

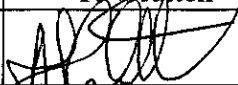


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**SUMMARY**

UKAEA has reviewed the programme of monitoring of the local beaches for the second half of year 2005. The finds for this period are summarised and analysed. The total number of beach surveys in this period was 37. Six of the beach surveys were carried out on Sandside beach, nineteen on Dounreay foreshore (one of which is the March survey postponed by SEPA) and the rest on the other beaches. Also the 2005 survey of Dunnet beach was completed with the coverage of areas inaccessible during the monitoring in the spring time. Considering all the beaches and foreshores, an area in excess of 2.6 million square metres has been monitored for fragments of irradiated fuel and a total of 8,779,804 Gamma readings were taken. The period of severe weather coupled with technical difficulties during January has resulted in poor area coverage for that month. However the following surveys have enabled UKAEA to comply with the yearly targets for area coverage and number of surveys. During the period reviewed, July to December 2005, the surveys on Sandside beach resulted in the detection of two particles. No particles were detected in any of the surveys of Dounreay foreshores, Thurso, Scrabster, Brims Ness, Crosskirk and Dunnet.

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## 1 INTRODUCTION

### 1.1 Background

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 from 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, was the only public beach on which particles have been found, until the particle detected on Dunnet beach on March 26<sup>th</sup> 2005. 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 been removed in the current version of the TID. Since October 2004 the 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 area coverage requirement for Sandside beach (in excess of 0.25 square kilometres per month) and its limitations is still in force.

UKAEA has also agreed with SEPA, albeit outwith the formal remit of the TIDs, to carry out three strandlines per year on each Scrabster and Thurso beaches and four strandlines on Dunnet beach. The strandline surveys will be carried out to the same technical specifications of the statutory monitoring.

The following tables summarise the current monitoring regime.

<b>Beach</b>	<b>Extent of monitoring</b>	<b>Grid references (GRs)</b>	<b>Frequency of monitoring</b>
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 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 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**

<b>Beach</b>	<b>Extent of monitoring</b>	<b>Grid references (GRs)</b>	<b>Frequency of monitoring</b>
Scrabster Beach	Strandline	as above	Three times per year
Thurso Beach	Strandline	as above	Three times per year
Dunnet Beach	Strandline	as above	Four times per year

**Table 1-2: Additional Beach monitoring requirements**

## 2 SUMMARY OF THE SURVEYS

The total number of complete beach surveys in the second half of 2005 is 37. Six of them were carried out on Sandside beach, nineteen on the Dounreay foreshores, six on the small beaches around Ushat Head and six (three surveys and three strandlines) on Scrabster and Thurso, as summarised in Table 2-1.

Further coverage of Dunnet beach has also been carried out in order to close gaps in the survey completed in the spring.

	Sandside	West Foreshore	East Foreshore	Crosskirk	Brims Ness	Scrabster	Thurso	Dunnet
Jul 2005	✓				✓	✓		✓
Aug 2005	✓			✓			✓	
Sep 2005	✓	✓	✓		✓	✓		
Oct 2005	✓	✓	✓	✓			✓	
Nov 2005	✓	✓	✓			✓		
Dec 2005	✓	✓	✓	✓	✓		✓	

**Table 2-1: Survey summary with dates**

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

### 2.1 Sandside Beach

For the reasons discussed in the previous report EPD(05)P220, the January survey did not cover the required area. During subsequent surveys, attempts were made to have coverage well in excess of 250,000 square metres, so that the average figure for the calendar year were compliant with the TID requirement. This trend of high area coverage continued in the second half of 2005. Access consent was withdrawn for April, May and June; as a result, the average monthly coverage for 2005 is 302,874 square metres, well above the statutory requirements.

	area [m <sup>2</sup> ]	Gamma readings [number]
July 2005	359,983	1,289,539
August 2005	400,435	1,284,047
September 2005	358,548	1,198,984
October 2005	322,001	1,058,715
November 2005	307,119	959,960
December 2005	339,046	1,080,037
total	2,087,132	6,871,282

**Table 2-2: Sandside surveys details**

In the second half of 2005, two particles was detected and recovered from Sandside beach.

