Meeting to discuss radioactive contamination of Dalgety Bay

Date: 7th November 2005
Location: Queensferry Lodge Corus Hotel

Attendees:

Paul Dale **(PD)**	(SEPA)
Adam Stackhouse **(AS)**	(SEPA)
Alda Forbes **(AF)**	(SEPA)
John Burton **(JB)**	(Health Protection Agency)
Jackie Highland **(JH)**	(NHS Fife)
Colin McPhail **(CM)**	(Chairman of Dalgety Bay and Hillend Community Council)
Stuart Randall **(SR)**	(Fife Council - Cllr for Dalgety Bay East)
Stephen Chorley **(SR)**	(SEPA East Area Board) (Dalgety Bay and Hillend Community Council)
Phil Mawhood **(PM)**	(Fife Council)

1 PD welcomed those present and outlined that the main reason for calling this meeting was the recent media interest in the radioactive contamination on Dalgety Bay foreshore and the potential implications of the proposed radioactive contaminated land regulations for Scotland.

2 PD gave the meeting a presentation detailing the finding of the recent survey commissioned by SEPA and the implications of those findings in light of the proposed Radioactive Contaminated land regulations.

3 During the presentation questions were asked about the precise nature of the health effects resulting from coming into contact or ingestion/inhalation of the particles. There were no experts in health physics around the table but it was agreed that it would be unreasonable to suggest that receiving a skin burn from the radioactive material would increase the risk of cancer.

4 CM asked if SEPA had compared the activity of the "hotspots" in the current survey to those of previous surveys. PD responded that the activity of the "hotspots" had not been measured in the current survey as the items were not removed. However, the instrumentation used to find the "hotspots" on the most recent survey was similar to that used on previous surveys so count rates can be compared. This comparison suggests that the activity of the items currently on the beach is similar to those previously removed.

5 JH asked if the risk assessment undertaken by Aberdeen University in 1996 was comprehensive. PD responded that he thought the report was dated and that he did not believe it was comprehensive as current assessment, for example it did not bound the extent of the contamination.

6 Following the presentation PD asked the question; "Is any action warranted and if so who will undertake such actions?" At Dunnet Beach, a similar case of radioactive items being found on the foreshore existed. In this case, one fragment of irradiated nuclear fuel was found and also a piece of contaminated plastic. In response signage

had been erected near the beach to alert the public to the finds and the potential hazard.

7 PM said that Fife Council would take advice from the experts whether signage was necessary or not.

8 CM stated that the issue of signage had been discussed previously with Dunfermline Council, on that occasion it had been decided signs were not necessary. Nothing had changed since the early 1990's except potential legislation therefore the risk was still minimal and signs are still unnecessary.

9 SC noted that the existing contaminated land regime was regulated by local authorities and asked if the proposed radioactive contaminated land regime was similar.

10 PM stated that the Local Authorities have no powers at the moment with regards radioactively contaminated land.

11 AS added that the current consultation proposed that SEPA would be given powers regarding the identification of radioactively contaminated land. However, this was a question being asked in the consultation. It is therefore not clear who will have the new duty but it will almost certainly fall to either Local Authorities or SEPA.

12 SC said that he believed that Fife Council (as the body already responsible for contaminated land in general) should take ownership of the problem and begin to draw together information to form recommendations, rather than allowing the situation to continue going around in circles like it has for the past 15 years. In effect, can the council prepare a "road map" to deal with this issue?

13 CM asked when the new regulations would come into force and asked if the 50 mSv would definitely make the foreshore "contaminated land".

14 PD answered that the regulations should be in force by April and that it would depend on the dose assessment whether or not the foreshore would be classed as contaminated land.

15 CM asked if a study on the effect of the contamination on sailing club members could be used as an assessment of the harm that contamination poses. He went on to say that the contamination had been there since the 1950's and there had been no adverse affects. The last thing that we want to do is close the sailing club.

16 PD responded that the proposed radioactive contaminated land legislation prescribed dose limits where the land must be considered to be radioactively contaminated. The dose limit in question for Dalgety Bay is a skin equivalent dose of 50 mSv. This is also the same as the statutory skin dose that a member of the public would be allowed to receive from an authorised practice. However, in reality an authorised practice would result in a dose at a fraction of this level due to other regulatory requirements.

