WEST CUMBRIA SITES STAKEHOLDER GROUP
ENVIRONMENTAL HEALTH SUB-COMMITTEE

MEETING 68 OF THE EHSC
HELD AT CLEATOR MOOR CIVIC HALL
ON 29th November 2007.

Present:

Prof John Haywood	Chairman
Mr Ron Hargreaves	Parish Councils
Dr Graham Hutson	Parish Councils
Dr Matthew Emptage	EA
Mr Stephen Tandy	EA
Mr Tim Parker	Sellafield Ltd
Mr Nick Atherton	Sellafield Ltd
Dr Katherine Eilbeck	Sellafield Ltd
Mr John Titley	EA
Mr Ray Pemberton	EA
Mr Kins Leonard	CEFAS
Dr Paul McDonald	Westlakes Scientific Consulting
Mr M Davidson	Allerdale BC

Apologies:

Prof Steve R Jones	Vice Chairman
Dr Susan McCready-Shea	NII
Mr S Standage	Allerdale Borough Council
Mr S Moffatt	Allerdale Borough Council
Mrs E Sherwen	National Farmers Union

Public and Press

Ms J Allis-Smith	CORE
Mr G Brown	Press (Freelance)
Ms E Turner	
Ms C James	

1. AGENDA ITEM 1. Chairman's introduction
2. The Chairman opened the meeting by welcoming those attending, including representatives of CEFAS, the Food Standards Agency and the Environment Agency involved in the publication of RIFE-12. Also Dr Katherine Eilbeck of Sellafield Ltd who will be presenting the findings of the Sellafield Groundwater Annual Report
3.
4. AGENDA ITEM 2. Minutes of Meeting 67
5. 2.1 As no amendments were raised, the minutes were approved for issue.
6. 2.2 There were no matters arising from the previous meeting minutes
7.
8. AGENDA ITEM 3.1. RIFE-12, Terrestrial Monitoring presented by Mr Stuart Conney (FSA)
9. Mr Conney introduced his presentation on the Terrestrial Monitoring undertaken and reported in RIFE-12 for the Sellafield area. A summary hand-out was passed around to support the presentation.

10. The RIFE-12 report was a collaboration between 4 agencies, the Environment Agency, Environmental Heritage Service of Northern Ireland, Food Standards Agency (FSA) and the Scottish Environmental Protection Agency.
11. The FSA undertake terrestrial monitoring. This includes the collection of samples from around Drigg and Sellafield. In the Drigg and Sellafield area milk is collected from 22 local farms on a weekly basis and bulked into weekly, monthly and quarterly samples. In total, 974 analyses are carried out on milk.
12. Non-milk samples are collected from animals and crops. In total 74 samples are analysed for 586 determinants.
13. A map of the sampling locations for West Cumbria was shown. The majority of samples were collected from the area around Sellafield and LLWR, although there are some 'far' samples from the estuaries to the north and south.
14. The sample results are used to undertake a dose assessment. This involves using the measured level of activity in the food (Bq/kg). The amount of each food consumed (kg/yr) is taken from a survey of local persons diet. These surveys are carried out yearly for seafood and every 5 years for terrestrial foods. An internationally agreed dose coefficient is used in the equation to calculate the estimated dose
15. The dose limit in the UK is the limit for public exposure to all sources of radioactivity (excluding medical practises) ie 1000 μSv per year
16. The estimated dose to the terrestrial group at Sellafield is 29 μSv per year. This is modelled to the critical group in the area which is a 1 year old infant consuming above average amounts of locally grown food and milk. The dose estimate is conservative as a concentration of Ruthenium-106 was used in the calculations when the actual value was below the limit of detection.
17. The 29 μSv per year Sellafield dose was compared to other estimated UK doses. The dose from natural radionuclides in food and water was 250 μSv per year and the annual UK dose from all natural sources at 2230 μSv per year.
18. In conclusion, the monitoring carried out around Sellafield shows low levels of radioactivity in food and the environment which are well within recommended limits.
19. Mr Conney gave details of the internet site and advised that information for the 2007 report was being gathered and that the website is updated monthly with the raw monitoring data.
20. Dr Hutson asked if the dose estimate was too pessimistic due to the use of Ruthenium Limit of detection results. Mr Conney answered that he did not think it was too pessimistic. They would like to be able to reduce the limit of detection for Ruthenium to be able to improve the assessment
21. Mr Davidson enquired on the selection of sites. If this was plume derived he would expect to see more samples taken at a greater distance for allow for re-deposition. Mr Conney advised that the production of milk and food is concentrated along the coastal plain. Some samples also consider the potential for deposition of activity from the sea to land. Mr Parker added that, under the majority of conditions, maximum deposition of discharged activity occurred within 1.5 km of the site.
22. Ms Allis-Smith asked about the testing of sheep on Corney Fell for Chernobyl fallout and that the results showed 50% of the activity was from Sellafield discharges. Also asked if these results had been included in the dose estimate. Mr Conney stated that the FSA are still undertaking some tests of sheep from Corney Fell and that there are still restrictions in place. These are not included in the assessment as they do not enter the food chain. Due to the length of time since the Chernobyl event it is now hard to differentiate between the Sellafield activity and Chernobyl due to the decay of Ceasium-134.

23.
24. AGENDA ITEM 3.2. RIFE-12, Marine Monitoring presented by Dr Kins Leonard Cefas.
25. Cefas work with the Envionment Agencies and the FSA to collate information from 7 laboratories. They also design and operate the marine programme; they run models to calculate information for data gaps; collect habit data, asses the doses; write and agree the text and produce the report. Data from the 2006 Total Dose Assessments in the report is contained on the CD
26. Cefas have made a number of improvements to the report for this year. These should make it easier to read and include changes to the colour and fonts, adding key point summaries to each chapter and removing all of the generic information (which is still included on the CD). Relevant to Sellafield they have also added new time series data for Amercium-241 and Caesium-137 in sediments and a gamma dose rate figure for areas of the Irish Sea.
27. The habits surveys are completed as 5 year reviews for aquatic and terrestrial and a yearly review for aquatic. The surveys interview local authorities and people from Parton to Tarn Bay and include surveys every 1km for housing and 5 km for farming. They record local food production and activities. Approximately 500 observations are recorded and analysed.
28. In addition to interviewing in 2006 Cefas also logged seafood consumption rates of higher rate consumers of molluscs/crustaceans over 3 week periods every 3 months. This has resulted in a slight increase in the consumption of molluscs being recorded. Time series graphs were shown of the local consumption rates for different molluscs and coastal crustaceans
29. A plan showing the marine monitoring locations was displayed. These were the same locations as the 2005 survey.
30. The time series trend of Carbon-14 discharges against concentration found in Lobster, Winkles and Plaice was shown. This showed a decrease in concentrations in all three which was expected due to last years decreased Magnox reprocessing.
31. The time series trend of Technetium-99 discharges against concentration found in Lobster, Winkles and Plaice near Sellafield was shown. This showed a decrease in concentrations in all three which again mirrored the recent decreases in the discharge rates.
32. The time series trend of Caesium-137 discharges against concentration found in Lobster, Winkles and Plaice near Sellafield was shown. The concentrations in concentration in the foods has remained constant over the past few years which is likely to be the result of the contribution from the re-suspension of activity from the sea bed rather than discharges. The same was also shown on the time series graphs of Plutonium isotopes and Americium-241.
33. The findings of the marine monitoring programme were summarised. The concentrations/dose rates are broadly similar to 2005. The local enhancement of Carbon-14 in fish and shellfish has decreased after a slight lag from the decrease in discharge levels. In fish the highest concentrations of beta/gamma isotopes are from Tritium and Carbon-14 at approximately 100 Bq/kg. For shellfish the highest concentrations are from Tritium, Carbon-14 and Technetium-99. Technetium-99 was found to be up to 1000 Bq/kg which is a decrease from the 2005 concentration of 1800 Bq/kg.
34. An inter-comparison exercise of Alpha, Tritium and Technetium-99 has now been completed. This paper was published at Environmental Radiochemical Analysis III, a RSC event. The paper can be made available on request.

