U-235, U-238, Pu-238, Pu-239, Pu-240, Am-241. A gamma scan may also be used.

Other information: Average food consumption rates, plus assessments of dose from the consumption of food are included with each site's results. Results are presented from the monitoring of airborne activity using arrays of dry cloth collectors maintained around major nuclear sites (9 Nuclear Electric, 3 BNFL, 2 UKAEA, 2 Amersham International). Brief reports of investigations into accidental releases of radiation are also given.

4.1.8 National Radiological Protection Board (NRPB)

- Generic title:** Environmental Radioactivity Surveillance Programme: Results for [year]
- Published by:** National Radiological Protection Board, Chilton, Didcot, Oxon OX11 0RQ
- Available from:** HMSO, PO Box 276, London SW8 5DT
- Cost:** £4
- Frequency:** Annually
- First issue:** For 1975 (published 1976)
- Scope:** Airborne dust is sampled continuously through polystyrene or polycarbonate filters. These are collected fortnightly and gamma-ray-emitting radionuclides are determined in each sample. Filters are bulked on a quarterly basis for the determination of alpha-emitting isotopes of plutonium. The sampling stations are in London, Guernsey and Glasgow. Rainwater is also collected continuously at these sites as well as at Belfast and Bridgend. Samples are analysed for gamma-ray-emitting radionuclides on a monthly basis and bulked quarterly for the determination of strontium-90. Samples of milk are obtained each month from over 70 creameries that account for a significant proportion of the milk production of the UK. These are bulked in a statistical manner to provide samples that are representative of England, Wales, Scotland and Northern Ireland. Monthly bulks are then combined on a quarterly basis for the determination of caesium-137 and strontium-90. Separate analyses are carried out for samples from the Channel Islands and the Isle of Man. Summaries of all of these results are presented along with estimated effective dose equivalents and an assessment of possible human health implications.
- Other information:** Methods of sampling and analyses are described and there is a full reference list. The programme for airborne dust and rainfall proceeds in collaboration with that operated by AEA Technology (sub-section 4.1.10). Results for the AEA sampling station at Milford Haven are included in the NRPB report.

4.1.9 **Radioactive Incident Monitoring Network (RIMNET)**

- Generic title:** RIMNET. Gamma-radiation Dose Rates at Monitoring Sites Throughout the United Kingdom [date]
- Published by:** Government Statistical Service (as a Department of the Environment Statistical Bulletin)
- Available from:** DOE, Room A522, Romney House, 43 Marsham Street, London SW1P 3PY
- Cost:** No charge
- Frequency:** Biannually
- First Issue:** 1989
- Scope:** The Radioactive Incident Monitoring Network (RIMNET) has been set up as part of the Government's National Response Plan for detecting and responding to overseas nuclear incidents. The Phase 1 RIMNET System, currently in operation, is described in the HMSO booklet "The National Response Plan and Radioactive Incident Monitoring network (RIMNET), Phase 1", which is available from the above address.
- Location:** RIMNET Phase 1 fixed monitors are located at 46 sites throughout the United Kingdom.
- Samples:** Gamma radiation dose rate only. Readings are made manually.
- Analytes:** Gamma dose rate. Values quoted are total instrument indications and include cosmic and inherent background components as well as terrestrial gamma dose rates.
- Sampling frequency:** Hourly readings are taken and are published as monthly averages for each site with standard deviations and maximum and minimum readings during the month.
- Other information:** The RIMNET Phase 2 system will become operational in 1992. Fixed monitors will be located at 92 sites and will transmit readings automatically to a central database.

4.1.10 United Kingdom Atomic Energy Authority (UKAEA) - Fallout

- Generic title:** Radioactive Fallout in Air and Rain - Results to the End of [year]
- Published by:** UKAEA
- Available from:** HMSO, PO Box 276, London SW8 5DT or from Environmental and Energy Division, Harwell Laboratory, Oxfordshire OX11 0RA
- Cost:** £8.00
- Frequency:** Annually
- First issue:** 1957
- Scope:** Original radioanalytical data are published from monitoring as follows:
- Airborne particulates: Lerwick, Glasgow, Eskdalemuir (Dumfries), Conlig (Co. Down), Orfordness (Suffolk), Milford Haven, Chilton, Compton and London in the UK, plus 11 other sites scattered worldwide.
 - Rainwater: To the above list for the UK, add Snowdon, Aldergrove (Antrim). Internationally, there are 6 additional sites.
 - Analytes: Cs-134, Cs-137, Ce-144, Zr-95, Sr-90, Pu-238,239 and 240, tritium.
- Other information:** Scientific implications and any special features of the results are discussed (e.g. effects of the Chernobyl reactor accident). The results for Glasgow and London are provided from the programme operated by NRPB (subsection 4.1.8).

4.1.11 *Welsh Office (Environmental Digest)*

Generic title: Environment Digest for Wales

Published by: Welsh Office and Government Statistical Service

Available from: Environmental Protection Division, Welsh Office, Cathays Park, Cardiff CF1 3NQ

Cost: £6.00

Frequency: Annually

First issue: 1987

Scope: The Digest contains one chapter which abstracts information, from a number of monitoring programmes, on the levels of environmental radioactivity in Wales. Results are presented for the monitoring of radioactivity in rainwater and air and also in the foodstuffs milk and laverbread. The report summarises the discharges from the Nuclear Electric power stations at Trawsfynydd and Wylfa and the Amersham International and Atomic Weapons Establishment sites at Cardiff. Gamma radiation doses, collective doses and the radioactivity of environmental materials around the power stations are presented, together with information on levels of radioactivity near the Cardiff sites. Finally, summaries of gamma dose rates, and beta and gamma radioactivity around the Welsh coast and in the Irish Sea are given, to show the trends with time.

Other information: The levels of radioactivity measured in the previous year are collated.

4.2 Site Operators' Programmes

4.2.1 British Nuclear Fuels plc (BNFL)

- Generic title:** Radioactive Discharges and Monitoring of the Environment [year]
- Published by:** British Nuclear Fuels plc (BNFL), Health and Safety Directorate
- Available from:** BNFL, Health and Safety Directorate, Risley, Warrington, Cheshire WA3 6AS
- Cost:** No charge
- Frequency:** Annually
- First issue:** 1977
- Scope:** Original radioanalytical data are published from monitoring of the following locations, species and analytes:
- Location:** Coastal waters and terrestrial environments local to Sellafield, Drigg, Capenhurst, Chapelcross and Springfields.
- Species:** In the aquatic environment: seawater, about 10 species of fish (marine and fresh), about 5 species of shellfish, various seaweeds and sediments. In the terrestrial environment: air, green vegetables, root crops, grass, milk, meat (beef, pig, lamb), eggs, soil and animal faeces.
- Analytes:** Internal exposure: Total alpha and beta analyses are presented with some data on specific radionuclides. Gamma data are covered by individual radionuclides. About 20 individual radionuclides are reported on, of which about 5 are actinides. External exposure: gamma dose rates are reported, predominantly at locations close to the nuclear sites.
- Other information:** Data are included on liquid and gaseous discharges, and for solid waste disposals at Drigg, Ulnes Walton and Clifton Marsh. Critical group doses are estimated, along with collective dose to the UK population and European population (including the UK). The appendices include Site Discharge Authorisations and data on dose per unit intake.

