

SELLAFIELD RADIOACTIVE PARTICLES IN THE ENVIRONMENT

PROGRAMME OF WORK

February 2008

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SELLAFIELD RADIOACTIVE PARTICLES IN THE ENVIRONMENT

PROGRAMME OF WORK

1. Introduction

Radioactive particles¹ are known to have been released into the environment as a result of historical operations and events at the Sellafield nuclear site. A number of well documented historical events are known to have caused radioactive particle contamination on Cumbrian beaches.

Discharges of radioactive waste from Sellafield site are regulated through an authorisation, issued by the Environment Agency under the Radioactive Substances Act 1993. While the current authorisation requires that solid matter is, as far as possible, excluded from discharges, it is recognised that on-going operations at the site present the possibility - if not necessarily a likelihood - that further particles could be released into the environment.

This document sets out the scope, contents and structure of a programme of work for the assessment and regulation of contamination by radioactive particles on and around the west Cumbrian coastline. The Environment Agency's role is to facilitate the delivery of the work programme, which will involve contributions from the Sellafield site operator and also a number of partner organisations. In defining this programme of work, our over-riding concern as a regulator is to ensure that the public and the environment are protected, both from the legacy of past discharges, and also from current and future operations at the site.

2. Background to the Monitoring Programme

While the west Cumbrian beaches have been monitored for many years to check for the presence of radioactive particles, work using the most modern instrumentation to characterise the current levels of radioactive particle contamination on west Cumbrian beaches began in late 2006. Trials to evaluate the use of a vehicle mounted 'large area' surveying technique, originally developed for Dounreay beach surveys, were conducted successfully on Sellafield beach and adjacent Ehen Spit.

Since April 2007 Sellafield Ltd has been required to employ this survey technique routinely in order to develop our understanding of the distribution of radioactive particles on west Cumbrian beaches, and beaches along the north Solway coastline.

This programme of more intensive monitoring has revealed the presence of increasing numbers of radioactive particles, with over 320 having been detected in 140 Ha surveyed by February 2008.

Details of the work carried out, and results of the on-going monitoring programme, are regularly updated on the Sellafield Ltd web-site at <http://www.sellafieldsites.com/page/sellafield-site-operations/feature-projects/beach-monitoring>

¹ The term 'particle' is used in this document in its general sense. It should be noted that a formal definition of 'particle' in the context of this programme has not yet been established, and developing such a definition will constitute part of the programme of work. See Work Stream 2.

3. Structure of the Document

This document describes a work programme for the Sellafield particles issue, comprising a number of discrete work-streams. Objectives for the programme as a whole, and for each specific work-stream, are presented.

Outlines of the tasks comprising each work-stream, together with indicative details of the deliverables, timescales, and organisation responsible for delivery, are presented in the work-stream schedules to the document.

The development of detailed work plans is not addressed in this document; this is a matter for the organisation tasked with delivery in the work-stream schedules.

4. Overall Programme Objectives

The principal objectives of the programme are set out as follows.

- To facilitate the characterisation of the population of particles in terms of their locations, the hazards that they pose, potential exposure pathways, and the associated risks to humans and the wider environment.
- Using a precautionary approach, to establish the levels of and natures of any interventions necessary to provide adequate protection of human health and the environment.
- To identify the origins, sources and release routes to the environment of the particle populations that are identified.
- Where necessary and practicable, take appropriate regulatory actions to ensure that future releases of particles from site are prevented or mitigated.
- To develop and maintain an effective programme of communication to ensure that any actions taken by stakeholders are informed by an objective assessment of risk.
- To build, in so far as is possible, application of sound science bringing a consistent approach to the characterisation and management of radioactive particles in the environment.

The approach set out in this programme will lead to a position where existing Sellafield particle populations in the environment have been comprehensively characterised, and any resulting risks to the public and the environment have been addressed. This is considered to be the 'end point' of the programme. Beyond this, any potential for on-going site operations to release particles will be addressed as part of the Environment Agency's day-to-day regulation of the site under the Radioactive Substances Act.

Formal indicators for the criteria that will be used to identify the programme 'end point' will be developed as the programme progresses. We will strive to complete the programme and reach the 'end point' as quickly as possible.

5. Structure of the Work Programme

The programme of work comprises a number of work-streams, as follows:

1. Environmental Monitoring Programme.
2. Particle Analysis and Characterisation.
3. Transport and Dispersion Model Development.
4. Hazard and Risk Assessment.
5. Intervention Strategy.
6. Regulation and Enforcement.

The inter-relationships between these elements are depicted in figure 1.

The Agency's role is to oversee delivery of each of these streams in the context of meeting the objectives set out above. This role will also extend to ensuring open and transparent communication with key stakeholders. Additionally there will be a requirement to keep national and international developments under review, to ensure that the project approach employs best practice, and takes full account of evolving techniques and scientific understanding. The following additional work-streams will therefore also constitute elements of the overall programme:

7. Communications Strategy.
8. Research and Development.

It is envisaged that independent scrutiny and peer review will be delivered via a specifically-convened sub-group of the Committee on Medical Aspects of Radiation in the Environment (COMARE).