## 2.2 Thurso and Scrabster Beaches

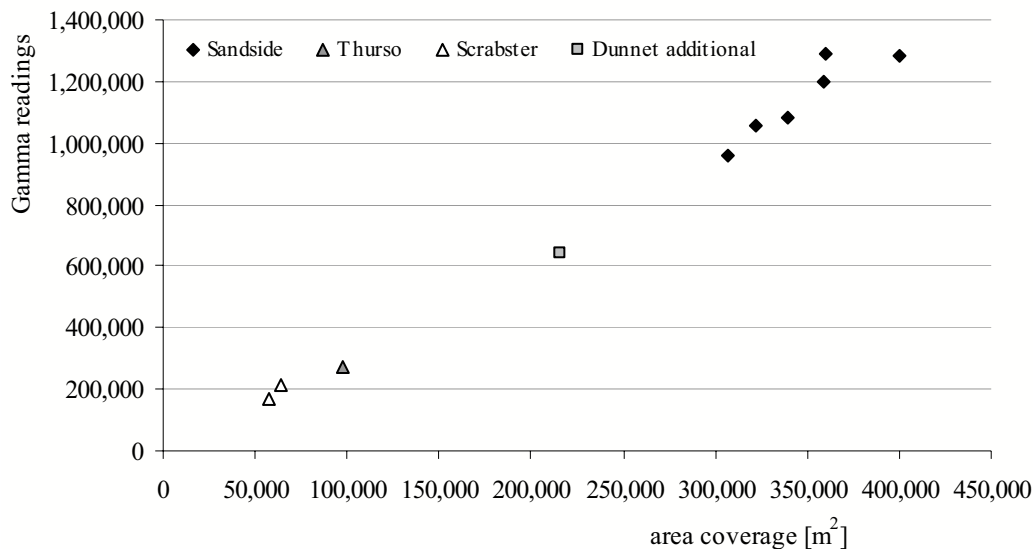
A total of three surveys and three strandlines were carried out on Thurso and Scrabster during the period considered. A summary with area covered and number of sensor readings acquired is reported in Table 2-3 for the two beaches. No particles were detected during any of the monitoring.

	area [m <sup>2</sup> ]	Gamma readings [number]
Scrabster - July 2005	57,682	166,621
Thurso - August 2005 *	6,085	19,021
Scrabster - September 2005 *	4,126	13,529
Thurso - October 2005	97,383	275,019
Scrabster - November 2005	63,938	217,084
Thurso - December 2005 *	6,003	19,333

\* Strandline survey

**Table 2-3: Thurso and Scrabster surveys details**

The chart in Figure 2-1 shows the relationship between gamma readings and area coverage for Sandside, Scrabster and Thurso surveys and the Dunnet additional coverage.



**Figure 2-1: Area - counts scatterplot for Sandside, Scrabster and Thurso**

The chart above, as its counterparts for the other beaches reported below, gives a graphical description of the relationship between number of readings and area coverage. With the new speed limitations introduced in the TID in October 2004, a higher number of readings is needed in order to survey the same areas covered when a higher speed was used. All the surveys are laying approximately on the same line which slope is an indication of the average area covered with a single reading.

### 2.3 Brims Ness

In the second half of 2005 a total of three surveys were carried out on Brims Ness. A summary with area covered and number of points acquired is reported in Table 2-4. No particles were detected during any of these surveys.

	area [m <sup>2</sup> ]	Gamma readings [number]
July 2005	1,471	10,870
September 2005	1,375	8,757
November 2005	1,821	8,295