17 SC asked where the new dose limits came from?

18 PD answered that the dose limits proposed in the radioactively contaminated land regulations were based on advice from the Health Protection Agency. This advice

was in turn based on European legislation (Basic Safety Standards) and the recommendations of the International Commission of Radiological Protection (ICRP).

19 SC said that in anticipation of the new regulations, Fife Council and SEPA should be taking action and investigating the various options available to them.

20 CM asked to the status of discussions with the Ministry of Defence?

21 PD responded that MoD did not accept responsibility for the contamination, however negotiations with the MoD are ongoing with regards them assisting with the disposal of material recovered from Dalgety Bay. SEPA are committed to undertake a further survey of the foreshore and to remove the contamination however, this can not take place until the MoD will agree to accept the waste as had previously been the case.

22 SR asked why this disposal route had become unavailable.

23 PD said that had been a decision made by the MoD. SEPA were unable to remove and dispose of the contamination due to the high costs involved. If SEPA did undertake the work under existing powers they would be compelled to try and recover the costs from the occupier of the land. If this was unsuccessful they would try to recover costs from the owner of the land.

24 SR asked if SEPA were committed to removing the contamination if no disposal route was available.

25 PD answered that SEPA would not remove the items until a disposal route had been agreed. He also added that he would not like the people to get the impression that a one-off survey and removal exercise would guarantee the safety of the public. Repopulation of the particles means that contamination could be present on the foreshore the day after any such exercise.

26 JH asked if it was possible to cap the source?

27 SC noted that the key part of the “road map” that he was proposing was a risk assessment including gathering information from the MoD on the actual disposal practices undertaken at the airfield. This would give a good idea with regards the source of the contamination and what has to be done to stop repopulation of the beach.

28 CM stated that he could provide evidence and eyewitness accounts as to the MoD actions. There was certainly an incineration point at the woodland, the wastes from which were dumped into the mound on which the sailing club is now built. There is also some evidence of sea dumping of some aeroplane parts. CM reiterated that there was currently no evidence of any problems [regarding health of sailing club members] so, as long as the mound was not excavated or land use changed what is the problem?

29 JH said that people have a right to have more information. It is not possible to say there have been no health effects without doing a proper study. For example, people often get cuts and bruises without knowing how or why.

30 SR said that it was important not to overreact to the situation otherwise the cure could be worse than the disease. Concrete slabs covering the beach and radioactive warning signs were not what we wanted. SR suggested that most Dalgety Bay residents know about the contamination already, visitors however did have a right to be concerned.

31 SC said that it was necessary to give sensible information to the public but that this information should be accompanied with a proposal of what we are going to do to remove the hazard/risk.

32 PM stated that under contaminated land regulations remediation did include removing access to the contaminated areas if other options are impracticable or uneconomic.

33 CM suggested that the route of the coastal path could be rerouted and that access to the beach could be restricted to informed members of the sailing club.

34 JH said that she had spent some time walking on Dalgety Bay beach and had observed clinker type material outside the area that had recently been surveyed, i.e. near Crow Hill outcrops. This part of the foreshore did not belong to the sailing club. Additionally JH had observed people digging in the bay and taking things away.

35 PD said that he could only advise on the survey result and the risk that this inferred. If no action was taken before the radioactively contaminated land regulations came into forces then SEPA or the Local Authority may have to do something when they do.

36 SR disagreed with the assessment of risk as there was no information on how much of the clinker was radioactive. He added that if there was a lot of clinker on the beach and only 1 in a 100 of those bits of clinker was radioactive then there is only a 1 % risk of being exposed by picking up such a piece of clinker.

37 SC said that due to time constraints imposed by the impending regulations a risk assessment must be started now. It is necessary to (1) define the scope of the assessment, (2) if we were to do it it, how could we restrict access – provide information and (3) consider what legal moves could be taken to show that the MoD are responsible for the contamination.

38 PD agreed that these actions needed to be undertaken as soon as possible but the question to be answered now is: should signs be going up around the beach now?

39 SEPA and Fife Council agreed that they would meet in late November to discuss the way forward regarding a full risk assessment of the contamination on Dalgety Bay foreshore. The aim of the meeting would be to produce the aims of a risk assessment including a breakdown of what information is required and what information is missing. Identifying this information would help inform the strategies for reducing the risk and removing the hazard.