We will work with the Scottish Environment Protection Agency (SEPA), Health Protection Agency (HPA) and others to develop a methodology that is broadly applicable for the characterisation and management of radioactive particles not just at Sellafield, but also in other relevant situations.

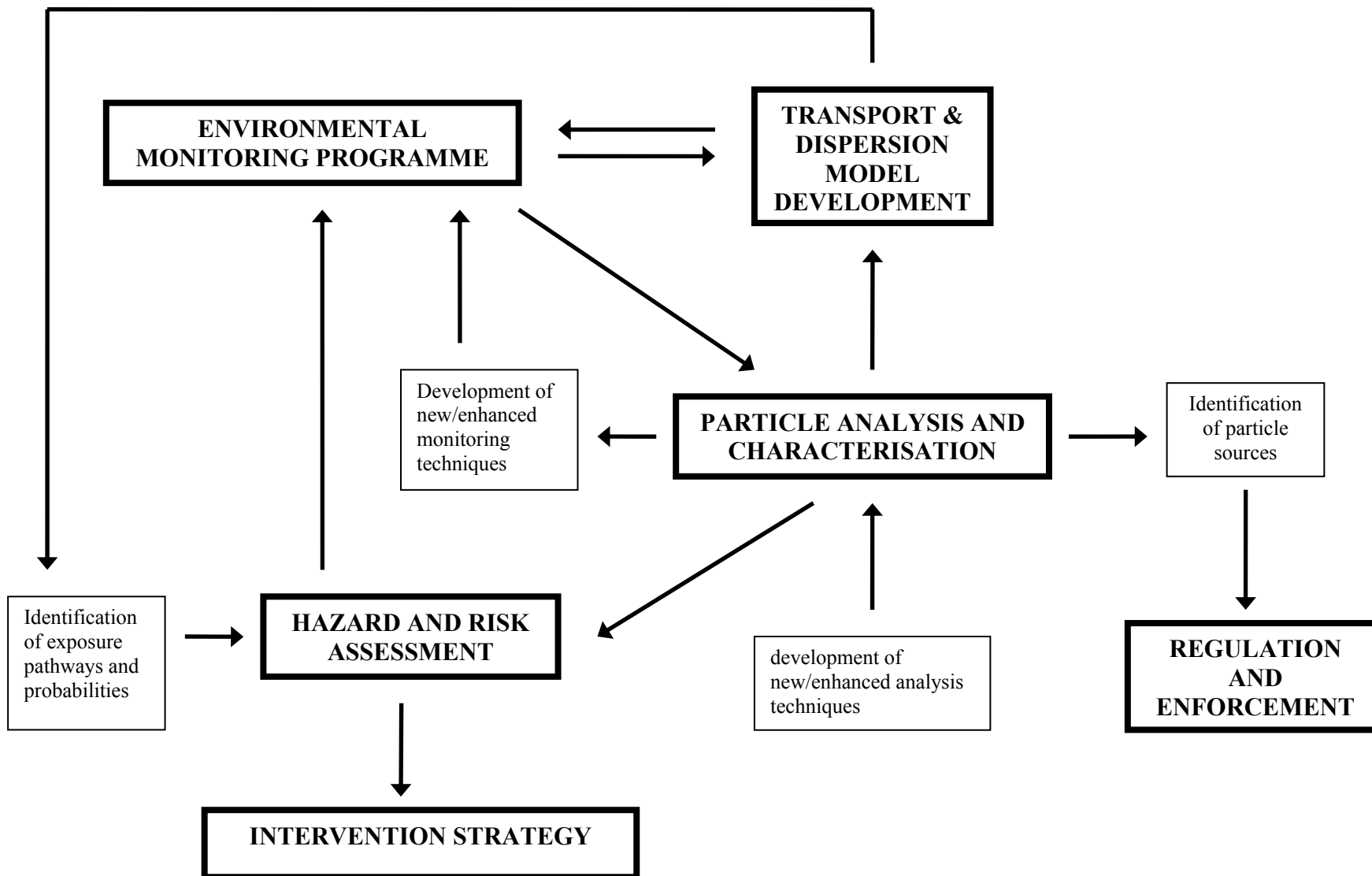


Figure 1 Schematic of project elements

6. Individual Work-Stream Objectives

This section sets out the specific objectives which will guide the individual work-streams referred to in section 5, and specified in greater detail in the schedules of work later in this document.

6.1 Environmental Monitoring Programme

- To ensure that best practice is employed to measure radioactive particle distributions on beaches, in offshore sediments and on land, based on the use of appropriate, defined performance criteria.
- To generate, in so far as is reasonably practicable, a comprehensive picture of those distributions and densities, and how they may change over time.
- To ensure adequate quality assurance arrangements for the monitoring programme in order to demonstrate the reliability of the data that is generated, and to establish the errors and limitations that attach to the data.
- To remove particles from the environment, to reduce the potential for the exposure of the public and other species and habitats, and to provide reassurance to stakeholders.
- To obtain sufficient number of particles to ensure screening that allows more effective and representative detailed analysis of populations with similar characteristics and origins.
- To inform the process of hazard and risk assessment.