**Table 2-4: Brims Ness surveys details**

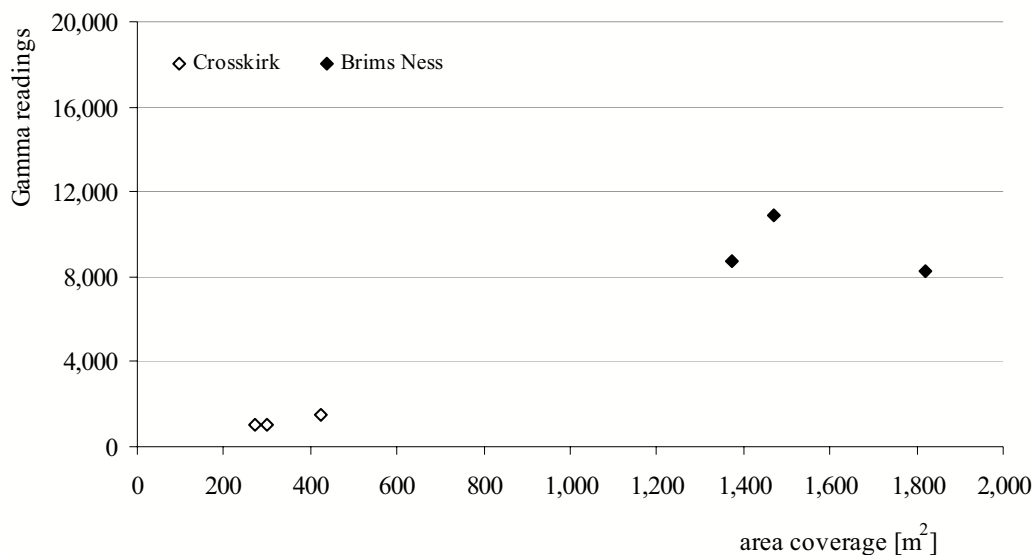
### 2.4 Crosskirk

The number of surveys carried out on Crosskirk during the period considered in this report is three. Table 2-5 summarises the area covered and number of points acquired for each survey. No particles were detected during any of these surveys.

	area [m <sup>2</sup> ]	Gamma readings [number]
August 2005	425	1,487
October 2005	271	1,074
December 2005	297	986

**Table 2-5: Crosskirk surveys details**

The chart in Figure 2-2 shows the relationship between gamma readings and area coverage for Crosskirk and Brims Ness surveys.



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

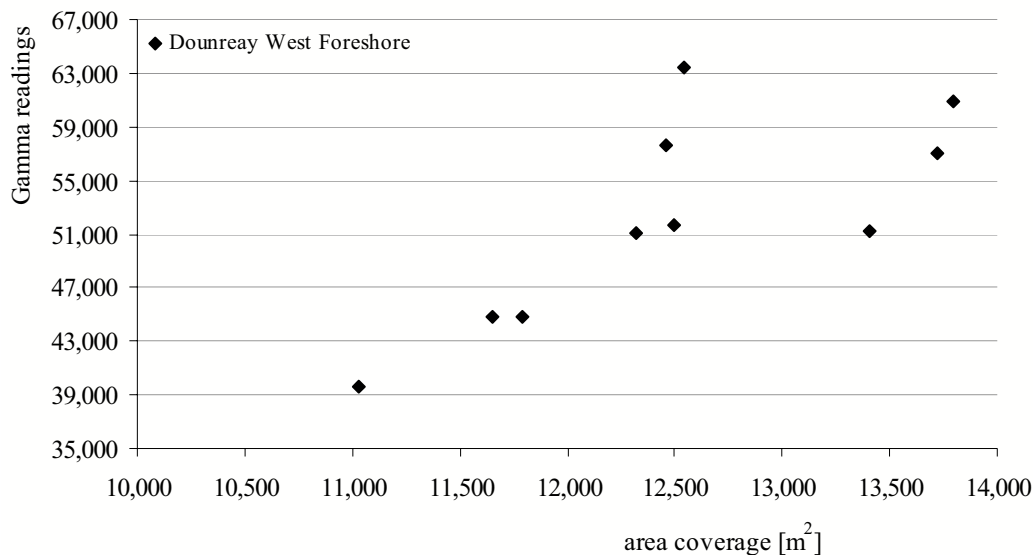
## 2.5 Dounreay Foreshore

The number of surveys planned on the Dounreay foreshore in the second half of 2005 is nineteen. Ten of them were successfully carried out on the West foreshore. Lack of sand on the eastern foreshore prevented the execution of any survey. Table 2-6 summarises the area covered and number of points acquired for each survey.

	area [m <sup>2</sup> ]	Gamma readings [number]
September 2005 I	12,458	57,653
September 2005 II	12,323	51,013
September 2005 III	12,541	63,358
October 2005 I	13,793	60,864
October 2005 II	13,403	51,200
November 2005 I	12,498	51,628
November 2005 II	11,033	39,642
December 2005 I	11,793	44,791
December 2005 II	13,720	57,079
December 2005 III	11,654	44,754

**Table 2-6: Dounreay foreshore surveys details**

The chart in Figure 2-3 shows the relationship between gamma readings and area coverage for the surveys carried out on Dounreay foreshore.



