

**REPORT OF INVESTIGATION INTO PARTICLE FIND ON THE
DOUNREAY CASTLE FORESHORE - 4 DECEMBER 2000
(UNOR Reference ATO92/00/389)**

Team Members:

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During the investigation, various expert witnesses, plant operators and other specialist staff were called to give evidence.

1. INTRODUCTION

- 1.1 A particle was found on the Dounreay Castle foreshore on 4 December 2000 during a reassurance survey of the area around the Dounreay Castle. SEPA were informed by telephone on the same day. On 5 December 2000, the particle find was confirmed to SEPA by letter (also faxed) (Annex 1 refers).
- 1.2 SEPA opined on a number of possible origins of the particle and requested that UKAEA should “undertake a detailed investigation into the possible pathways that may have lead to the deposit of the fragment” (SEPA letter of 12 December 2000 at Annex 2 refers).

2. TERMS OF REFERENCE

- 2.1 The terms of reference for the investigation were:
1. To establish the facts of the particle find
 2. To consider the pathways by which the particle could have arrived there and evaluate the pathways using the best information available
 3. To review the implications of this particle find for the risk and hazard assessment of particles
 4. To review the reporting arrangements and stakeholder management
 5. To consider any implications of this find for the future planned work programme on particles
 6. To make appropriate recommendations

3. **BACKGROUND**

- 3.1 On the morning of 4 December 2000, during a survey of the area to the SE of the Castle/cottage forecourt, on the Dounreay foreshore, a radioactive 'particle' was detected (Annex 3). The grid reference of the find was NC 98330 66938. The particle and surrounding soil were removed, returned to site, separated and analysed. Gamma spectrometry showed the activity of ¹³⁷Cs (generally used as an indication of the overall activity of Dounreay particles) to be 1.1×10^6 Bq.
- 3.2 As a result of past operations at the UKAEA Dounreay site, the Castle environs became affected by radioactive contamination as a result of effluent dispersion experiments carried out in the mid 1950's. A non active discharge pipe (known as the Castle Gate Drain, terminating in Outfall No 4) had also been found to be contaminated. This was replaced and the Castle ground remediated in late 1997/early 1998, and has been subject to reassurance surveys every six months since that time.
- 3.3 Remediation of the Castle ground involved removal of the soil and its replacement with clean soil from outside the Dounreay site. The area around the drain used clean soil that had been separated from contaminated spoil from the Dounreay Castle forecourt excavation. Substantial monitoring and sampling took place during the remediation works that would have detected particles like that found on 4 December 2000. Surveys following completion of the remediation showed the Castle forecourt to be clean. Similar instrumentation to that currently used for beach monitoring for particles was employed at that stage. There is controlled access to the Castle area by members of the public by prior arrangement with UKAEA. There is a high degree of confidence that the particle was not present at the completion of the remediation works. The area has been "open" to interested members of the public by prior arrangement with UKAEA. The arrangements for access to the Castle area involve monitoring of all personnel leaving the area in the same way as for visitors to other parts of the foreshore.
- 3.4 Regular monitoring to provide reassurance that there was no recontamination has taken place every six months since the remediation was completed. The last survey was on 13 August 2000, when, in common with previous surveys, no contamination was found. Reassurance monitoring was not designed to seek particles and therefore did not necessarily need to cover the total ground area. It is therefore possible that the particle could have been missed in previous reassurance monitoring.

4. **THE INQUIRY**

Interviews

- 4.1 Members of the inquiry team consulted persons with relevant experience and knowledge, as set out in Annex 4.