ACTION: Fife Council and SEPA to meet in November to discuss the scope of a risk assessment

40 SR responded to PD's question 'should signs be going up now?': No, there should be no signage and no control of access until the risk assessment has been undertaken. SC

said that we must scope the risk assessment now as that will inform us whether or not we must restrict access. CM also believed that restrictions are inappropriate. However, it may be appropriate to put signs up in the sailing club. SC said that signs could not be put up in the sailing club and not on the coastal path. SR stated that it could be appropriate to have differential information. People will misinterpret the action of putting up signs and will believe that the contamination is much worse than it really is. The risk is still very small.

41 PD said that he understood the views expressed.

42 SR suggested that it would be sensible to put a notice on the sailing club notice-board and that annual updates could be sent to Dalgety Bay residents via the community newsletter. Signs on the beach are unnecessary as external visitors have a lower risk.

43 JH disagreed and said the equal information must be given to everybody.

44 CM said that it was important that PD's presentation was given to the sailing club committee and the Local Community Council at their December meeting. CM asked is SEPA intend to do another survey and whether or not the particles will be removed if MoD agrees to take them?

45 PD agreed to give a presentation to the sailing club committee and to the local Community Council. He also answered hat SEPA would undertake a further survey and remove the contamination if MoD agreed to take the waste. Such a survey could be undertaken before the end of the year.

46 CM asked that the sailing club be informed prior to any future survey. PD agreed that he would attempt to inform the sailing club prior to any future survey.

47 Returning to the question of signage PM said that Fife Council would take the advice of the experts.

48 JH asked JB what the view of the HPA was.

49 JB said that it seemed reasonable that the public were informed of the potential hazard.

50 JH asked if HPA could draft some words which could go on possible notices.

51 It was discussed around the table and it emerged that current advice being given to residents was that they should not pick up and remove clinker. It was unsure when this advice was given but it was suggested that it could have been in the early 90's following the public meeting with Aberdeen University.

52 JB said that he would have to take the request back to HPA, but thought that they would be able to provide a form of words.

ACTION: HPA to provide a form of words to go on possible signs

53 PD asked if the people around the table could give a final view on the need for warning signs.

54 JH said that she believed that the public should be informed but that it was important for this group to agree the words used on any such sign. JH again asked that HPA provide such a form of words.

55 It was the view of the Local Community Council that the recent survey report should be available in the local library and possible the Community website and that feedback from this meeting should be given to the relevant people but that there was no need to erect signs at the moment as the situation on the beach had not changed since previous surveys.

56 PD said that SEPA could not give recommendations regarding signs as SEPA is only able to provide information on the results of the survey and the implications of those results.

57 SR said that all information relating to the contamination at Dalgety Bay should be available in the public domain through press releases and websites for example, but there was no need for action such as erecting signs or restricting access at the moment.

58 PM said that Fife Council were neither for nor against erecting signs and would take advice from NHS Fife and the Local Community Council.

59 PD pressed PM stating that such advice had been given, NHS-Fife was in favour and the Local Community Council was against. PM said that they must wait to see the wording of the proposed sign.

60 A discussion was held regarding who had powers to erect signs. It was suggested that signs could only be erected with the permission of the land owners. A discussion followed regarding the extent of the contamination and which landowners were involved. It is likely that the contamination exists outside the land owned by the sailing club. A large piece of land is owned by Barratt homes and there are numerous private individuals who own small sections of the foreshore.

61 PD asked whether it was prudent to contact all of these as it may be unwise to inform the sailing club and nobody else.

62 It was generally agreed that until the extent of the contamination found in all of the previous surveys had been collated it was not necessary to contact any other landowner. PD took an action to review the previous surveys to identify appropriate landowners.

ACTION: PD to look at the previous surveys to see which landowners are affected

63 Fife Council, NHS Fife and SEPA agreed to attend the Local Community Council meeting in December.

64 It was agreed that the next meeting of this group would be held during the week commencing the 16th of January. The meeting would include a discussion of the assessment strategy proposed by SEPA and Fife council.

Summary of actions

ACTION: Fife Council and SEPA to meet in November to discuss the scope of a risk assessment

ACTION: HPA to provide a form of words to go on possible signs

ACTION: PD to look at the previous surveys to see which landowners are affected

Public Notice
Dalgety Bay

Radioactive materials have been found on this beach.

There is low risk to the public.

Mainly for general hygiene reasons, please wash your hands if you handle material on the beach and do not remove any material.

