ISSUE SECTION SAFETY AND ENVIRONMENT GROUP	MARKING NONE	DOCUMENT REF: EPD(05)P198 Issue 1
TITLE:	**ANNUAL REVIEW OF THE MONITORING OF LOCAL BEACHES - YEAR 2004**	
STATUS:		
DOCUMENT TYPE: Paper	**Uncontrolled**	**FILE NO:**
COPY NO: N/A	**ISSUED BY:** Environmental Programmes Department, D2003	**PAGE:** Page 1 of 19

SUMMARY

UKAEA has reviewed the programme of monitoring of the local beaches for year 2004. The finds for this period are summarised and analysed. The total number of beach surveys in 2004, is twenty-five. Four of them were carried out on Sandside beach, one on Melvich beach and the remaining on the other beaches. During 2004, considering all the beaches and foreshores, an area in excess of 1.5 million square metres has been monitored for fragments of irradiated fuel and a total of 4,140,421 Gamma readings were taken. When compared to the coverage achieved in 2003, the overall coverage in 2004 was lower. This is due to the denial of access to Sandside beach from end of April to mid December. Since the beginning of October a new TID is regulating the monitoring regime. Dounreay foreshores are included in the monitoring considered in this report. Evidence is presented that the increase in particle finds on these foreshores is likely to be due to the enhanced detection capabilities of Groundhog Evolution as compared to its predecessor. This is similar to what was observed for the Sandside finds when Groundhog Evolution was first introduced. Furthermore, a one-off survey of Melvich beach was carried out in July. No particles were detected in any of the surveys of Thurso, Scrabster, Melvich, Brims Ness and Crosskirk.

Issue	Date	Author Name Signature	Checked by Name Signature	Issue Approved Name Signature
1	March 2005	Ing. M. Scirea	Dr. J. Toole	M. Liddiard

Distribution

TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

1.1 Overview

In 1983, a routine radiological survey at predetermined locations on the Dounreay beach discovered a particle of irradiated Material Testing Reactor (MTR) fuel. The particle was primarily composed of aluminium and contained a small amount of uranium as well as fission products. Since the 1983 discovery, routine monitoring for particles has been carried out at selected locations distributed over some 25 kilometres of coastline, centred on the Dounreay Foreshore and the public beaches at Sandside Bay. Other local beaches from Melvich in the West to Thurso in the East have been checked. Particles have also been found in the seabed sediments offshore of Dounreay.

Ten particles were found on the Dounreay Foreshore during the first surveys in January 1984. Since then, particles have been found on the Dounreay Foreshore at a variable rate during the routine surveys. Most particles identified originate in MTR fuel, but particles have also been found which can be associated with the Dounreay Fast Reactor DFR. A few particles of activated steel have also been recovered.

Sandside, three kilometres West from Dounreay, is the only public beach on which particles have been found. One particle was discovered on Sandside beach in 1984 and since that time a routine programme of beach monitoring has been conducted. A second particle was discovered on Sandside beach in May 1997. The radiological monitoring of the local coastline and, in particular, Sandside Beach, has been progressively increased since May 1997. The development of the monitoring regime is fully described in previous reports.

1.2 Current Statutory Monitoring Requirements

UKAEA Dounreay's Authorisation conditions for the Disposal of Liquid Radioactive Waste require the implementation of a regime of environmental monitoring. In particular, the current environmental programme associated with liquid discharges, as defined in the latest issue of Technical Implementation Documents (TIDs) related to Liquid Radioactive Waste Disposals dated October 2004, includes, among other investigations, beach monitoring in accordance with Table 1-1.

The radiological target has disappeared in this latest version of the TID. The new requirement is to deploy Groundhog Evolution operated at an average velocity not greater than 1 m/s and discarding for area coverage purposes any reading taken when velocity is greater than 1.2 m/s. The coverage requirement for Sandside beach (in excess of 0.25 square kilometres per month) and its limitations is still in force.

Since October, the frequency of Brims Ness and Crosskirk monitoring has increased and new beaches have entered the schedule, namely Dounreay foreshore, Melvich and Dunnet. The following table summarises the new monitoring regime.

