

**PARTICLES RETRIEVAL ADVISORY GROUP
(DOUNREAY)**

ANNUAL REPORT TO SEPA AND DSRL

**SUMMARY OF PRAG(D) RECOMMENDATIONS AND FINDINGS
DURING THE PERIOD MAY 2009 TO MARCH 2010**

PARTICLES RETRIEVAL ADVISORY GROUP (DOUNREAY)

MARCH 2010

1. INTRODUCTION

The Dounreay Particles Advisory Group (DPAG) completed its work programme following production of its Fourth Report.

Dounreay site has developed a “Particles BPEO” which resulted in the site deciding to undertake a programme of targeted offshore removal of particles, as recommended by DPAG. As the source of the particles is finite, this programme will ultimately mitigate their migration onto publicly accessible areas. This programme will also improve understanding of the extent of the contamination, the effectiveness of removal of particles and, ultimately, permit the definition of end-points for both the retrieval work and, potentially, the beach monitoring work. It was noted that expert scrutiny of the information generated would allow the progress of the BPEO implementation to be independently reviewed and improve public confidence. As a direct result, SEPA formed the Particles Retrieval Advisory Group (Dounreay), (PRAG(D)).

The principal duties, operation and current membership of PRAG(D) are summarised in Appendix 1. This Report fulfils one of the duties.

2. ANNUAL REVIEW

2.1 Work Programme

The work programme of PRAG for 2009/10 was agreed with members together with SEPA and DSRL. This work programme focussed on five areas:

1. Comparison of expected numbers, activity, depth and distribution of retrieved particles with expectations from Fourth DPAG Report. Implications for the Retrieval Programme in 2010 and subsequently;
2. Performance of the retrieval equipment with respect to its efficiency of detection and recovery as well as coverage. Identification of modifications and improvements;
3. The significance of mobile particles in terms of understanding their behaviour and future movement, especially onto beaches;
4. The significance of buried particles that may not be retrievable, particularly any implications for health;
5. Implications of the limited data available from beach monitoring since the Fourth DPAG Report.

2.2 Particles recovered offshore

In its Third Report, DPAG recommended that serious consideration should be given to targeted removal of *significant* particles in the marine environment. In its Fourth

Report, DPAG welcomed information from DSRL that it intended to undertake offshore recovery of particles and that it accepted a recommendation from DPAG that a sentry box system would be adopted. This system is intended to provide an early warning system if high activity particles were moving toward the mouth of Sandside Bay.

Since the work of DPAG was completed, two years of offshore recovery work, 2008 and 2009, has been undertaken. This work has demonstrated that offshore recovery of particles buried at depth is possible and provided information on areas where further refinement of the monitoring and recovery technique was possible. PRAG notes that following the 2008 work, recovery performance in 2009 significantly improved.

The Group has noted that DRSL has decided to appoint a different contractor for next season's work, using a new system for particle retrieval during 2010. Consequently, the Group recommends that the new detection and recovery technique should be re-evaluated during the next year, which will be included in the next annual report of PRAG(D).

In 2008, offshore recovery work tended to focus on demonstration of capability and only limited areas of the seabed were monitored. However, in 2009, greater areas of the seabed were monitored. In 2009, the sentry box was monitored prior to and following the recovery programme, no particles being found. A further 7.6 Ha of the seabed in an area to the W of the main particle plume and the Old Diffuser were monitored. The numbers of recovered particles in 2008 and 2009 were:

	2008	2009
No. of particle contacts	70	168
No. of particles retrieved	55	115
<i>Significant</i>	30	28
<i>Relevant</i>	16	38
Other	9	49
No. of mobile particles	10	23
No. of particles left in-situ	5	16
No. of anomalous contacts	0	14
Area surveyed (Ha)	1.4	7.6

Although the areas of the seabed monitored in total in 2008 and 2009 are relatively small, initial consideration of the numbers of particle contacts indicate that they are broadly in the range of those predicted by DPAG in its Third and Fourth reports. It is also noteworthy that, during 2008 and 2009, three particles were recovered with an activity of greater than 1 E8 Bq ¹³⁷Cs which, if ingested, could have had significant health implications, or, if in contact with the skin, could have exceeded the ED₅₀ for acute ulceration within a few minutes. Recovery of such particles whilst in the marine environment, where contact is highly improbable and before such particles may be transported onto local beaches, is clearly to be welcomed.

