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Measures of dispersion from discharge pipelines at nuclear sites in the UK using caesium-137 in sea water data

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SUMMARY

The Ministry of Agriculture, Fisheries and Food has been monitoring the concentrations of caesium-137 in sea water in the vicinity of nuclear sites since 1962. The concentrations measured are due to liquid discharges from the nuclear sites, superimposed upon a background which may comprise the effects of distant discharges from British Nuclear Fuels plc (BNFL) Sellafield and fallout from nuclear weapons testing and, in recent years, from Chernobyl. A method of estimating the initial dispersion in the immediate area of a nuclear site, by calculating the concentration of caesium-137 in sea water for a unit rate of introduction in liquid effluent, is described and illustrated by a number of examples. Allowances are made for the background, which has been deduced from measurements of radiocaesium taken at remote positions mainly during research vessel cruises.

1. INTRODUCTION

Waste disposal operations of the nuclear industry are authorised under the terms of the Radioactive Substances Act, 1960 (Great Britain - Parliament, 1960). The Directorate of Fisheries Research (DFR) of the Ministry of Agriculture, Fisheries and Food (MAFF) has responsibilities devolving from the Act to keep under review the radiation exposure of members of the public due to the discharge of liquid radioactive effluent into the sea from licensed nuclear sites. An important part of these responsibilities involves the assessment of the radiation exposure of the most exposed group of individuals, the so-called 'critical group', at each site. During the planning of new nuclear establishments and as part of the authorisation process, predictive models are used to assess future exposures to ensure that they will comply with national and international dose limitation criteria. A computer program called IDLE (Hunt, 1982) is used at DFR to estimate the exposures of individuals through a variety of environmental pathways. Concentrations of each radionuclide in sea water in the immediate vicinity of the site are calculated from radionuclide discharge rates using a simple dispersion model. The model takes into account the uptake of radionuclides on to suspended particulates, and their removal to the seabed. Dilution in the water mass is represented by a dispersion factor. The dispersion factor can be derived from an interpretation of current meter and other hydrographic measurements but it is also possible to establish an empirical factor using environmental measurements of radionuclides. The purpose of this report is to present the method and results of such an empirical approach for determining the dispersion factor used within IDLE.

The method of estimating dispersion, described here, can be used when the discharges from operational nuclear establishments result in measurable radionuclide concentrations in sea water, which are above any concentrations due to background effects. For example, Figure 1 shows measured concentrations near Sizewell nuclear power station corrected for background effects and plotted against rates of discharge. A linear correlation is observed, indicating that dispersion can be represented by the normalised activity concentration (NAC), that is the concentration of caesium-137 in sea water, background adjusted and normalised to a unit rate of discharge of caesium-137. NACs are expressed in units of Bq litre^{-1} per TBq day^{-1}*.

Locations of the nuclear sites, for which NACs have been estimated, are shown in Figure 2. Included are the BNFL Sellafield site in Cumbria which undertakes the reprocessing of spent nuclear fuel, and the United Kingdom Atomic Energy Authority's Dounreay site which discharges into the Pentland Firth. The Nuclear Electric plc power stations (Bradwell, Berkeley, Dungeness 'A', Hinkley Point 'A', Oldbury and Sizewell 'A') and the Scottish Nuclear Ltd power station

** Activity is measured in becquerels (Bq). 1 TBq is 10^{12} Bq*

(Hunterston 'A') are powered by Magnox type reactors. All are still operational, except for Berkeley and Hunterston which ceased to generate electricity in 1989 and 1990 respectively, although radioactive waste still needs to be disposed of from these stations as part of decommissioning operations. Discharges of caesium-137 from the Advanced Gas Cooled Reactors (AGRs) at Dungeness, Hinkley Point and Hunterston have not been included in this study because they are insignificant compared with discharges from the Magnox reactors co-located at each site. Discharges from AGRs at the Nuclear Electric plc power stations, Hartlepool and Heysham and the Scottish Nuclear Ltd power station, Torness are also low and do not increase the concentrations of caesium-137 measured in sea water above background levels. These sites have therefore been excluded from this study. Liquid wastes from Berkeley and Oldbury are discharged to the same stretch of the Severn Estuary, and are therefore considered together for the purpose of this work. Effluent from Bradwell power station is discharged to the estuary of the River Blackwater.

MAFF has operated an extensive monitoring programme, sampling sea water around the British Isles and beyond since the early 1960s. Measurements of radiocaesium in sea water have been compiled in a computer database at DFR. The data set includes results for the Irish Sea, Bristol Channel, English Channel, North Sea, Scottish waters and other parts of the marine environment of northern Europe. The Irish Sea data have been reported by Jefferies *et al*. (1982), who have used them to estimate dispersion in the vicinity of BNFL Sellafield and by Jefferies and Steele (1989) to tune a hydrographic compartment model for the Irish Sea. Marine dispersion has also been previously estimated for Sizewell (Jefferies, 1982) in support of a Technical Proof of Evidence to the Sizewell 'B' Inquiry, and for Hinkley Point (Camplin *et al*., 1989) as part of an impact assessment for the proposed Hinkley Point 'C' Pressurised Water Reactor.

2. PROCEDURE

The level of discharge of caesium-137 from nuclear sites, its relatively conservative nature in sea water, and the availability of sensitive techniques for its measurement have made this radionuclide suitable for calculating NACs. MAFF's sea water monitoring programme has included shoreline and offshore sampling for radiocaesium, during routine monitoring trips and dedicated cruises using MAFF and other research vessels. The results of radiocaesium analyses for the period 1962-89 are now fully documented in a series of reports (Baxter *et al*., 1992; Baxter and Camplin, 1993 (a-c); and Camplin and Steele, 1991). Details of the methods of sample collection and analytical procedures are provided in these reports.

In the case of nuclear power stations, the strategy adopted to calculate the NACs relies on the condenser cooling water, sampled from the inlet, being typical of the local well-mixed water mass into which the radioactive waste is discharged. For other nuclear establishments suitable shoreline locations in the vicinity of the site have been selected. A reasonable understanding of local dispersion, in particular the direction of residual water currents, is required in order to select representative sampling locations. Not all of the caesium-137 measured is necessarily from the nuclear establishment in question. Some may occur in sea water due to fall-out from nuclear weapons testing and from Chernobyl, and some may be attributable to discharges from BNFL Sellafield. These background interference problems have been allowed for, using measurements of radiocaesium taken at remote positions, mainly during research vessel cruises, but also as part of the routine monitoring programme. Thus, background values have been deducted from the concentrations of caesium-137 in the local water mass, to give the net concentration of caesium-137 in sea water which is attributable to the local discharge.

The background adjusted concentrations of caesium-137 (in units of Bq litre^{-1}) have been normalised by dividing by the site discharges of caesium-137 in units of TBq day^{-1}. NACs, in units of Bq litre^{-1} per TBq day^{-1}, were thus calculated over a number of different time periods. The discharge data used are based both on MAFF's own analyses of quarterly bulked effluent samples, and on monthly bulked effluent samples which were analysed by the operator and reported to MAFF. NACs have been calculated, using the arithmetic mean of the concentrations of caesium-137 measured in a calendar year, related to the total discharge of caesium-137 in the same calendar year. To investigate the sensitivity of the results to the choice of time period for averaging, additional calculations were performed: (a) at Sellafield using monthly means of results from sampling at St Bees and Seascale, related to the discharge of caesium-137 in each concurrent month; (b) at Nuclear Electric plc sites (excluding Sizewell) using the arithmetic mean of concentrations of caesium-137 measured during a quarter, related to the discharge of caesium-137 in the same quarter; and (c) at Sizewell, where a more detailed approach has been used, based on monthly and quarterly arithmetic means of monitoring results from the station's cooling water inlet, Sizewell beach, Aldeburgh, Southwold and Lowestoft. In the case of approach (c) the means have been related to the discharge of caesium-137 estimated for the 28 day period prior to the date of sea water sample collection. Discharges which occurred during this 28 day period were perceived to be those that would most affect the concentrations of caesium-137 measured in sea water.

3. CONCENTRATION AND DISCHARGE DATA

The aim of this report is to provide an account which fully documents the concentration and discharge data, and the methods used to calculate the measure of dispersion, for each site. Table 1 provides a guide to the data used in this study, which were collected as part of MAFF's routine monitoring programme. The temporal scope of the data for each sampling location is shown in the table, and references to where the published data can be found in the series of reports (Baxter *et al*., 1992; Baxter and Camplin, 1993 (a-c); and Camplin and Steele, 1991) entitled, 'Radiocaesium in the seas of northern Europe' are included. These samples were collected both from the shoreline and at offshore positions (to be found, respectively, in Annex 1 and Annex 2 of the reports above). The latter have mainly been used to evaluate background concentrations of caesium-137, and are indicated by the letter 'B' in Table 1. Sampling locations used to assess 'local' concentrations in the immediate vicinity of the pipeline are flagged by the letter 'L'. Background data, obtained by dedicated cruises using MAFF research vessels, have been extracted from the radiocaesium data reports mentioned above and are listed at Annex 1 for ease of reference. Individual tables for each site comprise: the cruise reference which is made up of the name of the research vessel, the cruise number and the year; the station number; date of sample collection; the station position recorded as latitude and longitude in integer degrees, minutes and seconds; and the concentration of caesium-137 in Bq m^{-3}.

Discharge data for each site, except Hunterston, are included at Annex 2. The layout and content of these tables varies between organisations, depending on whether the data are based on MAFF's own analyses of quarterly bulked effluent samples, or on monthly bulked effluent samples which were analysed by the operator and reported to MAFF. In the case of the Nuclear Electric sites, excluding Sizewell, individual tables for each year list: the first and last date of each quarter; the number of days in each quarter; the date that the decay of individual nuclides is corrected to (i.e. the middle of the quarter); the activity concentration of caesium-137 in the bulked effluent sample in kBq m^{-3}; the total volume of effluent discharged during the quarter in cubic metres; the total activity of caesium-137 assumed to have been discharged during the quarter in GBq; the averaged

daily activity of caesium-137 discharged during the quarter in TBq day^{-1}; and the FLR number, which identifies the source of the data within DFR. These data are summarised and annual figures are reported. Monthly discharge data have been compiled for Sellafield and Dounreay in a similar format. Tables for Sellafield, at Annex 2.1, list data for the period 1978-91 in the following categories: the number of days in the month; the total activity of caesium-137 discharged during the month in GBq, and also in Ci up to and including 1984; the averaged daily activity of caesium-137 discharged during the month in TBq day^{-1}; and the FLR number. The form used by the operator to report the discharges from Dounreay, to MAFF was changed in 1989. This is why after 1989 data presented at Annex 2.2 includes only the total activity of caesium-137 discharged during the month in GBq, and the averaged daily activity of caesium-137 discharged during the month in TBq day^{-1}. For the period 1982-89, the following categories of data are provided at Annex 2.2: the number of discharges made during the month; the first and last date of the period; the number of days in the period; the total volume of effluent discharged during the period in litres; the activity concentration of caesium-137 in the monthly bulked effluent sample in Bq litre^{-1}; the total assumed activity of caesium-137 discharged during the period in GBq; the averaged daily activity of caesium-137 discharged during the period in TBq day^{-1}; and the FLR number. Discharges from Sizewell are made about five times per month, at low water, on flood tides. The discharges take about 5 hours. In the case of Sizewell, data relating to individual discharges are available and are presented. The following information is included in the tables for Sizewell: the date of the discharge; the total non-tritium activity in the discharge in GBq; and the monthly or quarterly total of caesium-137 discharged in GBq, based on analyses of monthly and quarterly bulked effluent samples.

3.1 Sellafield

Local concentration data used for Sellafield were collected routinely for shoreline stations at Seascale and St Bees. The locations of these stations and the Sellafield site are shown in Figure 3. In the case of Sellafield, the background is of little significance and is taken to be zero. A time trend plot of concentrations of caesium-137 in sea water at Seascale and St Bees for the period 1978 to 1991 is presented in Figure 4. Monthly discharges of caesium-137 from Sellafield, for the same time period, are illustrated as a bar chart in Figure 5. The discharge data are also listed at Annex 2.1.

3.2 Dounreay

Local concentration data used for Dounreay were collected routinely for a shoreline station at Sandside Bay. Background concentration data were collected routinely for offshore stations at Cape Wrath and Pentland Firth, and also during MAFF research cruises. The latter are listed at Annex 1.1. The locations of these sampling positions and the Dounreay site are shown in Figure 6. A time trend plot of concentrations of caesium-137 in sea water at Sandside Bay, and annual mean background concentrations is presented in Figure 7. Monthly discharges of caesium-137 from Dounreay, for the same time period, are illustrated as a bar chart in Figure 5. The discharge data are also listed at Annex 2.2.