Beach	Extent of monitoring	Grid references (GRs)	Frequency of monitoring
Sandside Bay	All of the sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	295700, 966280 & 296690, 965780	Monthly
Sandside Bay	Accessible sandy areas which do not permit vehicle access including North beach, harbour, sandy areas below Fresgoe House, bands of sand Northeast of the beach below the public lavatories and the sandy areas North of Isauld Burn	295700, 966280 & 296690, 965780	Monthly
Sandside Bay	Strandline that can be accessed by vehicle between GR's in column 3	295700, 966280 & 296690, 965780	Fortnightly
Thurso Bay	All sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	311360, 968960 & 312070, 968850	Three times per year
Scrabster Bay	All sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	310040, 970180 & 310605, 969170	Three times per year
Crosskirk Bay	All accessible sandy areas from MHWS to low water* between GRs in column 3	302860, 969900 & 302970, 970250	Six times per year
Brims Ness	All accessible sandy areas from MHWS to low water* between GRs in column 3	304250, 971270 & 304410, 971030	Six times per year
Dounreay East Foreshore	All accessible sandy areas from MHWS to low water* between GRs in column 3	298650, 967410 & 299020, 967670	Fortnightly except during the period 1 May to 31 August
Dounreay West Foreshore	All accessible sandy areas from MHWS to low water* between GRs in column 3	298190, 967029 & 298340, 967095	Fortnightly except during the period 1 May to 31 August
Melvich Bay	All accessible sandy areas from MHWS to low water* between GRs in column 3	288246, 965662 & 289109, 965028	Once during 2004
Dunnet Bay Beach	All accessible sandy areas from MHWS to low water* between GRs in column 3	320336, 968460 & 321440, 970870	Once during 2005

* Low water means as reasonably practicable to low water springs, but at least to neap low water

Table 1-1: Statutory Beach monitoring requirements

2 SUMMARY OF THE SURVEYS

The total number of complete beach surveys in 2004 is 25. Four of them were carried out on Sandside beach, twenty on the other beaches, as summarised in Table 3-1, which shows the surveys in chronological order for each of the five beaches. A further one-off survey of Melvich beach was carried out in July.

Furthermore, two strandlines were carried out on Sandside beach in May and December.

	Sandside	West Foreshore	East Foreshore	Crosskirk	Brims Ness	Scrabster	Thurso
January 2004	✓						✓
February 2004	✓				✓		
March 2004	✓					✓	
April 2004	✓			✓			
May 2004	✓*						✓
June 2004					✓		
July 2004						✓	
August 2004				✓			
September 2004							✓
October 2004		✓	✓		✓		
November 2004		✓	✓	✓		✓	
December 2004	✓*	✓	✓	✓	✓		

* Owing to denied access for most of the month only a strandline survey was carried out

Table 2-1: Survey summary with dates

In the next sections a summary is given for each beach.

2.1 Sandside Beach

Permission to access the beach was withdrawn from end of April to mid December. The April survey was supposed to be completed in the first days of May. The denied access prevented to reach the minimum coverage of 250,000 square metres.

	area [m^2]	Gamma readings [number]
January 2004	267,517	726,156
February 2004	286,166	788,263
March 2004	263,663	692,395
April 2004	235,446	603,521
May 2004 (str.)	1,824	6,344
December 2004 (str.)	7,858	24,754

Table 2-2: Sandside surveys details

For every month of complete survey the minimum area coverage of 250,000 square metres was exceeded (with the exception of April, for the above mentioned reasons).

The number of readings acquired every month is variable. The chart in Figure 3-2 shows the relationship between gamma readings and area coverage month by month.

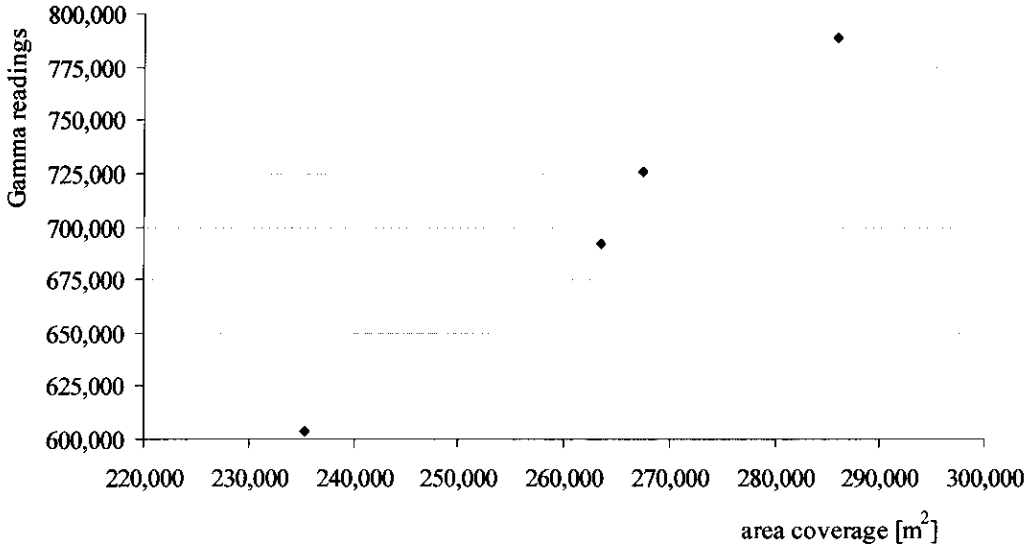

Figure 2-1: Area - counts scatterplot for Sandside (May and December not plotted)

2.2 Thurso Beach

A total of three surveys were carried out on Thurso beach during 2004. A summary with area covered and number of points acquired is reported in Table 3-3.

	area [m^2]	Gamma readings [number]
January 2004	53,448	139,710
May 2003	68,511	170,237
September 2003	67,228	160,770

Table 2-3: Thurso surveys details

No particles were detected during the surveys.