5. ESTABLISHING THE FACTS – (TERM OF REFERENCE 1)

5.1 The issues addressed in establishing the facts were

- The circumstances in which the particle was found
- Confirmation of the location of the find
- Recent history of this area of ground
- Details of the particle itself
- Other particles that have been found in this area/on and off site

Circumstances of the find

5.2 The particle was found some 8.5m above sea level by the reassurance monitoring of the area carried out every six months. The area surveyed includes the Castle courtyard, the surrounding grass areas, and includes the ground reinstated after the replacement of the Castle-Gate drain. This reassurance monitoring is designed to demonstrate the ongoing performance of the remediation work carried out at the Castle and Castle-Gate drain. It does not necessarily need to cover the whole area and is therefore not optimised to locate and recover particles. It complements the monitoring surveys of the beach and foreshore, which extend to only about 8m above sea level (Annex 7). Since the inquiry, consideration has been given to the need to extend the scope of the routine particle monitoring programme. In the light of the evidence of occasional inundation (Annex 8), in future the ground around the Castle will be monitored for particles every two months.

Location of the find

5.3 The Health Physics Surveyor who found and recovered the particle marked the ground where the particle was found, as shown in the photograph at Annex 9. The Surveyor confirmed that the particle had either been on the surface or very close to the surface and had been scooped up on a trowel with about 1 cm of soil. The location of the particle was in clean soil above the refurbished Castle-Gate drain that terminates in the non-active Outfall Number 4.

5.4 The area in which the particle was found is not normally accessible to the public although visits to the location can be made by prior arrangement with UKAEA and through the main Dounreay site. All visitors to the area are escorted and each person who has visited the area is monitored prior to leaving. In the last six months, 23 people have visited the area.

Recent history of the area of the find

5.5 As a result of past operations at the UKAEA Dounreay site, the Castle environs became affected by radioactive contamination as a result of effluent dispersion experiments carried out in the mid 1950's. The objective of the experiments was to investigate the dispersion characteristics of radioactive species discharged into the sea, in order to provide data for the design of a sea discharge system for effluent containing radioactivity. The experiments involved the discharge of a mixed fission product liquor into the Pentland

Firth via a temporary tank and pipeline arrangement set up from the Castle courtyard. The tank was removed in 1995 and in 1997/8 the Castle, its immediate environs and the beach to the north were remediated by excavating and disposing of contaminated soil by the authorised route for LLW. Monitoring and sampling of the excavated and remaining soil continued throughout the project. For this part of the remediation work, fresh clean soil was brought onto site from one of the adjacent farms to refill the excavations.

- 5.6 Once the works on the area around the Castle had been completed, the damaged and contaminated drain was excavated and replaced. Monitoring and sampling of the excavated and remaining soil continued throughout the project. For this part of the remediation work, clean soil separated from the contaminated material excavated during the castle remediation was used to refill the excavation. It is on this soil that the particle was found. There is a very high degree of confidence from the staff engaged in the remediation that the monitoring and separation methods used during the project would easily have detected and removed a particle of this size.
- 5.7 A post completion survey, carried out in May 1998 used the Groundhog system (similar to that currently deployed for Sandside and other local public beach particle surveys, but not for Dounreay foreshore particles). It was sensitive enough to find that particle had it been located there. This system has the advantage of a GPS record of the survey linked to gamma spectrometry. The record shows that the area where the particle was found was surveyed and no particles were present at that time. Annex 10 shows the record of the survey.
- 5.8 Comments by several individuals who had worked in the vicinity of the castle testified to the occasional inundation of the whole area, including and within the security fence, by the sea. Recent examples include:
- Flooding of the Milliscreen Station 4 (which is inside the security fence) on 29 January 2000 as a result of inundation by the sea. This would indicate that the surge tide reached a height of about 9m AOL.
 - On 27 February 1998, the surge reached the top of the Castlegate ramp at about 8.5m AOL.
- 5.9 During the course of the inquiry (on 14 December 2000) a storm surge took place and inundated the Castle and courtyard including the place where the particle was found. Photographs of this inundation (Annex 8) clearly shows that the tide does inundate the Castle under extreme conditions presenting the possibility of a particle being deposited near the Castle from the sea. Under extreme weather conditions it is already known from the investigational work carried out offshore that sediments known to contain particles are mobilised.