35. The doses received from gaseous discharges have decreased. The dose from seafood has slightly increased from 0.22 to 0.23 μSv per year; this was due to the altered consumption rates from the habits surveys rather than an increased discharge from Sellafield.
36. The seafood doses are shown to decrease with distance from the Sellafield site.
37. An update on the work Cefas have undertaken to look at the remobilisation of Technetium-99 from the seabed. The study has looked at the association of Technetium-99 to sediment types by the collection of sediment cores. Modelling of the potential for Technetium-99 to be remobilised was undertaken under different conditions.
38. Approximately 37 TBq of Technetium-99 is thought to be attached to sediments. At present the data set for Technetium -99 is small, therefore Ceasium-137 is being used as an analogue to test the model. The validation exercise has shown that the model is in good agreement for Caesium-137 and the next step is to repeat the exercise for Technetium -99 and predict the doses from seafood consumption.
39. Cefas have just started work on Sellafield hot particle simulations. They are considering the potential dispersion method from the discharges points and the length of time to move onshore. Early work has shown a strong onshore movement with particles reaching the coast within 1.5 years. The onshore movement of particles is also thought to be confined to the vicinity of Sellafield.
40. Cefas are also undertaking a project to complete an overview of radioactive discharges in relation to Article 35 of Euratom.
41. Mr Hargeaves asked if the Tc-99 modelling had looked at a situation where all of the inventory will be released. This was not known yet but the model will be able to predict. It was reiterated that the dose from the re-suspension of Technetium-99 would be small if compared to the dose from discharges.
42. Mr Hargreaves asked whether they thought that hot particles are still being released. Mr Emptage answered by stating that the review of the control of particulate release from the effluent system was being completed and was due to report on 1 April 2008. The EA also have their own review which will include looking at the draft assessments and will be undertaking a site inspection of the effluent system controls in December. Evidence to date shows that the particles recovered are quite old, but that this doesn't necessarily mean that they are not still being discharged.
43. Mr Hargreaves asked if the work Cefas are undertaking for the EC will consider the oil and gas industry discharges. Dr Leonard stated that this was not included in their scope of work.
44. Mr Hutson asked if the Technetium-99 modelling work had taken into account the differenct oxidation states as Caesium and technetium are likely to be different. Technetium is present in 2 forms. The oxidised state does not stick to the sediments so the Technetium-99 in sediments is likely to be in the reduced form. It is possible that microbial action could be involved in this state change.
45. Mr Davidson asked if any work had been undertaken to look at the potential for the remobilisation of activity from the construction of an offshore wind farm in the Solway? Dr Leonard said that he does not know of any work for the Solway but similar work has been carried out for a wind farm in Morecombe Bay and for dredging work The conclusions were that doses received were well below legal limits for workers and the public, due to these activities.
46. Ms Allis-smith enquired if the modelling work on Technetium-99 has considered the effects of climate change. Dr Leonard answered that climate change had not been considered but they had considered the effects of storms. This is why core samples

had been taken to obtain a full inventory of Technetium in sediments.

47.

48. AGENDA ITEM 3.3. RIFE-12, Environmental Monitoring for Sellafield and LLWR 2006 presented by John Titley and Matthew Emptage (Environment Agency).
49. The revised authorisation of discharges from Sellafield reduced the limit for Technetium-99 from 20 to 10 TBq per year. 16 nuclides are included in the sea discharge authorisation as well as Total Alpha, Beta and Uranium by mass.
50. A table showed the current and previous years liquid discharges in comparison to the limits. All of the current discharges are within the 3 to 56 % of the limits.
51. A table showed the 2006 gaseous discharges in comparison to the limits. All of the current discharges are within the 1 to 66 % of the limits. The limits are unchanged from the previous year. Antimony-125 has the highest percentage discharge compared to the limit.
52. The solid disposal to LLWR in 2006 consisted of 1 to 61 % of the limits with Other Alpha being the highest percentage.
53. The EA undertake check monitoring to verify the reported discharges. This monitoring programme checks the liquid discharges from EARP, SIXEP, SETP, Factory Sewer, the Lagoon and Laundry and from LLWR. The EA also undertakes check monitoring for borehole groundwater data. Aerial discharges from Magnox reprocessing and THORP are also checked. Checks are also made of LLW disposal from nuclear sites to LLWR.
54. For Sellafield liquid discharges, The EA check monitoring was within 10% of the site reported levels. Of the 664 comparisons only a small number were classed as a poor correlation.
55. From 2006, Quarter 3 check monitoring of borehole data was commenced. This undertook quarterly checks from 5 boreholes for comparison with the operator results. 60 comparisons were undertaken with 68% classed as good. Of the discrepancies the majority were not significant, with only a slight discrepancy or from results at very low activity concentrations.
56. From the LLWR, liquid discharges were checked with 36 comparisons made. 10% were classed as poor. In all cases the site reported results lower than the EA laboratory results.
57. For the Sellafield gaseous check monitoring, of the 68 comparisons there were 22 discrepancies. In the majority of cases the site results were higher than the EA results and were predominantly due to Carbon-14. It was concluded that this was due to different analytical methods.
58. From 2007, the EA will be using a new laboratory for the effluent check monitoring.
59. The EA undertake check monitoring of solid LLW. They usually check 2 to 3 ISO containers a year. Both non-destructive and destructive tests are undertaken. Non-destructive methods include segmented gamma scanning, real-time x-ray and passive neutron coincidence counter. Destructive test include radiochemical analysis. ISO's were checked from Hinkley Point A and AWE Aldermaston. Reference drums were sent to facilities in Sellafield WAMAC, Sizewell B and Devonport Dockyards.
60. From Hinkley Point B the key findings were that 1 drum was split, 2 were dented and 16 had loose lids. Uranium-235 and Radium-226 were found but not declared. Activities of beta/gamma emitters were within the LLW limit. 2 drums were greater that 12 GBq/T based on site figures.
61. From Aldermaston the drums were found to be in good condition. Cobalt-60, Plutonium and Americium were over declared.
62. For the reference drums. WAMAC detected all nuclides with the exception of

Americium-241. Sizewell B reported activities greater than the reference activities. Devonport detected all radionuclides and quantified to a reasonable degree.

63. In 2006, the EA undertook monitoring of dose rates, sands and mud sampling and seaweeds. They also undertake strandline monitoring within a 50 km radius of Sellafield, collect seawater samples, surface water samples and sediment samples from drains.
64. In the vicinity of Sellafield the highest annual dose rates are found in the River Mite, Newbiggin and the upper River Calder which were all approximately twice background.
65. A graph was displayed which showed the decrease in dose rates from Ravenglass silt and St-Bees sand over time. A summary of the silt concentrations at Eskmeals was also displayed which compared the current concentrations to the average concentration from 1998 to 2005. This showed a decreased concentration of Cobalt-60 and Ruthenium-106, but an increase in Caesium, Americium and Plutonium.
66. More detailed graphs compared the Eskmeal sediment concentrations over time to the discharge rates. For Cobalt-60 the spikes in silt concentrations followed a spike in discharge concentration but with a lag. The decease in Rutherium-106 has followed the decrease in discharges. For Caesium-137 the comparison is variable, whilst for Amercium-241 and Plutonium the silt concentrations are increasing despite the decrease in discharges.
67. The non-food doses were given for critical groups for the past 3 years. The critical groups were Ravenglass recreational use, Ravenglass nature warden and Ribble houseboat dweller. All are within the dose limit of 1 mSv. There have been slight increases in the dose to recreational users and houseboat dwellers some of which is due to new habit data.
68. A table was displayed which showed the dose rates from different food groups for the previous three years. All were below the 1 mSv per year limit. A yearly summary of the total dose to the West Cumbria critical group was displayed which included the dose from Sellafield and Rhodia (Po-210) discharges. The total dose has decreased in the past 2 years due to a decrease in the dose from Rhodia.
69. Mr Emptage gave a summary of the 2007 waist-high gamma re-survey of the Esk estuary. This followed concerns raised by CORE following the November 2006 meeting. The concern related to the Caesium-137 and Plutonium concentrations not being explained by the trend in discharges. Initially the EA met with CORE to discuss the monitoring locations. The EA instigated a resurvey of the Esk estuary. This was done by Liverpool University and was a repeat of the 1989 survey undertaken by Lancaster University. The new survey was not as comprehensive and there were also a few gaps due to access constraints.
70. In summary the results of the 2007 survey were lower than the 1989 survey. This is as expected due to the decay of the Ceasium-137 which has an approximate 30 year half life. There will also have been some sediment movement and shielding of higher concentration sediment (from historical discharges) by lower concentration sediments (from more resent discharges).
71. There is still concern that Plutonium and Caesium concentrations in sediments are not decreasing with a decrease in discharges. More investigation will look to take cores of the sediment to see if this is just a surface effect or is throughout the profile.
72. Mr Leonard advised that there was a study of the estuary undertaken by Defra and there may have been some information which was not published. He will check and pass to the EA if possible.
73. Mr Davidson enquired as to whether it was possible to use RIFE information to

reassure tourists of the safety of the Solway Coast.