4.2.2 Ministry of Defence, Atomic Weapons Establishment

- Generic title:** Radiological Monitoring During [year] in West Berkshire and Northern Hampshire in the General Locality Surrounding the Ministry of Defence (PE) AWE Stations in Berkshire Located at AWE (Aldermaston) and AWE (Burghfield)
- Published by:** Atomic Weapons Establishment, Safety Division
- Available from:** Safety Division, AWE (Aldermaston), Reading, Berkshire RG7 4PR.
- Cost:** No charge
- Frequency:** Annually
- First issue:** Not stated, but 1985 or before
- Scope:** Original radioanalytical data are published from monitoring of the following locations, materials and analytes:
- High volume air sampling: At Aldermaston, Burghfield, Newbury, Basingstoke, Reading and Tadley. Levels and origin of uranium and plutonium components of collected dusts are measured, plus total alpha and total beta activities, and airborne lead particles.
 - Airborne dust sampling - passive type: At the boundary of, close to and distant from the AWE sites. Average alpha radioactivity concentration (kBq/kg) is measured.
 - Surface water sampling: At Aldermaston, Burghfield and at about 12 other sites within 12 km. Levels of uranium, plutonium, tritiated materials, total alpha and total beta radioactivity are measured.
 - Soil and vegetation: As for passive airborne dust sampling. Total alpha, total beta and tritiated materials are measured routinely, uranium and plutonium as resources permit.
 - Radiation exposure: Routine survey at Aldermaston and Burghfield using thermoluminescent dosimeters.
 - Rainfall: Total alpha and tritiated water in rainfall are assessed at Aldermaston.
- Other information:** Data for liquid effluents and airborne discharges are given, together with results of any special surveys, e.g. to cover leaks or spills.
-

4.2.3 Ministry of Defence, Defence Radiological Protection Service

- Generic title:** Marine Environmental Radioactivity Surveys at Nuclear Submarine Berths in the UK [year]
- Published by:** HMSO
- Available from:** HMSO, PO Box 276, London SW8 5DT
- Cost:** £8.95
- Frequency:** Annually
- First issue:** For 1988 (published October 1989)
- Scope:** The report details results of routine marine environmental radioactivity surveys undertaken by DRPS around the main nuclear submarine berths in the UK (Rosyth, Devonport, Faslane and Holy Loch) and at other locations visited by nuclear-powered submarines. A US Navy report describing their environmental surveys at Holy Loch is also included.
- The monitoring programme covers both intertidal and underwater areas around the berths and includes:
- (i) Gross gamma dose rate measurements along the shoreline close to the low water line. Sediment and biological samples (seaweed, shellfish, etc.) are collected for laboratory analysis.
 - (ii) Underwater sediment samples collected in harbours and surrounding waters to indicate the distribution of any radioactivity which may be present.
- The emphasis of the DRPS programme is on the detection and measurement of cobalt-60 which is the major nuclide of concern, although analysts routinely search for all other gamma-emitting radionuclides which may be present. The US survey at Holy Loch is generally similar in scope.
- Other information:** The report includes details of radioactive discharges to the marine environment, and calculations of the radiation doses received by the critical group in each location.

4.2.4 Nuclear Electric plc

- Generic title:** Report on Radioactive Discharges and Environmental Monitoring at Nuclear Sites During [year]
- Published by:** Nuclear Electric plc, Health and Safety Department
- Available from:** Nuclear Electric plc, Health and Safety Department, Bedminster, Bristol BS13 8AN
- Cost:** £15 (cover price)
- Frequency:** Annually
- First issue:** Previous issues have been published by National Power and the Central Electricity Generating Board since 1978.
- Scope:** The document summarises the results of measurements made at each of the Company's nuclear sites for the previous year to assess the quantities of radioactive waste discharged and to determine the effect of such discharges on the environment. Comparisons with statutory or other limits, and with previous measurements are made. The following materials are analysed: atmospheric dust from dry cloth collectors, milk from local farms, herbage, soil cores (to 15 cm), and silt, seaweed, shellfish and fish, together with gamma dose rates over intertidal silts in the vicinity of marine discharges. Trout and perch are sampled at Trawsfynydd. Samples may be analysed for S-35, Sr-90, total beta, transuranics and by gamma spectrometry as appropriate. Environmental gamma dose rates are measured by portable instruments at distances up to 30 km from stations, but mostly at radii of 1 and 10 km. Integrating dosimeters are deployed around perimeter fences. The nuclear power station sites are at Berkeley, Bradwell, Dungeness, Hartlepool, Heysham, Hinkley Point, Oldbury, Sizewell, Trawsfynydd and Wylfa.
- Other information:** Data on discharges and waste disposals are also given.

4.2.5 *Scottish Nuclear Ltd*

<i>Generic title:</i>	Safety and the Environment [year]
<i>Published by:</i>	Scottish Nuclear Ltd
<i>Available from:</i>	The Director of Safety, Scottish Nuclear Ltd, Minto Building, 6 Inverlair Ave, Glasgow, G44 4AD
<i>Cost:</i>	No charge
<i>Frequency:</i>	Annually
<i>First issue:</i>	For 1990
<i>Scope:</i>	The report contains information on radioactive discharges and monitoring of the environment in relation to the Hunterston and Torness nuclear power stations operated by SNL. Marine monitoring around both sites takes into account potential exposure pathways for critical groups of humans and includes external gamma dose rates at beach locations, fore-shore sediments, sea foods and seaweed. Isotopes typical of the site discharges are analysed. The dispersion of gaseous discharges of radionuclides is monitored with passive Tacky Shade samplers positioned around the sites. They are routinely analysed for adhering activity. Local terrestrial foodstuffs including milk, herbage and crops, together with soil are also analysed. Summaries of all of these results are presented in order to make a complete assessment of the possibility of human health hazards arising from the two power stations.
<i>Other information:</i>	The report also contains summaries of liquid, gaseous and solid discharges, and relates these to operations during the year.