Details of the particle

- 5.10 The laboratories at Dounreay examined the recovered soil and a particle of activity 1.1 E6 Bq of Cs 137 was separated out. The SEM/EDAX¹ analysis (copy attached at Annex 11) showed that its composition was typical of MTR particles and that it measured 0.93 mm long by 0.74 mm wide. The particle was rounded in shape and had similar characteristics to other particles found on the Dounreay foreshore.

Other particles found nearby

- 5.11 Approximately 100 similar particles have been found since 1984 on the beach to the north of the Castle. Of those, 3 particles have been found near the Castle at only a slightly lower elevation to this latest particle. Those particles have a rounded profile which is characteristic of particles washed up by the sea onto the beach or foreshore. Two previous particles have been found on the 8m contour and this particle find was at the 8.5m contour.

6. **PATHWAYS (TERM OF REFERENCE 2.)**

- 6.1 Potential pathways by which the particle may have reached the location where it was found under the following headings:

- Air
- Liquid
- Solid

- 6.2 Twelve potential pathways were identified. For each pathway, an assessment was made of:

- a) The evidence to support or to question the pathway as the likely route for deposition of the particle
- b) The likelihood of this pathway being the source of the particle
- c) The adequacy of the control of access and monitoring for particles

- 6.3 For completeness, all credible potential pathways were reconsidered.

Potential Pathways

- 6.4 Annex 12 lists all the potential pathways by which the particle could have reached this location near the castle and a summary of the main conclusions on each pathway.

¹ SEPA have subsequently pointed out (letter 22 December 2000) that they consider that the requirement for UKAEA “determination of the activity and nature of the fragments of irradiated fuel by non-destructive means” does not permit SEM/EDX and prior consent should have been sought.

Airborne Pathways

- 6.5 The evidence provided by Professor Clayton, and others, shows that particles of this size can be levitated in airflow velocities of about 6.5ms^{-1} . It is not uncommon at Dounreay to encounter such wind velocities. It is therefore possible that this particle could have reached its final location by being blown from the beach, and this particle had characteristics common in beach particles. It is less likely that a particle could be blown from the site.
- 6.6 Maximum flow velocities in the D1213 FCA main stack also reach 6.5ms^{-1} . Consequently, discharge from the main stack is theoretically possible (Annex 5), but there is no evidence to show that this has ever occurred. If the D1213 stack was a source of particles, there would be a characteristic plume of particles around the stack. Despite extensive site surveys such a plume has never been detected. A map illustrating metallic particle finds on the site and foreshore (1984-2000) is attached at Annex 13. Particles found on the foreshore have accretions that it is thought originate from exposure to the sea. They are also usually fairly smooth. It is difficult to see how either of these characteristics is consistent with discharge from the main stack and ventilation system.
- 6.7 Whilst the flow velocities in the D1213 stack are just about high enough to allow a particle of this size already in the stack to reach the top and be discharged, it is very difficult to see a route for the particle to get into the stack in the first place. This matter will be the subject of a further investigation to be completed by the end of March 2001.

Liquid pathways

- 6.8 The similarity to other beach particles from the sea is important, as is the evidence that the sea from time to time inundates the location of the find. The nearby non-active discharge pipeline to Outfall No 4 was replaced soon after the Castle remediation project and there is no evidence of leakages from the new pipeline. The investigation team were aware of the extensive survey of the site's non-active drains^(Ref 1) and the more recent work to investigate areas where enhanced radiation had been recorded. Near the Castle, it was this work that led to the replacement of the Castle Gate drain, during which no particles were encountered.

Solid pathways

- 6.9 The investigation team paid particular attention to the way in which the remediation work near the Castle was the subject of careful investigation. Both oral and written evidence from the project manager (Annex 6 refers) showed that the material used was clean and that there were no particles encountered. He confirmed that the soil used for the part of the excavation on which that particle was found had come from the Dounreay site. Hence the finding of this particle does not imply that soil from outside the site (SEPA refer to the Dounreay Farm in their letter) is contaminated with particles.