6.2 Particle Analysis and Characterisation

- To establish a definition for the radioactive particles of relevance to this programme.
- To ensure that best practice is used to characterise the particles that are recovered, in order to establish the physico-chemical behaviour of the particles in the environment, and their associated transport properties, for example:
 - i) the longevity of the particles in their actual and potential environmental settings;
 - ii) the radiobiological characteristics of the particles in terms of their potential to cause harm to humans and biota; and
 - iii) the technical requirements for providing efficient monitoring arrangements.
- To generate relevant data on particle properties at a sufficient rate and with sufficient reliability to satisfy work streams 3, 4 and 7 (described later).
- To ensure adherence to an appropriate quality assurance plan for the analysis programme in order to demonstrate the reliability of the data that is generated, and to establish the errors and limitations that attach to the data.

6.3 Transport and Dispersion Model Development

- To develop a modelling capability to predict the dispersion and transport of Sellafield radioactive particles in the littoral and marine environment, taking into account both normal and extreme weather events, to:
 - i) facilitate the targeting of monitoring effort;
 - ii) inform our understanding of the significance of potential exposure routes;
 - iii) contribute towards the development of our understanding of risk;
 - iv) assist in the identification of the original sources of the particles, and pathways into the environment.
- To understand the potential for further movement of existing particle populations with time, including beach repopulation and the implications of on-going beach sediment removal and deposition.
- To ensure that a good understanding of likely transport mechanisms is developed and maintained throughout the project, based on up-to-date research and published material.
- To identify other data requirements that will be necessary to support our understanding of Sellafield particle transport.

6.4 Hazard and Risk Assessment

- To develop an understanding of risks associated with exposure of both human (priority) and non-human species to the full range of particles that are identified, specifically addressing;
 - i) external doses;
 - ii) internal doses; and
 - iii) stochastic and deterministic effects.
- To reduce uncertainties associated with existing dosimetric assumptions on hazard, and as far as possible to quantify such uncertainties as remain.
- To develop a comprehensive picture of potential exposure pathways (human habits surveys; environmental receptors; behaviour and habits of biota).
- To develop a representative mechanism for estimating the likelihood of exposure occurring (human and non-human species).
- To apply the resulting risk assessment methodology to actual and predicted particle populations, to facilitate informed and proportionate decision-making on the need for interventions and our communications with stakeholders.

6.5 Intervention Strategy

- To develop a protocol based on clear, risk-based, proportionate but precautionary criteria for intervening to manage the risks of harm that are predicted to arise as a result of exposure to particles.

- Within the protocol, to use quantitative risk thresholds for advising on or recommending, to the decision makers, the following general levels of intervention:
 - i) no action;
 - ii) scope for proactive information giving (could include information notices or advice to the public);
 - iii) access restrictions, restrictions on foods from affected areas (advice to partner organisations), etc
 - iv) targeted remediation; and
 - v) large-scale area remediation and other possible interventions.

The strategy should take into account the practicabilities of proposed interventions, the views of stakeholders, the levels of uncertainty, and should be informed by the guidance of relevant national and international expert bodies.

6.6 Regulation and Enforcement

- To endeavour to correlate particle finds with operational activities, both past and present, at Sellafield site in order to establish:
 - i) whether activities have been in compliance with the relevant provisions of the RSA authorisation;
 - ii) if no, whether any enforcement response is required;
 - iii) to ensure that Best Practicable Means are being employed by the site operator to prevent and mitigate further particle releases to the environment.

and in so doing ensure protection of the public and the environment, and provide stakeholder confidence.

6.7 Communications Strategy

- To ensure that clear and timely information is provided on this issue, and that, where necessary, participation of stakeholders in seeking solutions to the issues is facilitated.
- To provide appropriate information to facilitate informed, risk-based decision making by appropriate agencies and stakeholders.
- To encourage and take into account stakeholder views and expectations in our overall approach to the investigation and regulation of the Sellafield particles issue.

6.8 R&D

- To maintain awareness of national and international developments of relevance to monitoring, analysis and risk assessment associated with radioactive particles in the environment.
- To provide information and support to relevant national and international expert bodies such as IAEA Coordinated Research Programmes.

- To identify those aspects of the project where there are important gaps in our knowledge, high levels of uncertainty, or where we are aware of potential innovations that might improve our understanding of the issues, that warrant the commissioning of specific research and development work.

7. Review of Progress

A series of meetings and workshop events will support delivery of the programme of work. These will be co-ordinated by the Environment Agency.

The development of a suitable programme of meetings, both EA-internal, external with partner organisations, and external with stakeholder groups, is to be developed as part of work-stream 7.

At this stage it is envisaged that a further stakeholder workshop event will be organised for Summer 2008.

SELLAFIELD RADIOACTIVE PARTICLES IN THE ENVIRONMENT
SCHEDULES OF WORK

WORK STREAM 1

ENVIRONMENTAL MONITORING PROGRAMME

There is limited information available on the distribution and density of Sellafield particles in the environment. Prior to November 2006 only limited data had been generated as a result of 'walking' surveys using hand-held instruments.