Radiation Protection Division of the Health Protection Agency

Further information can be found on (awaiting Q&A to discuss use of NHS 24 for health information)

Do you want to add a SEPA contact number?

UPDATED STUDY OF CANCER INCIDENCE IN DALGETY BAY, FIFE - 1975-2002

1. Summary

This study represents an update of a previous study designed to assess the incidence of radiation-associated cancers in the Dalgety Bay area of Fife, against a background of potential exposure to radium-226 disposed of locally during the 1940's. The study is complicated by rapid population growth, demographic change and the relatively high socioeconomic status of the Dalgety Bay population. To assess the risk of relevant cancers in the population of the study area, the observed numbers of cancers were compared to expected numbers derived from national background rates. For the most recent period evaluated (1986-2002), the ratios of observed to expected numbers were standardised for age, sex, and deprivation, yielding standardised incidence ratios (SIRs). The main findings for this recent period were as follows:

• Overall cancer incidence (all malignant neoplasms excluding non-melanoma skin cancer) in the Dalgety Bay area has tended to be slightly lower than the national average. However, the differences from national background rates are comparatively small and do not attain statistical significance.

• No higher than expected numbers of cases were observed in the cancers most frequently associated with radiation, and no significantly higher than expected numbers of cases were observed in the cancers classified as occasionally associated with radiation. Multiple myeloma (defined as occasionally associated with radiation) was found to have a higher than expected number of cases, but this excess did not attain statistical significance.

• In the group of cancers determined as rarely associated with radiation, Brain and other CNS, major salivary gland, rectum and connective tissue cancers were found to have higher than expected numbers of cases, but these also do not attain statistical significance. Corpus uteri cancer was found to have significantly higher than expected numbers of cases.

• Additionally pancreas cancer and childhood leukaemia were found to have higher than expected numbers of cases, but do not attain statistical significance.

In summary, there were no statistically significant excesses of cancers most commonly associated with exposure to ionising radiation. The excess of corpus uteri cancer is unexplained, but could represent a chance finding in the context of multiple significance tests.

2. Background

This investigation was conducted by the Information Services Division (ISD Scotland) of NHS National Services Scotland as part of a standing commitment to examine periodically the incidence of cancers in the Dalgety Bay area which might be caused by exposure to radium-226 disposed of locally during the 1940s.

The analyses reported here were based closely on those reported in a previous assessment: Black RJ, Sharp L, Finlayson AR, Harkness EF (1994). Cancer incidence in a population potentially exposed to radium-226 at Dalgety Bay, Scotland. British Journal of Cancer 69, 140-143, and on subsequent updates to this study.

Two sets of analyses have been conducted: 1975-2002 with adjustment for age and sex and 1986-2002 with adjustment for age and sex, and the socio-economic characteristics of the Dalgety Bay population.

3. Data & Methods

Boice et al (1996)1 ranked individual major cancer sites according to the degree to which ionising radiation had been identified as a causative factor. This ranking was used to identify the specific cancers to be considered in this updated study of cancer incidence in the Dalgety Bay area (see Appendix 1). The incidence of cancer of the pancreas, non-melanoma skin cancer and childhood leukaemia (each identified as having higher than expected risks in previous studies), and the incidence of all malignant neoplasms combined, excluding non-melanoma skin cancers, were also examined.

Observed incidence data presented here are based on the Scottish Cancer Registration System, extracted in November 2005.

Age- and sex- specific population estimates for Scotland are available at ISD Scotland by arrangement with the General Register Office for Scotland (GRO(S)). In order to assess whether the level of occurrence of cancer in the defined area appears to be unusual, information on local population estimates must also be assembled. Annual estimates of population are not calculated for areas below the level of the Local Council Areas, so for this study, population data at the census enumeration district and output area level(s) were taken from the 1971, 1981, 1991 and 2001 censuses.

The estimated age and sex specific populations at risk for each of these areas over the period 1975-2002 were

calculated as a linear interpolation of the data for years between 1971 and 2001 and a linear extrapolation for 2002. The calculations also accounted for the changing population in the inter-censal periods in Scotland using GRO(S) mid-year population estimates.