6.10 The Head of Profession, Radiological Protection was asked his opinion on the possibility of on-site contamination being the source. In his judgement, the current programme of monitoring of people and items from Controlled Areas, and of general site monitoring, provides adequate reassurance that contamination is not spreading from Controlled areas on site. These arrangements are reviewed regularly. The equipment is properly controlled. The Head of Profession does not believe that a requirement for any additional monitoring is indicated by this event.

Categorisation of possible pathways

6.11 After due consideration of the available evidence, a category was assigned for each pathway by the investigation team to signify the likelihood of this pathway being involved. The categories are as follows:

- Category 1: Significant probability that this pathway may have been involved
- Category 2: Lower probability that this pathway may have been involved but cannot be ruled out completely at this stage
- Category 3: Unlikely that this pathway was involved

6.12 The following table summarises the categorisation determined by the investigation team for the particle found at the Castle on 4 December 2000. In carrying out this work the team were aware of, and took into account, the more general work previously carried out on potential particle routes into the environment^(Ref 2). Information on the historical origin of particles and known historical incidents that might involve particles were also borne in mind^(Refs 3, 4)

Pathway	Description	Categorisation
Airborne	Windblown from beach after deposition by the sea	1
Airborne	Windblown from the site	2
Airborne	Discharged from the FCA main stack	2
Liquid	Direct deposition by the sea	1
Liquid	Surface water from the site	3
Liquid	Groundwater from the site	3
Liquid	Liquid discharges via the main pipeline	3
Liquid	Non-active drains and land drains	3
Solid	Coming from the fill material	2
Solid	Transport on vehicles or human boots or by wildlife	3
Solid	Unauthorised disposal of spoil	3
Solid	Malicious, ie deliberate planting of particle	3

Conclusions reached regarding pathways

- 6.13 The following conclusions were reached regarding pathways:
- a. The most likely pathways (assessed as category 1) are those of direct deposition from the sea, or windblown from the beach following a period of submersion in the sea and deposition on the beach. All the evidence suggests that the particle has come from the sea. This is indicated by the rounded shape of the particle (particles which have never been in the sea tend to be more angular) and by its activity which is typical of those found on the Dounreay foreshore.
 - b. Documented evidence of the castle forecourt being inundated by the tide at periods of storm surge and high spring tide confirms that direct deposition would have been possible. Equally, wind speeds at Dounreay often exceed those that could have carried the particle from the beach.
 - c. The second category of pathways included those of windblown from the site, discharge from the FCA stack, deposition during backfilling of the area following remediation of the ground in the Castle forecourt and transport by vehicles/people/wildlife. Whilst theoretically possible, the physical processes are not readily foreseeable, and particularly these pathways are assessed as significantly lower probabilities.
 - d. Pathways assessed as being in the third category have been ruled out for all practical purposes and have not been subject to any further investigation.

7. **RISK ASSESSMENT (TERM OF REFERENCE 3.)**

- 7.1 Controls and precautions for each potential pathway were considered to minimise the risk to workers, members of the public and the environment. All personnel leaving the foreshore areas (this includes the Castle) are monitored before returning to site. The Head of Profession Radiological Protection has given his opinion that the present regime is sufficient to protect people returning to the site.
- 7.2 A programme of frequent routine monitoring is already in place to detect and remove particles from the foreshore, but these do not extend to the Castle forecourt. Now that evidence has been drawn to the attention of the investigation team that the Castle area is inundated from time to time, consideration has been given to extending the routine monitoring to include this area.