2.3 Scrabster Beach

During 2004, the number of survey carried out on Scrabster beach were a total of three. Table 3-4 below reports the extent of each survey both in terms of area and number of readings.

	area [m^2]	Gamma readings [number]
March 2004	44,283	109,031
July 2004	41,119	107,247
November 2004	44,991	137,696

Table 2-4: Scrabster surveys details

None of the surveys resulted in the detection of particles. The chart in Figure 3-4 shows the relationship between Gamma readings and area coverage for Thurso and Scrabster surveys. It also contains the Melvich survey, summarised in Section 2.7.

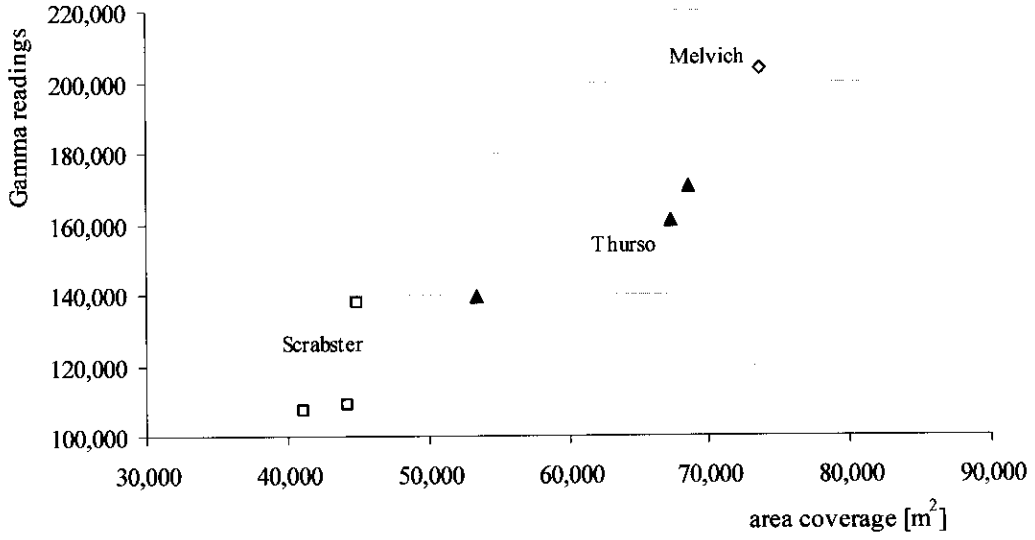

Figure 2-2: Area - counts scatterplot for Thurso, Scrabster and Melvich

2.4 Brims Ness

In 2004 a total of four surveys were carried out on Brims Ness. A summary with area covered and number of points acquired is reported in Table 3-5.

	area [m^2]	Gamma readings [number]
February 2004	1,240	3,793
June 2004	6,551	37,226
October 2004	3,003	11,944
December 2004	501	2,132

Table 2-5: Brims Ness surveys details

No particles were detected during the surveys. Technical and environmental reasons prevented the execution of the December survey, which was carried out in January 2005.

2.5 Crosskirk

The number of surveys carried out on Crosskirk during 2004 is four. Table 3-6 summarises the area covered and number of points acquired for each survey. No particles were detected during the surveys. As in the case for Brims Ness, technical and environmental reasons prevented the execution of the December survey, which was carried out in January 2005.

	area [m^2]	Gamma readings [number]
April 2004	650	3,353
August 2004	561	2,977
November 2004	149	747
December 2004	872	4,688

Table 2-6: Crosskirk surveys details

The chart in Figure 3-5 shows the relationship between gamma readings and area coverage for Crosskirk and Brims Ness surveys.