74. Mr Titley advised that there was a comprehensive set of information which demonstrates that doses are well within dose limits. The Rife report also showed that the discharges from Sellafield have decreased over the past 10 year by an order of magnitude. Mr Leonard advised that Cefas will consider having a time series dose graph for the Solway Coast in the next report, which shows this improvement.
75.
76. AGENDA ITEM 4.1. Annual report on discharges and monitoring of the environment. Presented by Mr T Parker
77. A slide showed the aerial view of Sellafield which showed the basic extent of the Sellafield monitoring Programme. This comprised the surrounding farms, coast and sea. A conceptual model was also displayed which described the pathways by which discharged radioactive liquids can result in a dose to humans.
78. The scope of the marine monitoring programme was discussed. This showed the marine monitoring programme collected samples from 15 km north and south of Sellafield and included the collection of shellfish and fish samples. The consumption data is key to the calculation of the doses. A graph was displayed to show the dose to seafood consumers (marine critical group) compared with consumption rates. The seafood consumption has increased year on year since 1997. The 2006 dose to seafood consumers was 212 μSv per year.
79. The marine critical group dose was broken down into pathway contributions. The main contributions were from external radiation and the consumption of winkles. Americium and Plutonium were shown to be the main contributing radionuclides.
80. The concentration of Americium and Plutonium in mussels was compared to the discharge of Americium and Plutonium from Sellafield over time. This showed that even though the discharge rate has greatly decreased the mussel concentration had only slightly decreased, which was probably due to natural fluctuations.
81. A similar graph compared the Technetium-99 concentration in lobsters to the discharge rates. The lobster concentrations had decreased in line with discharges.
82. The conceptual model for aerial discharges was displayed. The 2006 monitoring programme undertook a full suite of milk and air sampling, however meat sampling was removed, following the review of the programme in 2005, and FSA figures used in the calculations. Most samples were collected from within 4 km of the Sellafield site as this was the main area of maximum concentrations.
83. The terrestrial critical group dose was compared with Argon-41 discharges. Argon discharges ceased upon the closure of Calder Hall and this has resulted in a large decrease in the dose to the terrestrial critical group. The main pathways to the critical group were shown to be from milk and direct irradiation. The Milk consumption is based on an infant consumption rate (therefore high). The main dose contributions are from Strontium and Others.
84. In summary this was the first year of the revised programme. The programme worked well and there are no major changes for the 2007 programme.
85. Prof Haywood enquired as to why the mussel concentration has not decreased following a decrease in Technetium discharges, while lobsters did?
86. Mr Parker advised that it will be due to the different uptake methods, with lobsters the main mechanism is from solution while for mussels it is from food.
87. Ms Allis-Smith asked if the report had been published. Mr Parker advised that it was, gave Ms Aliss-Smith a copy and advisedthat it will be available on theSellafield website shortly.
88.

89. AGENDA ITEM 4.2, Comparison of findings of Sellafield Ltd, FSA/SEPA and EA annual environmental monitoring reviews for 2006 – Presented by Paul McDonald.
90. Westlakes Scientific consulting have compared the Sellafield Ltd results with the RIFE results. Where there were differences in the results they would aim to determine the cause of the difference. There are a number of potential differences including laboratory techniques, limit of detections for the analytical methods and different sampling locations.
91. A slide was displayed showing the comparison for marine and terrestrial discharges. One of the things that this shows is that the marine monitoring programme has more positive values while the terrestrial monitoring programme had more limit of detection values.
92. A number of graphs showed direct comparisons for a number of nuclides. Each graph showed the line of 1 to 1 comparison and factor of two either side, within which was classed as a good comparison.
93. For Caesium-137 there was a good comparison for all samples. For Plutonium Alpha the results for Plaice and Fucus were slightly outside the factor of 2. The Technetium-99 graph showed that the results for Plaice, Winkles and Porphyra were outside of the factor of 2. For Plaice Sellafield Ltd collected samples from off-shore and in-shore while RIFE do not state the sample collection positions. For Winkles the concentration will be very dependant upon the sample collection period and how this compares to Technetium discharges. With regard to Porphyra, the RIFE samples are collected from St-Bees while Sellafield Ltd collects samples from location up and down the coast. Strontium-90 has a poor comparison for Fucus and Porphyra which is due to the Sellafield method having a higher limit of detection. For milk the poor comparison is due to the sample locations being different as Sellafield Ltd only sample milk from the farms directly adjacent to the site. Carbon-14 analysis showed a poor comparison for Porphyra, this was likely to be due to the sampling location.
94. A graph was displayed which compared the doses from each marine pathway between Sellafield Ltd data and RIFE data. This showed a good comparison in all cases and the total dose was estimated to be the same at 0.18 mSv per year.
95. A comparison of the RIFE-12 and Sellafield Ltd terrestrial critical group doses was shown. The estimated Sellafield Ltd doses were lower than the RIFE doses. These were due to:

    RIFE
    LOD values for Cobalt-60 and Antimony-125 in milk
    LOD value for Rutherium-106 in domestic fruit (apples)
    Sellafield Ltd
    no inclusion of Cobalt-60 in milk,
    a Antimony-125 LOD value in milk five times lower than in RIFE
    apple, blackberry and elderberry consumption treated as wild fruit rather than domestic fruit

96. Mr Hargreaves had a query relating to the sampling of Porphyra which seemed to be the main discrepancy; to correct this is it possible for both labs to use the same samples so that the samples are collected at the same time? Apart from this the agreement between Sellafield Ltd and RIFE were good.
97. Mr McDonald agrees that the factor of two comparison is very tight and so the two data sets were good. The worst cases are due to the different limit of detection for sample methods.
98. Mr Emptage stated that keeping the two programmes separate adds strength to the comparison

99.

100 AGENDA ITEM 4.3 – Beach monitoring update presented by Mr Tim Parker.

101 A background to the issue was given. Beach monitoring has been carried out since 1984. A trial of more sensitive equipment was carried out on Sellafield Beach in November 2006 and there were 9 "finds". Following that a second location was required to be monitored using the same equipment. A full monitoring programme was then required by the Environment Agency for 2007/8. Equipment used is carried on an eight-wheeled vehicle called a Groundhog. Monitoring is carried out by an independent contractor (NUKEM)

102 The Environment Agency set a requirement for monitoring of beaches between Ravenglass and St Bees using the Groundhog. 15 Ha of beach are to be monitored before 31 July 2007, concentrating on Sellafield, Seascale and St Bees –**completed June 2007.** 100 Ha of beach are to be monitored before 31 March 2008, covering beaches between Ravenglass and St Bees- **completed November 2007.** Monitoring to be capable of detecting 100,000 Bq of Caesium-137 buried at a depth of 10cm in sand with a 95% probability.

103 The Environment Agency has increased the 2006/7 requirement for monitoring of beaches to 147 ha. The additional 47 ha is to include beaches beyond St Bees Head and within the Solway. Monitoring to be capable of detecting 100,000 Bq of Caesium 137 buried at a depth of 10cm in sand with a 95% probability.

104 Continuous programme (probably for next few years) with the following objectives:-

1. Determination of the risks to members of the public.
2. Identification of the source(s) of the particles.
3. Determination of a long term monitoring programme that represents BPM.

Strand line monitoring by BNGSL will continue as normal.