4.2.6 United Kingdom Atomic Energy Authority (UKAEA) - (all sites)

- Generic title:** Radioactive Waste Disposal by UKAEA Establishments During [year] and Associated Environmental Monitoring Results
- Published by:** UK Atomic Energy Authority
- Available from:** Safety and Reliability Directorate, UKAEA, Wigshaw Lane, Culcheth, Warrington WA3 4NE or HMSO and agents
- Cost:** £6.00
- Frequency:** Annually
- First issue:** Not stated
- Scope:** This is a summary report for the whole of AEA, incorporating Harwell and Winfrith data (see separate summaries, sub-sections 4.2.7 and 4.2.8), plus contributions from Dounreay, Windscale and Springfields for which separate reports are not published.
- Dounreay: Dose rates to salmon netmen and those eating winkle flesh (critical groups) are summarised, along with measurements in marine sediments, seaweed (*Fucus serratus*), winkles, various fish and crustaceans. Analytes include Sb-125, Ce-144, Ru-103/106, Zr-95, Nb-95, Cs-137, Co-60, Ag-110m, Mn-154, plus gross alpha activity. Milk is sampled from 14 farms within 8 km of Dounreay and analysed for I-131, Sr-90, Cs-137 and I-129, and results are summarised in this report. Results from herbage, air and rainwater collected locally are also given.
- Windscale: Environmental monitoring in respect of discharges from the Sellafield site (including AEA Windscale) are published by BNFL (see separate report summary, sub-section 4.2.1).
- Other information:** The report gives data for waste discharges to air, water and land from all AEA sites, including solid disposals to Drigg and at Dounreay.

4.2.7 UKAEA (Harwell)

- Generic title:** Harwell Laboratory Radioactive Discharges and Environmental Monitoring [year]
- Published by:** UK Atomic Energy Authority
- Available from:** Environmental Research Division, Harwell Laboratory, Oxfordshire OX11 0RA
- Cost:** No charge
- Frequency:** Annually
- First issue:** Not stated
- Scope:** Original radioanalytical data are published from monitoring of the following materials:
- Air: Cs-137, Pu-238, 239 + 240 are measured using high-volume air samples, four on the Harwell site, and one 7 km north east (Sutton Courtenay).
 - Soil: Sr-90, Cs-137, Pu-238, 239 + 240 are measured in soil samples at 5 locations within 3 km of the Harwell site.
 - Vegetables: Tritium, Sr-90, Cs-137, Pu-238, 239 + 240 are measured in beetroot, swede and cabbage taken from an allotment near the Harwell site.
 - Milk: Milk samples are analysed from four farms in the Harwell district for I-131, Cs-137, Sr-90 and tritium.
 - External irradiation: Background gamma dose rate is measured on site and in the surrounding district.
 - River water: The River Thames is sampled continuously, above and below the site discharge. Analytes are gross alpha, gross beta, Cs-137, Pu and tritium activity.
 - River silt: Silt samples are collected from 5 locations downstream of the site discharge, and one upstream. Analytes as for river water.
 - External irradiation: Gamma radiation is surveyed along the river bank to measure increases due to deposits of Cs-137 in silt.
- Other information:** In addition to environmental monitoring data, details of waste discharges to air and water, as well as of solid wastes, are given, together with the results of any special investigations.

4.2.8 UKAEA (Winfrith)

- Generic title:** Annual Report on Radioactive Discharges from Winfrith and Monitoring the Environment [year]
- Published by:** UK Atomic Energy Authority
- Available from:** Radiological and Safety Division, Winfrith Technology Centre, Dorchester, DT2 8DH
- Cost:** No charge
- Frequency:** Annually
- First issue:** 1985
- Scope:** Original radioanalytical data are published from monitoring of the following locations, species and analytes:
- Locations:** Coastal waters and terrestrial environments in the vicinity of Winfrith.
 - Species:** In the marine environment, 3 species of seaweed, 4 species of crustaceans, 6 species of molluscs, 3 species of fish, plus sediments and direct dose rates at selected beaches.
 - In the terrestrial environment, airborne particulates on and off site, milk, rain and other waters, various species of fruit and vegetables, grass, rabbits and soil.
 - Analytes:** In the marine environment, Co-58, 60, Zn-65, Mn-54, Cs-137, Pu, Am-241, alpha and gamma activities. On land, gamma dose rates. For airborne particulates, alpha, beta and gamma activities. For milk, I-129, 131, Tritium, Sr-90, Cs-137. For waters around Winfrith, tritium, gross alpha and beta activities. For terrestrial plant materials and soil, gross alpha, gamma, Cs-137, Sr-90, Pu and Am-241.
- Other information:** Details of discharges to the sea and atmosphere, plus an assessment of doses to the public are also given.

4.3 Local and Public Authority Programmes

4.3.1 Avon County Council (RADMOSS)

- Generic title:* RADMOSS Radiation Monitoring on Severnside. Annual Report
- Published by:* Avon County Council
- Available from:* Mr R J Greenslade, County Laboratory, 7 Redcross Street, Bristol, Avon BS2 0BA
- Cost:* No charge
- Frequency:* Annually
- First issue:* 1989
- Scope:* The report provides a format for the reporting of the individual results from 5 counties participating in the RADMOSS programme. A full range of terrestrial, marine and atmospheric samples are included in the programme which is designed to supplement and complement those operated by Government and industry.
- Location:* Gamma dose rates are measured at over 180 points throughout Avon, Gloucestershire, Gwent, Somerset and South Glamorgan based approximately on an 8 km grid. Other samples are taken as detailed below.
- Samples:* Avon - gamma dose rate (40 points), beach monitoring (7), foods, herbage soils silt. Gloucestershire - gamma dose rate (45). Gwent - gamma (25), beach (5), milk (13), herbage/soil (4), silt, seaweed, fish. Somerset - gamma (66), beach (6), milk (11), herbage (10), rain (10), fish, shellfish, sediment, seaweed. South Glamorgan - gamma (8), air (8), deposition (5), seaweed, silt, water, foods. Some programmes include non-local samples of foods, fertiliser, animal feed.
- Analytes:* Gamma radiation, gamma spectroscopy for atmospheric particulate, foods and other environmental samples; total beta activity for some water, air and deposition samples. Individual nuclides reported include Cs-137, Cs-134, I-131, C0-60, Mn-54, Am-241, K-40.
- Sampling frequency:* Gamma dose rate and TLD's changed every one or two months; beach monitoring often monthly as is some of the milk sampling; marine sampling usually quarterly. Other samples taken as required.
- Analysts:* Local Authority laboratories - Avon County, Somerset County, Cardiff City and Gloucester Royal Hospital
- Other information:* The programme will probably be developed to include gross beta and gross alpha in some atmospheric particulate and rainwater samples. The monitoring in Somerset also includes surface contamination of Bridgewater railway sidings and Tc-99 and I-131 determination in sewage works waste.