8. **REPORTING ARRANGEMENTS (TERM OF REFERENCE 4.)**

8.1 The Regulators were informed of the discovery of this particle within the agreed 24 hours reporting period. Details of the reporting sequence are:

- 4 December Particle found on Dounreay Castle Foreshore and SEPA informed by telephone
- 5 December SEPA advised by letter from Guy Owen (also faxed) (See Annex 1)
- 7 December Dounreay Bulletin issued advising stakeholders of find (See Annex 14)

9. **IMPLICATIONS OF THIS FIND FOR FUTURE PLANNED WORK (TERM OF REFERENCE 5.)**

9.1 The investigation considered the current and future work being carried out on particles summarised in the report^(Ref 5). The programme manager also advised the team on more detailed aspects of the planned work. The main thrust of the UKAEA work programme is to understand the movement of particles and the mechanisms by which they reach the foreshore and the public beach at Sandside. In addition to the routine monitoring of beaches to identify and remove particles, this involves both theoretical modelling and offshore surveys. Considerable effort is being placed on understanding the processes that deposit particles on the shoreline close to Dounreay from the sea, and whether intervention is possible, practicable or justifiable. Both health hazard and contact risk is being studied. Potential recontamination pathways are being investigated along with relevant hydrogeology and geological features. Consideration is being given to a process which would make the results more widely available via a BPEO is planned during 2001 to allow a wider range of stakeholder interests to be taken into account in deciding what is the most appropriate long term action.

9.2 Part of this further work includes collating, into a single report, the results of the studies that have been undertaken over the last 5 years examining the D1213 stack as a potential source of particles. A full report on this aspect will be complete by the end of March 2001 in response to SEPA's request following this particle find at the Castle. In relation to the specific questions raised in SEPA's e:mail of 13 December 2000 (Annex 15), the inquiry team have formed the following conclusions:

- i. D1213 Stack. The investigation assessed that the D1213 stack was unlikely to be the source of the particle found at the Castle. A full report will be prepared by the end of March 2001.

- ii. Particle Finds on Site. Some 80 particles have been found on the site. About half of these were found during the full site survey conducted in 1995/96. Most were detected on road verges or close to roadways. A full map showing the location of all these particle finds is included in this report (Annex 13 refers).
- iii. On Site Monitoring. No particles of the foreshore type have been detected on site by high volume air samplers and tacky shade monitors. This supports the view of the investigation that re-suspension of particles from the site is unlikely to be the source of this particle at the Castle.
- iv. Soil from the Upper Dounreay Farm. The discussions on Friday 15 December with SEPA clarified the position that the area in which the particle was found was part of the Castle remediation and Castle gate drain replacement programme. Detailed search of the records has shown that the specific location where the particle was found, almost directly over the drain, was backfilled with soil from the Castle excavation. The soil had been monitored twice and found to be free from contamination or particles. The soil was not from Upper Dounreay Farm.
- v. Dounreay Castle Surveying. It is one of the recommendations of this investigation that we will consider the need for changing the environmental monitoring arrangements for the ground around the Castle
- vi. Monitoring Off-Site. Dounreay will review what is appropriate and feasible for particle detection in general areas off site.

10. CONCLUSIONS

10.1 After considering all available evidence, the team concluded that the most likely pathways were:

- Direct deposition of the particle in this location from the sea
- Windblown from the beach

10.2 Subsequent to the main investigation, consideration has been given to:

- The need for changing the environmental monitoring arrangements for the ground around the Castle
- A review of procedures for the admittance of visitors to the Dounreay Castle area by end January 2001

10.3 The conclusions of these investigations are:

- Further to the advice of the Head of Profession Radiological Protection, summarised in paragraph 7.1 above, the practical implementation of the arrangements were re-examined and found to be satisfactory. However, the documentation required to gain access to the area is to be modified to provide further information, particularly for visitors to the Castle.

- All visitors to the Castle gain access through the UKAEA Dounreay site and are escorted. Amendments to the documentation, described above, will provide further information, particularly in the unlikely event of a site emergency.
- Monitoring of the area around the Castle for particles will, in future, be carried out every 2 months.