105 All the finds are currently being monitored during retrieval and then subjected to gamma spectrometry in the laboratory.
Sellafield has agreed a further analysis protocol with Environment Agency and this is to be applied to a selection of the finds (51 in total)
The analysis will be carried out by an external contractor of international repute.
Several of the analyses are very time consuming and the results will not be complete until summer 2008.

106 The finds to date for Sellafield coast are as follows

- 65 finds – 7.9/ha
- 10 pebbles
- 55 particles (<10mm)
- 61 finds located by Caesium-137
- 4 finds located by Americium-241

107 The find for the Ehen spit are as follows:

- 55 finds—6.3/ha
- 21 pebbles
- 32 particles (<10mm)
- 52 finds located by Caesium-137
- 3 finds located by Americium-241

108 The finds on Sellafield North are as follows:

- 83 finds –5.4/ha
- 56 particles(<10mm)
- 27 pebbles
- 78 finds located by Caesium-137

- 4 finds located by Americium-241
- 1 find located by Co-60

109 The find on Braystones are as follows:

- 5 finds –0.3/ha
- 5 particles (<10mm)
- 4 finds located by Caesium-137
- 1 find located by Americium-241

110 Seascale North finds were

- 3 finds—0.3/ha
- 3 particles(<10mm)
- 3 finds located by Caesium-137

Seascale South finds were

- 3 finds—0.25/ha
- 3 particles (<10mm)
- 3 finds located by Caesium-137

111 For St-Bees the finds were

- 6 finds—0.28/ha
- 6 particles(<10mm)
- 4 finds located by Caesium-137
- 2 finds located by Americium-241

and Drigg were

- 5 finds—0.32/ha
- 5 particles (<10mm)
- 2 finds located by Caesium-137
- 2 finds located by Americium-241
- 1 find located by Colbolt-60

112 Based on the results the Health Protection Agency have advised:
" *On the basis of information provided by the Environment Agency on 6 July 2007 on the finding of radioactive particles on beaches near the BNG Sellafield site, the Health Protection Agency (HPA) considers that no special precautionary actions are necessary at this time regarding access to or use of these beaches. However, HPA will continue to work with relevant authorities to keep the situation under investigation."*

113 In summary the majority of finds are close to Sellafield, especially on the beach (where the discharge pipe crosses) and on the Ehen Spit. The find frequency rapidly decreases with distance, with a sharper decrease to the south than the north. The number of contaminated pebbes drops with distance. Maps showing the survey areas and the finds were shown.

114 Maps of the finds and survey areas were shown. The key aim of the investigation is to assess the frequency of finds and the activity concentration. This will allow sound advice to be given to the public. The surveys can only assess certain areas which the machine (or hand held) can access. These areas are however constantly changing as sand/silt is deposited/removed from the beaches.

115 Mr Hutson asked what the definition of a find is?

116 The finds presented to date are those which have caused an alarm in the monitoring vehicle and been retrieved. The alarm is set to respond to an increase in either background, Caesium or Cobalt concentrations. Following this the operators go back over the area to retrieve the find.

117 Mr Leonard enquired about the analytical investigation.

118 Mr Parker advised that the first stage was to undertake non-destructive testing which

assesses the size, shape and density. This will be followed by destructive analysis which will assess the activity and composition of each find.

119 Mr Tandy added that the risk assessment also included the habit surveys of the critical groups. The EA had also worked with Sellafield limited to design the investigation programme so that it is prioritised to inform the risk assessment.

120 Ms Allis-Smith asked if the maps would be available to the public?

121 Mr Parker advised that at present they were only rough maps, but that they are being improved so that they can be put on the Sellafield web site.

122 Ms Allis-Smith asked if the monitoring programme will also survey beaches to the south as well as the north?

123 Mr Parker advised that it was being considered in the future but that current modelling and results indicate that the drift is to the north. This is therefore where the resources are being targeted.

124 Ms Allis-Smith asked about a find on Braystones which was identified as Tin-126. What was the find and how did it get there?

125 Mr Parker advised that this was the only find with a positive detection for Tin-126 content and they are still investigating what it is. It may be possible that other finds will contain Tin-126 but at levels below the analytical limit of detection.

126 Mr Davidson asked if the drift north will take account of any eddy caused by the St-Bees head?

127 Mr Parker advised that they are considering Whitehaven and that there is also survey work along the north Solway coast planned.

128

129 AGENDA ITEM 5 – Groundwater Monitoring Annual Report presented by Dr Katherine Eilbeck.

130 The Contaminated Land team at Sellafield have the responsibility for the monitoring of groundwater. The Team is relatively new (less then 2 years old).

131 The Site License holder, Sellafield Ltd, have a statutory responsibility under Radioactive Substance Act (RSA) to conduct routine monitoring of radioactivity levels in the surrounding environment in order to assess the radioactive impact of site operations.

132 The groundwater monitoring objectives are:

- Maintenance of public confidence via annual publication of monitoring results
- To provide data to enable the current impact on humans and non-human species, of contaminants in groundwater
- Monitor changes in groundwater quality between the points that groundwater enters the Sellafield site to the points it leaves the site
- Determine the nature, scale and location of activity and other contaminants in the groundwater leaving the Sellafield site and/or available to human and non-human species
- Provide details of groundwater quality across the Sellafield site
- Provide information to improve the conceptual hydro-geological model of the Sellafield site
- Provide information to identify the role of colloids, particles and dissolved salts in the migration of contaminants within the groundwater
- Facilitate planning and prioritisation of remedial action

133 The groundwater monitoring programme utilises an array of on and off site boreholes a map of which was shown. The monitoring programme has been designed on the conceptual understanding of the site. A map of the groundwater movement pathways

was shown which is the predicted flow direct of groundwater and any contamination. The wider conceptual model is that the main flow is from the mountains towards the coast; however this is modified by a number of factors including the site itself and the rivers Ehen and Calder. The model also includes the potential migration rates of the different contaminants. A graph of these were shown, this showed that the quickest contaminant was Tritium, followed by Technetium-99.

134 58 Boreholes over the past year had reportable increases in radionuclide concentrations.
On each occasion these are investigated, the results are confirmed, reports compiled, operating units contacted and other boreholes in area are considered and in some cases increased monitoring. Almost all instances have been found to be due to historic contamination. A few anomalies are still being investigated.

135 Total Alpha concentrations mainly concentrated to the north west of Separation Area. They are dominated by Uranium with some Plutonium. The majority of groundwater samples are however below the limit of detection. WHO drinking water limit was exceeded in only 6 boreholes.

136 For Total Beta the majority of boreholes which exceed WHO drinking water guideline values are located within Separation Area. However, a number are located to the south and south west of Separation Area. Strontium 90 is the dominant beta emitting nuclide with the distribution across site mirroring Total Beta.

137 Slightly elevated Tritium activities are found within Separation Area and in a south westerly direction towards the coast. Only 3 boreholes exceed the WHO drinking water guideline which are located to the south west of separation area
Groundwater data is assessed as follows:

- Interpretation / Investigations
- Modelling
- Data / information retention
- Safety Case
- Separation Area characterisation
- Long term remediation

The Contaminated Land team are currently undertaking a project to investigate the Separation Area which will also improve the borehole network.

138 In conclusion contaminated groundwater is not a new issue and monitoring has been carried out for decades. Concentrations of nuclides in groundwater offsite are not dangerous.
The perimeter monitoring network has been radically improved. Further geological and hydrogeological characterisation is currently being undertaken in Separation Area.
Treatment options are being developed and evaluated to allow decisions on their application at Sellafield.

139 Mr Hargreaves asked how deep the boreholes were?

140 Dr Eilbeck advised that the deepest are up to 60 meters below ground level.

141 Mr Emptage advised that the EA had recently reviewed the progress of the groundwater monitoring programme. Mr Emptage asked about the progress which has been made with the Contaminated Land Website.

142 Dr Eilbeck advised that the website is currently being developed and is likely to be available in January.

143 Ms Allis-Smith asked if there were some boreholes off site which are monitored by Sellafield Ltd?

144 Dr Eilbeck confirmed that there were.

Mr Leonard asked whether the influence of colloids had been considered.
Dr Eilbeck advised that they have a contractor currently undertaking experimental work to assess the influence. LLWR have also undertaken a similar investigation which showed that colloidal movement was not significant transport mechanism.