4.3.2 **Bedfordshire**

- Generic title:** Annual Report on Progress of Radiation Baseline Monitoring
- Published by:** Bedfordshire Joint Local Authorities Steering Group on Radiation Baseline Monitoring
- Available from:** County Emergency Planning Officer, Bedfordshire County Council, County Hall, Cauldwell St., Bedford, MK42 9AP
- Cost:** No charge
- Frequency:** Annually
- First issue:** August 1989
- Scope:** Location: 8 monitoring sites in Bedfordshire (1 airport, 1 school, 6 sewage treatment works).
Samples: Gamma dose rate, soil, milk, grass, water.
Analytes: Gamma dose rate. Gamma spectroscopy (Be-7, K-40, Cs-137).
Sampling frequency: Gamma dose rate and soil initially sampled weekly but frequency now reduced to fortnightly, results reported monthly. Milk and grass results reported monthly; water results bi-monthly.
- Analysts:** Gamma dose rate measurements made by local authority staff. Analysis of environmental samples now carried out on behalf of programme managers by AEA Technology, Harwell.
- Other information:** Proposals for the programmes' future include more extensive gamma dose rate measurements, based on 5 km grid, quarterly soil, milk and herbage sampling.

4.3.3 Cleveland

- Generic title:* Report of the Boroughs of Cleveland Pollution Control Group
- Published by:* Boroughs of Cleveland Pollution Control Group
- Available from:* Environmental Services Department, Stockton-on-Tees Borough Council, 16 Church Road, Stockton-on-Tees, Cleveland S18 1TX
- Cost:* No charge
- Frequency:* Biennially
- First issue:* Radiological measurements began in 1982
- Scope:* The report covers environmental measurements, principally of air quality, carried out in Cleveland. The pollution control group, set up in 1974, considers data on smoke, sulphur dioxide, nitrogen dioxide, landfill gases, odours, waste incineration, CFC's, noise as well as radiological monitoring.
- Location:* Measurements made in each of the Boroughs of Hartlepool, Lanbaugh-on-Tees, Middlesborough, Stockton-on-Tees. Gamma dose rate measurements made at 27 locations, 10 dry cloth deposition collectors deployed, silt samples taken from 4 locations and milk taken from one farm.
- Samples:* Food - milk, fish and shellfish.
Environment - gamma dose rate, atmospheric particulate, silt, grass, seaweed.
- Analytes:* Gamma radiation, gamma activity on particle collectors (with occasional gamma spectroscopy), gamma spectroscopy on other environmental samples with results for only Cs-137 reported explicitly.
- Sampling frequency:* Gamma dose rate and atmospheric particulate measured monthly; milk is sampled monthly from one farm and analysed quarterly; silt analysed quarterly; other samples taken as required.
- Analysts:* Initial analyses are carried out by local authority laboratories in the county, with a selection analysed for individual radionuclides at an (unspecified) outside laboratory. Advice provided by Cleveland Medical Physics Unit.
- Other information:* The Group collaborated in the IEHO national survey of radon on homes with samples analysed at the University of Lancaster. No further surveys of radon are planned.

4.3.4 Cumbria

Generic title: Environmental Radiation Monitoring by Local Authorities in Cumbria

Published by: City of Carlisle

Available from: Director of Environmental Services, Civic Centre, Carlisle,
Cumbria CA3 8QG

Cost: No charge

Frequency: Annually

Scope: The report is a compilation of data provided by the six District Councils in Cumbria.

Location: 69 gamma radiation monitoring sites.

Six district councils, grouped in pairs, sampled for food produced locally.

Samples: Two samples of water, milk, fruit or vegetables, vegetation or honey.

Analytes: Cs-134/137, K-40.

Sampling frequency: Monthly.

Analysts: Regional Medical Physics Department, Newcastle General Hospital.

4.3.5 Dyfed (RADMID)

Generic title: RADMID. Radiation Monitoring in Dyfed

Published by: Carmarthen District Council

Available from: Director of Environmental Health/Carmarthen District Council, District Council Offices, 3 Spilman Street, Carmarthen, Dyfed SA31 1LE

Cost: No charge

Frequency: Annually

First issue: 1988

Scope: This report is the first from a programme set up in 1987 as a joint exercise between the Dyfed County Council, the 6 District Councils (Carmarthen, Ceredigion, Dinewr, Llanelli, Preseli Pembrokeshire, South Pembrokeshire), and the Milford Port Health Authority and covers measurements of the local environment and samples together with imported foods.

Location: Gamma dose rate measurements are taken at 66 locations throughout the county based on a 10 km grid. Monitoring of activity on beaches including the estuaries of the Dovey, Ystwyth, Teifi, Loughor and areas at Tenby, Canaston, Newland Quay, Ferryside, Fishguard. Shellfish from Pwllcrochan Flats, Borth, Amroth, Burry estuary. Grass from 6 sites; sheepmeat from 7 sources and milk from 12 areas; water from 5 areas.

Samples: Environment - gamma dose rate, flotsom and jetsom on beaches, mud and silt, seaweed, grass.
Ingestion - water, shellfish, fish, sheepmeat, milk, imported yoghurt.

Analytes: Gamma dose rate. Gamma spectrometry and total beta activity. Individual nuclides reported include Cs-137, Cs-134, Ru-106, Nb-95, Th-234, Am-241, I-131.

Sampling frequency: Approximately quarterly for gamma dose rate although it is intended that the programme continues with monthly readings. Other samples taken on an occasional basis.

Analysts: Radman Associates and Cardiff City Council Public Analysts Radiochemical Section.

4.3.6 East Sussex

- Generic title:* Annual Report of East Sussex Radiation Monitoring Group
- Published by:* Emergency Planning Division, East Sussex County Council
- Available from:* Emergency Planning Division, PO Box 5, County Hall, St Annes Crescent, Lewes, East Sussex BN7 1SW
- Cost:* No charge
- Frequency:* Annually
- First issue:* 1989
- Scope:* The programme aims to provide background data, available to the public, and identify any trends in radiation exposure across the county. The programme is operated by, and on behalf of, a consortium of East Sussex County Council, local authorities (Borough and District Councils), the National Rivers Authority and Brighton Health Authority.
- Location:* 28 monitoring sites in East Sussex (together with 4 in mid-Sussex) at locations approximating to a 10 km grid.
- Samples:* Food - milk, meat, fish, shellfish, fruit, vegetables, honey, eggs, wine and other locally produced foodstuffs.
Environment - gamma dose rate, silt water.
- Analytes:* Gamma dose rate. Gamma spectroscopy (Co-57, Co-58, Co-60, Ce-144, Ce-141, I-131, Ru-103, Ru-106, Cs-134, Cs-137, Zr-95, Nb-95, Mn-54, Zn-65). Alpha analysis (Pu-239+240, Pu-238).
- Sampling frequency:* Gamma dose measurements made monthly. Food samples taken quarterly, and other samples as required.
- Analysts:* Department of Physics, University of Surrey, Guildford.
- Other information:* Am-241 results to be reported in future for marine samples.