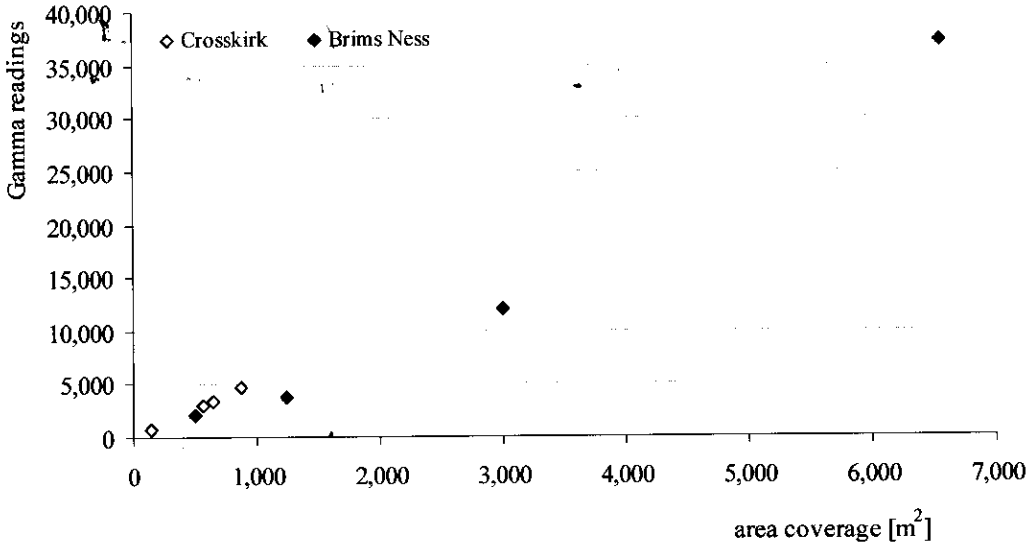

Figure 2-3: Area - counts scatterplot for Crosskirk and Brims Ness

2.6 Dounreay Foreshore

The number of surveys carried out on the Dounreay foreshore in 2004 since October 2004, when the new TID came into force is six. All of them were carried out on the West foreshore. Lack of sand on the eastern foreshore prevented the execution of any survey. Table 2-7 summarises the area covered and number of points acquired for each survey. A total of 5 particles were detected during the surveys.

	area [m^2]	Gamma readings [number]
October 2004 I	9,276	33,426
October 2004 II	3,748	15,317
November 2004 I	9,851	43,104
November 2004 II	9,360	32,336
December 2004 I	10,412	45,577
December 2004 II	8,740	34,276

Table 2-7: Dounreay foreshore surveys details

2.7 Melvich

During July 2004 a one-off survey of Melvich beach was carried out. The survey was intended to be a reassurance non-statutory survey to confirm the results of the survey carried out in year 2000 with Groundhog Mark I. However, the new TID requires a one-off Melvich beach survey. The requirement of average survey velocity of the new TID is fulfilled. When the ceiling of 1.2 m/s is considered, the total coverage has to be lowered by approximately 7,527 square metres. No particles were detected during the survey.

area	Gamma readings

	[m^2]	[number]
July 2004	73,588	203,401

Table 2-8: Melvich survey details

The figure below summarises the relationship between gamma readings and area coverage for the surveys carried out in all the beaches. It should be noted that scale is bi-logarithmic.

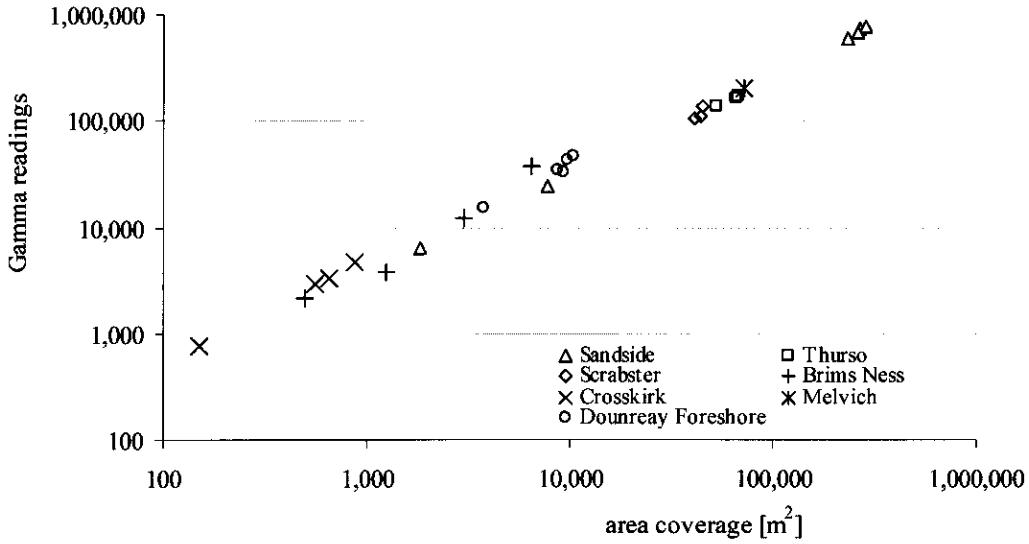

Figure 2-4: Area - counts scatterplot for all the 2004 surveys

3 SUMMARY OF THE FINDS

In this section a summary of particle finds for year 2004 is given. To start, a listing of the finds is reported. Then a study of their activity distribution is carried out, followed by considerations about their geographical location.