AGENDA ITEM 6 – Items of Environmental Interest – presented by Mr Tim Parker.
The EA has completed an aerial audit in June. This identified good practises and no non-compliances. A number of issues were raised and will be considered
The PPC permit has now come into force and as a result there are new chemical discharge limits. The permit is currently being implemented. There are also requirements on energy and water usage.
In November, Sellafield Ltd and UKAEA Windscale have begun shadow working for environmental compliance, prior to the full scale merger. There is not expected to be an environmental impact.
The EA have authorised Sellafield Ltd to begin new disposals to CLESA. The disposals are to consist of low level soil and rubble.
An external audit of the Sellafield Ltd Environmental Management System was undertaken. This has confirmed that the site is still certified to ISO 14001 and there has been a general improvement.

AGENDA ITEM 7 – Works Update – presented by Mr Tim Parker
Both MOX and THORP plants are operating although at reduced rates. As advised at previous meetings this will result in reduced discharges.
Mr Emptage advised that the NDA business plan is out for consultation. The business plan has some relevance for discharges as it is likely that Magnox reprocessing will continue to 2019.
Ms Allis-Smith asked if Sellafield Ltd could still meet the OSPAR obligations if reprocessing were to continue? The new reprocessing end date is based on 700 tonnes per year being reprocessed, which is currently not being achieved.
Mr Parker advised that the plan is produced by the NDA. As Sellafield Ltd are the site operator is will be their responsibility to deliver the plan. Mr Parker still thinks that the OSPAR target will be met as there will be a rapid decrease in discharges following the cessation of reprocessing. Sellafield Ltd are also confident that 700 Tonnes per year could be achieved.
Mr Emptage advised that the EA does not endorse this element of the NDA plan. However the NDA plan is also looking at alternatives to reprocessing and they would like to see this concluded prior to finalising their opinion. If the only option was to reprocess the EA would need to see investment

AGENDA ITEM 8 – Far future distributions of marine activity – presented by Professor Haywood.
Following on from the NDA stakeholder dialogue which was looking at end states for the nuclear sites. Professor Haywood noted that 95% of the activity ever likely to be discharged to the Irish Sea is already there. He therefore wanted to know if the distribution of this activity at far future times and distances could be predicted.
If this was possible it would be able to give some reassurance to the users of the Irish Sea and further afield
Mr Leonard advised that there has been a lot of nuclide-specific research done on the transit and half time to reach the north channel. As far as he is aware there has been no summary of this since 1999. This would be the best starting point for any

investigation. To be able to undertake this calculation you would need a have good source term information which also need to consider Americium in-growth.

Mr Hargreaves added that initially simple calculations would be worthwhile.

Mr Emptage added that the effects of sea level changes should also be considered

Ms Allis-smith asked if the calculations would consider the deliberate discharge of plutonium into the Irish Sea which was used to assess sea to land contamination effects.

AGENDA ITEM 9 – Election of Chairman and Vice Chairman

There were no new candidates for either position. Professor Haywood advised that he would be happy continue the Chairman role. It was decided that even though he was not in attendance, Mr Jones could be nominated for re-election as the Vice Chairman. Both were re-elected by a unanimous vote.

Secretary`s note: Professor Jones has now confirmed acceptance of the nomination.

AGENDA ITEM 10 – Press release

The draft Press Release was discussed and amended for issue to local papers

The effectiveness of the press release was discussed; the lack of press awareness was highlighted by Ms Allis-Smith. She suggested that newspapers should be rung to advise of the meeting, or that adverts be put in the papers. Ms Turner advised that this comment would be taken back to the WCSSG secretary.

AGENDA ITEM 11 – Any Other Business

No further issues were raised.

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FOOD STANDARDS AGENCY

RADIOACTIVITY IN FOOD AND THE ENVIRONMENT (RIFE) 2006:

Summary of Monitoring Results for Sellafield

INTRODUCTION

The Food Standards Agency has responsibility for food safety throughout the UK. The Agency has an extensive monitoring programme to measure radioactivity in food and this programme is independent of the monitoring undertaken by the nuclear industry. The programme has been running since 1963 and its purpose is to ensure that any radioactivity in food does not affect food safety and that doses to consumers are below national and international limits.

The Environment Agency (EA) seeks to secure continuous improvement in the protection of the public and the environment from the disposal of radioactive wastes. In support of its regulation under the Radioactive Substances Act 1993, the EA commissions independent monitoring of radioactive waste discharges and assesses their impact on the environment.

The annual Radioactivity in Food and the Environment (RIFE) report contains a comprehensive set of results from the monitoring of food and the environment throughout the UK. The report is a collaboration between the Food Standards Agency and all three UK Environment Agencies (the Environment Agency, the Scottish Environment Protection Agency and the Environment and Heritage Service of Northern Ireland).

The aim of Food Standards Agency's programme is to monitor all foods produced in the vicinity of the main nuclear sites, e.g. milk, crops, fish and seafood. Where food is not available indicator materials such as seaweed or grass are sampled. Samples are analysed for a wide range of radionuclides including all that are known to be discharged from the nuclear site. Doses are estimated, based on consumers eating above-average amounts of locally produced food and/or their exposure to environmental radioactivity.

SAMPLES AND RESULTS

During 2006, 74 terrestrial and 380 aquatic samples of food (excluding milk) and indicator materials were collected to assess the effects of the Sellafield and Drigg sites as part of the Food Standards Agency's programme. Milk was collected weekly from 22 local farms and then bulked together on a weekly, monthly or quarterly basis

prior to analysis. In addition, the Environment Agency collected a number of environmental samples.

The results for terrestrial samples obtained by the Food Standards Agency around the Sellafield area are shown in tables 1 to 3. Full tables showing the long distance sampling and Environment Agency results are published in Chapter 2 of the Radioactivity in Food and the Environment report (see below for details on how to obtain a copy).

DOSE ASSESSMENT

In general the doses are estimated for the 'critical group', that is those people who are likely to receive the greatest dose as a result of their age, diet or way of life. The dose estimates exclude natural background radiation.

In 2006, the critical group around the Sellafield site was the local fishing community, consuming locally caught fish and shell fish. The dose to this group was 230 microsieverts (μSv). The non-fishing community, consuming above-average amounts of locally grown food and milk, received a dose of less than 29 μSv.

These doses are comparable to those of last year and are well within the annual dose limit of 1000 μSv for members of the public from man-made radioactivity. The doses can also be compared with the average natural background dose in the UK of 2230 μSv/year; although in some parts of Cornwall the natural background dose is 7000 μSv/year.

The total alpha and total beta activity concentrations in freshwaters were below the World Health Organisation (WHO) screening levels. Previous work by the EA has shown that the drinking water pathway is insignificant in terms of public radiation exposure.

FURTHER INFORMATION

Details of the methods, analysis and dose assessments, including all the data are available in the Radioactivity in Food and the Environment report 2006 (RIFE 12). Printed copies of the report may be requested free of charge from:

Mr Alan Funnell
Emergency Planning, Radiation and Incidents Division
Food Standards Agency
Aviation House Room 715C
125 Kingsway
London, WC2B 6NH

or by e-mail: radiological.surveillance@foodstandards.gsi.gov.uk

Alternatively, electronic copies of the RIFE report can be downloaded from our website, where you can also find provisional results for 2007, which are updated quarterly. Our website address is: www.food.gov.uk/science/surveillance/radiosurv/

Table 1 - Concentrations of radionuclides in terrestrial food and the environment near Sellafield, 2006