4.3.7 Forth Estuary

Generic title: Standing Conference of Local Authorities in the Forth Estuary: Quarterly Compilation of Radiation Monitoring Results

Published by: The Standing Conference of Local Authorities in the Forth Estuary

Available from: Dunfermline District Council, 5-7 Comely Park, Dunfermline, KY12 7HU

Cost: No charge

Frequency: Quarterly and annually

First issue: April 1988

Scope: The quarterly reports contain results for 3 months monitoring of the aquatic, terrestrial and atmospheric environments by a consortium of local authorities around the Forth Estuary. Comment is reserved to 6 monthly and annual report.

Location: Samples taken from within the following districts: Berwickshire, E. Lothian, Midlothian, W. Lothian, Edinburgh, Falkirk, Stirling, Clackmannan, Dunfermline, Kirkcaldy, N.E. Fife. Gamma dose rate at 80+ locations.

Samples: Food - fish, shellfish, milk, vegetables. Environment - silt, sediment, soil, peat, dust, grass, seaweed, air, deposition, gamma dose rate.

Analytes: Cs-137, Cs-134, Co-60, in all samples; I-131, Be-7 occasionally. Gamma dose rate.

Sampling frequency: Monthly for most samples; some gamma dose rate measurements made fortnightly.

Analysts: Edinburgh Radiation Consultants, Napier College, Lothian Regional Analyst's Laboratory, and Stirling University. Dose rate measurements by Environmental Health staff and Edinburgh Radiation Consultants.

4.3.8 Kent

- Generic title:** Environmental Radiation Monitoring in Kent
- Published by:** Kent Chief Environmental Health Officers Group, Radiation Monitoring Working Group
- Available from:** Secretary of Kent CEHO Group, Tonbridge and Malling Borough Council, Council Offices, The Air Station, West Malling, Kent ME19 6LZ
- Cost:** No charge
- Frequency:** Occasional
- First issue:** 1990
- Scope:** The programme was set up in order to supplement the data available from the RIMNET scheme which was considered insufficient for an accurate radiological assessment on a District by District basis.
- Location:** 42 monitoring sites within the county of Kent, distributed approximately according to a 10 km grid pattern.
- Samples:** Gamma dose rate.
- Analytes:** Gamma dose rate.
- Sampling frequency:** Monthly, with data for October 1989 - March 1990 contained in the first report.
- Analysts:** Measurements made by local authority staff.
- Other information:** Extension of the monitoring schedule, and the possible inclusion of sampling of foodstuffs will be considered in the light of recommendations from LARRMACC.

4.3.9 Lancashire (RADMIL)

- Generic title:** Annual Report of RADMIL
- Published by:** RADMIL (Radiation Monitoring in Lancashire) Steering Group
- Available from:** On request from the County Analyst, Lancashire County Council, County Laboratory, Pedders Lane Road, Dock Estate, Aston on Ribble, Preston PR2 2TX
- Cost:** No charge
- Frequency:** Annually
- First Issue:** 1986
- Scope:** Original data are reported from local authority monitoring programmes operating in Lancashire, and results compared with those from Government and nuclear operators. Dose assessment is discussed and results compared with GDL's.
- Location:** Lancashire including BNFL Springfields. TLD's are deployed at 72 sites, mainly residential but including 4 beach and coastline areas. Instantaneous gamma dose rate measurements at intertidal areas of major estuaries. Foodstuffs sampled from local points of production or landing and retail sources.
- Samples:** Internal exposure - locally produced foodstuffs (cows and goats, milk, meat, vegetables, fruit, fish, shellfish), atmospheric particulate. Imported foods from Eastern Europe.
External exposure - gamma dose rate; activity in sediment.
- Analytes:** Gamma dose rate; total beta contamination of material stranded on beaches; gamma scan (Ru-106, I-131, Cs-137, Cs-134, Th-234) in food and environmental samples. Alpha spectroscopy (Pu-238, Pu-239, Pu-240, U-234, U-235, U-238) in fish, shellfish, sand and sediment.
- Sampling frequency:** TLD's changed monthly. Static gamma dose rate measurements taken quarterly, and beach surveys carried out monthly. Milk sampling variable but some monthly and quarterly schemes in evidence. Other environmental material sampled occasionally.
- Analysts:** University of Lancaster and County Council analytical services.
- Other Information:** The reports incorporate data from the independent Lancaster City Council Monitoring Programme. Results from radon monitoring are the subject of separate, irregular, reports.

4.3.10 Manchester

- Generic title:* Background Gamma Radiation Monitoring in Greater Manchester and Surrounding Area.
- Published by:* Manchester Area Pollution Advisory Council
- Available from:* Principal Environmental Health Officer, Borough Environmental Health and Consumer Protection Department, Wigan Metropolitan Borough Council, New Town Hall, Library Street, Wigan WN1 1NN
- Cost:* No charge
- Frequency:* Occasional
- First issue:* 1988
- Scope:* Location: 22 regular monitoring sites for gamma radiation dose in 13 local authority areas (Bolton, Bury, High Peak, Macclesfield, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford, Warrington, Wigan).
- Samples: Gamma dose rate. Results from a programme of food monitoring are not presented.
- Analytes: Gamma dose rate.
- Sampling frequency: Gamma dose rate measurements made at each of the regular monitoring points every 28 days.
- Analysts:* Measurements taken by local authority staff. Food analyses to be carried out by Greater Manchester Scientific Services Laboratory.

4.3.11 Newcastle-upon-Tyne

- Generic title:** Consumer and Environmental Protection in Newcastle-upon-Tyne - Annual Report
- Published by:** City of Newcastle-upon-Tyne
- Available from:** Director, Department of Engineering, Environment and Protection, City of Newcastle-upon-Tyne NE1 8PD
- Cost:** No charge
- Frequency:** Annually
- Scope:** Radiation monitoring data is included in the Department's annual report.
- Location:** An automated gamma radiation monitoring network throughout the Tyne and Wear area came into operation in February 1991. Dose rates are also measured at various locations in the City on a monthly basis.
- Samples:** Four samples of each of drinking water, meat and milk from sources in the City.
- Analytes:** Gamma radiation, Caesium 134/137 and gamma spectroscopy search for I-131, Co-60, Ru-103 and Ru-106.
- Sampling frequency:** Quarterly for food and water samples; gamma dose rates monitored continuously at two points within the City (and at another 8 points within Tyne and Wear).
- Analysts:** Regional Health Authority Medical Physics Laboratory

4.3.12 Northern Ireland Public Health Committees

<i>Generic title:</i>	Report on the Northern Ireland Local Authority Environmental Monitoring Programme
<i>Published by:</i>	Belfast City Council
<i>Available from:</i>	Deputy Chief Administrative Environmental Health Officer, Northern Group Public Health Committee "Ardeevin", 80 Galgorm Road, Ballymena, Co. Antrim BT42 1AB
<i>Cost:</i>	No charge
<i>Frequency:</i>	Annually
<i>Scope:</i>	<p>The report covers the monitoring by the four Public Health Committees of Northern Ireland in conjunction with Belfast City Council.</p> <p>Location: Marine sampling sites are located at 32 points around the North East coast between Campsie (Londonderry City Council) and Warrenpoint (Newry and Mourne District Council).</p> <p>Samples: Fish, shellfish, seaweed and silt.</p> <p>Analytes: Caesium-134 and Caesium-137.</p> <p>Sampling frequency: Between 3 and 6 monthly intervals.</p>
<i>Analysts:</i>	University of Surrey
<i>Other Information:</i>	Samples taken are typical of those included in the Sellafield statutory monitoring programme.

