

Dounreay

Determining a strategy for managing radioactive particles in the environment



January 2007

This is the 6th Public Participation Newsletter produced by UKAEA. This newsletter has two aims. The first is to provide an update on the work already undertaken to determine a strategy for managing radioactive particles in the environment. The second is to establish the views of stakeholders regarding the relative importance of the criteria that will be used to evaluate particle management options.

INTRODUCTION

Small fragments of irradiated nuclear fuel, called particles, have been found on the seabed off Dounreay, on the Dounreay foreshore, on Sandside Beach 2 km (1.2 miles) to the west of the site, and one particle was found in 2005 on Dunnet beach, 25 km (15.5 miles) east of Dounreay. It is believed that the majority of these particles were discharged to sea through the active liquid effluent discharge system and others through surface drains and other routes when Dounreay reprocessed nuclear fuel. These plants have closed and the site is now being decommissioned. The total number discharged is uncertain and the actual number may never be known. Ongoing studies will continue to ensure the best possible understanding of the extent of contamination.

The particles are similar in size and density to grains of sand, hence they move about the seabed in a similar way. Since 1997 offshore studies using divers and more recently, a remotely operated vehicle (ROV), have been carried out to determine where the main concentrations of particles, detectable by the equipment in use, are found on the seabed. As of December 2006, 929 particles have been retrieved from the seabed, with a further 204 identified but not retrieved.

Although many of the particles remain on the seabed in sediment, some of the particles have been, and continue to be, transported to the shore. 241 particles have been detected and removed from the Dounreay foreshore and 75 from the beach at Sandside (as of December 2006). A particle was found at Dunnet beach in 2005, but none were found during a second survey in 2006. To date, a total of 1450 particles have been detected on the beaches and seabed with 1246 particles being recovered to Dounreay.

The revised criteria following consultation

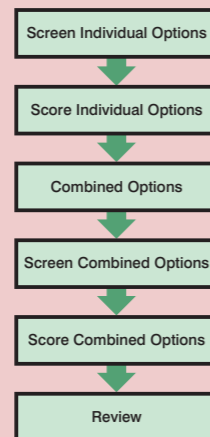
Criteria	Sub-criteria
Environment	Flora and fauna Onshore Flora & Fauna* Offshore Flora & Fauna*
	Physical environment Air Quality Water Quality Land Quality Particle Contamination Onshore* Sea floor Quality Particle Contamination Offshore* Visual Impact Nuisances Environmental Hazard Cultural heritage**
	Waste Radioactive Waste Non-Radioactive Waste
	Resource usage Energy Water Materials*
Health & Safety	Public health & safety Public Radiological Risk Public Non-radiological Risk
	Worker health & safety Worker Radiological Risk Worker Non-Radiological Risk
Technical Performance	Deliverability Regulatory & Legislation Implications* Permanence of Solution*
	Viability Feasible Technology Proven Technology
	Flexibility Compatibility with Other Options* Ability to Cope with Change in Circumstance
	Scope for corrective action Scope for Corrective Action
Social & Economic	Socio-economic impacts Economic Impacts Tourism* Quality of Life*
Cost	Cost

* New or revised criteria following January 2006 public consultation meetings

** Moved from 'Socio-economic Impacts' after the scoring panel meeting on 13 July 2006.

Scoring Panel

In July 2006 a scoring panel was established, comprising five independent members and four from UKAEA whose expertise included health and safety, socio-economics, technical feasibility and regional issues. The scoring panel met for one day to agree the process for considering the options. The panel then met over a three day period to identify the options most likely to succeed. The process adopted by the scoring panel is summarised in the following diagram.



Option combinations

Full notes of the scoring panel meeting are publicly available on request or can be found on UKAEA's website. The scoring panel, after considerable discussion and debate, agreed that 11 option combinations should be taken forward by the BPEO process. This followed recognition that the BPEO had to be composed of at least one offshore and one onshore option. The combinations are as follows:

We want to hear your views

We are keen to incorporate the views of interested parties into the BPEO process. We would like to obtain your views on:

- the combined option strategies
- the relative importance of the Criteria Group

How can I express my views?

You can express your views by completing the accompanying questionnaire and returning it to the address below by 23 February 2007. The questionnaire is also available at: www.ukaea.org.uk/dounreay/particles_in_marine_environment.htm and may be submitted electronically. Public exhibitions will be held in January 2007 where additional information will be available and the opportunity to discuss your views with members of the particles project team. Workshops will also be held throughout February 2007.

What happens next?