3.3 Berkeley and Oldbury

Local concentration data used for Berkeley and Oldbury were generally collected for the site cooling water inlets, although samples for Oldbury were initially collected from a shoreline station known as Oldbury. Background data were collected for the mouth of the Bristol Channel during MAFF cruises at sampling locations within an area bounded by 51°30'N and 50°30'N to the north

and south, and 7°W and 5°W to the west and east. These data are listed at Annex 1.2. The locations of these sampling positions and the Berkeley and Oldbury sites are shown in Figure 9. A time trend plot of mean local concentrations of caesium-137 in sea water, and background concentrations is presented in Figure 10. Quarterly discharges of caesium-137 from Berkeley and Oldbury, for the same time period, are illustrated as bar charts in Figures 11 and 12, respectively. The data are also listed at Annexes 2.3 and 2.4.

3.4 Bradwell

Local concentration data used for Bradwell were collected routinely for a shoreline station known as Waterside. Background data were collected during MAFF research cruises in the mouth of the Thames Estuary, and are listed at Annex 1.3. The locations of these sampling positions and the Bradwell site are shown in Figure 13. Concentrations of caesium-137 in sea water at Waterside and background concentrations are plotted against time in Figure 14. Quarterly discharges of caesium-137 from Bradwell, for the same time period, are illustrated as a bar chart in Figure 15. The discharge data are also listed at Annex 2.5.

3.5 Dungeness

Local concentration data used for Dungeness were collected routinely for the site cooling water inlet. Background concentration data were collected during MAFF research cruises in the eastern English Channel, and are listed at Annex 1.4. The locations of these sampling positions and the Dungeness site are shown in Figure 16. Local concentrations of caesium-137 in sea water and background concentrations are plotted against time in Figure 17. Quarterly discharges of caesium-137 from Dungeness, for the same time period, are illustrated as a bar chart in Figure 18. The discharge data are also listed at Annex 2.6.

3.6 Hinkley Point

Local concentration data used for Hinkley Point were collected routinely for the site cooling water inlet. Background concentration data were collected during MAFF research cruises in the mouth of the Bristol Channel, and are listed at Annex 1.5. The locations of these sampling positions and the Hinkley Point site are shown in Figure 19. Local concentrations of caesium-137 in sea water and background concentrations are plotted against time in Figure 20. Quarterly discharges of caesium-137 from Hinkley Point are illustrated as a bar chart in Figure 21. The discharge data are also listed at Annex 2.7.

3.7 Sizewell

Local concentration data used for Sizewell were collected routinely for shoreline stations at Lowestoft, Southwold, Aldeburgh and Sizewell (known as PLZ). Samples were also collected from the site cooling water inlet. The locations of these sampling positions and the Sizewell site are shown in Figure 22. Comparison between the measured concentrations of caesium-137 in sea water collected from these various sampling locations over the same time periods show that similar levels of enhancement of caesium-137 are found at all of these locations. Thus, the averaging of data over these locations to represent the local area was considered to be justified. A time trend plot of the mean concentrations of caesium-137 in sea water in the local area and background concentrations in the southern North Sea is shown in Figure 23. The background data plotted are based on assessments of contour plots (Hunt, 1984; Hunt, 1985(a); Hunt, 1985(b); Hunt, 1986; Hunt, 1987; Hunt, 1988; Hunt, 1989; Hunt, 1990; and MAFF, 1993) of

cruise data for the North Sea. Quarterly discharges of caesium-137 from Sizewell are illustrated as a bar chart in Figure 24. More detailed discharge data are listed at Annex 2.8.

3.8 Hunterston

Local concentration data used for Hunterston were collected routinely for the site cooling water inlet. Background concentration data were collected routinely for a shoreline station at Knock Bay, several offshore stations in the North Channel; and also during MAFF research cruises. The data obtained by MAFF research cruises are listed at Annex 1.6. The locations of these sampling positions and the Hunterston site are shown in Figure 25. A time trend plot of concentrations of caesium-137 in sea water at Hunterston, and annual mean background concentrations is presented in Figure 26. Annual totals of discharges of caesium-137 from Hunterston were taken from a Scottish Nuclear Annual Report (Scottish Nuclear, 1991).

3.9 General

For each of the nuclear sites, Table 2 shows the range of annual discharges of caesium-137 and the summarised results of regular monitoring of caesium-137 in filtered sea water. The temporal scope of the data for each site, also presented in this table, is dictated by the availability of concurrent monitoring and discharge data. In the case of Sellafield, the scope has been further limited to exclude inappropriate data for reasons which will be discussed later. Annual discharges of caesium-137 from the power stations varied between 0.16 and 1.7 TBq. The summed discharges of Berkeley and Oldbury showed a slow reduction between 1980-86. Sizewell discharges fell by approximately 50% between 1987-88. Discharges from Sellafield reduced slowly during the period of interest, from 4100 to 2000 TBq $year^{-1}$, but were nevertheless the dominant source of caesium-137 in British waters. At Dounreay, the discharges reached their maximum during 1983-84, and were reduced significantly by 1986, after which time there was a steady slow decrease.

Background concentrations of caesium-137 measured in the vicinity of the sites fall into the following three distinct categories :

(i) In the case of Sellafield, the background is of little significance and is taken to be zero.

(ii) For Hunterston, Dounreay and Sizewell, the discharge from Sellafield forms the major component of the background concentration in sea water, which will therefore follow similar time-trends to those seen in the Irish Sea, making it necessary to estimate a background value for each year. The effects of fallout from weapons testing are minor in comparison. It is difficult to distinguish individual sources in the background, but caesium-134 evidence (Baxter and Camplin, 1993 (c)) suggests that fallout from Chernobyl probably made a significant contribution to the background at Dounreay for a limited period during 1986. Annual arithmetic means of the background data used for Dounreay are shown in Figure 7. Individual results from the local sampling at Dounreay, where quarterly monitoring has been carried out since 1983, are also plotted to show the magnitude of the difference between background values and local concentrations influenced by the discharge. A steady reduction in local concentrations, in line with discharges from Dounreay and Sellafield, is seen until 1989 when the background source begins to dominate. In Figure 23, annual background values for the Sizewell area, estimated from contour plots of the North Sea, are shown. The Sizewell data points, also shown, represent monthly and quarterly measurements, meaned over several sampling locations, and indicate a steady reduction until 1988, which is attributable to changes in the background source and the local discharges.

(iii) The last case applies to Berkeley/Oldbury, Bradwell, Dungeness and Hinkley Point, where the Sellafield discharge has had relatively little temporal influence during the periods of interest. Constant background levels of 20 Bq m^{-3} for Bradwell and 10 Bq m^{-3} for the other nuclear sites have been adopted. These levels will include not only the effects of Sellafield but also those due to weapons fallout which contributes about 5 Bq m^{-3} (Camplin and Aarkrog, 1989). Figures 10, 17 and 20 show the results of measurements of caesium-137 which have been used to establish a value of 10 Bq m^{-3} for Berkeley/Oldbury, Dungeness and Hinkley Point, respectively. Similarly, Figure 14 shows the background data that have been used for Bradwell to determine a value of 20 Bq m^{-3}. Monthly results of samples which were collected from Hinkley Point cooling water inlet between 1977 and 1988 are also plotted in Figure 20, showing a large variation between samples, although a general trend of a very gradual fluctuating decline is apparent in line with discharges at the site.

In general, at a given site there is a relatively large variability in the measured caesium-137 concentrations in sea water. For example, at Hinkley Point, the concentrations of caesium-137 measured at the inlet, illustrated in Figure 20, have occasionally been elevated outside the range of concentrations which might normally be expected. This is unlikely to have been due to radiometric errors in the analyses of sea water which are typically less than 5%, nor to inadvertent or unreported discharges from the sites which have a rigorous effluent analysis programme which is independently checked by government departments. Of more relevance, is the assumption that the sampling location is representative of the receiving water mass, which at the time of sampling is assumed to be well-mixed and at a state of equilibrium. However, whether or not this is attained will depend upon the magnitude and frequency of the discharges, the design and positioning of the discharge pipeline, and the timing of sample collection relative to recent discharges. It is our view that these and many other environmental factors result in the large variation between the sampling results, seen in the monitoring data.

4. MEASURES OF DISPERSION

All of the NACs which have been calculated are listed at Annex 3, along with the generalised concentration and discharge data that were used to produce them. The Annex comprises Part A and Part B for each site. NACs calculated on a monthly or quarterly basis are presented in Part A. NACs calculated annually are provided in Part B. The data listed at Annex 3 comprise the following categories: the period of interest, that is the month, quarter or year; the local concentration of caesium-137 in sea water in Bq m^{-3}, meaned spatially over more than one sampling location and/or temporally when sampling occurred more than once during the period of interest; the background concentration of caesium-137 in sea water, in Bq m^{-3}; the background adjusted concentration of caesium-137 in sea water in Bq m^{-3}; the averaged daily discharge of caesium-137 for the period of interest in TBq day^{-1}; and the NAC in Bq $litre^{-1}$ per TBq day^{-1}. At the bottom of Part A and Part B, the NACs are summarised by the arithmetic mean and the standard deviation. As NACs were assessed on an annual basis only for Dounreay and Hunterston, there is no Part A for either of these sites. In the case of Sellafield, listed at Annex 3.1, monthly and annual NACs are also presented separately for the two sampling stations, Seascale and St Bees.

Plots of NACs against time are provided for each site, excluding Hunterston for which there is insufficient data, in Figures 27 to 33. Table 3 summarises the NACs which have been calculated for each site. They vary between sites, with Dounreay and Sellafield having the lowest NACs at 3.6 and 3.2 Bq $litre^{-1}$ per TBq day^{-1} respectively, and Bradwell having the highest at 78 Bq $litre^{-1}$ per TBq day^{-1}. In general, there is no significant difference between the means of NACs calculated on an annual basis or over the shorter, monthly or quarterly, time scale. However, the

spread of data is much greater in the latter case, as is indicated by the standard deviations provided in Table 3, and as illustrated by the time trend plots for Sellafield (Figure 27), Bradwell (Figure 30), Hinkley Point (Figure 32) and Sizewell (Figure 33). This difference is mainly due to sampling variation being smoothed out by the averaging of all concentrations of caesium-137 in sea water measured in each year. An example of this is provided by data for Hinkley Point, shown in Figure 32, where NACs for the second quarter of 1979 and the third quarter of 1981 do not agree well with other quarterly NACs calculated in those years. However, the annual mean concentrations, normalised to unit discharge rate for 1979 and 1981 are within and just outside, respectively, one standard deviation of the mean NAC for all years given in Table 3. In the case of Berkeley and Oldbury, the trend plot (Figure 29) suggests that seasonal fluctuations occur, with a tendency for the NAC to increase during the summer months. This may be due to reduced flow in the upper stretches of the Severn Estuary resulting in less dilution of the effluent.

The background values used in this method of estimating dispersion are of crucial importance: all sources of caesium-137, other than the nuclear site discharge, must be assessed in order that the background adjusted concentrations of caesium-137 in sea water can be confidently assumed to be arising entirely from the local discharge. Inconsistencies or temporal trends, which may result when an inaccurate background is assumed, can be identified by calculating NACs, using regular discharge and monitoring data collected over a long period. Consistent results, for example those illustrated in Figure 30 for Bradwell, verify the approach of describing dispersion using NACs. However, time trends have also proven to be useful. In the case of Sellafield, a significant change in the observed NAC has been used to demonstrate the existence of another source of activity. Discharges from Sellafield fell rapidly after 1985 (see Figure 5) with the operation of the Site Ion-exchange Effluent Plant (SIXEP). It is known that a significant proportion of the caesium-137 discharged to the eastern Irish Sea from Sellafield resides in the muddy, seabed sediments. Under conditions of decreased sea water concentrations, as have resulted from the reduced discharges, it might be expected that sediment-bound caesium-137 might be remobilised into the water column. The concentrations of caesium-137 in sea water at Sellafield, normalised to unit discharge rate, shown in Figure 27, were relatively constant up to 1982, but then began to increase with a significant peak during 1986-88. This has already been studied by Hunt and Kershaw (1990) using modelling techniques, and also using radiocaesium in sea water data, such as those shown in Figure 27, to estimate, by difference, the total activity of caesium-137 in sea water which is attributable to remobilisation. So, for the purpose of this study, data from the period 1978-82, when discharges were changing relatively slowly, are considered to be appropriate for use. Although, data for the extended period 1978-91 are listed at Annex 3.1 for completeness.