4.3.13 Northumberland (NORRAD)

- Generic title:* NORRAD (Northumberland District Council's Radiation Monitoring Group)
- Published by:* NORRAD
- Available from:* Environmental Health Department, Borough of Blyth Valley, Civic Centre, Blyth, Northumberland NE24 2BX
- Cost:* No charge
- Frequency:* Annually
- First issue:* 1989
- Scope:* The report contains data from the monitoring programme together with discussion of the central Government plans for detecting radiation incidents (RIMNET) and the role of local authorities in future incidents.
- Location: 53 sites on a 10 km grid in the boroughs of Berwick-On-Tweed, Alnwick, Castle Morpeth, Tynedale, Wansbeck and Blyth Valley.
- Samples: Environmental - gamma dose rate.
- Analytes: Gamma dose rate.
- Sampling frequency: One location in each Borough monitored daily but generally quarterly measurements, with additional discretionary measurements as appropriate.
- Analysts:* Measurements made by local authority staff.
- Other information:* Quarterly analysis of foods has been proposed, with measurements to be made by the Newcastle Hospital Medical Physics Department.

4.3.14 Norwich

<i>Generic title:</i>	Environmental Health Annual Report
<i>Published by:</i>	City of Norwich
<i>Available from:</i>	City of Norwich Environmental Health Department, Elliot House, 130 Ber Street, Norwich NR1 3AG
<i>Cost:</i>	No charge
<i>Frequency:</i>	Annually
<i>First issue:</i>	1989
<i>Scope:</i>	<p>The information on radiation monitoring forms a small section in the overall annual report of the activities of this single authority's Environmental Health Department.</p> <p>Location: 13 sites within Norwich City.</p> <p>Samples: Gamma dose rate only.</p> <p>Analytes: Gamma dose rate.</p> <p>Sampling frequency: Monthly</p>
<i>Analysts:</i>	Staff of the Environmental Health Department
<i>Other information:</i>	A Norfolk radiation monitoring group is proposed, comprising Norwich City, North Norfolk, King's Lynn, South Norfolk, Great Yarmouth and Norfolk County Council but no report has yet been produced.

4.3.15 Powys

<i>Generic title:</i>	Radiation Monitoring Scheme
<i>Published by:</i>	Powys County Council
<i>Available from:</i>	Powys Emergency Planning Team, Powys County Council, County Hall, Llandrindod Wells, Powys, LD1 5LG
<i>Cost:</i>	No charge
<i>Frequency:</i>	Monthly
<i>First issue:</i>	May 1987
<i>Scope:</i>	<p>Location: Measurements made at 34 points within the districts of Brecknock, Montgomeryshire, Radnor.</p> <p>Samples: Gamma dose rate only.</p> <p>Analytes: Gamma dose rate.</p> <p>Sampling frequency: Weekly.</p>

4.3.16 Somerset

- Generic title:** Somerset Environmental Radioactivity Monitoring Report
- Published by:** Somerset County Joint Consultative Committee on Environmental Radioactivity
- Available from:** Scientific Advisor and County Analyst, Somerset County Council, County Hall, Taunton, TA1 4DY
- Cost:** No charge
- Frequency:** Annually
- First issue:** 1988
- Scope:** County-wide monitoring incorporating samples taken from the Districts of West Somerset, Taunton Deane, Sedgemoor, Mendip and South Somerset. Results are compared with GDL's and the results from Government publications.
- Location:** 66 monitoring sites for gamma radiation dose locations approximating to an 8 km grid. Beach monitoring at 6 sites, other marine samples from 5 sites, herbage and milk from 10 and 11 sites respectively, rainwater from 10 sites.
- Samples:** Food - milk, meat, offal, fish, shellfish, fruit, vegetables, cereals, honey, mushrooms, drinking water.
Environment - gamma dose rate, herbage, silt/sediment, seaweed, rainwater, sewage works waste, surface contamination of railway sidings.
- Analytes:** Gamma dose rate. Gamma spectroscopy (Cs-134, Cs-137, K-40 for most samples; Co-60 for marine samples and Mn-54, Am-241. Total beta for sediment and silts and I-131 for milk). I-131 and Tc-99m for sewage works samples. Total beta for drinking water.
- Sampling frequency:** Gamma dose rate measurements made monthly. Milk and rainwater sampled monthly, herbage bi-monthly, silt/sediment, seaweed, shellfish quarterly. Other samples as required.
- Analysts:** Somerset Scientific Services.
- Other information:** This is a separate publication of the results which also appear in the RADMOSS reports. The report which initially covered results collected over 6 months will in future be published annually.

4.3.17 South Glamorgan

- Generic title:** Radiation Monitoring in South Glamorgan
- Published by:** City of Cardiff
- Available from:** City of Cardiff, Environmental Services, Wood Street, Cardiff CF1 1NQ
- Cost:** No charge
- Frequency:** Annually
- Scope:** The report covers a programme executed by officers of the South Glamorgan Trading Standards, Cardiff Environmental Services and the Vale of Glamorgan Environmental Health Departments.
- Location:** Marine samples taken from locations around the South Glamorgan coastline: Terrestrial samples and measurements are taken in Cardiff and the Vale of Glamorgan.
- Samples:** Approximately 16 samples of silt, 6 samples of seaweed and 5 samples of fish. About 8 samples of air particulates, 5 samples of rainwater, 5 samples of herbage, 7 samples of drinking water, 11 samples of milk, 5 samples of fruit, 7 samples of vegetables and 8 samples of meat. Occasional special samples related to unusual occurrences.
- Analytes:** Gamma ray spectrometry of silt, seaweed and fish in particular, Mn-54, Co-60, Cs-134/137, Am-241, K-40, I-131. Gross beta for airborne particulates and rainwater, gamma spectrometry of herbage, milk, fruit, vegetables and meat, in particular, Co-60, I-131, Cs-134, Cs-137 and K-40.
- Sampling frequency:** Samples taken throughout the year as appropriate to type.
- Analysts:** Cardiff City Analysts Laboratory.
- Other information:** Sampling and measurement programme prepared annually following a review of previous year's results and new areas of interest.