Material	Selection[a]	No. of sampling observ-ations[c]	Mean radioactivity concentration (fresh)[b], Bq kg^{-1}															
			Organic ^{3}H	^{3}H	^{14}C	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{125}Sb	^{129}I	^{134}Cs	^{137}Cs	Total Cs	Total U	^{238}Pu	^{239}Pu + ^{240}Pu	^{241}Pu	
Milk[d]		18	<4.9	<5.4	14	<0.22	0.075	<0.0035	<1.4	<0.44	<0.010	<0.20	<0.27	0.21		<0.00016	<0.00016	<0.027	<
Milk[d]	max		<6.3	8.0	19	<0.40	0.23		<2.1	<0.63	<0.021	<0.30	<0.48	0.44		<0.00020	<0.00018	<0.029	<
Apples		2	<9.0	8.5	9.0	<0.20	0.16	0.025	<1.8	<0.45	<0.030			0.40		<0.00025	0.00095	<0.044	
Apples	max		<11	10	12		0.26		<1.9	<0.50	0.030			0.66		0.00030	0.0016	<0.048	
Barley		1		<7.0	90	<0.40	2.0		<2.4	<0.70	<0.032			0.57		<0.0013	0.022	<0.15	
Beef kidney		1	4.0	9.0	35	<0.20	0.16	<0.027	<1.5	<0.40	<0.062			1.7		<0.00020	0.00030	<0.047	
Beef liver		1	<9.0	<9.0	31	<0.30	0.034	0.040	<1.2	<0.30	<0.027			0.92		0.00040	<0.0011	<0.15	<
Beef muscle		1	7.0	14	19	<0.30	0.0060	<0.026	<1.6	<0.40	<0.046			1.8		<0.00020	0.00030	<0.046	<
Blackberries		2	<4.5	5.5	21	<0.20	1.1		<1.2	<0.45	<0.028			0.29		<0.00040	0.0055	<0.048	
Blackberries	max		<8.0	6.0						<0.50	<0.033			0.33		0.00050	0.0057	<0.062	
Cabbage		2	<4.0	<4.0	<2.5	<0.35	0.54		<1.7	<0.50	<0.028			0.061		<0.00035	<0.00045	<0.076	
Cabbage	max				<3.0	<0.40	0.84		<2.1	<0.60	<0.030			0.067		0.00040	0.00050	<0.081	
Carrots		1	<5.0	<5.0	3.0	<0.20	0.42	<0.013	<1.5	<0.50	<0.024			0.22		0.00040	0.0015	<0.067	
Cauliflower		1	<4.0	<4.0	<4.0	<0.20	0.12		<2.1	<0.60	0.044			0.15	<0.035	<0.00010	<0.00020	<0.050	
Celeriac[e]		1	<6.0	<4.0	15	<0.20	1.2		<1.6	<0.30	<0.030			0.55	0.062	0.00040	0.0021	<0.034	
Duck		1	<6.0	<6.0	16	<0.10	<0.0080	<0.011	<1.7	<0.50	<0.036			3.3		<0.00020	0.00040	<0.074	
Eggs		1	<6.0	<6.0	30	<0.20	0.039		<1.0	<0.40	<0.029			0.14		<0.00010	0.00020	<0.028	
Elderberries		1	<6.0	5.0	15	<0.20	0.64		<1.8	<0.50	<0.035			0.33		0.0017	0.0090	<0.035	
Field beans		1		7.0	92	<0.30	0.53		<2.0	<0.70	<0.058			0.53		0.00090	0.00020	<0.037	
Honey		1		<7.0	46	<0.20	0.028		<1.4	<0.40	<0.014			0.063		<0.00010	<0.00030	<0.038	
Mushrooms		1	<3.0	<3.0	6.0	<0.30	0.073		<1.6	<0.40	0.031			0.25		0.00060	0.018	<0.068	
Onions		1	<9.0	8.0	6.0	<0.20	0.13		<1.3	<0.40	<0.032			0.066		<0.00040	<0.00010	<0.087	
Pheasants		1	<8.0	8.0	20	<0.20	<0.0070	<0.011	<1.0	<0.40	<0.032			0.39		<0.00060	<0.00040	<0.17	
Potatoes		1	<5.0	5.0	14	<0.30	0.047		<1.6	<0.50	<0.024			0.11		0.00010	0.00020	<0.033	
Rabbit		1	<5.0	<5.0	30	<0.20	0.082	<0.043	<1.4	<0.30	<0.036			2.1		0.00040	0.00030	<0.092	
Sheep muscle		2	<4.5	<6.0	28	<0.25	0.019	<0.025	<1.5	<0.50	<0.038			1.1		<0.00030	0.00050	<0.086	<
Sheep muscle	max		<5.0	7.0	33	<0.30	0.025	0.038	<1.6		<0.043			1.2			0.00070	<0.088	
Sheep offal		2	<6.5	<6.5	24	<0.25	0.16	<0.0095	<1.7	<0.50	<0.036			0.35		<0.00050	0.0018	<0.058	
Sheep offal	max		<7.0	<7.0	27	<0.30	0.23	<0.010			<0.037			0.38		0.00070	0.0028	<0.062	
Sprouts		1	<4.0	<4.0	<2.0	<0.20	0.12		<1.3	<0.50	<0.024			0.035		<0.00020	<0.00030	<0.036	
Strawberries		1	7.0	10	5.0	<0.20	0.058		<2.2	<0.60	<0.027			0.058		0.00020	<0.00030	<0.035	
Swede		1	<4.0	<4.0	10	<0.40	0.33		<1.7	<0.40	<0.032			0.081		<0.00010	0.00030	<0.034	

These Minutes have not yet been approved for issue by the EHSC.

Material	Selection[a]	No. of sampling observ-ations[c]	Mean radioactivity concentration (fresh)[b], Bq kg^{-1}														
			Organic ^{3}H	^{3}H	^{14}C	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{125}Sb	^{129}I	^{134}Cs	^{137}Cs	Total Cs	Total U	^{238}Pu	^{239}Pu + ^{240}Pu	^{241}Pu
Wheat		1		<6.0	89	<0.20	1.2		<0.70	<0.60	<0.045			0.37		0.00050	0.0042	<0.11
Wood pigeon muscle		2 sampling	<6.0	<6.0	19	<0.30	0.021		<2.3	<0.80	<0.043			21		<0.00020	<0.00020	<0.089
Wood pigeon muscle	max		<7.0	7.0		0.023		<2.4		<0.050			35	<0.00030	0.00020	<0.091	0.00050	
Grass		5			<0.40		<0.029	<1.7	<1.9		<0.30	2.0						
Grass	max						<0.030	<2.3	3.9			4.3						
Soil		3			<0.33			<2.0	<0.60		<0.23	55					4.7	
Soil[f]	max				0.50			<2.6			<0.30	71					6.3	

[a] *Data are arithmetic means unless stated as 'max'. 'Max' data are selected to be maxima.*
If no 'max' value is given the mean value is the most appropriate for dose assessments
[b] *Except for milk where units are Bq l^{-1}*
[c] *The number of farms from which milk is sampled. The number of analyses is greater than this and depends on the bulking regime*
[d] *The mean concentration of ^{131}I was <0.0080 Bq l^{-1} and the maximum was <0.0091 Bq l^{-1}*
[e] *The concentrations of ^{234}U, ^{235}U and ^{238}U were 0.024, 0.0013 and 0.021 Bq kg^{-1} respectively*
[f] *The concentrations of ^{234}U, ^{235}U and ^{238}U were 16, 0.72 and 15 Bq kg^{-1} respectively*

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Table 2 - Concentrations of radionuclides in terrestrial food and the environment near Drigg, 2006

Material	Location or selection[a]	No. of sampling observ-ations[c]	Mean radioactivity concentration (fresh)[b], Bq kg^{-1}															
			^{3}H	^{14}C	^{60}Co	^{90}Sr	^{95}Zr	^{95}Nb	^{99}Tc	^{106}Ru	^{125}Sb	^{129}I	^{134}Cs	^{137}Cs	Total Cs	^{144}Ce	Total U	^{238}Pu	^{239}Pu + ^{240}Pu
Milk		1	<5.0	15	<0.25	0.078	<0.43	<0.33	<0.0040	<1.6	<0.47	<0.0090	<0.23	<0.26	0.25	<0.96		<0.00020	<0.0001
Blackberries		1	<5.0	13	<0.30	0.27	<0.40	<0.30		<2.0	<0.40	<0.038			0.089	<1.1		<0.00030	0.0010
Cabbage		1	<4.0	<2.0	<0.10	0.27	<0.30	<0.30	<0.012	<1.6	<0.70	<0.024			1.2	<1.1		<0.00020	<0.0002
Deer muscle		1	12	18	<0.20	<0.0080	<0.40	<0.20	<0.011	<1.0	<0.50	<0.047			7.3	<0.90		<0.00020	0.00060
Eggs		1	6.0	19	<0.20	<0.0060	<0.30	<0.20		<1.7	<0.40	<0.028			0.10	<0.90		0.00020	0.00030
Potatoes		1	<5.0	15	<0.30	0.042	<0.50	<0.30	<0.011	<1.7	<0.60	<0.023			0.54	<0.80		0.00030	0.00050
Rabbit		1	<5.0	18	<0.30	0.011	<0.30	<0.30	<0.015	<2.1	<0.70	<0.034			2.2	<1.0		<0.00040	<0.0006
Sheep muscle		1	6.0	16	<0.30	0.040	<0.40	<0.30	<0.023	<1.7	<0.50	<0.028			2.0	<2.2		0.0010	0.0016
Sheep offal		1	<8.0	29	<0.10	0.16	<0.40	<0.30	<0.011	<1.8	<0.70	<0.029			1.1	<2.4		0.0029	0.017
Turnips		1	<5.0	10	<0.30	0.40	<0.40	<0.30		<1.6	<0.50	<0.032			0.30	<1.0		<0.00020	0.00050
Grass		2							<0.058								0.089		
Grass[d]	max								0.091								0.11		