11. RECOMMENDATIONS

11.1 The recommendations of the investigation are:

1. To collate into a single report, the results of the studies that have been undertaken over the last 5 years into the D1213 stack as a potential source of particles and issue this report to SEPA by the end of March 2001
2. To continue the present personnel and vehicle monitoring arrangements and review these periodically

31 January 2001

REFERENCES

1. Summary of radiological survey of Dounreay non-active drains SESG(96)P24 – September 1996
2. Metallic particles – a review of pathways into the environment SESG(96)P21 – August 1996
3. Dounreay particles – incidents potentially relevant to escape into the environment EPSC-TSG(98)P05 August 1998
4. Dounreay particles – a status report May 1999
5. Dounreay particles – a programme for future work EPD(00)P20 – January 2001

Interviews

Members of the inquiry team consulted the following persons with relevant experience and knowledge:

- The Health Physics Surveyor who found and recovered the particle (UNOR ATO92/00/389 refers – Annex 3)
- The Head of Profession Radiological Protection, on matters relating to on-site contamination as a source of "particles" on the foreshore and the implications of the Nuclear Site Licence and the Ionising Radiations Regulations 1999 to the recent particle find.
- A member of staff of the Technical & Safety Department who discussed the likelihood of particle levitation in the D1213 stack (written statement at Annex 5 refers)
- The Authority to Operate Holder for the Silo, Shaft, D1213 Stack and the D1211 Liquid Effluent and Low Active Drains Systems on potential routes for unfiltered entries to the stack.
- A retired UKAEA employee on the stack as a potential source of historical information on Site operations
- A member of the Babbie Group contract team, dealing with Dounreay contaminated ground remediation, working on the Castle remediation project and reassurance surveys.
- The Project Manager of the Castle and Castle Gate Drain remediation projects (Annex 6 refers)
- A member of the Safety & Environment Group relating to instances of inundation of the sea
- An employee of AEAT, dealing with particle surveys and environmental monitoring
- An employee of JCL, on evidence that the area around the castle is, on occasions, inundated by the sea (See Annex 8)
- The Agent for the Morrison Group on evidence that the area around the castle is, on occasions, inundated by the sea (See Annex 8)

POTENTIAL PATHWAYS

This Annex lists the potential pathways by which the particle found near the Dounreay Castle on 4/12/00 could have reached this location. The pathways are divided under the headings Air, Liquid and Solid depending on the primary mode of transport of the particle to its location.

AIRBORNE PATHWAYS

1. Windblown From Beach

- Sand particles of this size can become windborne at wind speeds in excess of about 6.5 m/s. This wind speed is frequently exceeded at Dounreay. Winds could have carried this particle from the beach to its discovered resting place either directly or by having been blown by the wind into the Castle structure and subsequently washed out or blown to its final resting place.

2. Windblown From the Site

- The map of particle finds both on and off site suggests that the source term for on-site particles is significantly smaller than the source term for beach particles.
- The particle found was typical of particles found on the foreshore. Particles found on site typically have sharper edges and are less active.

3. Discharged From the FCA Main Stack

- It is difficult to see how a particle of this type could get into the FCA ventilation system now. Radiological monitoring within facilities would detect particles and they would be removed before they could get into the ventilation system.
- Even in the 1960s and 1970s, it is unlikely that particles of this size and type would have been levitated by FCA facility space extract systems and enter the main ventilation duct leading to the D1213 stack.
- In the unlikely event of a particle of this size entering the ventilation system it is probable that the particle would deposit in one of the “dead spaces” in the D1209 duct system.
- There is no evidence of a distribution of particle finds emanating from the main stack. Most particle finds on site are adjacent to roadways. If particles of this size were being ejected from the D1213 stack, our ground surveys on the site would show evidence of deposition. There is no such evidence.