**Figure 2-3: Area - counts scatterplot for Dounreay foreshore**

A series of images related to the nine East foreshore surveys is reported in Appendix A. They illustrate the absence of accessible sandy areas for monitoring.

One West foreshore survey scheduled for the last week in March was cancelled under SEPA instruction in order to maximise the resources deployment on Dunnet beach. In order to compensate for that an additional survey was carried out in December.

## 2.6 Dunnet

During early 2005 a one-off survey of Dunnet beach was carried out. The survey spanned over almost four months, for a total of 33 days of effort and a total of almost 194 hours of surveying.

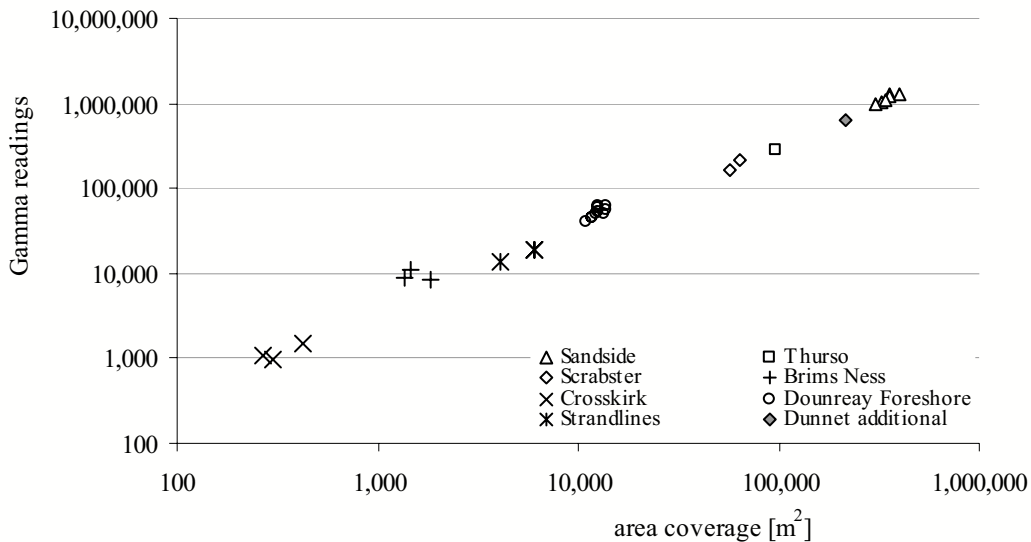
However SEPA pointed out that some patches of the beach have not been covered and there was no formal valid evidence of the obstructions (such as seaweed banks and pools of water) present on the beach at that time and preventing the coverage. Therefore SEPA required supplementary coverage to be carried out before the end of 2005.

During the last month of 2005 this supplementary survey was carried out and the results are summarised in the following table.

	area [m <sup>2</sup> ]	Gamma readings [number]
January to May 2005	1,087,092	3,396,125
Additional coverage	215,711	644,464
Final survey values	1,302,803	4,040,589

**Table 2-7: Dunnet 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 surveys**

### 3 SUMMARY OF THE FINDS

In this section a list of particle finds for the second half of 2005 is given along with considerations about their activity distribution and their geographical location.

#### 3.1 List of Finds

The following Table 3-1 summarises the finds on Dounreay foreshore and on the public beaches for the second half of year 2005, along with the corresponding data for the previous periods.

	up to 2004	2005 I	2005 II	total
Sandside Beach	51	4	2	57
Dounreay Foreshore	226	7	0	233
Other Beaches	0	1	0	1

**Table 3-1: Particle finds**

#### 3.2 Sandside Finds

The summary of the finds is reported in Table 3-2 below. EFSN is the Environmental Field Sample Number assigned.