2.3 ROV Detection Capability

As a basis for estimating detection capability, the results from the Fathoms performance in the UKAEA sand bed trials in 2006 have been used. The NaI detector crystal (10cmx10cmx40cm) was deployed parallel to the direction of travel, although the exact height above the sediment surface is not known

Whilst there are a number of uncertainties in this estimation the probability of detecting a *significant* particle (10^6 Bq) is 0.9 at about 35 cm depth, beyond which the probability will decline rapidly to 0.5 closer to 40 cm depth. In practice the system performance including operator intervention outperforms the theoretical capabilities. These results appear to be in agreement with the data presented in Figure 4 of the DSRL report LRP(09)P096.

2.4 Mobile Particles

The 2008 and 2009 seabed monitoring programmes have indicated that even in relatively stable conditions over the summer period a greater proportion of particles than predicted by DPAG (around 15%) is mobile within the surface of the seabed. If as assumed by DPAG, there is a relationship between mass and activity then it is likely that the bulk of these contacts will have been of lower activity and within the '*minor*' class as defined by DPAG. During winter storms, it is probable that a greater proportion of the particle population will be mobilised and could be entrained which provides a mechanism for higher activity particles to be moved in the marine environment. However, if the assumption about the relationship between mass and activity is valid, the higher activity particles will become deposited before the lower activity particles and thus become re-buried at depth. Consequently, higher activity particles may migrate at a slower rate from the point of entry than the lower activity particles, with the rate of differential migration being proportional to the mass. This effect may explain why numbers of particles of *significant* activity continue to be deposited on the Dounreay foreshore very close to the offshore cache whilst, to date, no *significant* particles have been detected on Sandside Beach and the particles detected at Dunnet were of only *minor* activity.

2.5 Buried Particles

The 2008 and 2009 recovery work has reported that a number of particle contacts were outwith the retrieval capabilities at that time. PRAG(D) understands that the capabilities of the system are to be modified for the 2010 recovery programme, which may allow some of these more deeply buried particles to be recovered. Since the detection capabilities of the system are inversely related to depth, these deeply buried particles are likely to be of high activity. It is desirable to recover these particles as there are processes whereby these particles can be mobilised and could present a hazard to the public.

In 2009, DSRL identified 9 particles which were too deeply buried to be recovered. The locations of these particles have been recorded to allow the recovery system to return in 2010 and attempt to recover the particles. Whether these particles have moved or remained *in situ* will provide real data on the potential movement of high activity particles deeply buried in the seabed over a winter period.

2.6 Offshore Particle Numbers

To date, offshore monitoring and recovery of particles using the ROV has been limited in extent and has not included some parts of the areas where DPAG predicted the greatest density of particles to reside. However, a survey including such areas is planned in 2010. In comparing population densities of particles detected by the ROV to that predicted by DPAG, further complications arise due to temporal trends and some of the areas have been monitored a number of times with recovery of some particles. Thus, interpretation of the particle population densities requires careful consideration. However, based on the limited information available, the range in the particle population densities is broadly in agreement with that predicted by DPAG but there is some indication that, overall, particle numbers might be lower.

2.7 Beach Monitoring

Monitoring of beaches around Dounreay has continued in 2008 and 2009. Further particles have been detected at Sandside, Dounreay Foreshore and Dunnet beaches. The detection and removal of these particles continues to demonstrate that there is a feed from the main particle plume onto local beaches. The numbers of particles detected in 2009 were:

	Number of particles	Max Activity Bq ¹³⁷ Cs
Sandside	33	1.3 E5
Dounreay Foreshore	11	2.0 E7
Dunnet beaches	1	9 E3

At Sandside, the monthly monitoring programme was incomplete in 2009 with only three surveys carried out. In June 2009, following a two month gap in monitoring, fourteen particles were detected and removed from the beach, an apparent increase above the average expected; around seven. However, statistical analysis of the probability of this occurring indicated that the chance of detecting 10 or more in a month is 5.4% (roughly 1 in 20). In subsequent months, when monitoring occurred, the number of particles recovered was similar to the average (6 in November and 6 in December) as shown in Appendix 2. Thus, at this time, PRAG(D) does not consider that the risk to members of the public at Sandside Beach has significantly changed from that estimated by DPAG. However, PRAG(D) echoes calls from DPAG and COMARE that consistent monitoring of Sandside Beach is required over the early years of the recovery programme to inform the need for any future action.