Once your views and the outcome of a series of workshops have been received, the preliminary BPEO will be developed ensuring issues raised are addressed. An explanation as to whether and how views were taken forward will be included. Once the preliminary BPEO is produced it will be made publicly available along with a non-technical summary for a further 12 week period for comment before the BPEO is finalised. The BPEO document is an aid to the decision-making process and other factors will be taken into consideration including input from the Scottish Executive, Scottish Environment Protection Agency and the Nuclear Decommissioning Authority.

More information

If you require additional copies of the questionnaire or more detailed information regarding particles, please refer to our website or contact June Love at the address below. All information previously made available can be accessed on the UKAEA website and will be updated as appropriate. You can find this information at: http://www.ukaea.org.uk/dounreay/particles_in_marine_environment.htm.

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Alternative formats of this publication, including large print and audio cassette, are available on request.

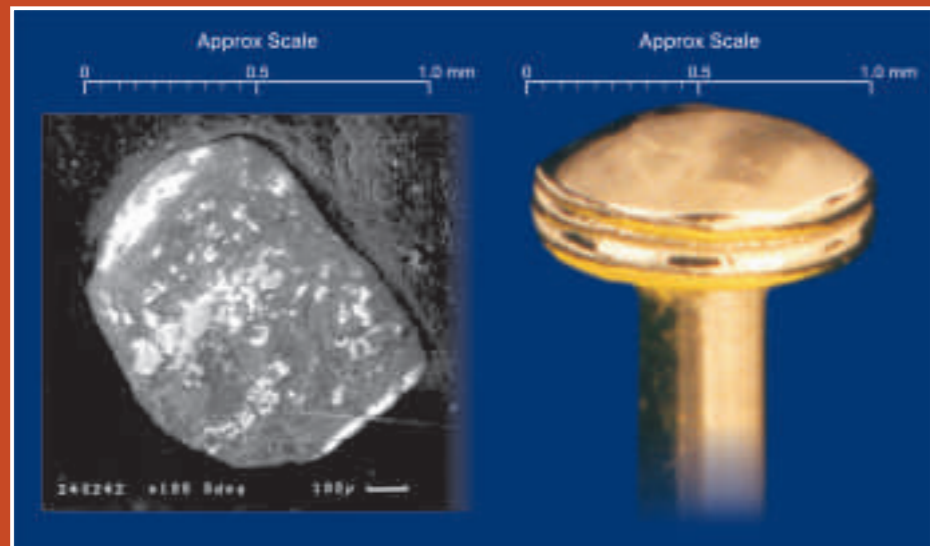
Summary of Combined Options

No.	Summary of Combined Options
2 and 10	Onshore monitoring with recovery plus offshore monitoring without recovery*
2 and 11	Onshore monitoring with recovery plus offshore monitoring with recovery
2 and 13	Onshore monitoring with recovery plus targeted recovery of detectable individual particles offshore
2 and 15	Onshore monitoring with recovery plus recovering offshore particles by the targeted bulk removal of marine sediments
3 and 11	Onshore recover all individual particles at all depths plus offshore monitoring with recovery
3 and 13	Onshore recover all individual particles at all depths plus targeted recovery of detectable individual particles offshore
3 and 15	Onshore recover all individual particles at all depths plus recovering offshore particles by the targeted bulk removal of marine sediments
4 and 13	Onshore bulk removal of beach sediments plus targeted recovery of detectable individual particles offshore
4 and 15	Onshore bulk removal of beach sediments plus recovering offshore particles by the targeted bulk removal of marine sediments
7 and 13	Onshore restrict public access plus targeted recovery of detectable individual particles offshore
7 and 15	Onshore restrict public access plus recovering offshore particles by the targeted bulk removal of marine sediments

* Current Particle Management Strategy, the status quo

What is a Particle?

Particles are small fragments of irradiated nuclear fuel. They were created by dismantling, preparation and dissolution of fuel during reprocessing at Dounreay. The reprocessing plants involved closed in the 1990s and are now being decommissioned. A range of particle types were discharged from the site, these are:



- Materials Test Reactor (MTR) particles
- Dounreay Fast Reactor (DFR) particles
- Stainless steel (cobalt-60) particles
- Uranium oxide particles
- Tarry agglomerate (ruthenium-106) particles

The most important of these, both numerically and in terms of potential risk, are MTR and DFR particles.

Findings from the Dounreay Particles Advisory Group 3rd Report

The Dounreay Particles Advisory Group (DPAG) was set up by UKAEA and the Scottish Environment Protection Agency (SEPA) in May 2000 to provide independent scientific advice. In November its 3rd Report was published which considers the sources of particles, current distribution in the marine environment, the potential number of particles within the main particle plume, the possibility of encountering a particle and their potential implications for public health.