1.1 Area monitoring capabilities

Starting in November 2006, large area monitoring trials were undertaken on Sellafield beaches using the 'Groundhog' vehicle-mounted scintillation counters. These units had been developed by RWE Nukem specifically to detect the ^{137}Cs content of radioactive particles, and have been employed successfully at Dounreay.

The trials confirmed that the technique was effective for detecting the gamma- and beta/gamma-emitting radionuclides that were encountered, and offered a limited capability to detect some alpha emitters via their low energy photon emissions.

The likely limitations of the monitoring technique for low energy gamma, alpha and for 'pure' beta emitters clearly limits the ability to characterise fully the extent of distribution of radioactive particles. Similarly particle depth in sediment will clearly affect the efficiency of detection.

Hand-held survey instruments can be employed, but at a significant penalty in terms of rate of area coverage. The development of enhanced or alternative techniques to address this issue is important, as is the development of a monitoring strategy to ensure that the on-going monitoring programme makes allowances for the technical limitations of the methods employed. Note that the identification of Best Practicable Means for beach monitoring is a requirement of the extant Environment Agency Requirements (EAR) specification, issued under the Radioactive Substances Act authorisation.

1.2 Large area monitoring - beaches

Given the success of Groundhog at detecting the gamma and beta/gamma emitters, the technique was required to be employed on a routine basis, as detailed in the EAR specification (dated 01/04/2007, para 13)

In October 2007 the EAR was revised to extend the survey area to 130Ha including the area to north of St Bees Head and, at the request of the Scottish Environment Protection Agency (SEPA), to incorporate monitoring of an additional 15 Ha of beach area on the north coast of the Solway estuary.

As of February a total of 140 Ha had been surveyed, revealing over 320 finds. The 15 Ha of monitoring along the N Solway coastline revealed no finds.

No resurveying of previously monitored areas has yet been carried out, and hence there is no information on the rate of repopulation.

1.3 Area monitoring – offshore

As of February 2008 only very limited offshore monitoring for particles has been conducted and no large area surveying has been carried out. Information on the existence or otherwise of such deposits will be important in informing the development of transport and exposure models (see later).

The potential presence of significantly more active particles offshore than have been detected on beaches, and the potential for these to enter the food chain and present significant exposures to humans, should lead to an increased priority being assigned to the monitoring of offshore areas where radioactive particles are believed to have the highest chances of accumulating.

1.4 Area monitoring – terrestrial

Considerable data exists on environmental monitoring that has been carried out on inland areas surrounding Sellafield site. However no such surveys carried out to date have employed vehicle-mounted large area detection systems such as now used on Groundhog. Undertaking a trial to bench-mark the performance of Groundhog in an area previously extensively surveyed and for which data is already available will be useful in terms of technical evaluation of capability, and also will provide a useful reassessment of environmental contamination.

1.5 Quality Assurance

The reliability of the monitoring approach in terms of data generation needs to be assured. A minimum specification for performance of the vehicle-mounted survey technique in terms of the detection of gamma-emitters has been developed, but this needs to be extended to all radionuclides of interest, and also needs to be supported by formal protocols for defining procedures, implementing checks, audit and calibration, and establishing uncertainty.

SCHEDULE OF WORK

ENVIRONMENTAL MONITORING PROGRAMME

Task	Details	Organisation responsible	Complete by	
1.1 Development of improved monitoring techniques	Specification of detection capability for the full range of likely beach finds	a) test bed calibration	Sellafield Ltd	31/03/08
		b) in-situ (beach) response characterisation	Sellafield Ltd	To be confirmed
	Identification, evaluation and selection of suitable techniques to optimise the detection of Am-241, Sr-90 and other relevant radionuclides in discrete radioactive particles (to include an assessment of, and where appropriate a programme for R&D for suitable large area beach survey monitoring systems and equipment)		Sellafield Ltd	30/09/08
	Report on the initial assessment of the Best Practicable Means for monitoring of beaches for particles (EAR requirement)		Sellafield Ltd	31/12/08
1.2 Large area beach monitoring programme	Monitoring of 147 Ha of beach between Ravenglass and Kirkcudbright		Sellafield Ltd	31/03/08
	Monitoring of specified beaches on the north Solway coastline		Sellafield Ltd	complete
	Development and implementation of post-March 2008 onshore monitoring requirements in EAR specification		Environment Agency	31/03/08
	Develop a specification for the collation, presentation and reporting of monitoring data		Environment Agency	31/03/08
1.3 Area monitoring – offshore	Collation and review of existing offshore monitoring data from past exercises (e.g. Sealine Removal Project)		Sellafield Ltd	31/03/08
	Review and selection of suitable large area monitoring techniques for offshore survey work.		Sellafield Ltd	31/03/08
	Development and implementation of offshore monitoring requirements in EAR specification for 08/09.		Environment Agency	31/03/08
	Completion of agreed offshore monitoring programme		Sellafield Ltd	31/03/09
1.4 Area monitoring – terrestrial	Trial deployment of Groundhog unit inland.		Sellafield Ltd	FY 09/10; 08/09 if availability allows