4.3.18 Southern England

- Generic title:** Southern England Radiation Monitoring Programme
- Published by:** Southern England Radiation Monitoring Group
- Available from:** On request from the Chief Environmental Health Officer, Portsmouth City Council Civic Offices, Portsmouth, Guildford Square PO1 2AL, Hants
- Cost:** Nominal
- Frequency:** Quarterly, with an annual summary
- First issue:** 1989 in present form, although reports of the initial programme date from 1987
- Scope:** Original data are reported for the following locations, samples types, analytes and sampling frequencies:
- Location:** Various terrestrial and coastal aquatic locations in Cornwall, Devon, West Wiltshire, Dorset, Hampshire, Isle of Wight, West Sussex, Berkshire, Buckinghamshire, Oxfordshire and the London Borough of Hillingdon. These are identified primarily by reference to those local authorities that support the sampling programme. Specific reference is made to radionuclides derived from UKAEA Winfrith, but no radioactivity has been reported from any other establishment in the area (i.e. Amersham International, Devonport, UKAEA Harwell or AWE Aldermaston).
- Samples:** In the aquatic environment - about 10 species of fish (marine and freshwater), about 5 species of shellfish, seaweed, river weed, sediment and freshwater.
In the terrestrial environment - milk (cows and goats), meat (beef, lamb, pork, turkey, offal), eggs, root vegetables, fruit, honey, vegetation (grass, moss, heather), soil and others.
- Analytes:** Internal exposure - data are provided for up to 8 gamma-emitting nuclides (Cs-137, Cs-134, Co-60, Co-58, Cr-51, Zn-65, Mn-54, I-131, Fe-59), Pu-238, Pu-239+240, Am-241.
External exposure - gamma dose rates are reported from measurements by 16 Borough Councils.
- Sampling frequency:** Gamma dose rates are measured weekly; frequency of other sampling is occasional.
- Analysts:** Gamma dose rate measurements are taken by local authority staff; all other analyses are carried out at the University of Southampton.
- Other information:** The programme was originally organised and published as the Hampshire, Dorset and Isle of Wight radiation monitoring programme before its expansion in 1989. Report includes descriptions of sample preparation and analysis. GDL's are shown and comparative data from other publications are presented.

4.3.19 Stoke-on-Trent

- Generic title:** Environmental Radiation Monitoring
- Published by:** City of Stoke-on-Trent Environmental Health Sub-Committee
- Available from:** Director of Housing and Health, PO Box 208, Unity House, Hanley, Stoke-on-Trent ST1 4QN
- Cost:** No charge
- Frequency:** Annually
- First issue:** 1989
- Scope:** Location: 6 regular monitoring sites for gamma radiation dose in parks within the city of Stoke-on-Trent supplemented by readings taken at random sites throughout the city such as colliery waste tips.
Samples: Gamma dose rate.
Analytes: Gamma dose rate.
Sampling frequency: Gamma dose rate measurements made at each of the regular monitoring points every 3 weeks.
- Analysts:** Measurements taken by local authority staff.
- Other information:** Results are compared with other data produced in Staffordshire.

4.3.20 *Strathclyde, Western Isles and Wigtown*

- Generic title:* Radionuclide Levels in Strathclyde, the Western Isles and Wigtown
- Published by:* Strathclyde Regional Council
- Available from:* Department of Regional Chemist, Public Analyst and Agricultural Analyst, Strathclyde Regional Council, 8 Elliot Place, Glasgow G3 8EJ
- Cost:* No charge
- Frequency:* Annually and quarterly
- First issue:* 1988
- Scope:* The programme covers a wide range of the pathways by which the public may be exposed to radiation in the area and results are both compared with GDL's and used in the calculation of theoretical doses. A descriptive guide to radiation, limits, exposure pathways is provided together with an explicit note of the limits of detection achieved by the analytical methods.
- Location:* Samples and measurements from 20 District Councils including the Western Isles.
- Samples:* Environmental - gamma dose rate, rain, particulate in air, reservoir sludge, tip leachate, seaweed, sediment, seawater, street dust, soil and grass.
Food - meat (beef, sheep, pig, poultry, offal, game), milk, freshwater and sea fish, fruit, vegetables, cereals, nuts, honey, drinking water. Imported foods.
- Analytes:* Gamma dose rate. Generally gamma spectroscopy with results reported variously for Cs-134, Cs-137, I-131, Co-60, Mn-54, Ce-144, Ru-106, Be-7. Results for total alpha and total beta are given for analysis of water.
- Sampling frequency:* Milk and fish generally quarterly, although monthly samples taken in a few areas. Soil and grass 6 monthly; seaweed and sediment quarterly as a rule. Other samples taken occasionally. Rain water and tacky shade samples taken monthly.
- Analysts:* Strathclyde Regional Chemists Department.
- Other information:* The programme continues to expand with the anticipated inclusion of other District Councils, and the addition of routine sampling at the Fairlie railhead. The laboratory is seeking NAMAS accreditation.

4.3.21 Surrey

- Generic title:** Monitoring of Radioactivity in Surrey
- Published by:** Surrey County Council
- Available from:** On request from the County Emergency Planning Officer, County Hall, Kingston-upon-Thames, KT1 2DN
- Cost:** No charge
- Frequency:** Annual report to the County Council
- First Issue:** 1990
- Scope:** Location: Instantaneous gamma dose rate measurements and TLD's are deployed at 26 points throughout the county, based mainly on school premises. Locally produced produce is sampled by Environmental Health staff and non-food products by Trading Standards Officers.
- Samples: Internal exposure - locally produced foods.
External exposure - instantaneous gamma dose rate and TLD's.
Other - non-food imported retail goods including toys, clothes, cosmetics.
- Analytes: Gamma dose rates and gamma spectroscopy for food and environmental samples.
- Sampling frequency: TLD's changed monthly. Gamma dose rate readings taken monthly. Foods sampled periodically. Non-food products sampled periodically.
- Analysts:** Gamma dose rate measurements are taken by local authority staff. TLD's are measured at the Department of Medical Physics, St. Luke's Hospital, Guildford and gamma spectroscopy of food and other samples is carried out at the University of Surrey, Department of Physics.
- Other information:** Dose rate results are compared with "normal background" and results from the analysis of foods are compared with WHO recommendations.

4.3.22 West Midlands

- Generic title:* Programme to Monitor Radiation in Food Samples in the West Midlands.
- Published by:* University of Birmingham, School of Physics and Space Research
- Available from:* Radiation Centre Materials Analysis (RCMA) Services, School of Physics and Space Research, The University of Birmingham, Birmingham B15 2TT
- Cost:* £10
- Frequency:* Annually
- First issue:* 1990
- Second issue:* 1991
- Scope:* 3-year programme to study the long-term trends of radiation in food from the West Midlands region.
- Location:* Samples are provided from the local authorities in Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall, Wolverhampton.
- Samples:* Mostly foodstuffs but also some samples of soil and water (tap and rain).
- Analytes:* Gamma spectrometry only. In the second year, out of 198 samples analysed, K-40 observed in 183 samples, Be-7 in 8, Cs-134 in 3, Cs-137 in 57, Co-60 in 1 and Zn-65 in 1.
- Sampling frequency:* Weekly.
- Analysts:* University of Birmingham.