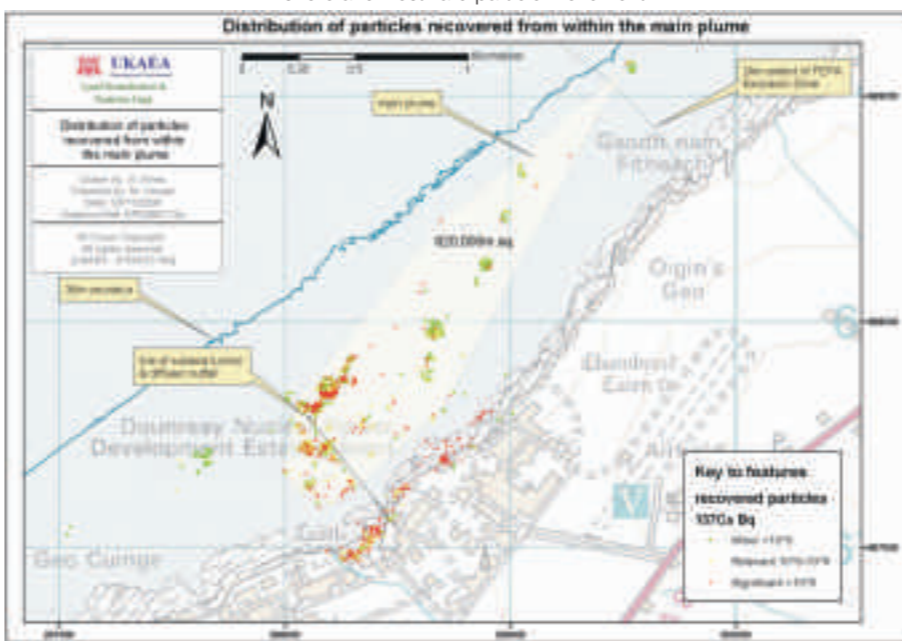
The following is an extract from the latest DPAG report which sets out DPAG's current understanding of the potential health effects of particles. The full report can be found at: http://www.sepa.org.uk/radioactivity/dpag/3rd_report.htm

On the basis of potential health effects DPAG have categorised particles as follows:

- Significant:** particles with an activity of 10^6 Bq ^{137}Cs or greater
- Relevant:** particles with an activity of 10^5 Bq to 10^6 Bq ^{137}Cs
- Minor:** particles with an activity of less than 10^5 Bq ^{137}Cs

DPAG concluded that a large proportion, especially of the *significant* particles discharged from Dounreay, have been buried in sediment or physically broken up to become smaller or fragmented particles and transported predominantly north-eastwards from the site. Currently it is believed that about **1100 significant**, **1000 relevant** and **3100 minor** particles are present within the main particle plume offshore from Dounreay (reference Table 4.6 DPAG 3rd report).

The diagram of 'Distribution of particles recovered from within the main plume' also shows some inshore and westward particle movement.



DPAG considers that the possibility for any member of the public coming into direct contact with a particle with potential to cause harm is extremely small. The chance is **1 in 80 million** per year for a particle with an activity of 10^5 Bq at Sandside beach.

DPAG has drawn upon work recently published by SEPA and conducted by the Health Protection Agency. This showed that particles with 10^5 Bq ^{137}Cs or less (relevant/minor), typical of those currently found at Sandside Beach, would need to remain in stationary contact with precisely the same area of skin for at least seven hours to cause any discernible health effect. For ingestion, such a particle, held stationary against the gut wall for six hours, might cause ulceration which would be repaired by natural regeneration.

Particles on the Dounreay Foreshore which have contained activity up to 1000 times greater could cause harm, but the foreshore is effectively inaccessible to the public.

DPAG concluded that only significant particles with activities of 10^6 Bq ^{137}Cs or greater pose a realistic potential hazard to members of the public. However, DPAG considers it prudent that, in addition to significant particles, relevant particles with activity of 10^5 Bq to 10^6 Bq ^{137}Cs should also be monitored for and removed from publicly accessible beaches.

The Group concluded that there is an extremely small possibility of a member of the public coming into contact with a relevant particle on local beaches (with the exception of the Dounreay Foreshore); if they did so, no significant adverse health effects would be expected.

Defining a Strategy - What has been done so far?

Independent Steering Group

In 2003, an independent external consultation steering group was established by UKAEA to oversee the transparency of the consultation process regarding development of a particles management strategy. The group is chaired by Councillor Bill Fernie (Highland Council) and members include John Thurso, MP, Rick Nickerson for KIMO, Iain Baikie at KP Technology Ltd, and Ian Clark for Dounreay unions. Fred Barker, an expert in consultation was also involved in the initial work of the group but due to work commitments no longer sits on the group. Meetings are held, as appropriate, to discuss and review the consultation process and the information which is made available.