3.1 List of 2004 Finds

The following table summarises the finds on Dounreay foreshore and on the public beaches for year 2004, along with the corresponding data for 2003 and for the previous years.

	prior to 2002	2003	2004	total
Sandside Beach	20	26*	5	51
Dounreay Foreshore	214	3	9	226
Other Beaches	0	0	0	0

*: two of these particles were detected during the Groundhog Evolution trials of Nov-Dec 2002

Table 3-1: Particle finds

3.2 Sandside Finds

The number of particles detected is only a fraction of the finds of the previous year. This is explained by the fact that only 4 surveys were carried out during 2004. More details are reported in Section 3.3.

The summary of the finds is reported in Table 3.2 below. EFSN is the unique environmental field sample number.

Date of recovery	Easting	Northing	Approximate depth [mm]	137Cs activity [Bq]	EFSN
21-Jan-04	296594	965450	40	6.22E+04	SS/04/01
19-Feb-04	296617	965453	100	4.40E+04	SS/04/02
01-Mar-04	296717	965497	50	1.40E+04	SS/04/03
18-Mar-04	296464	965395	100	9.70E+04	SS/04/04
28-Apr-04	296091	965484	40	7.30E+04	SS/04/05

Table 3-2: Groundhog Evolution particle summary data for Sandside

3.3 Spatial Distribution on Sandside

The image of Figure 3-1 shows the locations where the five particles were detected and recovered from during 2004 along with the particles found in previous years.

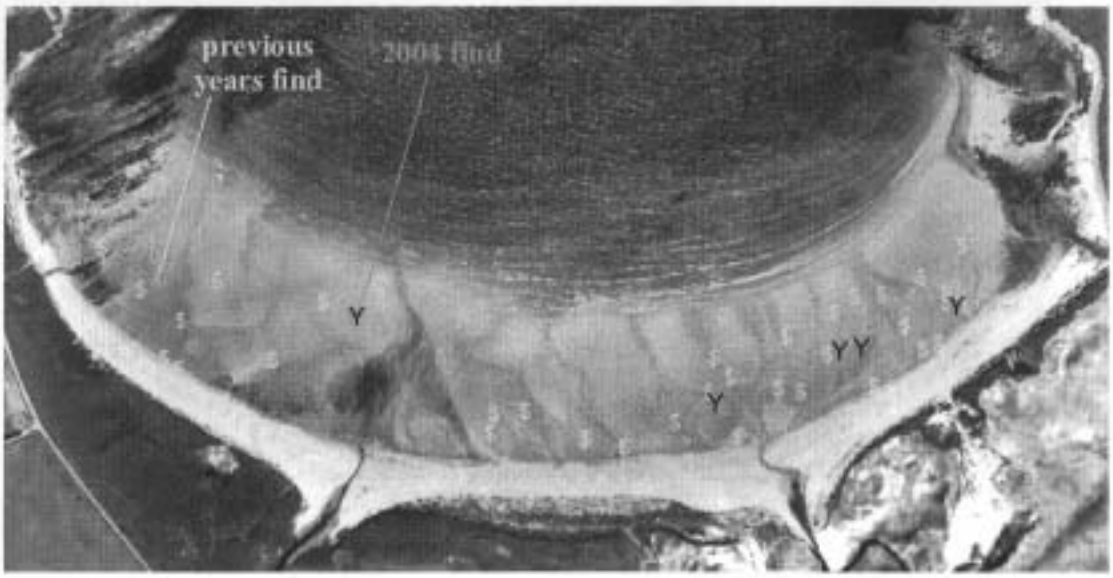

Figure 3-1: Georeferenced particle finds on Sandside beach in 2004 and in previous years

By observing the spatial distribution of the recent finds, it is possible to see that there are more finds on the Eastern than the Western side of the beach.

This trend seems to be the same observed in year 2004. Regrettably, the end of the surveys in April 2004 prevented the gathering of further meaningful information.

3.4 Space-temporal Distribution on Sandside

Despite the small number of particles available for year 2004, a brief study is presented in this section, aimed to find any relationship between chronological sequence and the position of detection of particles on the beach.

The first four particles recovered in 2004 were all in the eastern side of the beach, within 270 metres from each other.

The last particle found on April 28th was in the western side, some 500 metres West of the centre of the eastern cluster.

The chart in Figure 3-2 summarises the above description of find locations in time. Particles are plotted chronologically with their Easting as ordinate. By projecting horizontally on the image on the left it is possible to find out the area of the beach whence the particle was recovered.