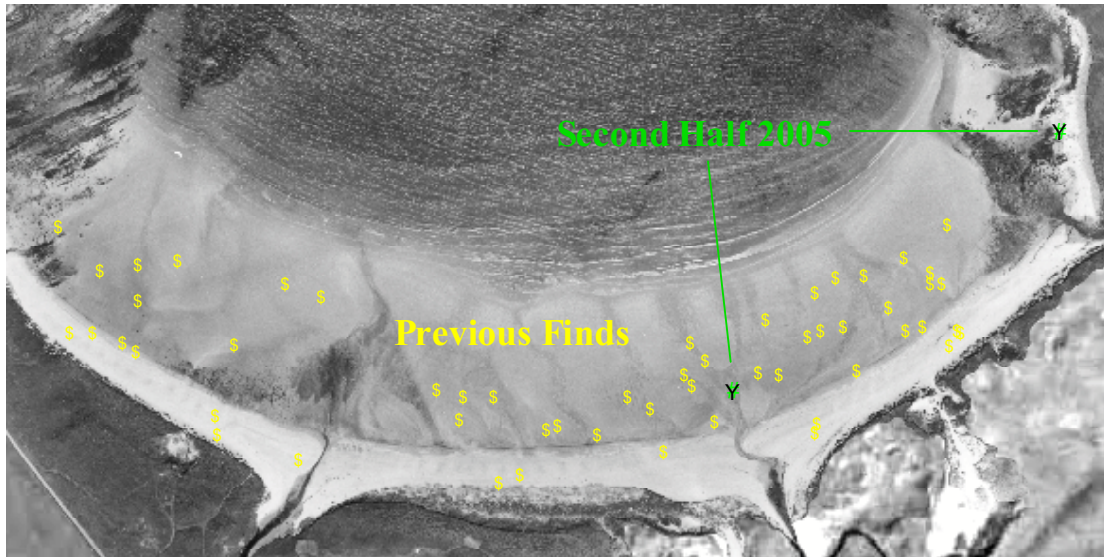
Date of recovery	Easting	Northing	depth [mm]	<sup>137</sup> Cs activity [Bq]	EFSN
09-Sep-05	296507	965390	100	1.90E+04	SS/05/05
17-Nov-05	296838	965653	130	6.40E+04	SS/05/06

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

Particle SS/05/05 found on September 9<sup>th</sup> also contained 49 Bq of <sup>94</sup>Nb activity.

#### 3.3 Spatial Distribution on Sandside

The image of Figure 3-1 shows the locations where the two particles were detected and recovered from during the period covered by this report (in green), along with the particles found previously (in yellow).



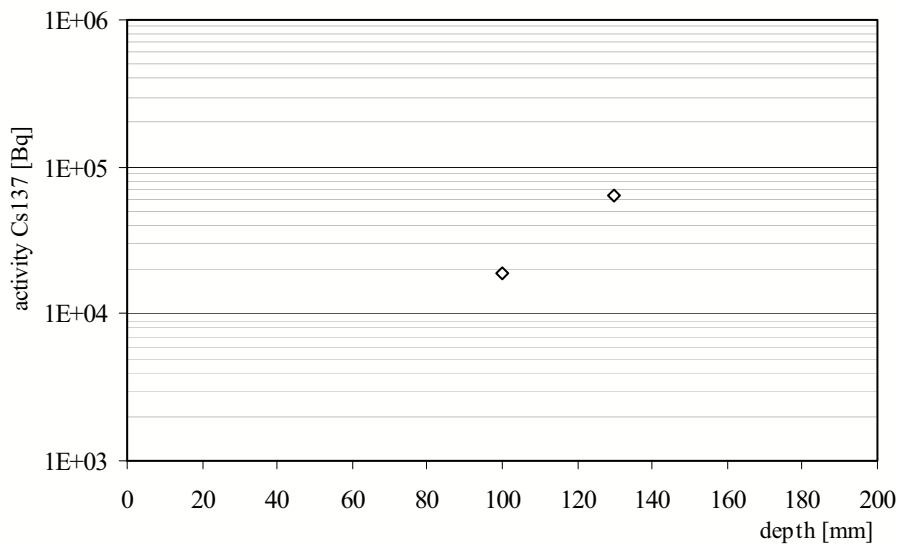
**Figure 3-1: Georeferenced particle finds on Sandside beach**

Particle SS/05/06 was the most Eastern find ever recorded on Sandside beach.