The physical extent of the study area corresponds as closely as possible with the area described in the paper by Black et al (1994). Incidence data for Dalgety Bay were selected using 1971 Enumeration Districts for 1975, 1981 Enumeration Districts for years 1976-1985, 1991 Output Areas for 1986-1995, and 2001 Output Areas for 1996 onwards. In practice, the 1971 and 1981 Enumeration Districts were the same. Appendix 2 shows the area studied for 1975-1995 and Appendix 3 shows the area covered for 1996-2002.

Expected numbers of registrations for each cancer type in these areas were calculated by applying sex- and age-specific national rates to the estimated local population at risk. The results are presented as numbers of cancer cases observed, numbers of cases expected, and observed to expected ratios, with 95% confidence intervals calculated using standard methods2. An observed to expected ratio (O/E) can be interpreted as an estimate of the true relative risk of contracting a disease for individuals in a group under study compared to individuals in a comparison group. An O/E ratio of 1.00 indicates identical risks in the study and comparison groups. However, the observed to expected ratio is subject to random variation, so confidence intervals are required to assess the extent to which the observed data indicate a true relative risk which differs from 1.00. By convention, a confidence interval that does not include the value 1.00 is interpreted as a statistically significant difference in risk between the two groups.

Additionally, in order to control for anticipated confounding by socio-economic status (Dalgety Bay being an area of relatively high affluence), a second set of expected numbers were prepared. Based on both 1991 and 2001

1 Boice JD, Land CE, Preston DL (1996). Ionizing radiation. In Schottenfeld D and Fraumeni Jr, JF. Cancer Epidemiology and Prevention. Second Edition, Oxford University Press.

2 Boyle P, Parkin DM. Statistical Methods for Registries. In: Cancer Registration Principles and Methods (Editors: Jensen
OM, Parkin DM, MacLennan R, Muir CS, Skeet RG). IARC Scientific Publication No. 95. Lyon: International Agency for
Research on Cancer, 1991.

Carstairs Deprivation scores (calculated at postcode sector level geography) in the lowest quintile (least deprived group), age-, sex- cancer registration rates, for Scotland, were calculated. To obtain both Scottish registration and population information:

- 1991 Carstairs' deprivation information was used to select registrations for the 10-year period 1986-1995 while 2001 Carstairs' deprivation information was used for the 7-year period 1996-2002
- 1991 census population data was used for the 10-year period 1986-1995 while 2001 census population data was used for the 7-year period 1996-2002. Calculations were performed on these data to take account of the changing population in the inter-censal periods in Scotland using GRO(S) mid-year population estimates.

Finally, the resulting expected cases were compared with the observed cases from the predefined Dalgety Bay area. Note: the deprivation-adjusted figures were calculated for the period 1986-2002 only, due to methodological complexities of producing figures for a longer time period, and difficulties in interpreting the results.

4. Population of the Dalgety Bay area

The Dalgety Bay area is known to have an unusual age structure in comparison to Scotland as a whole (Figure 1). At the time of the 1981 census, there was a high proportion of 25-39 year olds compared to Scotland, and at the time of the 1991 census there was a high proportion of 25-44 year olds compared to Scotland. In the 2001 census the 30-44 and 50-54 age groups represented a higher proportion of the population in Dalgety Bay than in Scotland as a whole. The proportion of the population in the 60+ age groups is lower than in Scotland and follows a similar, if slightly higher, pattern to previous census data taken in the Dalgety Bay area.

The Dalgety Bay area is also known to be an area of low socio-economic deprivation, with 96.6% of the population in the least deprived Carstairs' deprivation quintile in 2001.

4.1. Population age structure in Dalgety Bay compared with Scotland

Figure 1: Population age structure in Dalgety Bay in 1971, 1981, 1991, and 2001: population proportions by age group

5. Results adjusted for sex and five-year age group for 1975-2002

The observed incidence of the investigated cancers in the Dalgety Bay area, compared with expected values based on overall rates for Scotland, are shown in tables 1A to 1D.