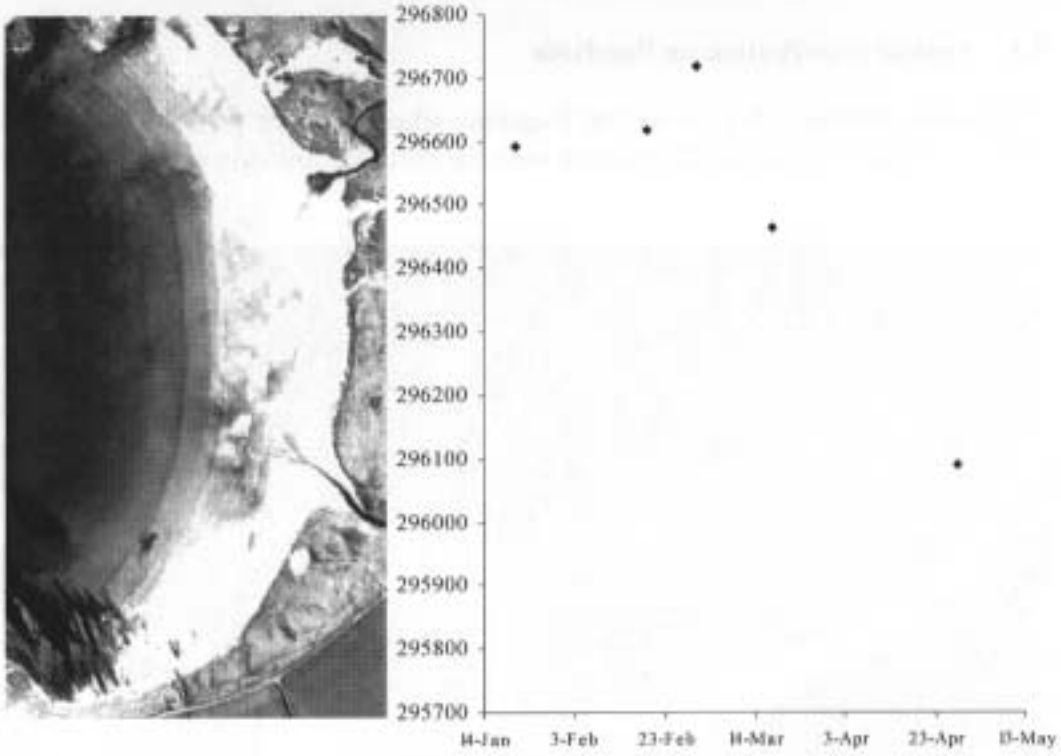

Figure 3-2: Easting - date scatterplot for Sandside finds in 2004

3.5 Dounreay Foreshore Finds

The following table summarises the finds of particles on Dounreay foreshore. EFSN is the unique environmental field sample number.

Date of recovery *	Easting	Northing	Approximate depth [mm]	137Cs activity [Bq]	EFSN
16-Aug-04	298380	967010	50	5.30E+05	DF/04/01
14-Oct-04	298371	967020	175	1.80E+05	DF/04/02
28-Oct-04	298309	966973	100	3.40E+05	DF/04/03
10-Nov-04	298343	966988	100	3.20E+05	DF/04/04
10-Nov-04	298263	966974	150	1.14E+05	DF/04/05
09-Dec-04	298337	966994	150	8.20E+04	DF/04/06
09-Dec-04	298359	967064	50	2.00E+05	DF/04/07
09-Dec-04	298269	966977	50	8.00E+05	DF/04/08
21-Dec-04	298352	967065	50	5.50E+05	DF/04/09

*: particle DF/04/01 was detected using Groundhog Mk 1, before the implementation of the new TID

Table 3-3: Groundhog Evolution particle summary data for Dounreay foreshore

The number of finds has increased in comparison with the results for the previous years. In a way similar to the one observed on Sandside beach since the deployment of Groundhog Evolution, the use of more sensitive equipment on Dounreay foreshore

has led to more finds. The locations of the particles on the west foreshore are shown in Figure 3-3.

Figure 3-3: Georeferenced particle finds on the west foreshore in 2004

3.6 Activity Comparison

The following bar chart shows a comparison between the activities of the particles recovered on Dounreay foreshore and Sandside beach.

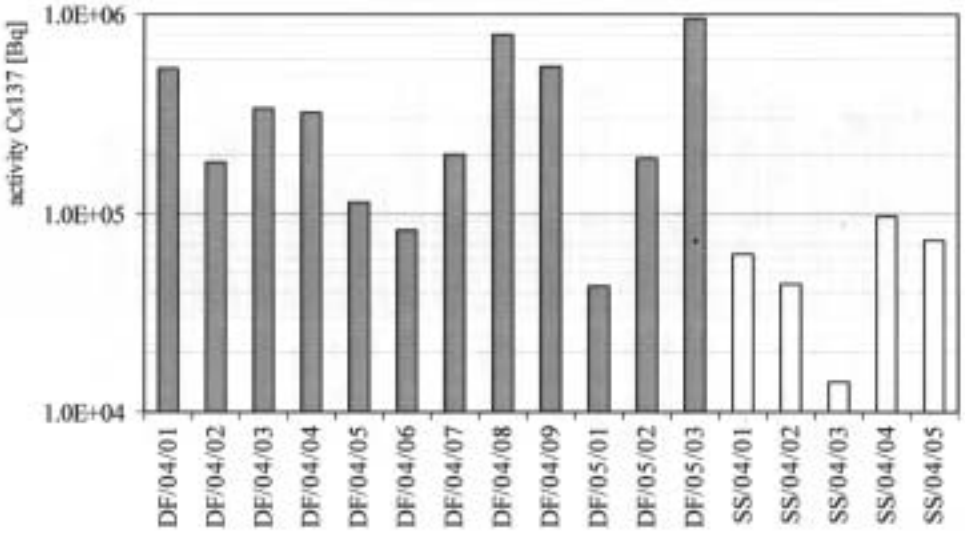

Figure 3-4: ^{137}Cs activities for particles from the west foreshore and Sandside