5. CONCLUSION

NAC values, which provide a measure of dispersion in the vicinity of discharge pipelines have been calculated for eight nuclear sites in the UK. They range from 3.2 to 78 Bq litre^{-1} per TBq day^{-1}, and can be used in assessments of planned discharges from the relevant nuclear sites. They also give an indication of the likely range of values for dispersion, say between 1 and 100 Bq litre^{-1} per TBq day^{-1}, which are likely to be encountered at similar establishments discharging into coastal waters.

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MAFF, 1993. Radioactivity in surface and coastal waters of the British Isles, 1991. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (***34***): 68pp.

SCOTTISH NUCLEAR, 1991. Annual Report on Safety and the Environment, 1990. Scottish Nuclear Ltd., Glasgow, 23pp.

Table 1. Summary of the routine monitoring data used, and where it can be found in the series of Water Data Reports (WDRs), entitled 'Radiocaesium in the seas of Northern Europe'

Establishment	Site no.	Station name	Period of Cover	Local (L) or Background (B)	Water Data Report [a]	Annex no.
British Nuclear Fuels plc						
Sellafield	1	Seascale	1978-91	L	WDR75, WDR80, WDR85, [b]	1
	1	St Bees-W	1978-91	L	WDR75, WDR80, WDR85, [b]	1
United Kingdom Atomic Energy Authority						
Dounreay	15	Sandside Bay	1983-91	L	WDR80, WDR85, [b]	1
	48	Cape Wrath	1983-91	B	WDR80, WDR85, [b]	2
	48	Pentland Firth	1983-91	B	WDR80, WDR85, [b]	2
Nuclear Electric plc						
Berkeley / Oldbury	6	Berkeley Inlet	1980-82	L	WDR80	1
	6	Oldbury Inlet	1985-86	L	WDR85	1
	11	Oldbury	1981-84	L	WDR80	1
Bradwell	7	Waterside	1978-82	L	WDR75, WDR80	1
Dungeness	8	Dungeness Inlet	1979,81-85	L	WDR75, WDR80	1
Hinkley Point	9	Inlet	1978-88	L	WDR75, WDR80, WDR85	1
Sizewell	12	Aldeburgh	1983-87,89-91	L	WDR80, WDR85, [b]	1
	12	Lowestoft Beach	1982-91	L	WDR80, WDR85, [b]	1
	12	PLZ	1989-91	L	WDR85, [b]	1
	12	Sizewell Inlet	1982-5	L	WDR80, WDR85	1
	12	Southwold Beach	1991	L	[b]	
Scottish Nuclear Ltd						
Hunterston	10	Inlet	1988-90	L	WDR85, [b]	1
	2	Knock Bay	1988-90	B	WDR85, [b]	1
	47	North Channel St 1	1988	B	WDR85	2
	47	North Channel St 2	1988	B	WDR85	2
	47	North Channel St 3	1988	B	WDR85	2
	47	North Channel St 4	1988	B	WDR85	2
	47	North Channel St 5	1988	B	WDR85	2
	47	North Channel St 6	1988	B	WDR85	2
	47	Larne-Stranraer Mid-Point	1988-89	B	WDR85	2
	52	North of Larne Harbour	1988-90	B	WDR85, [b]	1

[a] WDR75, WDR80 and WDR85 refer to the reports that include data collected during the periods 1975-79 (Baxter et al, 1992), 1980-84 (Camplin and Steele, 1991), and 1985-89 (Baxter and Camplin,1993(c)) respectively

[b] Data for period 1990-91 currently unpublished

Table 2. Ranges of annual discharges of caesium-137 and annual mean concentrations of caesium-137 in sea water

Establishment	Period of Cover	Range of Annual Discharges (TBq)	Sampling Locations	Range of Annual Mean Concentrations ($Bq\ m^{-3}$)	
				Receiving Water Mass	Background
British Nuclear Fuels plc					
Sellafield	1978-82	2000-4100	(b)	17000-28000	(h)
United Kingdom Atomic Energy Authority					
Dounreay	1983-91	2.2-23	(c)	27-380	16-230
Nuclear Electric plc					
Berkeley / Oldbury	1980-86	0.29-1.3(a)	(d)	21-140	5.0-25
Bradwell	1978-82	0.57-1.6	(e)	140-360	15-25
Dungeness 'A'	1979-85	0.57-0.93	(f)	16-52	8.3-17
Hinkley Point 'A'	1978-88	0.20-1.7	(f)	30-120	5.0-25
Sizewell 'A'	1982-91	0.16-0.64	(f, g)	27-150	10-110 (i)
Scottish Nuclear Ltd					
Hunterston 'A'	1988-90	0.15-0.61	(f)	110-180	75-110

(a) The sum of discharges from both sites
(b) St Bees and Seascale
(c) Sandside Bay
(d) Berkeley Inlet and Oldbury Inlet
(e) Waterside
(f) Cooling water inlet
(g) Sizewell Beach, Aldeburgh, Southwold and Lowestoft
(h) Assumed to be insignificant
(i) Based on an assessment of annual mean backgrounds from contour plots of cruise data

Table 3. Summary of normalised activity concentrations (NACs) for caesium-137 in sea water

Establishment	Period of Cover	Mean of NACs (Bq litre $^{-1}$ per TBq day^{1}) ± 1 standard deviation :-		Sample size (i.e. no. of NACs meaned)	
		(i) annually	(ii) monthly or quarterly	(i) annually	(ii) monthly or quarterly
British Nuclear Fuels plc					
Sellafield	1978-82	3.2 ± 0.66	3.2 ± 1.3	5	60
United Kingdom Atomic Energy Authority					
Dounreay	1983-91	3.6 ± 3.0		9	
Nuclear Electric plc					
Berkeley / Oldbury	1980-86	21 ± 17	25 ± 39	7	26
Bradwell	1978-82	74 ± 3.5	78 ± 18	5	18
Dungeness	1979-85	9.0 ± 6.3	9.0 ± 9.3	6	24
Hinkley Point	1978-88	30 ± 10	36 ± 28	11	44
Sizewell	1982-91	27 ± 6.0	34 ± 20	10	85
Scottish Nuclear Ltd					
Hunterston	1988-90	39 ± 4.8		3	

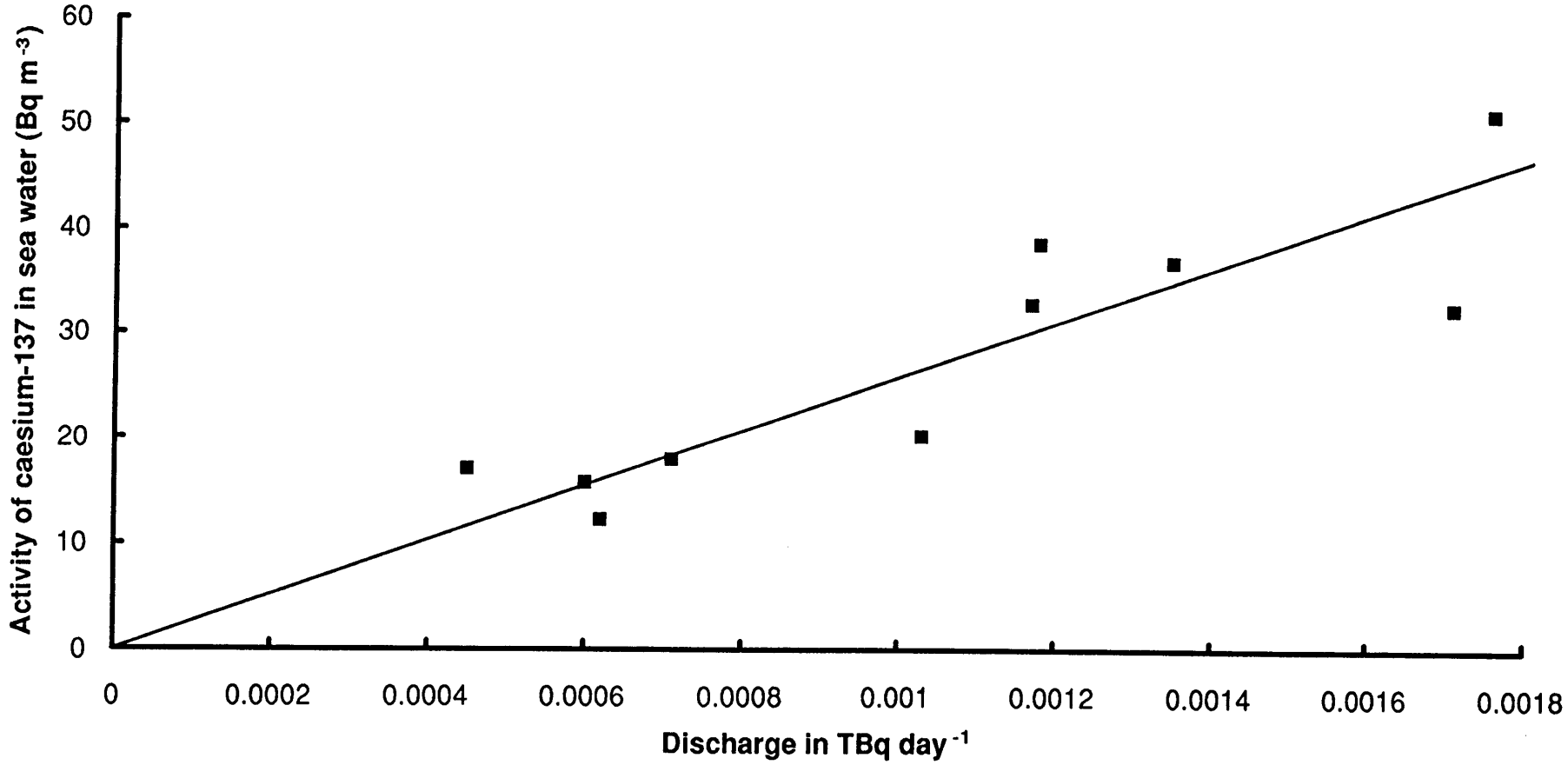

Figure 1. Background adjusted annual mean concentrations of caesium-137 in sea water in the Sizewell area related to discharge of caesium-137 in the same year, 1982-1991