[a] *Data are arithmetic means unless stated as 'max'. 'Max' data are selected to be maxima.*
If no 'max' value is given the mean value is the most appropriate for dose assessments

[b] *Except for milk and freshwater where units are Bq l^{-1}, and for sediment where dry concentrations apply*

[c] *The number of farms from which milk is sampled. The number of analyses is greater than this and depends on the bulking regime*

[d] *The concentrations of ^{234}U, ^{235}U and ^{238}U were 0.020, <0.0012 and 0.020 Bq kg^{-1} respectively*

These Minutes have not yet been approved for issue by the EHSC.

Table 3 - Concentrations of radionuclides in terrestrial food and the environment near Ravenglass, 2006

Material and selection[a]		No. of sampling observ-ations[c]	Mean radioactivity concentration (fresh)[b], Bq kg^{-1}															
			^{3}H	^{14}C	^{60}Co	^{90}Sr	^{95}Zr	^{95}Nb	^{99}Tc	^{106}Ru	^{125}Sb	^{129}I	Total Cs	^{144}Ce	Total U	^{238}Pu	^{239}Pu + ^{240}Pu	^{241}Pu	^{241}Am
Milk[d]		3	<5.0	16	<0.24	0.049	<0.40	<0.32	<0.0048	<1.6	<0.47	<0.0098	0.18	<0.93		<0.00018	<0.00016	<0.026	<0.00017
Milk	max		<5.3	17	<0.25	0.055	<0.42		<0.0060	<1.7	<0.51	<0.013	0.21	<0.99		<0.00020	<0.00018	<0.027	<0.00020
Apples		1	<5.0	11	<0.20	0.073	<0.40	<0.30	<0.026	<1.5	<0.40	<0.025	0.083	<0.90		<0.00020	0.00030	<0.061	0.00070
Barley		1	<7.0	45	<0.30	0.51	<0.60	<0.40	<0.022	<2.1	<0.60	<0.061	0.16	<1.4		<0.00090	<0.00060	<0.15	0.0025
Beef kidney		1	<9.0	44	<0.10	0.48	<0.40	<0.30	<0.026	<2.0	<0.70	0.080	0.82	<2.4		0.0013	0.0071	<0.091	0.029
Beef liver		1	<9.0	28	<0.20	0.15	<0.30	<0.20	<0.027	<1.2	<0.40	<0.044	0.66	<0.90		0.015	0.074	0.53	0.17
Beef muscle		1	8.0	17	<0.20	0.0080	<0.40	<0.30	<0.023	<1.8	<0.30	<0.031	1.1	<1.0		0.00030	0.00090	<0.048	0.0023
Beetroot		1							<0.013						<0.033				
Blackberries		1	<4.0	15	<0.20	0.47	<0.30	<0.30	<0.021	<1.8	<0.50	<0.050	0.12	<0.80		0.00030	0.0014	<0.036	0.0031
Broad beans[e]		1							<0.0090						<0.034				
Cabbage		1	<4.0	<3.0	<0.30	0.53	<0.40	<0.30	<0.012	<2.0	<0.80	<0.034	0.21	<1.2		<0.00030	0.00090	<0.079	0.0012
Carrots		1	<4.0	10	<0.30	0.16	<0.40	<0.30	<0.014	<1.7	<0.60	<0.027	0.16	<0.80		<0.00020	0.00020	<0.035	0.00030
Dwarf beans		1	<5.0	<3.0	<0.30	0.090	<0.40	<0.30	<0.012	<1.7	<0.50	<0.026	0.18	<1.1		<0.00030	<0.00030	<0.031	0.00050
Honey		1	<6.0	100	<0.20	0.056	<0.10	<0.20	0.019	<1.1	<0.40	<0.018	0.35	<1.5		0.00060	<0.00020	<0.077	0.00050
Pheasants		1	<5.0	27	<0.20	0.044	<0.30	<0.20	0.016	<1.6	<0.40	<0.050	0.44	<0.90		<0.00010	<0.00040	<0.093	<0.00020
Potatoes		1	<5.0	18	<0.30	<0.0090	<0.40	<0.30	<0.015	<1.1	<0.60	<0.027	0.25	<0.80		0.00040	<0.00020	<0.035	0.00030
Sheep muscle		2	<6.0	29	<0.15	<0.0095	<0.30	<0.25	<0.021	<1.7	<0.45	<0.025	1.9	<0.80		<0.00025	<0.00035	<0.059	0.00095
Sheep muscle	max			33	<0.20	0.012	<0.40	<0.30	<0.029	<2.1	<0.50	<0.026	2.2	<0.90		<0.00030	0.00050	<0.070	0.0015
Sheep offal		2	<7.5	23	<0.30	0.14	<0.45	<0.30	<0.039	<2.0	<0.65	<0.038	1.3	<2.1		0.0057	0.029	<0.29	0.037
Sheep offal	max		<8.0	29	<0.40	0.15	<0.60	<0.40	0.042	<2.3	<0.80		1.9			0.011	0.056	0.53	0.072
Grass		2							<0.026										
Grass	max								<0.029										
Soil[f]		1																	

[a] *Data are arithmetic means unless stated as 'max'. 'Max' data are selected to be maxima. If no 'max' value is given, the mean is also the maximum*

[b] *Except for milk where units are Bq l^{-1}*

[c] *The number of farms from which milk is sampled. The number of analyses is greater than this and depends on the bulking regime*

[d] *The mean concentrations of ^{134}Cs and ^{137}Cs were <0.21 (max <0.22) and <0.24 Bq l^{-1}*

[e] *The concentrations of ^{234}U, ^{235}U and ^{238}U were <0.0015, <0.00050 and 0.0025 Bq kg^{-1} respectively*

[f] *The concentrations of ^{234}U, ^{235}U and ^{238}U were 11, 0.36 and 9.8 Bq kg^{-1} respectively*

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Sellafield Ltd

Sellafield Ltd Groundwater Annual Report 2007

Summary

The Sellafield site is located on the north-western coast of England between the coastal town of Whitehaven to the north and the village of Ravenglass to the south. The surrounding land use is predominantly agricultural with a number of farms and villages. The topography of the site generally slopes towards the coast.

There are two major surface water features present within and adjacent to the site, the Rivers Calder and Ehen. The River Calder flows towards the site from the north, once it reaches the site it flows from north-north-east to south-south-west. The river has been straightened within the site. The River Ehen flows in a south-easterly direction between the site and the coast. The two rivers join to the south-west of the site where they discharge into the Irish Sea.

The geology of the site comprises a complex series of drift deposits consisting of clays, gravels and sands below which is sandstone and other sedimentary rock. There are two groundwater bodies within this material, the upper groundwater within the drift deposits and a lower groundwater body within the sandstone.

The industrial history of the Sellafield site began in 1941, when it was developed as a Royal Ordnance Factory. TNT production ceased at the end of the Second World War and the site was cleared in 1946. In 1947 the site was acquired by the government (Department of Supply) as the location for Britain's first atomic reactors and associated reprocessing plant. In the early 1950's the first power generation reactors (Calder Hall) were constructed. Expansion has continued intermittently since that time. With the exception of a prototype reactor, built in the 1960's, all of this construction has been for the purpose of reprocessing of spent nuclear fuel and the temporary storage of solid and liquid reprocessing wastes prior to vitrification, encapsulation and storage.