Continued monitoring at these beaches might reveal changes in the rate of particle arrivals as a result of the ongoing offshore particle recovery work.

3. APPENDIX 1

PRAG (D) MAIN DUTIES

The main duties of this group are:

- To review information received from DSRL on offshore particles recovered and seabed survey areas, with the aim of determining whether the offshore population diagrams in DPAG Fourth report and the estimates and distributions of *significant*, *relevant* and *minor* particles remain valid. The results of the review will be communicated to SEPA and DSRL;
- To review the effectiveness of offshore particle retrieval, to make recommendations for improvement and review the plan for the next year's recovery operations;
- To consider criteria for determination of the offshore recovery end point;
- To provide commentary on the potential re-population of offshore areas;
- To review beach monitoring information and make recommendations for improvement in techniques and changes in the frequency and extent of monitoring area (in relation to public health and other objectives);
- To assess the rate of particle finds for both offshore and onshore environments, taking account of equipment detection ability and assess whether current health advice with respect to particles requires modification.

Recommendations and findings from the main duties are to be provided to SEPA and DSRL in the form of a summary or report by the end of each financial year. This report forms that annual report.

3.1 Frequency

Three formal meetings of the group are scheduled to occur each year, to review offshore retrieval information and beach monitoring information and comment on plans for future monitoring. Further meetings may be arranged if required, following discussion with SEPA and DSRL.

SEPA and DSRL would provide input to the meetings as observers. An invitation to become observers at meetings has been extended to other interested groups including COMARE, Food Standards Agency, HPA, Scottish Government, NDA, Dounreay Site Stakeholder Group, following discussion with the Chair.

It is anticipated that the group will be required over a period of five years (i.e. terminating in 2014), or until the old diffuser has been sealed and sufficient information has been gained on the effectiveness of the offshore retrieval

work. However, the need for the Group will be reviewed after two years, by SEPA and DSRL, to ensure that the Group remained “fit for purpose”.

3.2 Membership

Membership of the Group has been drawn from experts reflecting the main duties of the group and covers a broad range of disciplines including:

1. Monitoring systems (offshore and onshore);
2. Statistical analysis of data;
3. Marine movements around Dounreay;
4. Exposure scenarios.

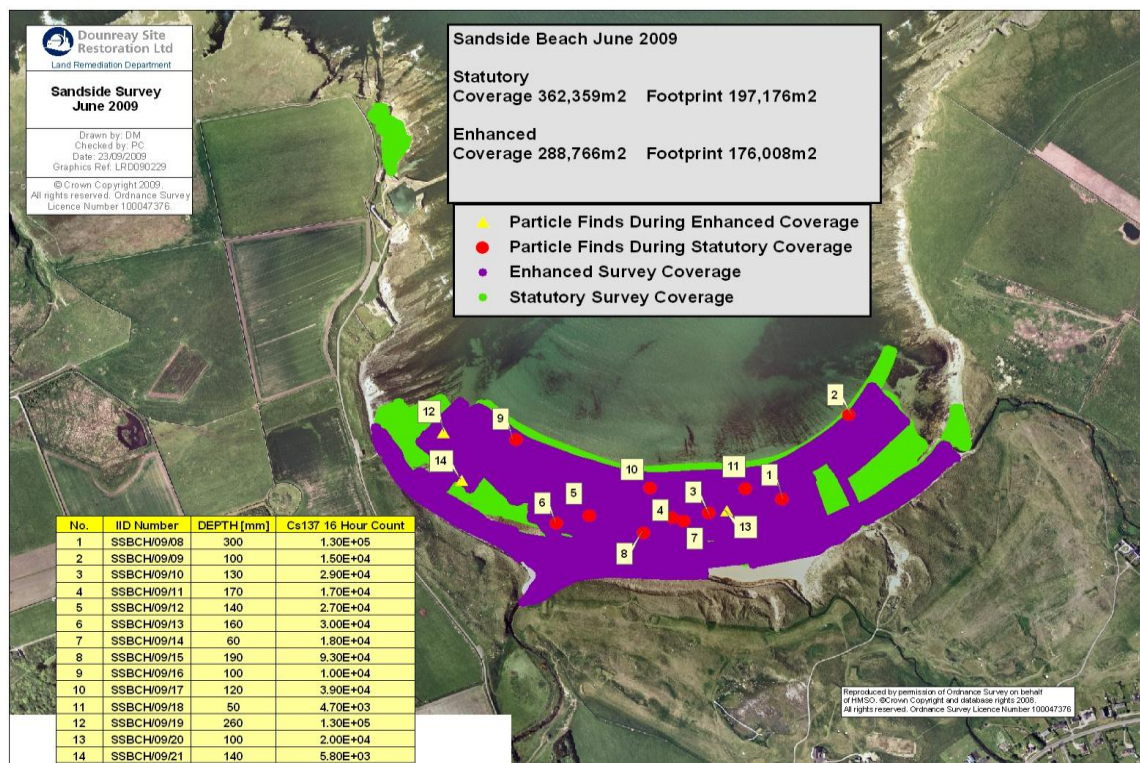
It was considered that a sound working understanding of the Dounreay particles issue would be beneficial for members. As a result, in the first instance membership was drawn from former DPAG members with expertise in the relevant areas. However, membership will be reviewed as work continues to ensure that appropriate expertise is available to the Group.