Table 1A. Incidence of “Group A” cancers (Cancers frequently associated with radiation) adjusted for sex and five-year age group (1975-2002)

Cancer Site	Observed registrations	Expected registrations	Standardised Incidence Ratio O / E	Lower 95% confidence interval	Upper 95% confidence interval
Leukaemia	15	15.32	0.98	0.55	1.62
Thyroid	6	3.76	1.60	0.59	3.48
Female Breast	92	84.6	1.09	0.89	1.33

Table 1B. Incidence of “Group B” cancers (Cancers occasionally associated with radiation) adjusted for sex and five-year age group (1975-2002)

Cancer Site	Observed registrations	Expected registrations	Standardised Incidence Ratio O / E	Lower 95% confidence interval	Upper 95% confidence interval

Lung
74
112.99
0.65
0.52
0.82
Stomach
10
27.04
0.37
0.18
0.68
Colon
44
46.61
0.94
0.67
1.28
Oesophagus
7
15.30
0.46
0.18
0.94
Bladder
22
26.97
0.82
0.51
1.23
Ovary
12
14.87
0.81
0.42
1.41
Multiple myeloma
8
6.51
1.23
0.53
2.42

Table 1C. Incidence of “Group C” cancers (Cancers rarely associated with radiation) adjusted for sex and five-year age group (1975-2002)

Cancer Site
Observed registrations
Expected registrations
Standardised Incidence Ratio
O / E
Lower 95% confidence

interval
Upper 95%
confidence
interval
Brain and other CNS
11
11.46
0.96
0.48
1.72
Kidney
7
12.01
0.58
0.23
1.20
Liver and intrahepatic bile ducts
2
4.55
0.44
0.05
1.59
Major salivary gland
2
1.57
1.27
0.15
4.60
Non-Hodgkin's Lymphoma
18
17.33
1.04
0.62
1.64
Malignant melanoma of skin
21
15.94
1.32
0.82
2.02
Rectum
32
23.78
1.35
0.91
1.92
Corpus uteri
16
9.06
1.77
1.01
2.86
Bone and articular cartilage
0

1.59
0.00
-
-
Connective tissue
3
3.43
0.88
0.18
2.56
Table 1D. Incidence of “Group D” cancers (Miscellaneous) adjusted for sex and five-year age group (1975-2002)
Cancer Site
Observed registrations
Expected registrations
Standardised Incidence Ratio O / E
Lower 95% confidence interval
Upper 95% confidence interval
Pancreas
18
14.42
1.25
0.74
1.97
Childhood Leukaemia (0-14)
4
2.12
1.89
0.51
4.83
Non-melanoma skin (nmsc)
129
101.60
1.27
1.07
1.51
All malignant neoplasms excluding nmsc
536
597.60
0.90
0.82
0.98
Data source: SOCRATES (Scottish cancer registration database); these figures prepared in November 2005. Population data supplied to ISD Scotland by GRO(S).
From the above results, the incidence of cancer was higher than may be expected for thyroid, female breast,

multiple myeloma, major salivary gland, non-Hodgkin's lymphoma, malignant melanoma of skin, rectum, corpus uteri, pancreas, childhood leukaemias and non-melanoma skin cancer(s). However, the results were only significantly higher than expected for corpus uteri and non-melonoma skin cancer(s). The incidence of cancer was significantly lower than expected for lung, stomach and oesophagus cancers, as well as all malignant neoplasms (excluding non-melanoma skin cancer).

6. Results adjusted for sex, five-year age group and deprivation for 1986-2002

The observed incidence of the investigated cancers in the Dalgety Bay area, compared with expected values based on overall rates for Scotland, are shown in tables 2A to 2D.

Table 2A. Incidence of "Group A" cancers (Cancers frequently associated with radiation) adjusted for sex, five-year age group and deprivation (1986-2002)

Cancer Site	Observed registrations	Expected registrations	Standardised Incidence Ratio O / E	Lower 95% confidence interval	Upper 95% confidence interval
Leukaemia	10	13.42	0.75	0.36	1.37
Thyroid	3	3.71	0.81	0.17	2.36
Female Breast	77	80.72	0.95	0.76	1.19

Table 2B. Incidence of "Group B" cancers (Cancers occasionally associated with radiation) adjusted for sex, five-year age group and deprivation (1986-2002)

Cancer Site	Observed registrations	Expected registrations	Standardised Incidence Ratio O / E	Lower 95%

confidence
interval
Upper 95%
confidence
interval
Lung
63
62.81
1.00
0.78
1.28
Stomach
9
15.53
0.58
0.27
1.10
Colon
40
42.68
0.94
0.67
1.27
Oesophagus
6
11.35
0.53
0.19
1.15
Bladder
18
20.12
0.89
0.53
1.41
Ovary
11
13.44
0.82
0.41
1.47
Multiple myeloma
7
5.95
1.18
0.47
2.42
Table 2C. Incidence of “Group C” cancers (Cancers rarely associated with radiation) adjusted for sex, five-year age group and deprivation (1986-2002)
Cancer Site
Observed
registrations
Expected
registrations