- Inspection of our archives has not identified any incident that could have led to significant contamination of the ventilation system with particles of this type.

LIQUID PATHWAYS

4. Directly from the Sea

- The particle is similar in activity and shape to other foreshore particles.
- There is documented evidence of the castle forecourt being inundated by the tide at periods of storm surge and high spring tide. On 29/1/2000, the sea penetrated the security fence and reached half way up the new access road to the LLLETP and resulted in flooding of milliscreen 4 (DN 113). See Annex 8 for further information.
- Under storm conditions, particles in the offshore sediments may be levitated by the large waves.
- Deposition of material at the end of the run-up zone of large waves is a well known phenomenon.
- The elevation of the location of this particle was 8.5m. This is only 0.5 metres higher than the 8.0 metre elevation contour where a beach particle had previously been found in 1988. Two other particles were found in the same area in 1984.

5. Surface Water from the Site

- There is no visible surface run-off from the site to the castle forecourt area, even during times of intense rainfall.
- The on-site area directly inland of the Castle has been monitored on several occasions. No particle has been found.

6. Groundwater from the Site

- It is difficult to envisage any way in which groundwater from the site could deposit a particle at the surface near the Castle. There are no known springs in the vicinity of the location of the particle find.

7. Liquid Discharges via the Main Pipeline

- There is no connection between the low level liquid discharge system to the area where the particle was found.
- We control particulate in our discharges to the 60 micron level by filtration of waste streams at source, as required in our Authorisation.

8. Non-Active Drains and Land Drains

- All non-active drains have been surveyed and drains that run by the Castle were replaced. No particles were recovered during this drain replacement work despite extensive radiological surveys.

SOLID PATHWAYS

9. Coming from the Fill Material

- The fill material used in the location where the particle was found was clean spoil separated from the contaminated spoil following the Castle forecourt excavation (initially wrongly reported as coming from the Upper Dounreay farm).
- This spoil was monitored twice during the Castle remediation and drains replacement project.
- It is unlikely but not impossible that a particle was missed in this double monitoring and that bioturbation (eg by earth worms) has brought it to the surface.

10. Transport on Vehicles or Human boots or by Wildlife

- Transport on a vehicle tyre, on the sole of a person's boot or by wildlife cannot be categorically ruled out.
- Transport from the beach to the final location is more likely than transport from the site.
- If the transport was from the beach to the Castle area, monitoring of vehicles and personnel on leaving the foreshore (at the Castle Gate) would not have detected it.
- Since 1984, all personnel and vehicles have been monitored as they leave the foreshore. No particle has been found.

11. Unauthorised Disposal of Spoil

- Access to the foreshore is controlled by the police. The area around the Castle is not an area where unauthorised disposal could be easily undertaken.

12. Malicious ie Deliberate Planting of Particle

- There are tight controls on the store of particles at Dounreay. It is almost impossible for someone to obtain a particle from this store without appropriate authorisation.
- Access to the Castle area is controlled by the police. It would be difficult for someone to plant a particle in this area without having a legitimate reason for accessing the foreshore.

EVIDENCE OF EPISODES OF INUNDATION OF THE CASTLE FORECOURT BY THE TIDE

The area around the Castle forecourt, including the security fence and up the to the milliscreen station, can be inundated by the tide when storm conditions coincide with a high tide. Examples of the evidence to support this vehicle are:

- E-mail from Gordon McIntosh (a JCL contractor) of the extent of the inundation of this part of the site during 29/01/2000. This resulted in flooding to the Milliscreen Station 4 (DN 113).
- On the 27/02/1998, Ross Kane (the agent for the Morrison Group) reported that very high winds had created a huge swell and that the tide had reached the top of the ramp at the Castle Gate. It was impossible for their company to undertake any of the planned work on the foreshore.
- Three photographs of the storm surge taken on 14/12/2000 which show clearly that the tide does inundate the area around the Castle under extreme conditions.