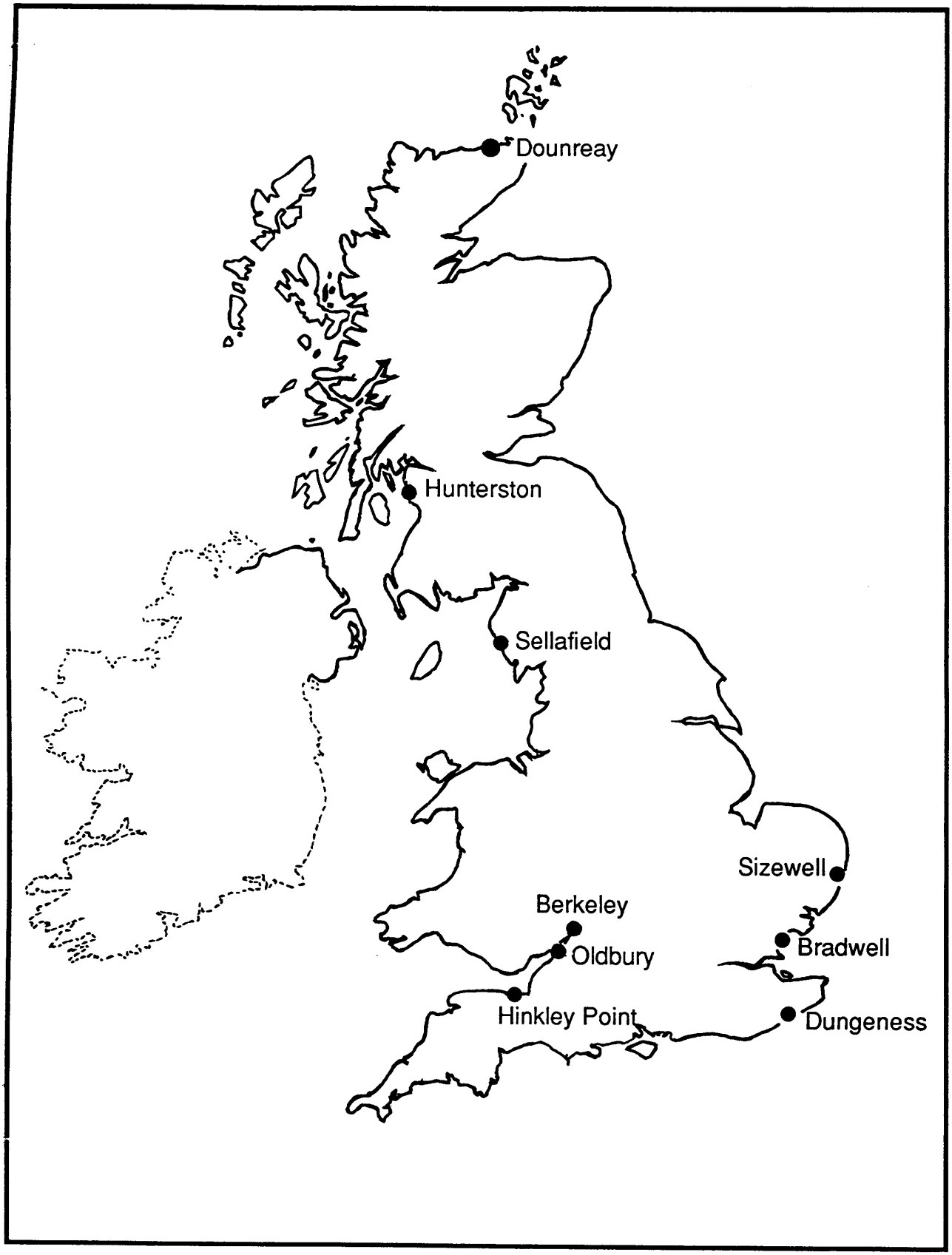

Figure 2. Locations of UK nuclear establishments considered in this study

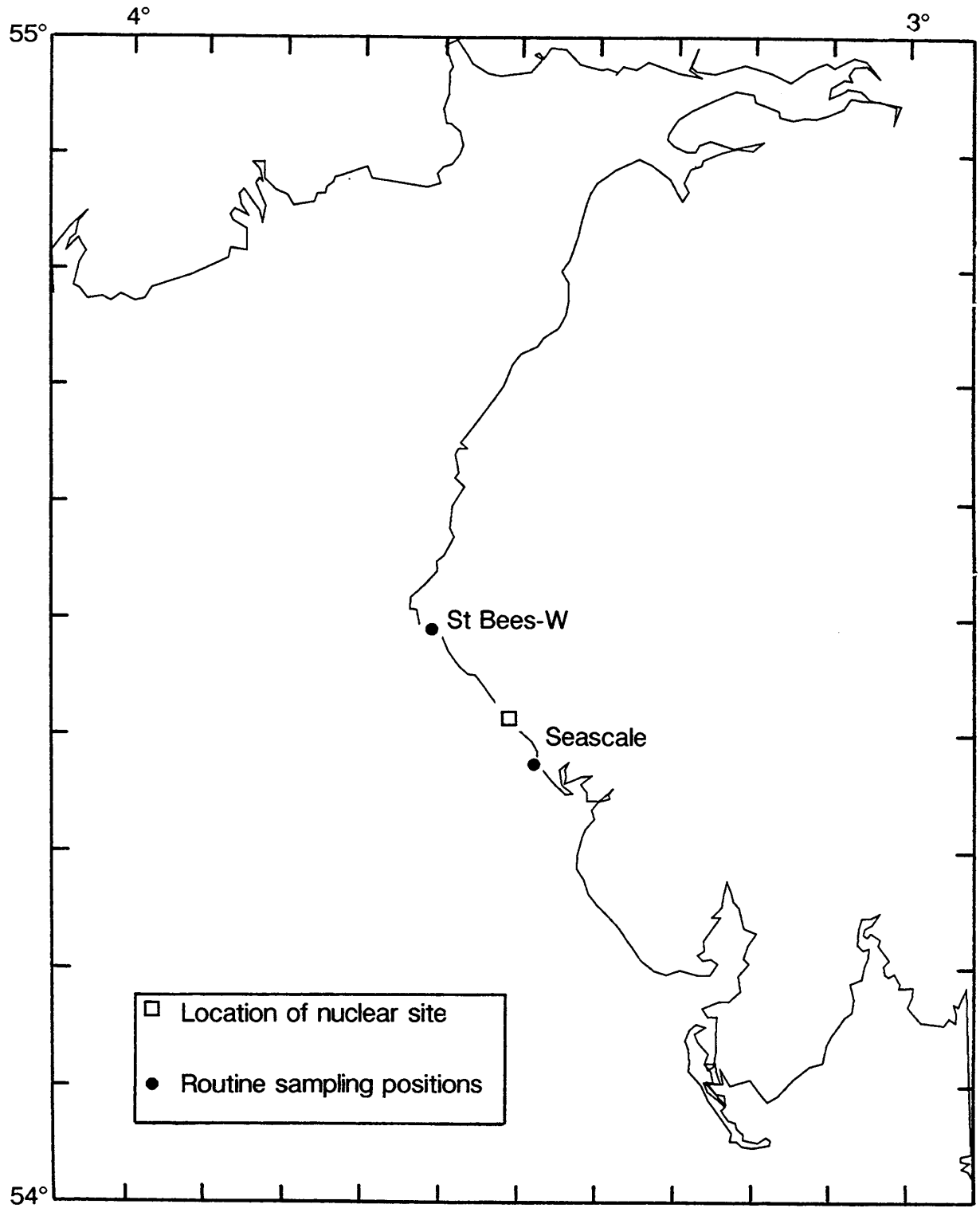

Figure 3. Sampling positions and location of the British Nuclear Fuels plc Sellafield site