Consultation on options and criteria

In 2006 UKAEA launched the first stage of public consultation to identify the Best Practicable Environmental Option (BPEO) for managing particles in the long term. Public exhibitions were held in Wick and Thurso and discussion meetings took place with a range of stakeholders, including, business groups, Reay/Dunnet residents, surfers and the Dounreay Stakeholder Group. A total of 100 people attended the exhibitions and 89 people took part in 15 discussion meetings. In addition to the feedback received at these meetings and exhibitions 123 feedback questionnaires were received. At this stage UKAEA wished to identify stakeholder concerns and the effect the particles had on the potential use of the beach, i.e. beach use, tourism, etc. UKAEA also wanted to establish other options and criteria that stakeholders wished to see considered. UKAEA reviewed all the responses and made changes to the original list of options and criteria which can be seen below. The analysis, records of discussion meetings and how UKAEA has responded to views are available on the UKAEA website. A key output following the consultation was a revised list of options and criteria. These revised lists are presented overleaf.

⁽¹⁾ **Radioactivity** is measured in becquerels (Bq). It measures the number of disintegrations of radioactive nuclei occurring each second in a sample.
⁽²⁾ **Caesium** – caesium-137 is a man-made radioisotope. Particles containing caesium-137 are located by the gamma rays.

The revised onshore and offshore options following public consultation

Number	Option	Description
	Onshore	
1	Onshore Monitoring Without Recovery	Monitor the beaches to identify where particles are (particles at depth may not be detected).
2	Onshore Monitoring With Recovery	Monitor the beaches to identify where particles are and recover them (particles at depth may not be detected and hence not recovered).
3	Recover all Individual Particles At All Depths Onshore	Identification and recovery of all detectable onshore particles facilitated by overturning the sediments to allow all particles at depth to be found.
4R	Bulk Removal of Beach Sediments	Remove the sand/sediment from the beaches to allow detectable particles to be separated out.
5	Onshore Immobilisation/ Isolation of Sediments	Solidify the beach, or cover it in a membrane to stop the particles present in the sediments from moving.
6	Onshore Bioremediation	Use biological processes to break down or take up the particles.
7	Onshore Restrict Public Access	Prevent the public from accessing areas affected by particles.
8	Onshore Sever Pathway	Build a barrier across affected bays to stop waves from washing particles on to the beaches.
9	Onshore Natural Attenuation	Do nothing and allow marine processes and radiological decay to reduce the risk naturally.
	Offshore	
10	Offshore Monitoring Without Recovery	Monitor the seabed to identify the location of offshore particles (particles at depth may not be detected).
11	Offshore Monitoring With Recovery	Monitor the seabed to identify where particles are and recover them (particles at depth may not be detected and hence not recovered).
12	Recover All Individual Particles At All Depths Offshore	Identification and recovery of all detectable offshore particles facilitated by overturning the sediments to allow all particles at depth to be found.
13R	Targeted Recovery of Detectable individual Particles Offshore	Overturn sediments, identify and recover all detectable particles in areas of high particle density, to reduce risk from offshore particles.
14R	Bulk Removal of all Marine Sediments	Dredge the seabed removing sediments to allow all detectable particles to be separated out, and return the sediments once processed.
15	Recovering Offshore Particles by the Targeted Bulk Removal of marine Sediments	Dredge areas of the seabed known to have high activity or a high density of detectable particles present, remove sediments, separate out particles and return processed sediments.
16	Immobilisation/Isolating Marine Sediments	Stop particles moving from the sediment by covering it in a membrane, capping with cement or vitrifying into a glass.
17	Offshore Bioremediation	Use biological processes to break down or take up the particles.
18	Active Dilution and Dispersion Offshore	Jetting or vacuuming the seabed to disperse the particles more widely through the marine sediments.
19	Temporary De-watering and Reclamation	Build isolation structures and dewater areas to allow monitoring and recovery of particles.
20	Offshore Restrict Access	Restrict human access to offshore areas affected by particles.
21	Offshore Natural Attenuation	Do nothing and allow marine processes and radiological decay to reduce the risk naturally.
22N	Particle Retrieval using Dolphins	Train dolphins to retrieve particles.
23N	Breakdown with Lasers	Use marine friendly lasers to break down particles.
24N	Passive Dredging	Use trenches/angled groynes to push sand and particles further out to sea or towards shore to all monitoring and removal of particles.

R - Denotes a revised option. **N** - Denotes a new option.