4 ANALYSIS OF SURVEY SPEED

Until end of September, UKAEA and its contractor adopted a ceiling speed of 1.6 m/s for the monitoring systems. This ceiling was unilaterally put into existence as a conservative margin for the performance of the system.

Since the beginning of October, SEPA enforced a new regime of monitoring in the latest issue of the TID related to the liquid discharges: the average survey velocity must not be greater than 1 m/s and no reading acquired at velocity in excess of 1.2 m/s can be used for the determination of the area covered.

The following charts and tables summarise the maximum (Figure 4-1) and average (Figure 4-2) speed for all the surveys carried out during 2004.

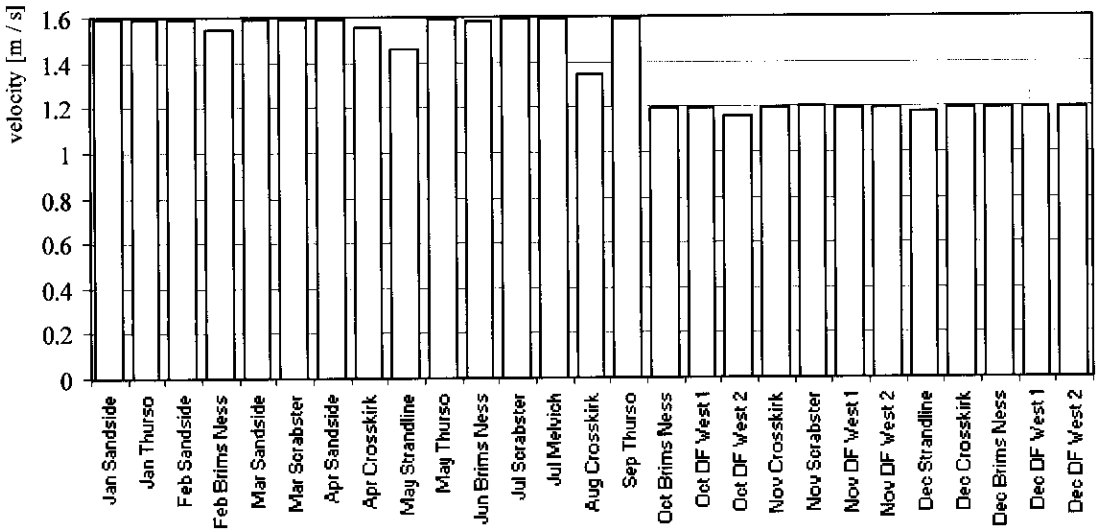

Figure 4-1: Maximum survey velocities

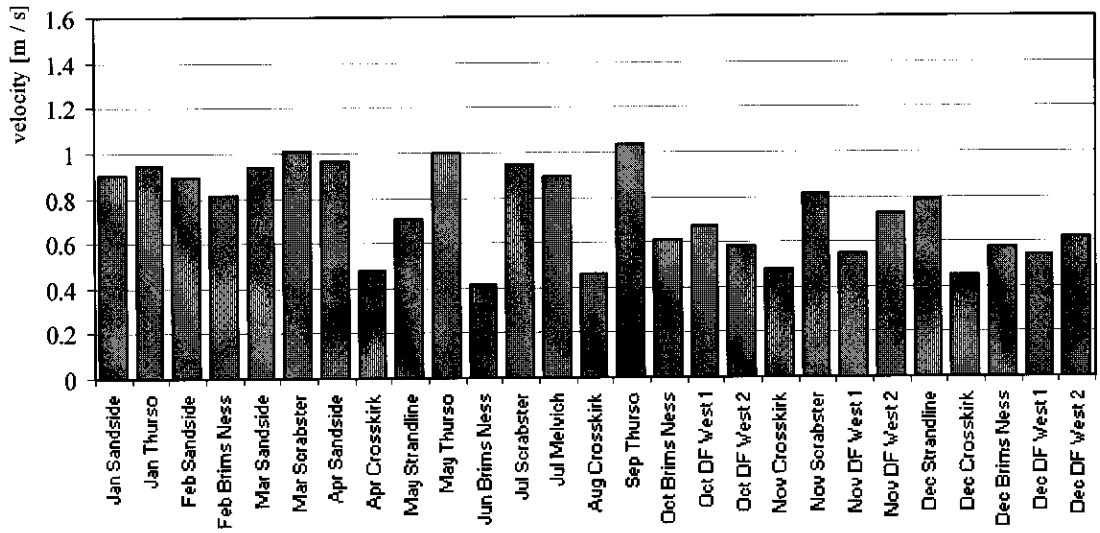

Figure 4-2: Average survey velocities

	velocity [m/s]	
	maximum	**average**
Jan Sandside	1.59	0.906
Jan Thurso	1.59	0.943
Feb Sandside	1.59	0.893
Mar Sandside	1.59	0.941
Mar Scrabster	1.59	1.005
Apr Sandside	1.59	0.964
May Strandline	1.46	0.707
May Thurso	1.59	0.998
Jul Scrabster	1.59	0.947
Jul Melvich	1.59	0.892
Sep Thurso	1.59	1.037
Nov Scrabster	1.20	0.811
Dec Strandline	1.18	0.787

Table 4-1: Velocity summary data for the main beaches

	velocity [m/s]	
	maximum	**average**
Feb Brims Ness	1.55	0.814
Apr Crosskirk	1.56	0.479
Jun Brims Ness	1.58	0.412
Aug Crosskirk	1.34	0.459
Oct Brims Ness	1.19	0.613
Nov Crosskirk	1.19	0.477
Dec Crosskirk	1.19	0.451
Dec Brims Ness	1.19	0.578

Table 4-2: Velocity summary data for the minor beaches

	velocity [m/s]	
	maximum	**average**
Oct DF West 1	1.19	0.676
Oct DF West 2	1.16	0.586
Nov DF West 1	1.19	0.545
Nov DF West 2	1.19	0.721
Dec DF West 1	1.19	0.543
Dec DF West 2	1.19	0.622

Table 4-3: Velocity summary data for Dounreay foreshore

The drop in the maximum speed following the new TID coming into force is easily observable in Figure 4-1. Also the average velocities after September appear to be lower in Figure 4-2. However, Crosskirk and Brims Ness were already monitored at a lower speed before the introduction of the new TID, as the analysis of the bar chart confirms.

5 CRITICAL REVIEW AND CONTINUOUS IMPROVEMENT

After a whole year of surveys a critical review of the coverage methodology and an examination of the possible improvements to the current survey system are carried out. Various issues emerged from this exercise.

5.1 Sandside Beach Coverage

At the beginning of 2004 it was agreed that the bulk of a survey will be carried out as before, that is with a regular seaward boundary; however, during the lowest tidal level of each particular survey, the vehicles would concentrate on a narrower sector of the beachfront. The approximate width was chosen as a sixth of the average strandline.