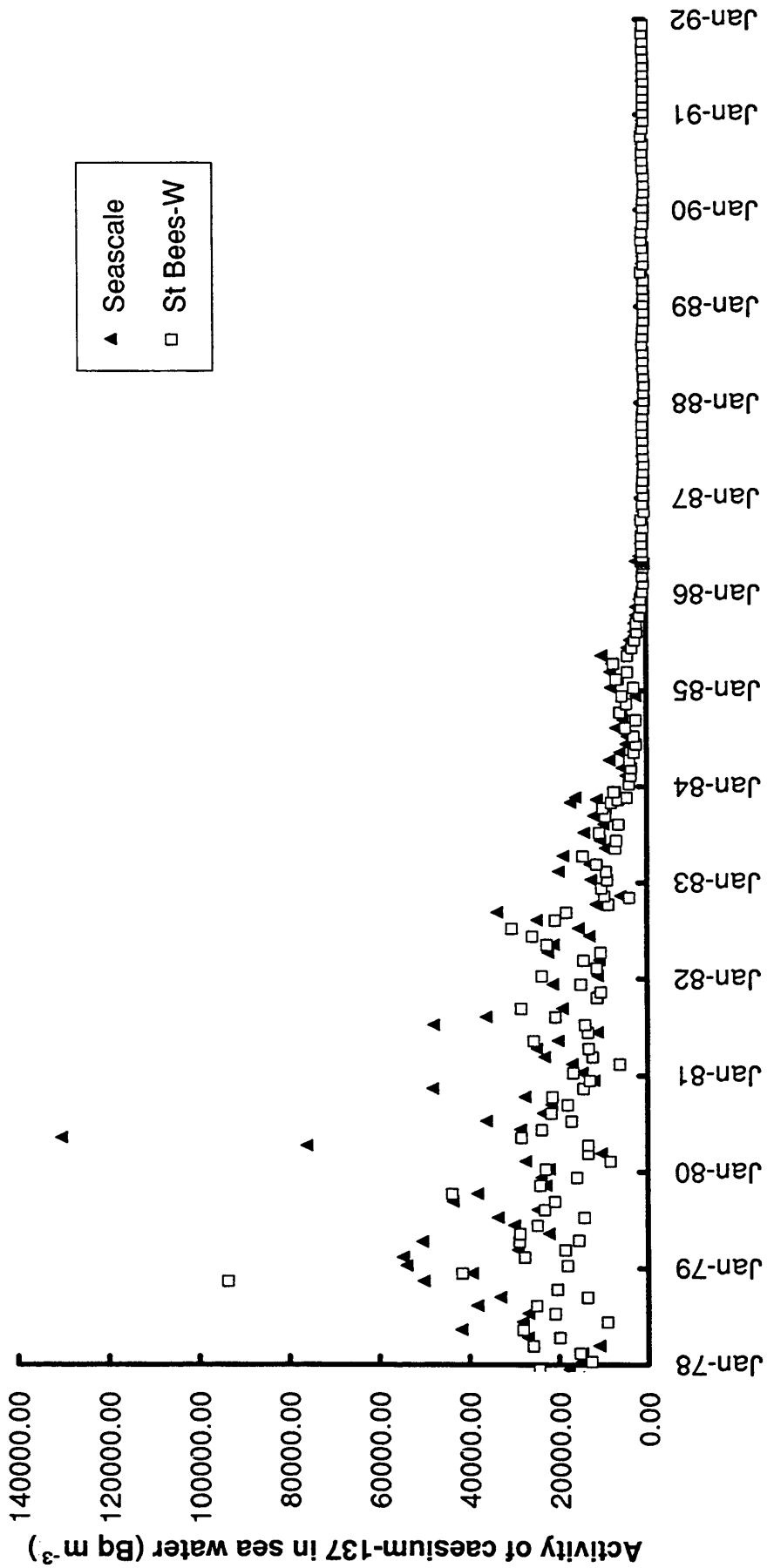

Figure 4. Caesium-137 in sea water at Sellafield, 1978 to 1991

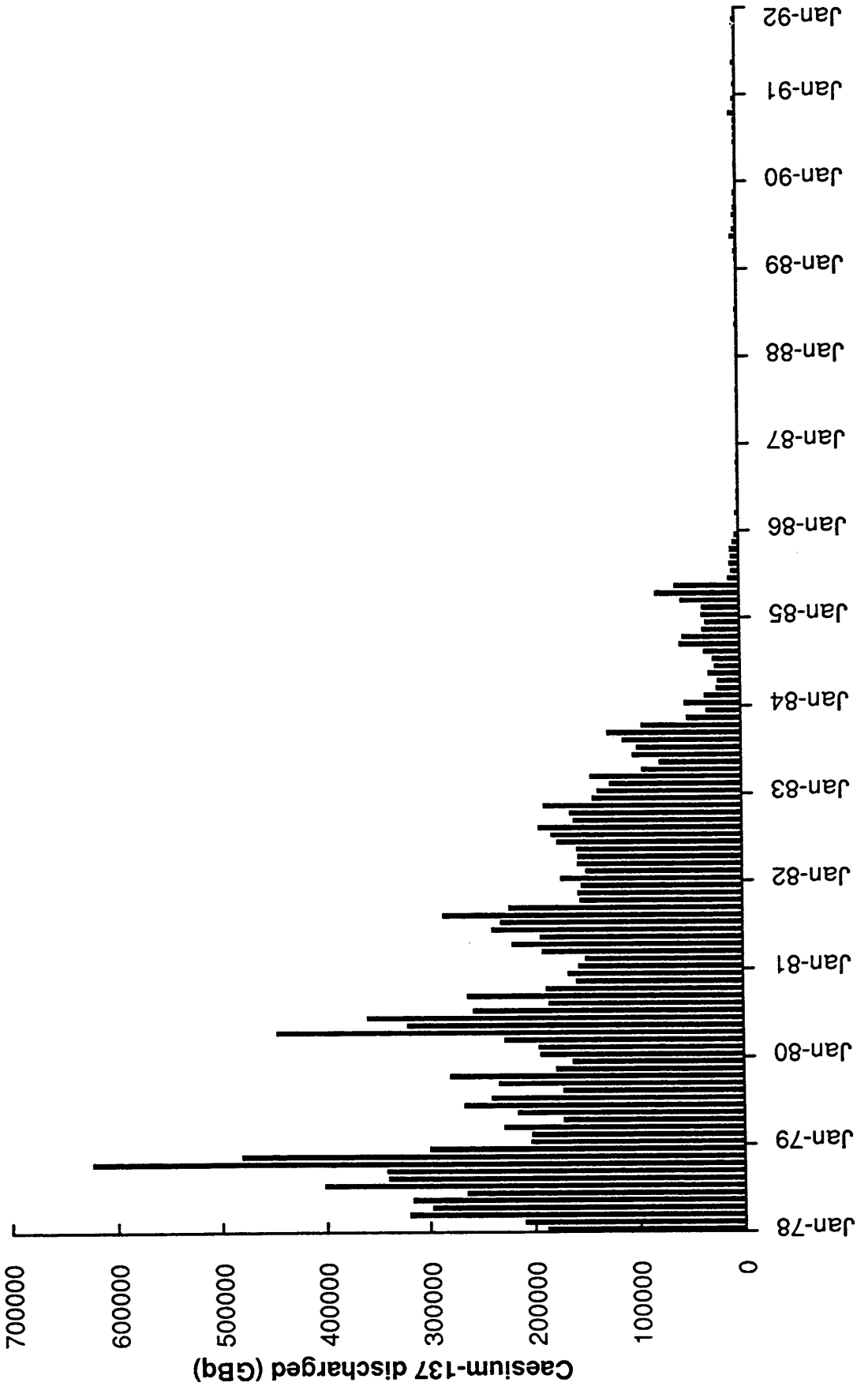

Figure 5. Monthly discharges of caesium-137 from Sellafield, 1978 to 1991

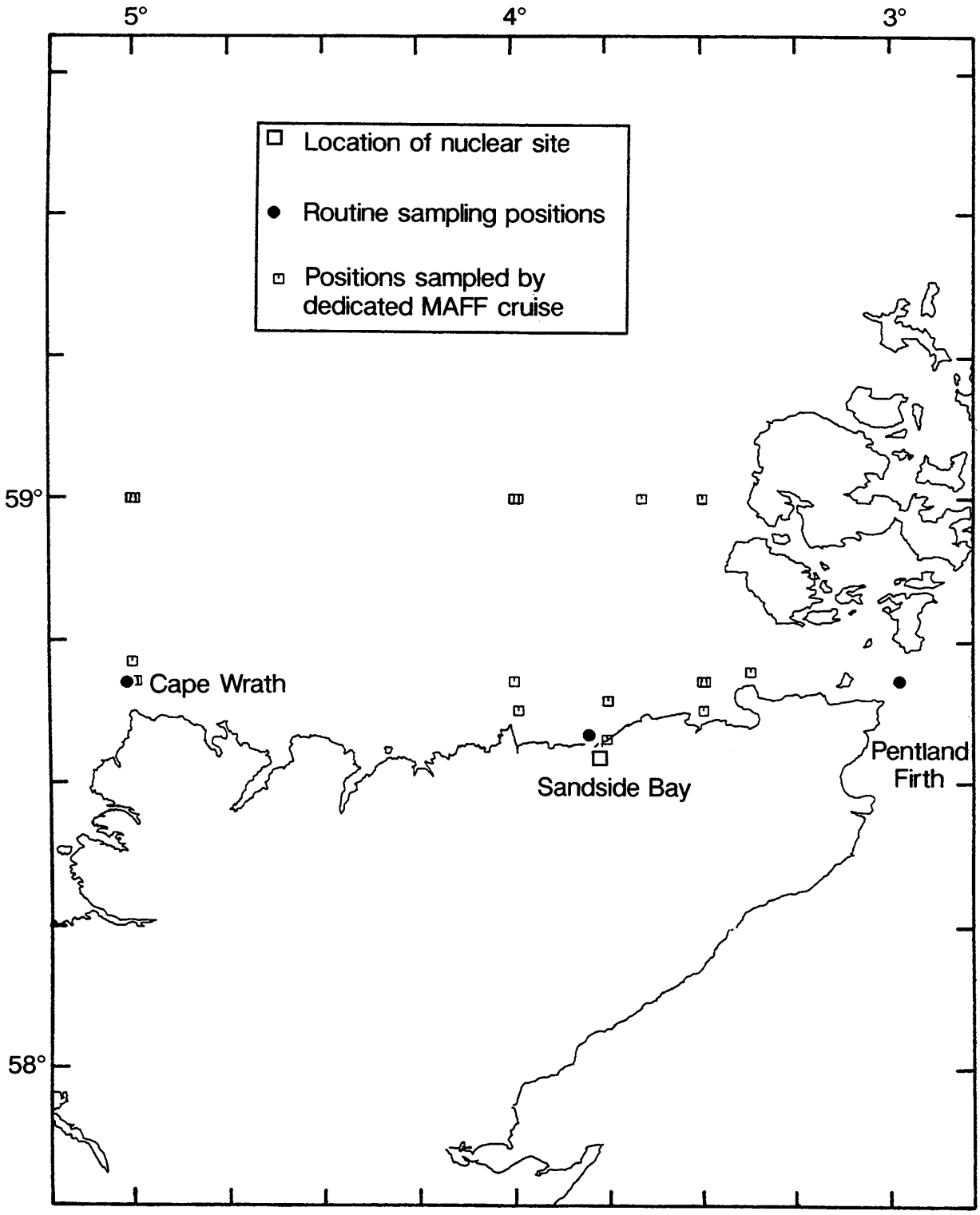

Figure 6. Sampling positions and location of the United Kingdom Atomic Energy Authority Dounreay site

Figure 7. Caesium-137 in sea water at Dounreay and annual mean background concentrations in the vicinity, 1983 to 1991

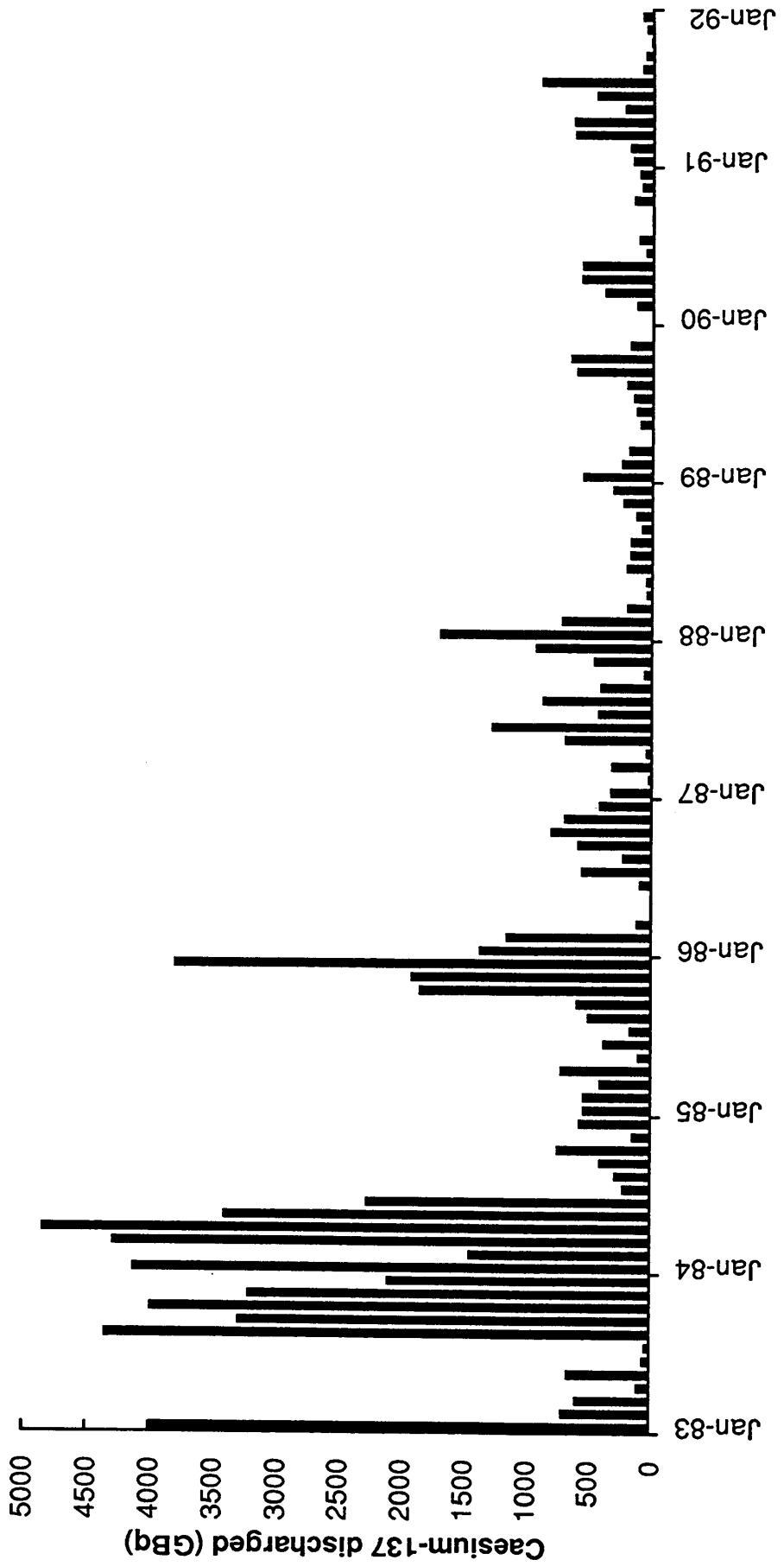

Figure 8. Monthly discharges of caesium-137 from Dounreay, 1983 to 1991

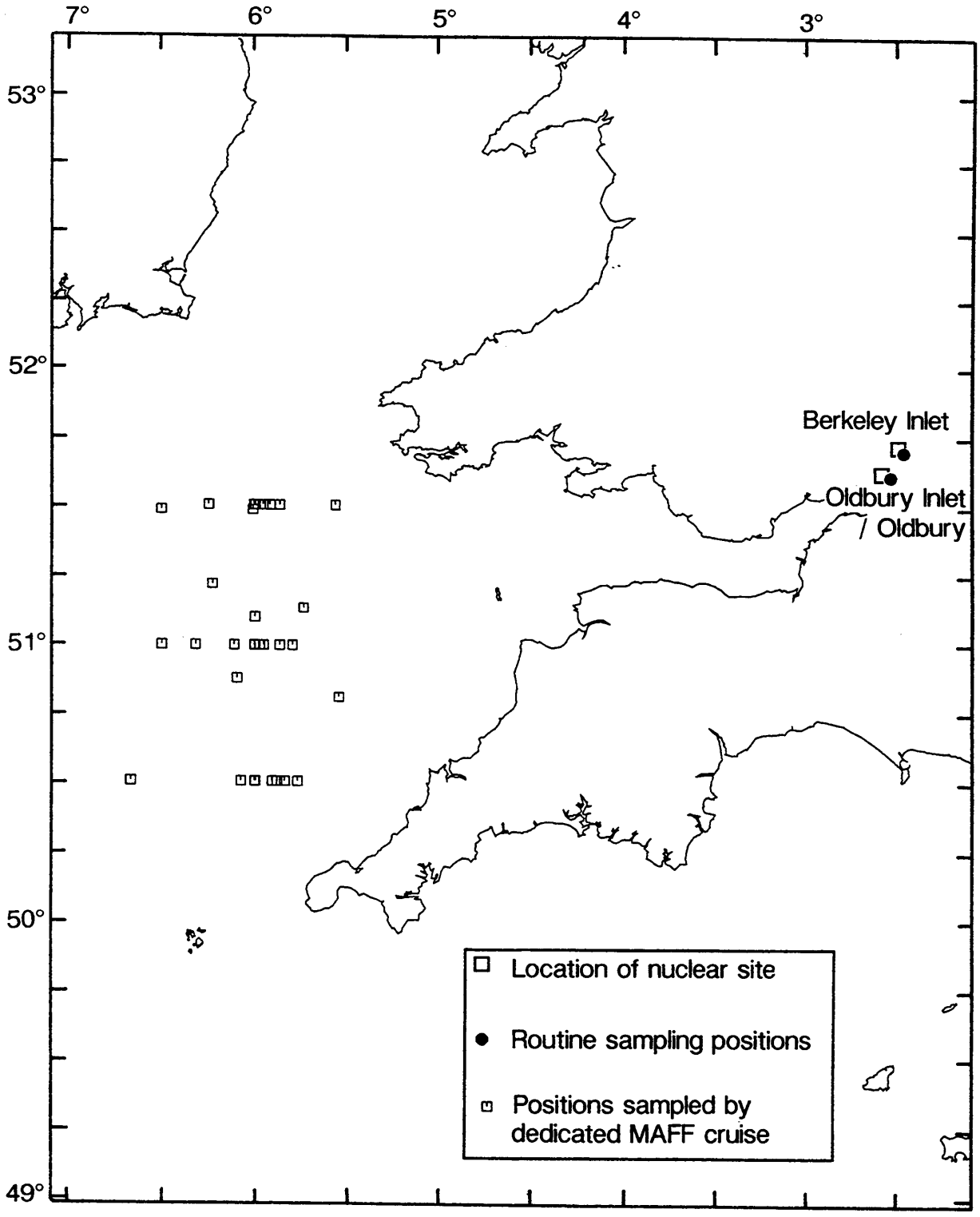

Figure 9. Sampling positions and locations of the Nuclear Electric plc Berkeley and Oldbury sites