Current members are: Professor Keith Boddy (Chair), Professor Marian Scott, Professor Tim Atkinson, Professor Alex Elliott, Dr Andrew Tyler. The Technical Secretary and administrative support is provided by SEPA.

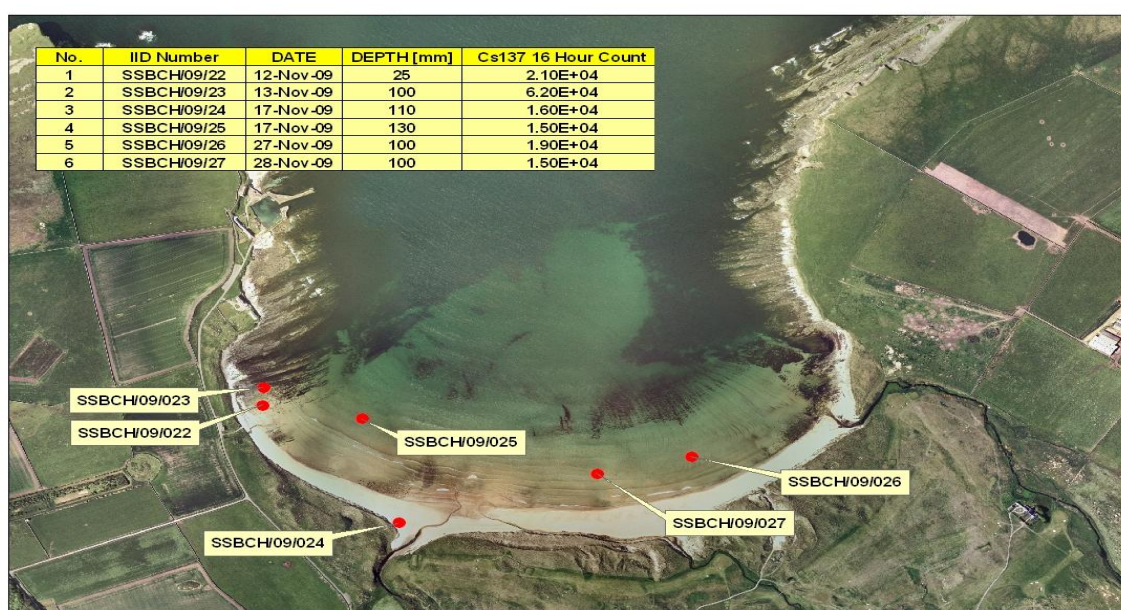
4. APPENDIX 2

PARTICLES DETECTED AT SANDSIDE

4.1 June 2009



4.2 November 2009



4.3 December 2009