By means of such methodology, every six months the full width of the lower part of the beach would attempt to be covered. In a complete year of surveys, the lower part of the beach would be aimed to be monitored twice.

During the first two months the proposed pattern was achieved. In March and April, however, the areas to be monitored in the lower part of the intertidal zone were flooded by the water of the two burns whose courses was converging, thus generating a wide area of flowing water and fluidised sand.

6 REPORTING AND PUBLICATION OF THE RESULTS

The current arrangements for reporting the results of the surveys involve notifying SEPA, both orally and in writing, whenever a particle is found. As soon as the Survey Team reports a contact, the UKAEA Project Manager contacts SEPA and notifies them of the find. The field data gathered by the team once the particle is separated and packaged for transport are then fed to SEPA through the UKAEA Project Manager.

Once the accurate positional data and the results of high resolution gamma spectrometry are available, generally not later than the day following the find, a formal letter is sent to SEPA.

SEPA are also able to review the survey reports and to request specific processing of the data in electronic format whenever they consider appropriate. The results of the surveys (the particles found) are summarised in the annual report to SEPA on Radioactivity Levels outside the Dounreay Site.

Although the above arrangements appear to satisfactorily convey the necessary information to SEPA, in light of the very large scale of the beach monitoring project, the significant cost to the public, and public interest in the ongoing investigation of the Dounreay particles, it was concluded by SEPA that an annual review of beach monitoring should be undertaken. This report has been produced in response to this requirement, and is the third annual report to be submitted.

It is also recognised that relatively wide public interest has been shown in local beach monitoring. The simplest and most accessible route by which information can be made available to the public is via the UKAEA website. The latest issued annual review and summary details of particle finds on public beaches are currently published on the UKAEA web site.

7 CONCLUSIONS

UKAEA believe that the 2004 monitoring with Groundhog Evolution not only fully satisfied the statutory requirements on Sandside beach but actually exceeded them. This provides a reassurance margin in the task of compliance with regulatory requirements and restoring the environment.

The positive results, however, do not make the pursuit of continuous improvements less important, and further developments will be tested and implemented in the future.