1.5 Quality Assurance and Quality Control	Identification of critical aspects of monitoring protocols and arrangements, and implementation of associated control arrangements to ensure that major uncertainties are minimised.	Sellafield Ltd	29/02/08
	Development of a QA/QC plan for particle monitoring, to include the implementation of formal management arrangements, and the specification of formal data quality objectives and controls.	Sellafield Ltd	31/03/08
	Full implementation of the plan	Sellafield Ltd	To be confirmed
	Employ peer review and audit	Environment Agency (contractor)	30/06/08

WORK STREAM 2

PARTICLE ANALYSIS AND CHARACTERISATION

Comprehensive characterisation of particles in terms of their physical, chemical and radiological properties will be a necessary element in the identification of potential sources of the particles, developing an understanding of transport and environmental behaviour, and to form a more realistic picture of hazards and risks to humans and the environment.

The methods to be applied will need to be fit for purpose in relation to these requirements, both in terms of the information to be provided and also its reliability.

One of the large area monitoring objectives is to yield sufficient numbers of particles for laboratory analysis and analytical method development work. This includes provision of particles for destructive testing, and subsequent in-vivo and in-vitro testing of particles of similar properties.

2.1 Definition of 'particle'

A formal definition of 'particle' in the context of this programme has not yet been established. Producing a definition of 'particle' based principally on physical properties will enable the overall programme of work to be suitably focused, particularly in relation to establishing mechanisms for transport and dispersion, and exposure pathways.

The working definition that has been used to date uses a lower average diameter threshold of 0.4microns – but with no defined upper limit. Establishing boundaries on for example composition (e.g. to exclude naturally occurring radioactive materials [NORMs]), and physical size, shape, and mass in relation to the potential for inhalation, ingestion, and external adhesion to the body will be necessary in order to provide focus and boundaries for the work programme.

No restrictive definition of 'radioactive particle' is proposed in terms of specific or total radioactivity within this work-stream, beyond the regulatory 'threshold' for solid anthropogenic radioactive substances of 0.4Bq/g (specified in the Radioactive Substances (Substances of Low Activity) Exemption Order 1986 No.1002). Consideration of hazard significance will constitute an aspect of work-stream 4.

It would be useful if any definition of 'radioactive particle' is applicable in other situations where such particles have been or might be encountered in the environment.

2.2 Physical, chemical and radiological characterisation of particles

Limited characterisation of particles has been carried out to date. Minimum standards of analysis applied by Sellafield involve radionuclide composition determination by high resolution gamma spectrometry, and scaled colour photography. Employing other non-destructive analytical techniques will be considered against monitoring objectives. Such techniques will need to be contracted out to specialist organisations.

No destructive testing of Sellafield particles using in-vitro and in-vivo techniques has yet been undertaken to understand issues of uptake and radiation dose delivery.

Assessment of the propensity of particles to undergo physical changes in the environment, for example fragmentation or attrition, will be of relevance in our subsequent assessment of the potential for transport and dispersion,

2.3 Development of a quality assurance scheme for particle analysis

No formal specification of precision or accuracy, nor those analytical protocols that have been implemented to provide assurance that specified standards of precision and accuracy will be achieved, have yet been specified. Furthermore, formal assessment of available analytical techniques against the analysis objectives has yet to be carried out to demonstrate that techniques are fit for purpose.

Data quality objectives addressing these issues therefore need to be established in relation to particle analysis (and monitoring – see above).

The development of a suitable analytical schedule and methodology is a requirement of the extant Environment Agency Requirements (EAR) specification, issued under the Radioactive Substances Act authorisation.

2.4 Control of particles transported off-site for analysis

We need to remain mindful of the wider logistical issues of storage and handling of radioactive particles at non-nuclear premises, and in particular consider the RSA93 obligations for any contractor at their analytical premises.

SCHEDULE OF WORK

PARTICLE ANALYSIS AND CHARACTERISATION

Task	Details	Organisation responsible	Complete by
2.1 Definition of 'particle'	Refine and agree a definition for radioactive particles for the Sellafield situation, in order to ensure that subsequent stages of the work programme are focused on addressing the particular hazards and risks presented by the Sellafield particles.	Environment Agency / Health Protection Agency / Sellafield Ltd	on-going
2.2 Development of analytical schedule and methodology	Establish programme of analysis and selection of contractor	Sellafield Ltd / Environment Agency	Complete
	Establish protocol for particle classification, prioritisation and selection for analysis	Sellafield Ltd	Complete
	Characterisation of particle radiological, physical and chemical properties against agreed programme of analysis, including dissolution studies in simulated environmental and organism fluids.	Sellafield Ltd (contractor)	Begin January 08
	Particle dosimetric studies, including in-vivo experimental work.	Sellafield Ltd (contractor)	To be confirmed
	Identify options for peer review of method development and hazard evaluation	Environment Agency	31/03/08
	Develop a forward programme for particle analysis for 2008/2009 and beyond.	Sellafield Ltd / Environment Agency	30/06/08
2.3 Quality Assurance and Quality Control	Identification of critical aspects of analytical protocols and arrangements, and implementation of associated control arrangements to ensure that major uncertainties are minimised.	Sellafield Ltd	29/02/08
	Development of a QA/QC plan for particle analysis, to include the implementation of formal management arrangements, and the specification of formal data quality objectives and controls.	Sellafield Ltd	31/03/08
	Full implementation of the plan	Sellafield Ltd	To be confirmed
	Employ peer review and audit	Environment Agency (contractor)	30/06/08
2.4 Control of particles transported off-site for analysis	Review of arrangements, in particular assessing analytical facility for the storage and handling of particles, and the transfer or disposal of particles and their residues.	Environment Agency	31/03/08