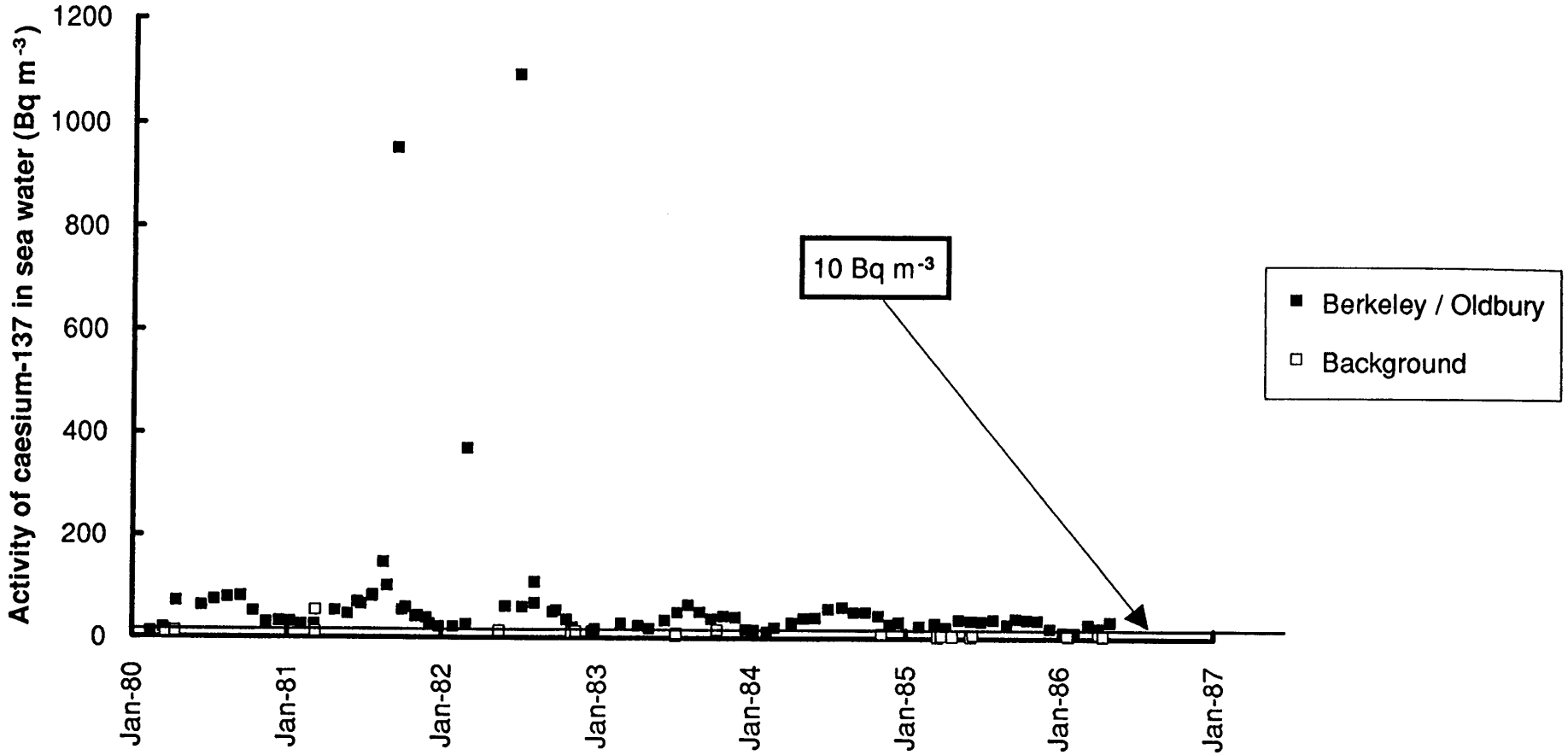

Figure 10. Caesium-137 in sea water at Berkeley and Oldbury and background concentrations at the mouth of the Bristol Channel, 1980 to 1986