4.3.23 *Yorkshire and Humberside*

- Generic title:** Yorkshire and Humberside Pollution Advisory Council Environmental Radiation Monitoring
- Published by:** Yorkshire and Humberside Pollution Advisory Council
- Available from:** Environmental Services Department, Glanford Borough Council, Council Offices, Station Road, Brigg DN20 8EG
- Cost:** No charge
- Frequency:** Annually
- First issue:** 1988
- Scope:** The programme is operated by a consortium of 17 local authorities and utilises a system of Regional samples (taken from all districts) and discretionary samples. The report presents original data and reviews published data from national and site-specific programmes.
- Location:** Sampling of atmospheric and environmental activity is undertaken at 15 locations from York to Doncaster, and Halifax to Cleethorpes. Retail sampling of items of interest (e.g. Brazil nuts) is included periodically. It is anticipated that the programme will extend into Lincolnshire.
- Samples:** Food - Milk, meat, vegetables, fruit, honey, cereals, sugar beet, freshwater and marine fish, Brazil nuts.
Environmental - atmospheric particulate, silt and soil, grass, moss, water. A programme of sampling dust from school playgrounds in the vicinity of the Capper Pass smelter is described.
- Analytes:** Food - gamma detection by sodium iodide and occasional spectrometry by germanium detector. Only Cs-137 and Cs-134 results quoted explicitly, except for Brazil nuts where additional data for Ac-228 and Bi-214 are given. Caesium is reported in soil, dust and sediment, with Po-210 additionally in the playground dust. Atmospheric particulate results are for total alpha, total beta, Cs-137, Cs-134, Be-7.
- Sampling frequency:** No details given but some results for atmospheric activity are reported on a monthly basis.

Table 1. Summary of materials and analytes in Government and Government-funded programmes

	Number of sub-section 4.1 (see contents list)										
	1	2	3	4	5	6	7	8	9	10	11
MATERIALS MONITORED											
Aquatic											
Seawater			*		*	*					
Freshwater fish						*					*
Seafish		*	*		*	*					*
Shellfish		*	*		*	*					*
Sediments		*	*	*	*	*					*
Seaweed		*	*		*	*					*
Others						*					*
Terrestrial											
Air					*			*		*	*
Vegetables					*		*				
Root crops					*		*				
Milk			*				*	*			*
Meat			*		*		*				
Soil			*		*		*				
Vegetation			*				*				
Water				*	*	*		*		*	*
Others			*		*		*				*
ANALYTES											
Gross alpha					*			*			
Gross beta		*			*	*					*
Gross gamma								*			
Gamma spectrometry		*	*		*	*	*	*			*
Radon	*				*						
Radiocaesium	*		*			*	*	*		*	*
Actinides		*	*			*	*			*	*
Other radionuclides	*					*	*	*		*	*
Dose rates		*	*		*	*			*		*

Table 2. Summary of material and analytes in site operators' programmes

	Number of sub-section of 4.2 (see contents list)							
	1	2	3	4	5	6	7	8
MATERIALS MONITORED								
Aquatic								
Seawater	*							
Freshwater fish	*							
Seafish	*			*	*	*		*
Shellfish	*		*	*	*	*		*
Sediments	*		*	*	*	*	*	*
Seaweed	*		*	*	*	*		*
Others								
Terrestrial								
Air	*	*		*	*	*	*	*
Vegetables	*				*		*	*
Root crops	*				*		*	*
Milk	*			*	*	*	*	*
Meat	*							
Soil	*	*		*	*		*	*
Vegetation	*	*		*	*	*		*
Water		*				*	*	*
Others	*	*						*
ANALYTES								
Gross alpha	*	*		*	*	*	*	*
Gross beta	*	*		*	*		*	*
Gross gamma			*					
Gamma spectrometry	*		*	*	*			*
Radon								
Radio caesium	*			*	*	*	*	*
Actinides	*	*		*	*		*	*
Other radionuclides	*	*	*	*	*	*	*	*
Dose rates	*			*	*		*	*

Table 3. Summary of materials and analytes in local and public authority programmes

	Numbers of sub-section of 4.3 (see contents list)											
	1	2	3	4	5	6	7	8	9	10	11	12
SPECIES MONITORED												
Aquatic												
Seawater												
Freshwater fish												
Seafish	*		*	*	*	*	*		*			*
Shellfish	*		*	*	*	*	*		*			*
Sediments	*		*		*	*	*		*			*
Seaweed	*		*	*	*		*					*
Others												
Terrestrial												
Air	*		*				*		*			
Vegetables	*			*		*	*		*			
Root crops	*			*					*			
Milk	*	*	*	*	*	*	*		*		*	
Meat	*			*	*	*			*		*	
Soil	*	*					*					
Vegetation	*	*	*	*	*		*					
Water	*	*	*	*	*	*					*	
Others	*			*	*	*	*		*			
ANALYTES												
Gross alpha	*											
Gross beta	*				*							
Gross gamma			*									
Gamma spectrometry	*	*	*		*	*			*			
Radon									*		*	
Radiocaesium	*	*	*	*	*	*	*		*		*	*
Actinides	*				*	*	*		*		*	
Other radionuclides	*	*		*	*	*	*		*		*	*
Dose rates	*	*	*	*	*	*	*	*	*	*	*	*

	Numbers of sub-section of 4.3 (see contents list)										
	13	14	15	16	17	18	19	20	21	22	23
SPECIES MONITORED											
Aquatic											
Seawater								*			
Freshwater fish									*	*	*
Seafish				*	*	*		*	*	*	*
Shellfish				*	*	*		*	*	*	*
Sediments				*	*	*		*	*		*
Seaweed				*	*	*		*	*		
Others						*		*			
Terrestrial											
Air					*						*
Vegetables				*	*	*			*	*	*
Root crops				*	*	*			*	*	*
Milk				*	*	*		*	*	*	*
Meat				*	*	*		*	*	*	*
Soil					*	*		*	*	*	*
Vegetation				*	*	*		*	*		*
Water				*	*	*		*	*		*
Others				*	*	*		*	*	*	*
ANALYTES											
Gross alpha								*			*
Gross beta				*	*			*			*
Gross gamma											
Gamma spectrometry				*	*	*		*	*	*	*
Radon				*							
Radiocaesium				*	*	*		*	*	*	*
Actinides				*	*	*		*	*		*
Other radionuclides				*	*	*		*	*	*	*
Dose rates	*	*	*	*		*	*	*	*		



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**Monitoring of radioactivity in the UK environment:
an annotated bibliography of current programmes**