WORK STREAM 3
TRANSPORT AND DISPERSION MODEL DEVELOPMENT

Predictions on how and to where particles might be transported have been made based on assumptions as to spatial size distributions (assuming equivalent to natural sediments), geomorphology, tidal and littoral transport mechanisms. The approach has assumed that the long outfall at Sellafield was the source of the particles.

This led to the conclusion that the main estuaries and harbours north and south of Sellafield provide the most likely accumulation locations (sediment sinks), with open coast pocket beaches and beaches with finer sediments than their surroundings also possibly providing temporary accumulation areas.

3.1 Modelling of particle transport

To date only a simple approach has been used to model particle transport mechanisms. There is considerable scope to develop more representative models, particularly in terms of accessing information on the dynamics and nature of the environment in the north Irish Sea, Solway Firth and adjoining coastal areas.

The process of refining the models to take into account particle properties and behaviour in the marine and coastal environments will be informed by the on-going survey and analysis work identified in work streams 1 and 2.

SCHEDULE OF WORK

TRANSPORT AND DISPERSION MODEL DEVELOPMENT

Task	Details	Organisation responsible	Complete by
3.1 Modelling of particle transport	Identification of candidate organisations to provide support and expertise on dispersion and transport modelling.	Environment Agency	31/01/08
	Development of a conceptual model for the transport of particles in the North Irish Sea / Solway Firth areas, principally based on existing published data.	Environment Agency (contractor)	31/08/08
	Review of the need for and options for developing more refined and representative models.	Environment Agency	31/10/08
	On-going refinement of the model using particle monitoring and analysis data as generated.	Environment Agency (contractor)	On-going
	Review the need to incorporate field data collection and model validation requirements into on-going SL monitoring programme	Environment Agency (contractor)	On-going

WORK STREAM 4

HAZARD AND RISK ASSESSMENT

4.1 Hazard assessment

Depending on activity and radionuclide type, radioactive particles have the potential to cause harm in the form of both short-term effects (deterministic – e.g. ulceration) and long-term effects (stochastic – e.g. increased risk of cancers), as a result of potential exposure both internally (ingestion, inhalation) and externally.

Preliminary assessments have shown that, given worst-case exposure situations, the external doses (to skin and the eye) associated with particles discovered to date would not give rise to deterministic effects. This is based on well understood effects on skin and eyes of external exposure to radiation.

Similarly, particles containing only beta/gamma-emitting radionuclides that have been found to date have not been sufficiently radioactive to give rise to deterministic effects to the digestive tract, should they be swallowed.

The hazard associated with internal exposure is significantly higher for those particles containing alpha-emitting actinides. Hazard quantification is currently based on the use of ICRP committed effective dose coefficients. While these factors are generally considered to be precautionary in nature for dispersible radioactive material, there is a degree of uncertainty as to the use of the approach for estimating dose delivery for particles where the radioactivity is in a concentrated form. There is also uncertainty surrounding the rate and extent of transfer into body fluids of the radionuclides associated with any ingested particles (for example, current use of the 10^{-4} factor for ^{241}Am , agreed at the 2007 June workshop² and recommended by HPA, is precautionary, but not necessarily worst-case).

Reducing uncertainty associated with dose estimates for ingested/inhaled particles is therefore a priority objective for the analysis of particles recovered as part of this programme.

The physical and chemical properties of particles encountered around Sellafield will affect the likelihood of, and behaviour following, either inhalation or ingestion. These aspects will need consideration in the overall process of hazard evaluation.

4.2 Exposure pathways and probabilities

The subsequent exposure of human and non-human species to hazardous particles requires an understanding of area occupancies, habits, food sourcing and food consumption patterns. Occupancy surveys, reviews of seafood landing information, and food consumption surveys have been carried out previously in the Sellafield area to contribute to the impact assessments associated with on-going routine discharges from the site.

4.3 Risk quantification and context

The overall risk will be estimated by assessing the potential dose delivered in a specified exposure scenario, in combination with the likelihood of that exposure

² Sellafield Radioactive Particles in the Environment - Note for the record of a workshop held at the Environment Agency, Penrith on 28 June 2007:
http://www.environment-agency.gov.uk/commondata/acrobat/sellafield_workshop_1922975.pdf

occurring. It is this understanding of risk that will be used to inform the decision-making process on interventions (see later). (Note that, for deterministic effects, an effects 'threshold' will apply.)