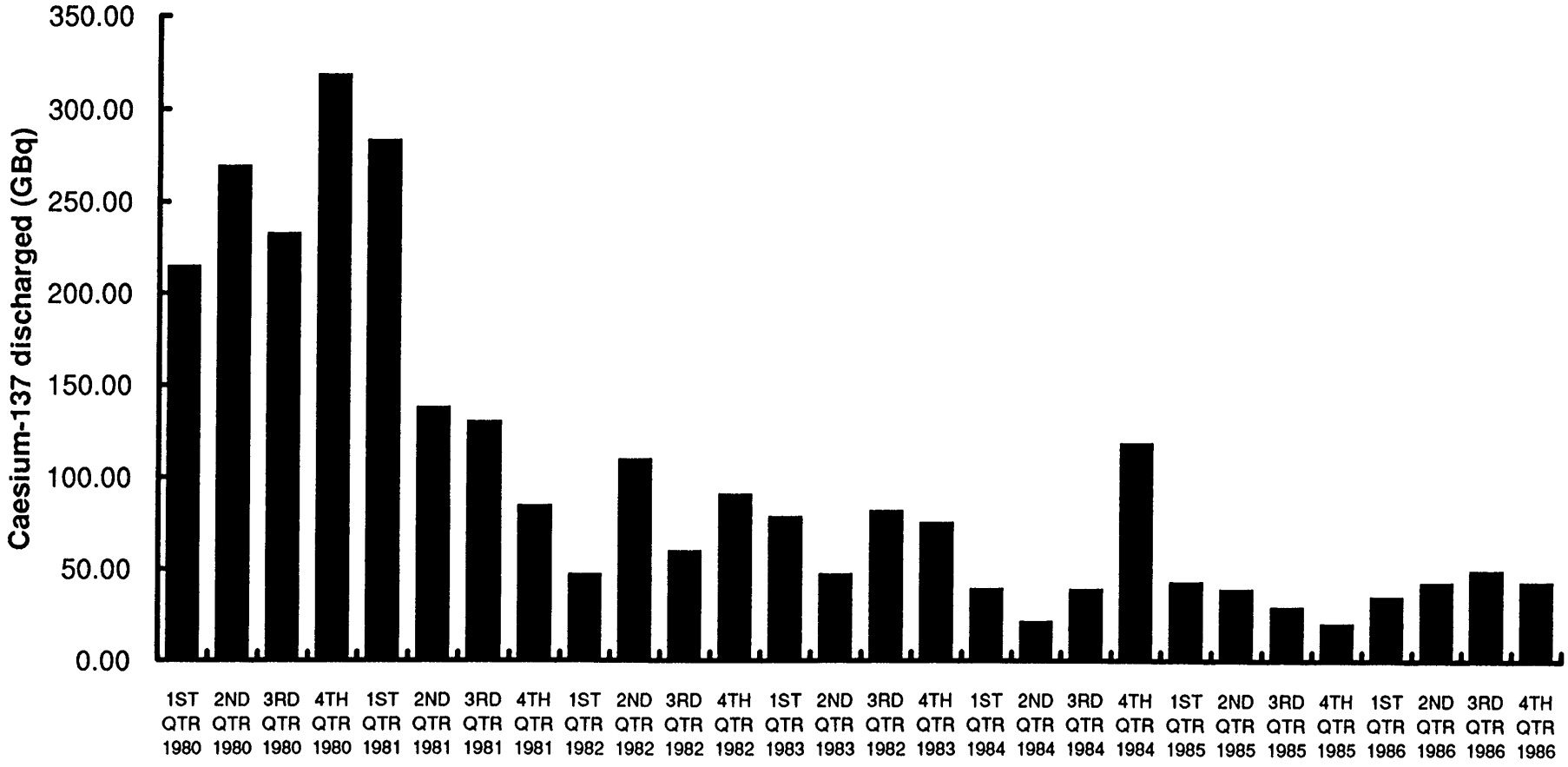

Figure 11. Quarterly discharges of caesium-137 from Berkeley, 1980 to 1986

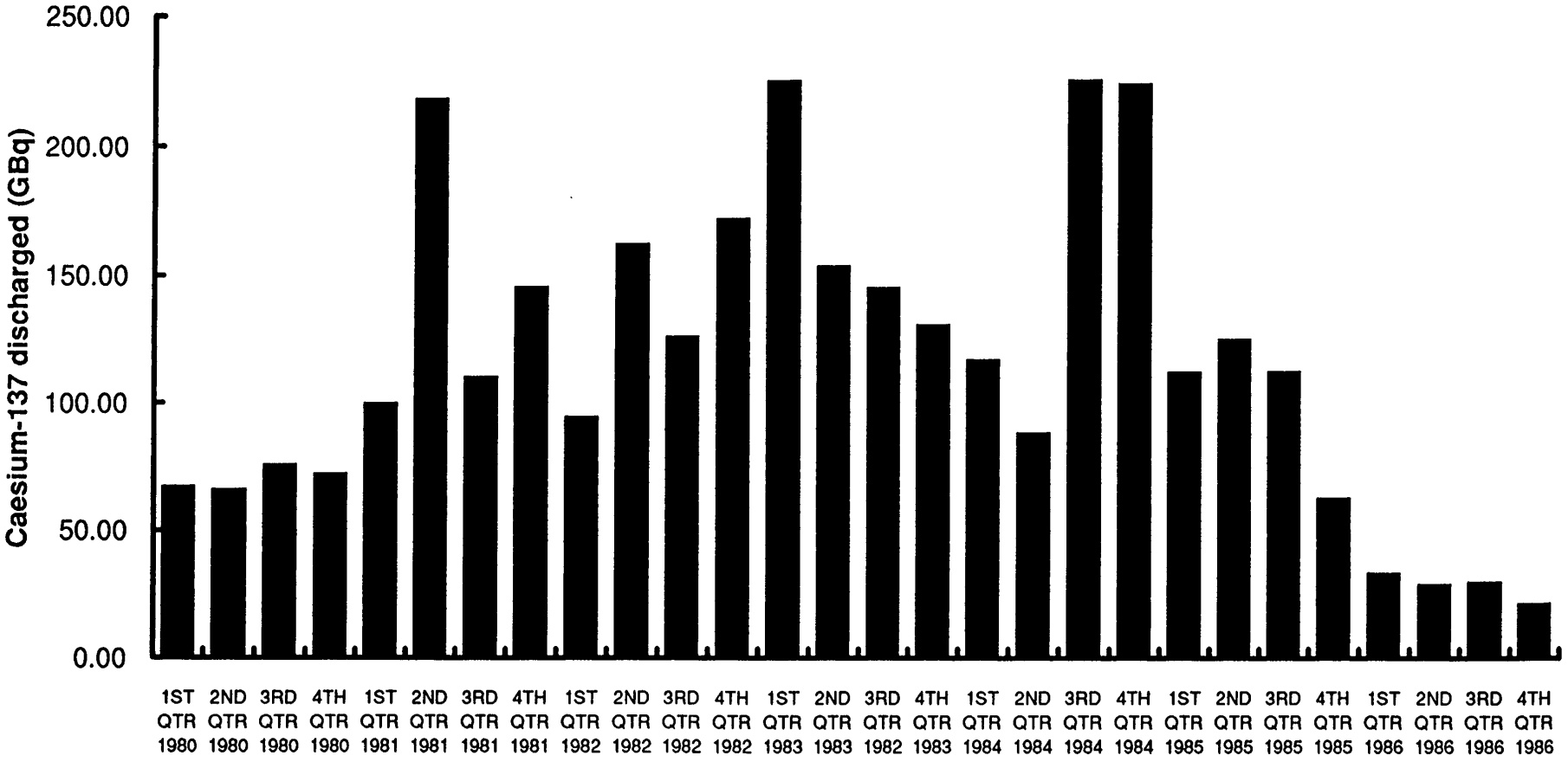

Figure 12. Quarterly discharges of caesium-137 from Oldbury, 1980 to 1986

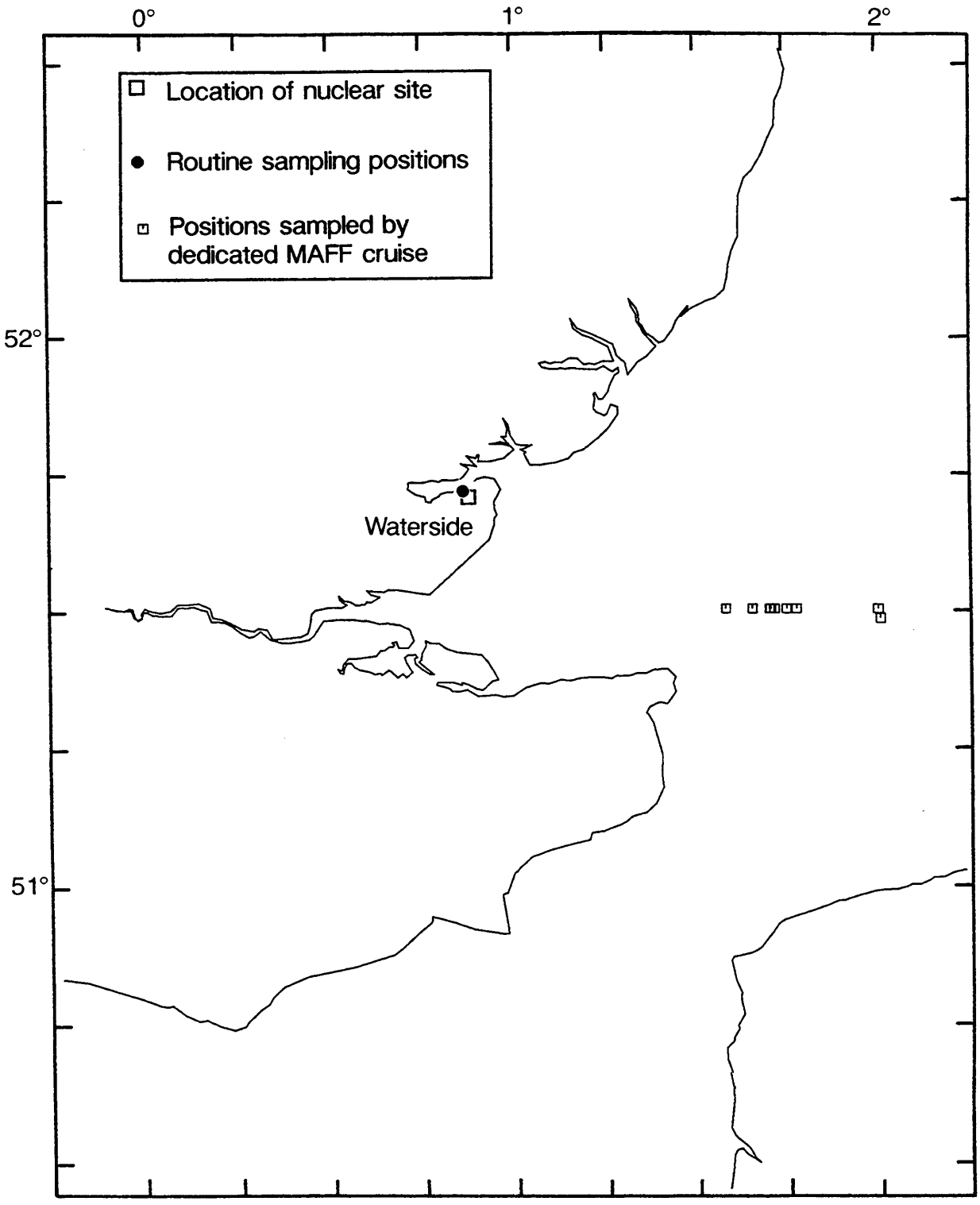

Figure 13. Sampling positions and location of the Nuclear Electric plc Bradwell site

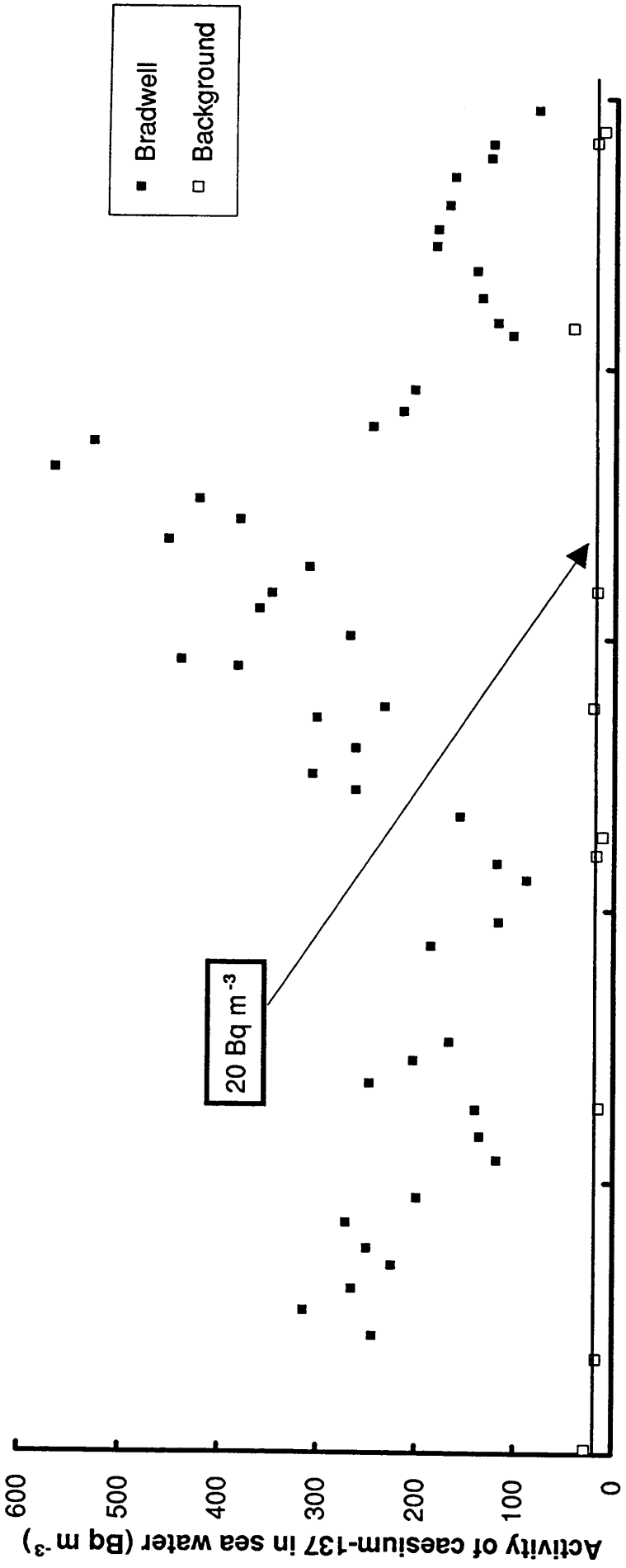

Figure 14. Caesium-137 in sea water at Bradwell and background concentrations at the mouth of the Thames Estuary, 1978 to 1982

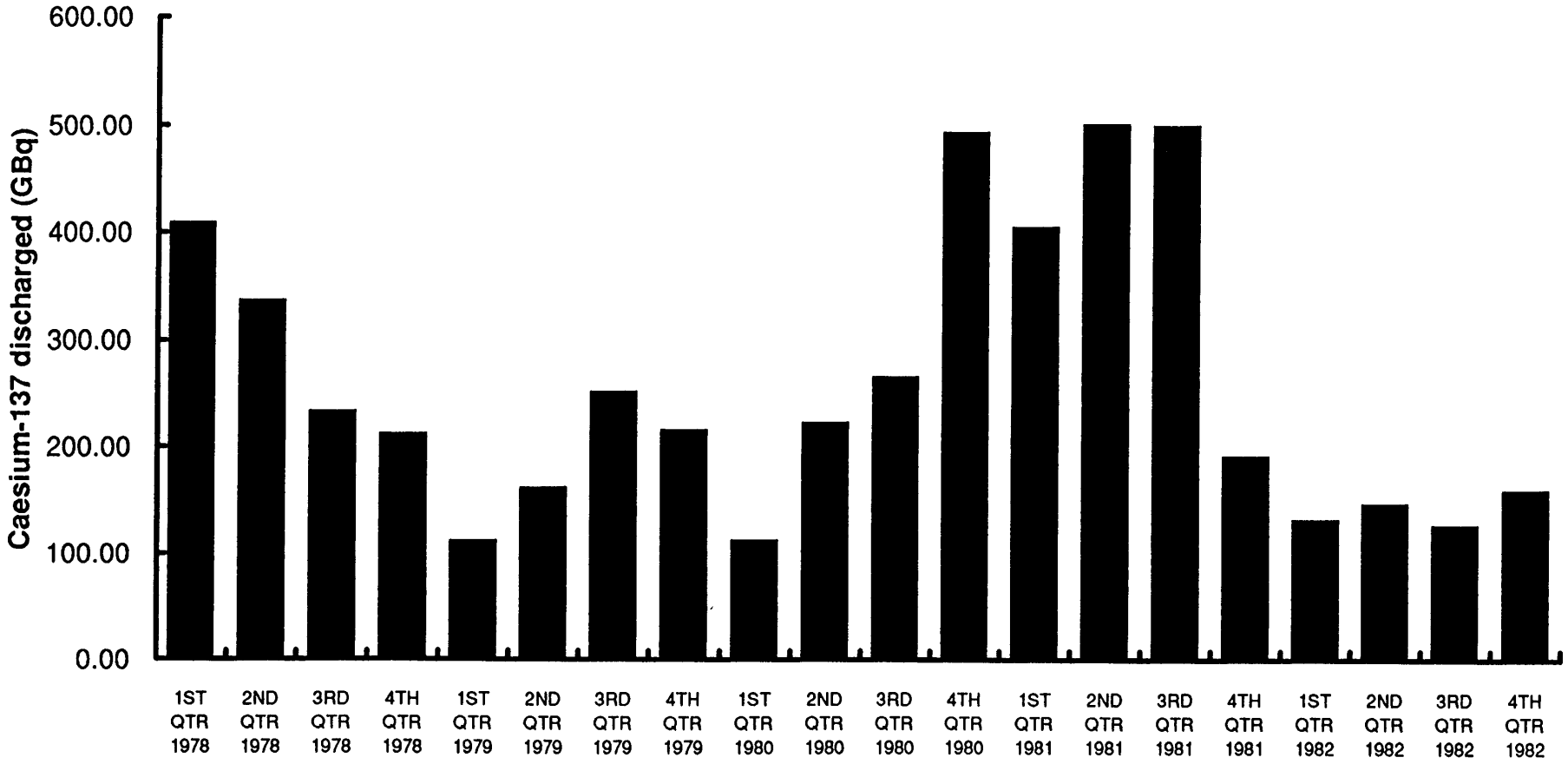

Figure 15. Quarterly discharges of caesium-137 from Bradwell, 1978 to 1982

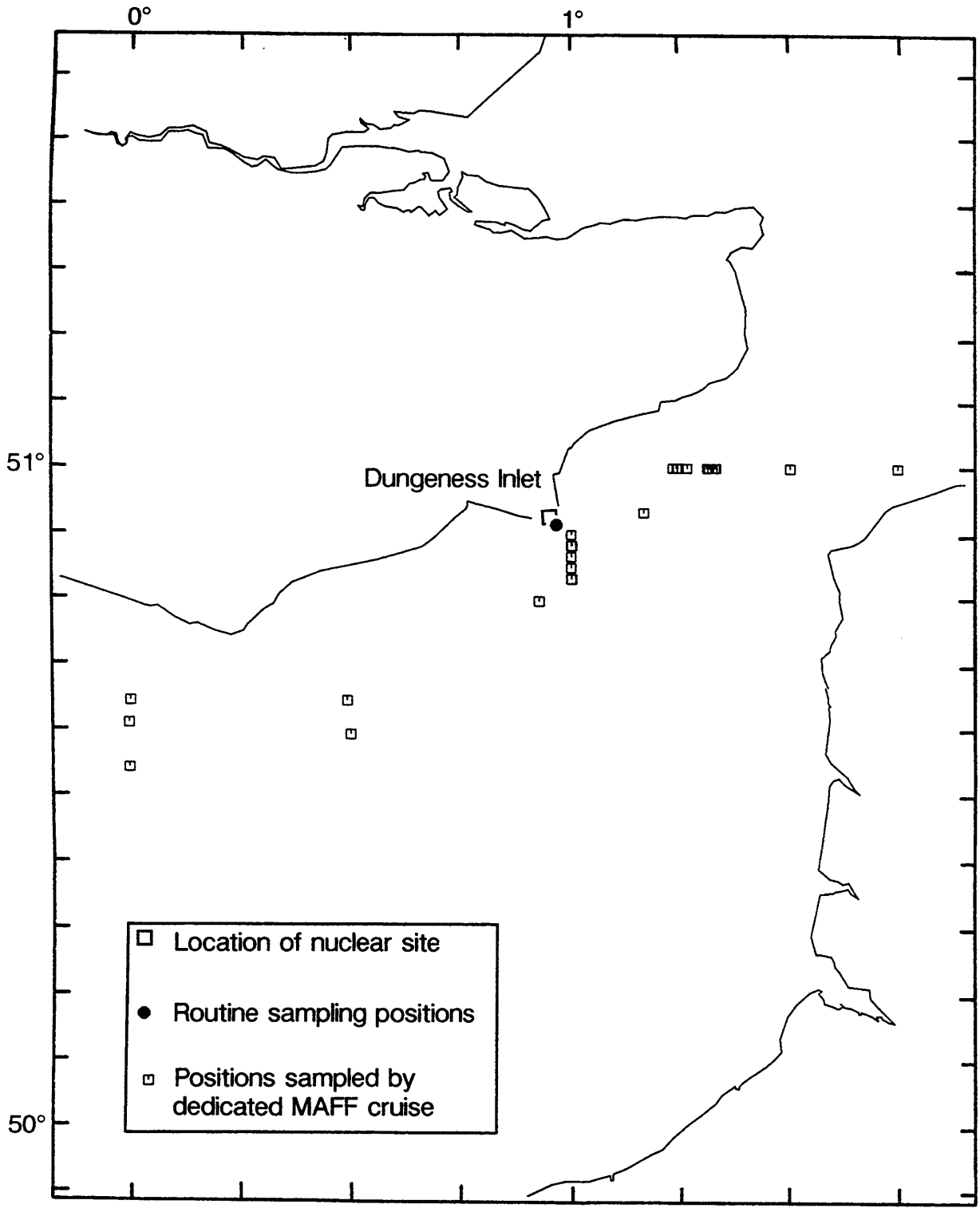

Figure 16. Sampling positions and location of the Nuclear Electric plc Dungeness site