Activities on site are currently focussed on reprocessing of spent nuclear fuel, fuel manufacture and site clean-up. Clean-up activities are currently forecast to last into the next century.

During the industrial history of the site there have been a number of incidents which have resulted in the contamination of the underlying soils and a reduction in the quality of the aquifers. The management of contaminated land and groundwater on Sellafield is undertaken by the Contaminated Land team, which forms part of the Decommissioning operating unit.

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Compliance with the Environment Agencies requirements with regard to groundwater monitoring

A number of scheduled samples were not collected within the monitoring period. A proportion of these were due to the sample point not containing sufficient water to allow sampling. Other reasons were due to access problems into areas where other work activities are taking place (such as construction and decommissioning projects). A small proportion (≈ 5%) of sample results did not meet the required limit of detection; this is a significant improvement on the previous year.

Through the year a total of 58 samples showed significant increases in activity concentration when compared to the previous results from those boreholes. The majority of these increases were from boreholes within areas of known contamination and within a plume of contamination extending to the areas between main gate and station gate.

When the groundwater monitoring programme was developed it was thought that the most significant Alpha emitting isotope would be Plutonium isotopes due to its potential to impact off site receptors. The strategy for the investigation of elevated Total Alpha concentrations within groundwater therefore concentrates on Plutonium. A review of the groundwater monitoring data undertaken as part of the annual report however indicates that in the majority of occasions Uranium isotopes are more prevalent. Due to this, a change in the strategy for the investigation of exceedences in Total Alpha has been recommended which will now investigate for Uranium contamination prior to Plutonium. A change has also been recommended for Uranium Alpha analysis. It is recommended that the same method is used but the results are reported as speciated Uranium isotopes rather than Total Uranium Alpha which assumes that natural Uranium is dominant. This change is recommended to improve the understanding of Uranium contamination.

The general approach to weak Beta contaminants is to use the analysis for Tritium and Technetium as indicators. A number of groundwater migration pathways on site were identified as potentially containing either Iodine-129 or Chlorine-36. Following a result greater that the limit of detection for Tritium or Technetium-99 (from a borehole in one of these pathways), samples should be analysed for Iodine-129. Then following a positive result for Iodine-129 the boreholes will be tested for Chlorine-36. A review of the groundwater monitoring data has been undertaken and a number of additional boreholes, which consistently exceed the LOD for Tritium and Technetium-99, have been scheduled for Iodine-129 and Chlorine-36 analysis.

Within the design of the original groundwater monitoring programme[(6)], the boreholes were divided into two categories. Category A boreholes are those that represent the key integrated monitoring programme. Category B boreholes were meant to supplement the key programme until enough data was available to ensure that the new boreholes (from SCLS phase 1) are providing valuable and representative detail of groundwater quality. The groundwater monitoring programme has now been collecting data since 2005 and therefore enough data exists to make this assessment. It is therefore recommended that the monitoring of Category B boreholes is continued at a reduced frequency from that in the

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current programme (an exception is for Category B boreholes which are currently monitoring groundwater with elevated activity, which will not be reduced).

Review of the groundwater monitoring objectives and best practise

A review of the groundwater monitoring programme has been undertaken to ensure that it is meeting its objectives. The review concluded that the groundwater monitoring programme is meeting its objectives. There is however the potential to make further improvements as follows:

- More improvements could be made to the analysis of trends within boreholes;
- More use of the groundwater head data could help to improve the understanding of groundwater movement in areas of the site.
- The groundwater monitoring programme should be expanded to provide more information on non-radioactive contaminants.

During the year there were a number of projects which have helped to improve the groundwater monitoring programme, these include:

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- A Best Practicable Means (BPM) assessment was undertaken on the management of contaminated land. The BPM assessment made a number of recommendations to further improve the management of contaminated land. These included recommendations to further limit the amount of water which enters the ground in areas of contamination, by preventing the infiltration of rainwater. Other recommendations also concerned the expansion of the groundwater monitoring programme to include non-radiological contaminants and to improve the interpretation of groundwater monitoring data so that it expands from looking primarily for concentration spikes.

- A quality assurance programme plan (QAQC) was developed for the groundwater monitoring programme. This quality assurance programme plan has the structure of ISO 9001:2000, and there is a near one-to-one correspondence between the subheadings in ISO 9001:2000 and the subheadings in the QA/QC plan. The primary quality objectives of the plan are to ensure:
    - data are traceable and fit for purpose,
    - samples are representative,
    - boreholes and monitoring wells meet quality requirements,
    - that data interpretations are clear and understandable and communicated appropriately to Regulators and Stakeholders,
    - that data and information are managed to assure their integrity and security.

  Following on from the QAQC plan, an analytical users manual was also developed. This document is largely about data quality; what parameters are important in data quality, how and when data quality should be prescribed, how data quality should be evaluated after receipt of data, and how the data should be flagged so that future users clearly understand the quality of current data.

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- A study was undertaken to investigate the occurrence and radionuclide association of colloidal material in Sellafield groundwaters. Results of this investigation demonstrated the presence of both particulate and colloid material in groundwater samples. The results from this investigation have also indicated that radionuclides potentially sorb onto the colloids. Radionuclides associated with Total Beta activity are sorbed onto colloidal material as shown by the reduction in activity following 30 kDa filtration of groundwater samples collected from a number of the boreholes. Results from Technetium-99 analysis showed that this radionuclide was removed from solution by 30 kDa (nominal 4 nm pore size) filters. This result was difficult to interpret due to the predicted speciation as a highly soluble pertechnatate of this radionuclide.

- An investigation of the groundwater data for Uranium was undertaken. It was observed that the correlation between Total Alpha and Uranium Alpha varies between locations, but is reasonably consistent within the data from any given installation. The Total Alpha is reported using an ICP-MS measurement, assuming a natural Uranium abundance. To try to understand this further, a number of Uranium Isotopic Analysis were undertaken for samples from 4538pp3, 743p1 and 784p1. The results from these analyses have shown that the assumption that the Uranium has a natural abundance is possibly inadequate, apart from the use of the data for trending and correlating to Total Alpha for Quality Assurance purposes. The investigation will continue through the following year. As discussed above, an improvement to the reporting of Uranium Isotopes has been recommended.

Groundwater quality at Sellafield

Screening results for Alpha-emitting radionuclides indicate that the large majority of monitored groundwaters contain Alpha activities below the analytical limit of detection. The WHO drinking water standard for Total Alpha (0.5 Bq/l) was exceeded in groundwaters from six boreholes, reaching up to an average in one borehole of 82 Bq/l over the April 2006 – March 2007 period. All six of these boreholes are located within the Separation Area.

Screening results for Beta-emitting radionuclides indicate that a proportion of boreholes contain groundwaters with Total Beta activities elevated above the WHO drinking water standard of 1 Bq/l. The majority of exceedences are from boreholes located within the Separation Area; however a number are also located outside of this area, predominantly to the south and south-west of the Separation Area. The pattern for Strontium-90 activity distribution generally mirrors that for the Beta analysis, indicating that this radionuclide is the predominant Beta-emitting contaminant in groundwaters on site. Fewer exceedences of the WHO drinking water standard are evident for Strontium-90 than Total Beta due to the less stringent standard (10 Bq/l) for this radionuclide than for the screening analysis.

The highest average Tritium activities are from boreholes located in and around the south-west corner of the Separation Area with averages up to 44000 Bq/l over the 2006 - 2007 period. Three boreholes in this area exceed the WHO drinking water standard for Tritium of 10000 Bq/l.

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Technetium-99 groundwater results indicate that the majority of monitored groundwaters contain average Technetium-99 activities below the typical analytical limit of detection (LOD) of 0.06 Bq/l. Most monitored groundwaters within the Separation Area lie above the LOD, but lower than the WHO drinking water standard of 100 Bq/l. The highest Technetium-99 activities in monitored groundwaters are measured in boreholes between the south-west corner of the Separation Area and the site main gate.

Further details of the area of Alpha, Beta and Technetium activity is discussed within the report.

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