Standardised
Incidence Ratio
O / E
Lower 95%
confidence
interval
Upper 95%
confidence
interval
Brain and other CNS
11
9.79
1.12
0.56
2.01
Kidney
5
11.26
0.44
0.14
1.03
Liver and intrahepatic bile ducts
2
3.61
0.55
0.07
2.00
Major salivary gland
2
1.23
1.63
0.20
5.87
Non-Hodgkin's Lymphoma
16
16.95
0.94
0.54
1.53
Malignant melanoma of skin
17
20.66
0.82
0.48
1.32
Rectum
29
21.67
1.34
0.90
1.93
Corpus uteri
16
8.92

1.79
1.03
2.91
Bone and articular cartilage
0
1.23
0.00
-
-
Connective tissue
3
2.85
1.05
0.22
3.08
Table 2D. Incidence of “Group D” (Miscellaneous) cancers adjusted for sex, five-year age group and deprivation (1986-2002)
Cancer Site
Observed registrations
Expected registrations
Standardised Incidence Ratio O / E
Lower 95% confidence interval
Upper 95% confidence interval
Pancreas
11
10.31
1.07
0.53
1.91
Childhood Leukaemia (0-14)
2
1.67
1.20
0.14
4.32
Non-melanoma skin (nmsc)
115
117.62
0.98
0.81
1.17
All malignant neoplasms excluding nmsc
450
482.73
0.93

0.85
1.02
Data source: SOCRATES (Scottish cancer registration database); these figures prepared in November 2005. Population data supplied to ISD Scotland by GRO(S).
From the above results, the incidence of cancer was higher than would be expected for multiple myeloma, brain and other CNS, major salivary gland, rectum, corpus uteri, connective tissue and pancreas cancers and also for childhood leukaemias. However, the incidence of cancer was only significantly higher than expected for corpus uteri cancer. None of the results are significantly lower than expected.

When adjustments are made for deprivation (in addition to age and sex adjustments), in most cases, the observed to expected ratio is attenuated to the extent that it is not statistically significant. Similarly, the higher than expected results for thyroid, female breast, non-Hodgkin's lymphoma and malignant melanoma of skin cancers are also diminished. However, despite such adjustments, there remain higher than expected numbers of multiple myeloma, major salivary gland, rectum and pancreas cancers and childhood leukaemia, and significantly higher than expected numbers of corpus uteri cancer. In addition, higher numbers of brain and CNS and connective tissue cancers were indicated when adjustments were made for deprivation. Note also that all cancers with significantly lower than expected incidence (when adjusted for age and sex) become non-significant once deprivation was adjusted for.
7. Discussion
It is important to consider the following issues when interpreting the results of this analysis:
1. The quality of cancer incidence data. Cancer registration data are believed to be of reasonably high quality in Scotland, both in terms of accuracy3,4 and completeness of ascertainment.5
2. Accuracy of population denominator data. When analysing data for small areas it is necessary to estimate person-years at risk based on census output. We have had to assume that the population characteristics of the study area between the census years 1971, 1981, 1991 and 2001 have changed in a linear fashion. However, the validity of our population estimates could have been affected, for example, by migration, especially occurring shortly after one or more of the censuses.
3. Despite the aggregation of incidence data spanning periods of more than 10 years, the number of some individual cancer registrations occurring is still relatively low, reflected by wide confidence intervals around the estimates of observed/expected ratios.
4. In the context of multiple tests of statistical significance, it is important to bear in mind that some apparently significant results can arise purely through the play of chance.
In summary, after standardisation for age, sex, and deprivation, there were no statistically significant excesses of any of the cancers most commonly associated with exposure to ionising radiation. The only cancer with a statistically significant excess is cancer of the corpus uteri (SIR 1.79; 95% CIs 1.03-2.91). While this is unexplained, it seems unlikely to be related to radiation exposure. It could represent a chance finding in the context of multiple significance tests.
3 Brewster D, Crichton J, Muir C. How accurate are Scottish cancer registration data? Br J Cancer 1994; 70: 954-60.
4 Brewster DH, Stockton D, Harvey J, Mackay M. Reliability of cancer registration data in Scotland, 1997. Eur J Cancer
2002; 38: 414-417.
5 Brewster DH, Crichton J, Harvey JC, Dawson G. Completeness of case ascertainment in a Scottish Regional Cancer Registry for the year 1992. Public Health 1997; 111: 339-43.