It will be important to relate this risk, associated with an exposure to radiation, to risk situations which are more familiar to the public particularly in relation to beach use, to help to put the significance of the risk in context.

SCHEDULE OF WORK

HAZARD AND RISK ASSESSMENT

Task	Details	Organisation responsible	Complete by
4.1 Hazard assessment	Implementation of arrangements for collating and reporting analysis data to HPA for hazard assessment.	Sellafield Ltd	31/01/08
	On-going review of data and provision of advice on particle hazard, based on available information	Health Protection Agency /Environment Agency	On-going
4.2 Habit and consumption patterns	Review and collation of habit data relating to external exposure pathways for particle contamination	Environment Agency (contractor)	31/03/08
	Review and collation of habit data relating to internal (consumption) exposure pathways - seafood catch data - consumption patterns (local and wider-range) - food exposure routes	Environment Agency (contractor) and Food Standards Agency (contractor)	30/06/08
	Identify, review and refine methodologies for assessing encounter probabilities for non-food exposure routes	Environment Agency / Health Protection Agency	30/06/08
4.3 Risk quantification and context	Development and application of a quantified risk assessment protocol, including on-going provision of advice as further monitoring/analysis/encounter probability information becomes available.	Health Protection Agency	On-going / tbc
	Extension of the approach to non-human species.	Environment Agency (review with EA Science group)	31/12/08
	Presentation of risk data in context of wide societal risks	Environment Agency / Health Protection Agency	30/06/08

WORK STREAM 5

INTERVENTION STRATEGY

The need for interventions, either to remove the hazard, to mitigate the risk, or to provide advice and information, will be determined by a good understanding of the risks posed by leaving particles *in situ*, but considered in the context of the Precautionary Principle.

5.1 Contaminated Land status

HPA Guidance supporting the Radioactively Contaminated Land Regulations identifies criteria for the designation of radioactively contaminated land based on critical group doses, and addresses situations where the exposure to radiation is not certain.

5.2 Protocol and criteria for interventions

At the time of defining this work programme, intervention to remove particles from beaches is carried out in relation to each and every radioactive particle identified by the beach monitoring work, irrespective of the levels of activity measured or radionuclide types identified.

To date, for England & Wales no clear criteria have been put in place to judge whether other measures, such as restrictions on public access to areas, information notices, or indeed taking a decision to take no actions, might be necessary.

Interventions could also apply to consumption pathways, where contamination of foods is identified as presenting a significant risk.

5.3 Common intervention philosophy for UK regulators

SEPA has developed an intervention strategy for Sellafield particles that might be encountered on beaches in SW Scotland (i.e. at significant distance from the source). The strategy is tailored for this application, and differs from that set out in HPA guidelines. There are clearly advantages in adopting a common approach for the UK, but clearly any strategy needs first of all to be fit for its specific application.

SCHEDULE OF WORK
INTERVENTION STRATEGY

Task	Details	Organisation responsible	Complete by
5.1 Contaminated Land status	Review the applicability of the Contaminated Land Regs to the Sellafield particles situation, and in particular the degree to which offshore particle caches might fall within the jurisdiction of the Regs.	Environment Agency	30/09/08
5.2 Protocol and criteria for other interventions	Develop criteria for intervention, including suitable critical group dose thresholds, on which to base the need for either recommending more detailed and specific health risk assessments, or for recommending direct interventions such as access restriction, signage, communications and other interventions.	Environment Agency / Health Protection Agency	31/03/08
5.3 Common intervention philosophy for UK regulators	Develop Sellafield particles intervention strategy, where possible building consensus and buy-in from fellow regulators (SEPA, NIE&HS, EA Wales, etc...), local stakeholders (e.g. WCSSG) and national bodies (e.g. HPA, FSA)	Environment Agency	30/06/08

WORK STREAM 6

REGULATION AND ENFORCEMENT

6.1 Identification of particle sources

No explicit authorisation of particulate discharges from Sellafield site has ever been made under RSA93 or its preceding Act. However, operational standards, and associated specified regulatory requirements, were in the past not as stringent as is the case currently. Additionally there have been a number of well documented incidents at Sellafield over the years that involved potential or actual release of solid matter into the environment.

Considerable historical information exists relating to past activities and specific events at Sellafield site. However this information has not been reviewed comprehensively in relation to its relevance for particle release, nor has it been collated into a single database.

6.2 Use of Best Practicable Means (BPM) to exclude solid matter from effluent streams

On Sellafield site a number of plants now have substantial particulate abatement, though there are others where the case has yet to be made conclusively that operations and abatement represent BPM - and therefore where there is potential for improvement.

The requirement to use BPM is an explicit requirement in the RSA93 authorisation held by Sellafield Ltd. There is an extant Enforcement Notice in place relating to the application of BPM for the removal of entrained solids from the Sellafield effluent systems.