The low number of surveys in a half year hampers the efforts to find further information useful in highlighting possible trends related to the reporting period.

### 3.4 Activity and Depth of Recovery

The following chart in Figure 3-6 shows the activity and depth scatterplot of the finds during the second half of 2005.



**Figure 3-2: Depth - activity scatterplot for the particle finds**

#### 4 ANALYSIS OF SURVEY SPEED

Since the beginning of October 2004, 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 in Figures 4-1 and 4-2 summarise the maximum and average speed for all the surveys carried out during the present reporting period.

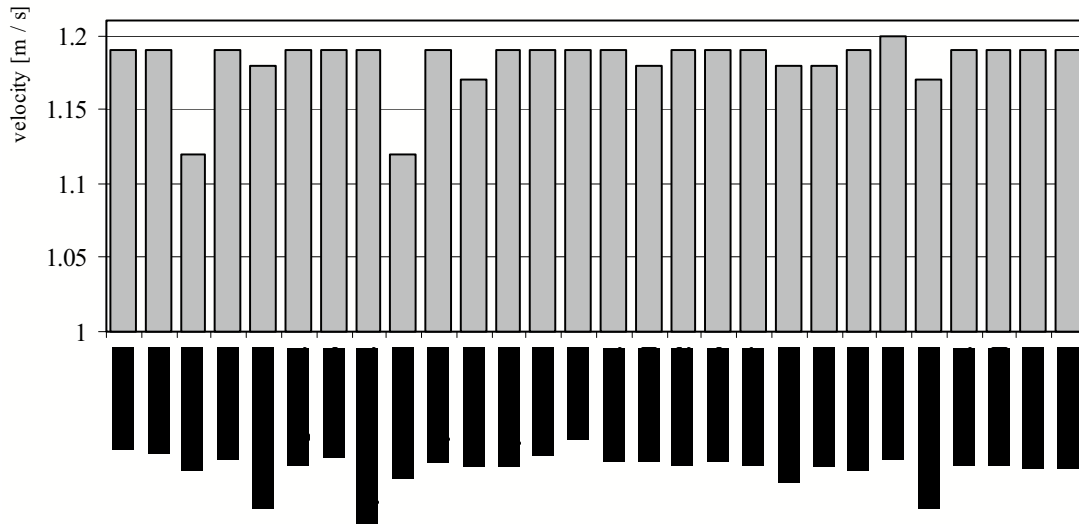


Figure 4-1: Maximum survey velocities

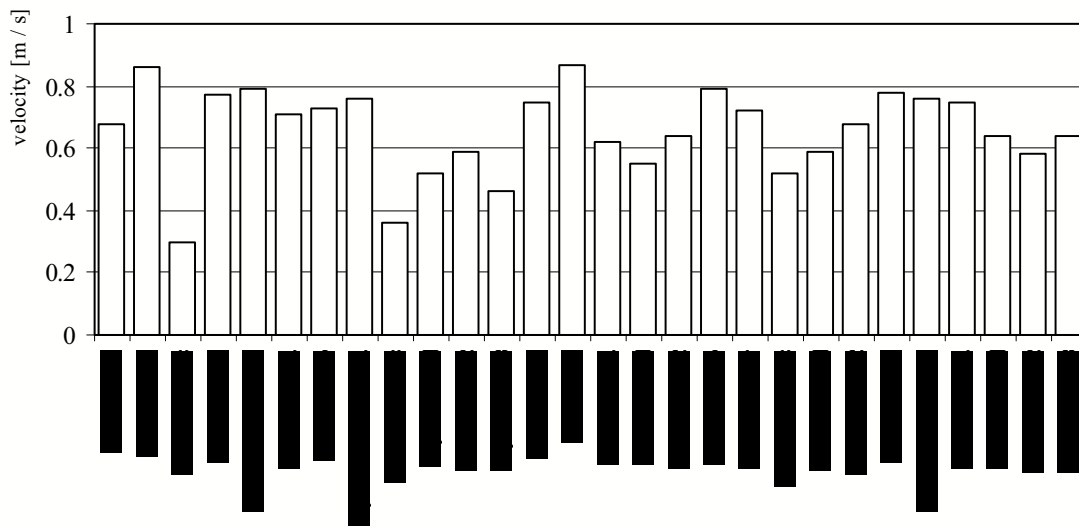


Figure 4-2: Average survey velocities

The following tables (Table 4-1 to Table 4-3) report the numerical values of average and maximum velocity used for each survey.