Appendix 1: Cancer sites and coding used.
Group A. Cancers frequently associated with radiation
Cancer Site
ICD-10 code
ICD-9 code
Leukaemia
C91-C95
204-208, 202.4
Thyroid
C73

193
Female Breast
C50
174
Group B. Cancers occasionally associated with radiation
Cancer Site
ICD-10 code
ICD-9 code
Lung
C33+C34
162
Stomach
C16
151
Colon
C18
153
Oesophagus
C15
150
Bladder
C67
188
Ovary
C56
183.0
Multiple myeloma
C88+C90
203, 238.6, 273.2, 273.3
Group C. Cancers rarely associated with radiation
Cancer Site
ICD-10 code
ICD-9 code
Brain and other CNS
C70-C72
191+192
Kidney
C64+C65
189.0+189.1
Liver and intrahepatic bile ducts
C22
155
Major salivary gland
C07+C08
142
Non-Hodgkin's Lymphoma
C82-C85
200, 202.0-202.2, 202.8
Malignant melanoma of skin
C43
172
Rectum
C19-C20
154.0+154.1

Corpus uteri
C54
182
Bone & articular cartilage
C40+C41
170
Connective tissue
C47+C49
171
Group D. Miscellaneous
Cancer Site
ICD-10 code
ICD-9 code
Pancreas
C25
157
Childhood Leukaemia (Age range 0-14)
C91-C95
204-208, 202.4
Non-melanoma skin
C44
173
All malignant neoplasms excluding non-melanoma skin
C00-C96 xC44
140-208 x173

Appendix 4: List of 1971/1981 Census Enumeration Districts and 1991/2001 Census Output Areas Used to define Dalgety Bay, Fife
1971 ED's
1981 ED's
1991 OA's
2001 OA's
12AR17
12AR18
12AR19
12AR20
12AR21
12AR22
12AR23
12AR24
12AR25
12AR26
12AR27
12AR28
12AR29
12AR30
12AR31
12AR32
12AR33
12AR34
12AR17
12AR18

12AR19
12AR20
12AR21
12AR22
12AR23
12AR24
12AR25
12AR26
12AR27
12AR28
12AR29
12AR30
12AR31
12AR32
12AR33
12AR34
12AR17A
12AR17B
12AR17C
12AR17D
12AR17E
12AR17F
12AR18A
12AR18B
12AR19A
12AR19B
12AR19C
12AR19D
12AR20A
12AR20B
12AR20C
12AR20D
12AR20E
12AR21A
12AR21B
12AR22A
12AR22B
12AR22C
12AR23A
12AR23B
12AR23C
12AR24A
12AR24B
12AR25A
12AR25B
12AR25C
12AR25D
12AR26A
12AR26B
12AR27A
12AR27B
12AR27C
12AR28A
12AR28B

12AR28C
12AR28D
12AR28E
12AR29A
12AR29B
12AR30
12AR33A
12AR33B
12AR33C
12AR33D
12AR33E
12AR33F
12AR33G
12AR34A
12AR34B
60QR000006
60QR000007
60QR000127
60QR000128
60QR000129
60QR000130
60QR000131
60QR000132
60QR000133
60QR000134
60QR000135
60QR000136
60QR000137
60QR000138
60QR000139
60QR000140
60QR000141
60QR000142
60QR000143
60QR000144
60QR000145
60QR000146
60QR000147
60QR000148
60QR000149
60QR000150
60QR000151
60QR000152
60QR000153
60QR000154
60QR000155
60QR000156
60QR000157
60QR000158
60QR000159
60QR000160
60QR000161
60QR000162
60QR000163

60QR000164
60QR000165
60QR000282
60QR000691
60QR002387
60QR002388
60QR002389
60QR002390
60QR002428
60QR002429
60QR002430
60QR002431
60QR002547
60QR002548
60QR002549
60QR002550
60QR002551
60QR002552
60QR002553
60QR002554
60QR002555
60QR002556
60QR002557
60QR002558
60QR002559
60QR002560
60QR002561
60QR002562
60QR002563
60QR002913
60QR002914
60QR002915
60QR002916
60QR002917
60QR002918
60QR002919
60QR002920
60QR002921