The site operator should be able to demonstrate that the particle content of aqueous waste streams associated with current and future site operations is understood; i.e. that information on the properties of particles either present on site or likely to be generated by on-going/future operations, their locations, quantities and likely circumstances of release, is known.

SCHEDULE OF WORK

REGULATION AND ENFORCEMENT

Task	Details	Organisation responsible	Complete by
6.1 Identification of particle sources	Review of historical events at SL with associated potential / actual release of particles	Environment Agency (contractor)	31/03/08
	Provision of resource and arrangements to review emerging particle analysis data against past and current operational knowledge	Sellafield Ltd	31/03/08
6.2 Use of BPM to exclude solid matter from effluent streams	Compliance with existing Authorisation and Agency 'specification of requirements'.	Sellafield Ltd	On-going
	Compliance with Enforcement Notice May 2007 – application of BPM for the removal of entrained solids from the system, including drains, source plants, treatment plants and final discharge.	Sellafield Ltd	April 2008
	Particle exclusion audit and BPM assessment.	Environment Agency	12/07 and on-going
	Further review of arrangements re. BPM, and consideration of further regulatory measures as might be necessary following completion of the above.	Environment Agency	May 2008

WORK STREAM 7

COMMUNICATION STRATEGY

The Agency has a communications strategy for the particles issue, which needs to be further developed and extended to reflect the scope of the overall programme.

Agency Communications with the public

Updates on the particle issue have been and continue to be provided by the Agency in quarterly reports to the West Cumbria Sites Stakeholder Group (WCSSG) – whose meetings are open to the public and press. Reports and meeting minutes are available on the WCSSG website. Additional briefing information and reports are now also being published to the Agency's web-site.

Sellafield Ltd

The site operator has been in liaison with local authorities since the first Sellafield Groundhog trial, in particular the Parish Councils and the Borough Council, and has presented monitoring results to the WCSSG Environmental Health sub-committee. Sellafield Ltd publishes its own updates on the particles monitoring programme on its web-site (at <http://www.sellafieldsites.com/page/sellafield-site-operations/feature-projects/beach-monitoring>).

Communications with partner Agencies

The Environment Agency has kept various other partners and stakeholders briefed, including NII, FSA, HPA, SEPA, Copeland BC, RPII, Defra and NDA.

The structure of the Sellafield particles project entails a collaborative approach with relevant partner organisations. A first multi-agency workshop was held at EA Penrith on 28 June 2007, with further multi-Agency workshops to be scheduled as the programme develops.

Implementation of monitoring requirements for beaches in SW Scotland, at the request of SEPA, has entailed an increased level of liaison between both regulators, NDA and SL in developing a communications plan specifically for this work.

SCHEDULE OF WORK
COMMUNICATION STRATEGY

Task	Details	Organisation responsible	Complete by
7.1 Development of a co-ordinated communications strategy	Produce an updated communications plan, including a publication strategy	Environment Agency	31/03/08
	Coordinate work-stream delivery with relevant partner regulators and other relevant agencies.	Environment Agency	Underway
	Develop a schedule of project and stakeholder meetings, and multi-Agency workshops.	Environment Agency	31/03/08
	Implement communications and briefings for peer review (COMARE)	Environment Agency	Underway

WORK STREAM 8
RESEARCH AND DEVELOPMENT

Some elements of the programme of work associated with the Sellafield particles programme may well challenge current levels of scientific understanding and technology development. Particularly this may be true in relation to the further development of large area monitoring techniques, particle analysis and dosimetry, and transport model development.

It is important that awareness of international scientific and technology developments of relevance to the project is maintained, and that the Agency's Science function is engaged to support this aspect of the programme.

Liaison with appropriate international organisations, including IAEA, will be important not just to maintain awareness, but to inform the wider community in relation to new areas of development.

SCHEDULE OF WORK
RESEARCH AND DEVELOPMENT

Task	Details	Organisation responsible	Complete by
8.1 Research and Development	Establish working arrangements, based on the relevant key workstream objectives, with the Agency's science group.	Environment Agency	Underway and on-going
	With partner agencies identify and engage with suitable national 'centres of excellence' in relation to potential developments in monitoring, modelling and analysis.	Environment Agency	Underway and on-going
	With partner agencies forge communications links with key international organisations.	Environment Agency	Underway and on-going

GLOSSARY OF TERMS

BPM	Best Practicable Means
CEAR	Compilation of Environment Agency Requirements
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
COMARE	Committee on Medical Aspects of Radiation in the Environment
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EAR	Environment Agency Requirements
FSA	Food Standards Agency
HPA	Health Protection Agency
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
NDA	Nuclear Decommissioning Authority
NIEHS	Northern Ireland Environment & Heritage Service
NII	Nuclear Installations Inspectorate
NORM	Naturally Occurring Radioactive Material
QA/QC	Quality Assurance / Quality Control
RPII	Radiological Protection Institute of Ireland
RSA93	Radioactive Substances Act 1993
SEPA	Scottish Environment Protection Agency
SL	Sellafield Ltd
WCSSG	West Cumbria Site Stakeholder Group