	velocity [m/s]	
	average	maximum
Jul Sandside	0.68	1.19
Jul Scrabster	0.86	1.19
Aug Sandside	0.77	1.19
Aug Thurso Strandline	0.79	1.18
Sep Sandside	0.73	1.19
Sep Scrabster Strandline	0.76	1.19
Oct Sandside	0.75	1.19
Oct Thurso	0.87	1.19
Nov Sandside	0.79	1.19
Nov Scrabster	0.72	1.19
Dec Sandside	0.78	1.20
Dec Thurso Strandline	0.76	1.17

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

	velocity [m/s]	
	average	maximum
Jul Brims Ness	0.30	1.12
Aug Crosskirk	0.71	1.19
Sep Brims Ness	0.36	1.12
Oct Crosskirk	0.62	1.19
Nov Brims Ness	0.52	1.18
Dec Crosskirk	0.75	1.19

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

	velocity [m/s]	
	average	maximum
Sep DF West 1	0.52	1.19
Sep DF West 2	0.59	1.17
Sep DF West 3	0.46	1.19
Oct DF West 1	0.55	1.18
Oct DF West 2	0.64	1.19
Nov DF West 1	0.59	1.18
Nov DF West 2	0.68	1.19
Dec DF West 1	0.64	1.19
Dec DF West 2	0.58	1.19
Dec DF West 3	0.64	1.19

**Table 4-3: Velocity summary data for Dounreay foreshore**

All the velocity limitations required by the TID (average velocity not greater than 1 m/s and no readings considered with velocity in excess of 1.2 m/s) are in every respect fulfilled.

The average velocity on the minor beaches tends to be lower than on the main beaches in order to compensate for the higher background known to be present.

## **5 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 results 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.

## **6 CONCLUSIONS**

UKAEA has fully and successfully implemented every aspect of the statutory monitoring schedule. Furthermore the following issues were also addressed:

- more extensive coverage of the Sandside surveys to readdress the yearly average and take it back to more than 250,000 square metres per month, following the low coverage in January 2005;
- one additional Dounreay West foreshore survey was carried out in December to recover the survey scheduled for the last week in March and postponed under instructions from SEPA.

**APPENDIX A**

The Eastern foreshore has been accessed as per planned schedule but on no occasion was sand available to be surveyed. In the following pages, a set of photographs is presented for the days in which a survey was planned.

<b>Date of survey</b>	<b>Number of photographs</b>
8-Sep-05	2
19-Sep-05	4
6-Oct-05	5
18-Oct-05	6
2-Nov-05	3
17-Nov-05	7
2-Dec-05	3
15-Dec-05	7
29-Dec-05	7



8-Sep-05 A



8-Sep-05 B



19-Sep-05 A



19-Sep-05 B



19-Sep-05 C



19-Sep-05 D



**6-Oct-05 A**



**6-Oct-05 B**



6-Oct-05 C



6-Oct-05 D



6-Oct-05 E



18-Oct-05 A



18-Oct-05 B



18-Oct-05 C



18-Oct-05 D



18-Oct-05 E



18-Oct-05 F



2-Nov-05 A



2-Nov-05 B



2-Nov-05 C



17-Nov-05 A



17-Nov-05 B



17-Nov-05 C



17-Nov-05 D



17-Nov-05 E



17-Nov-05 F



17-Nov-05 G



2-Dec-05 A



**2-Dec-05 B**



**2-Dec-05 C**



15-Dec-05 A



15-Dec-05 B



15-Dec-05 C



15-Dec-05 D



15-Dec-05 E



15-Dec-05 F



15-Dec-05 G



29-Dec-05 A



29-Dec-05 B



29-Dec-05 C



29-Dec-05 D



29-Dec-05 E



29-Dec-05 F



29-Dec-05 G

**APPENDIX B**

The birds-eye view below summarises the surveys carried out during the second half of 2005 - excluding the Dunnet supplementary coverage.