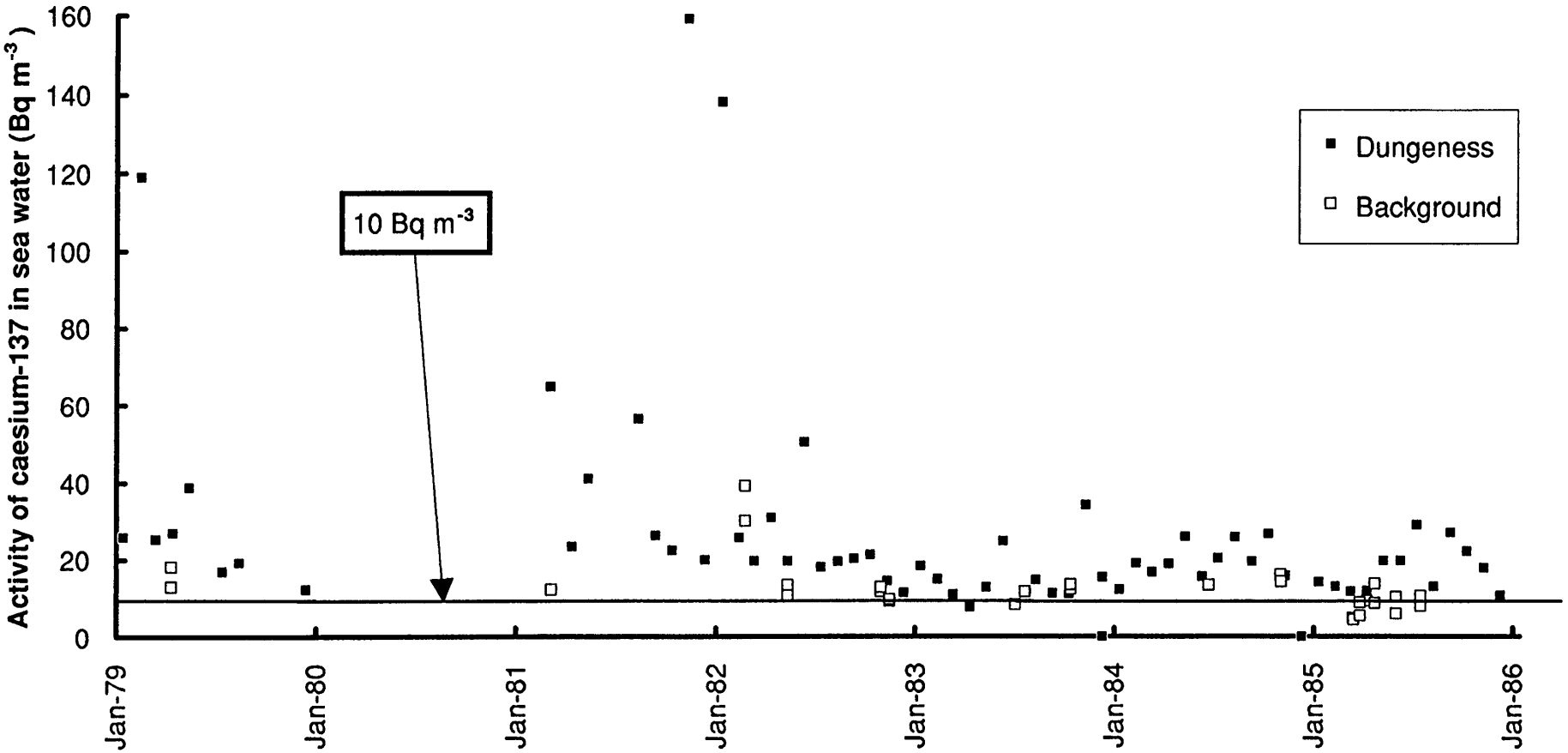

Figure 17. Caesium-137 in sea water at Dungeness and background concentrations in the eastern English Channel, 1979 to 1985

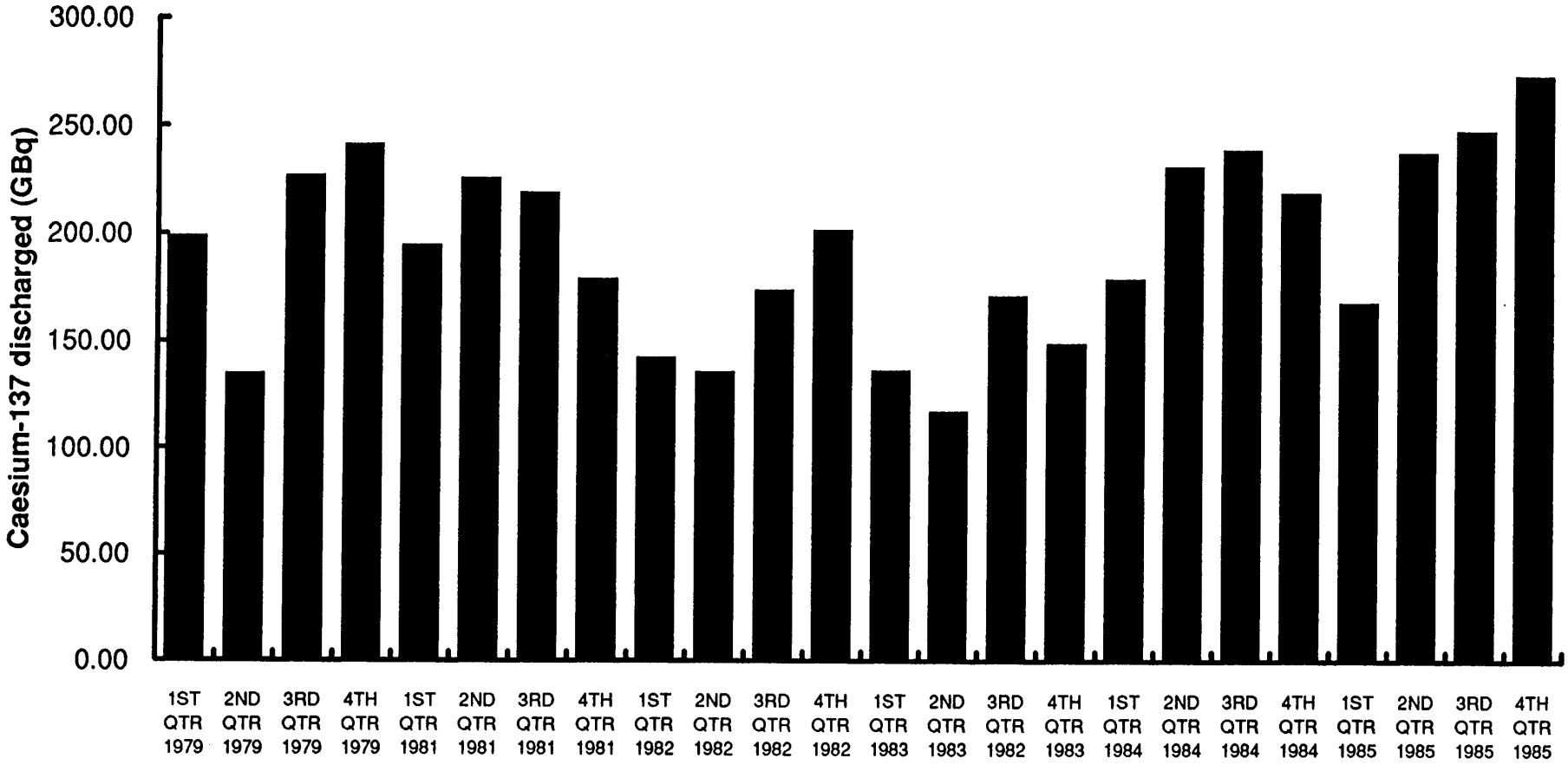

Figure 18. Quarterly discharges of caesium-137 from Dungeness, 1979 to 1985

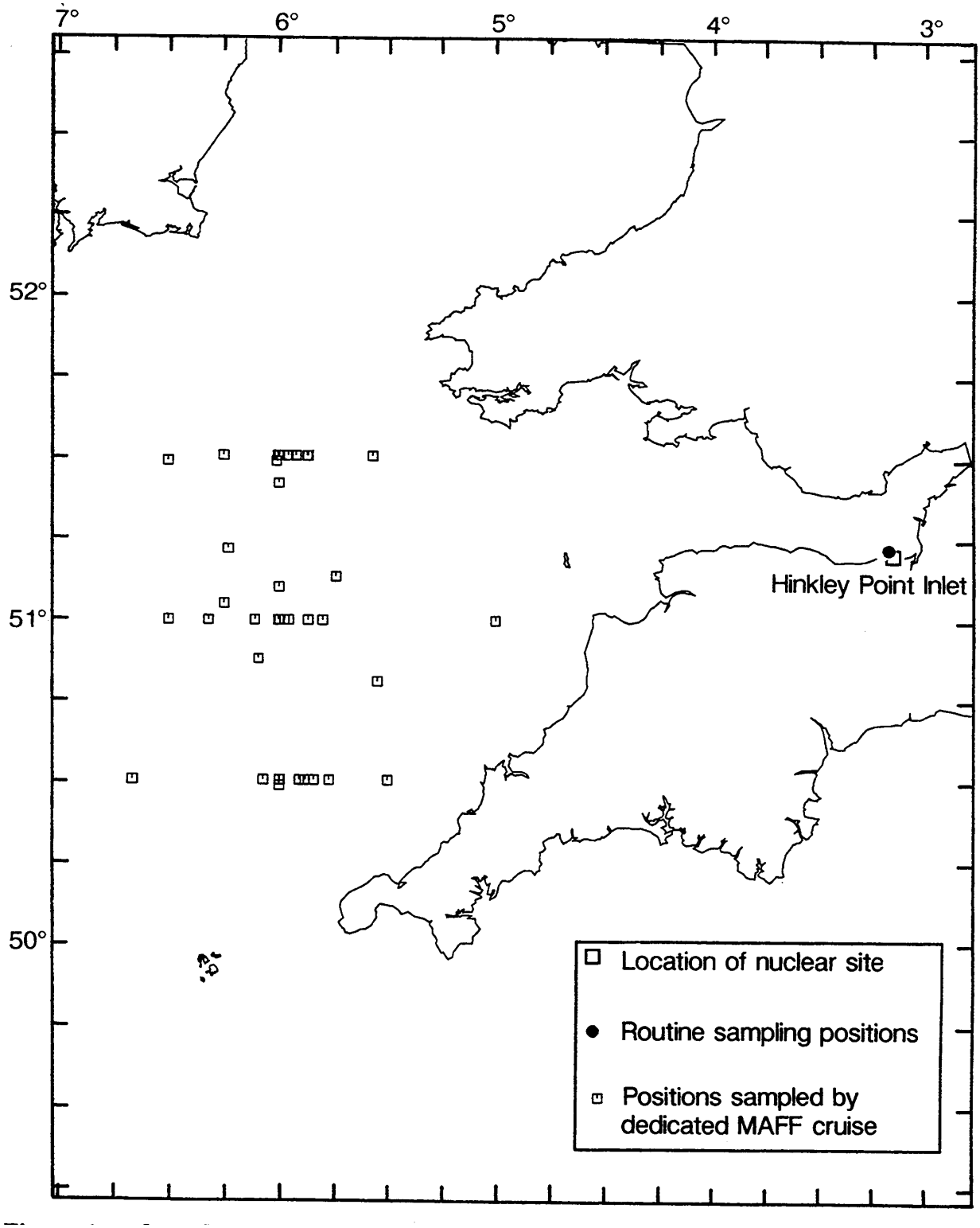

Figure 19. Sampling positions and location of the Nuclear Electric plc Hinkley Point site

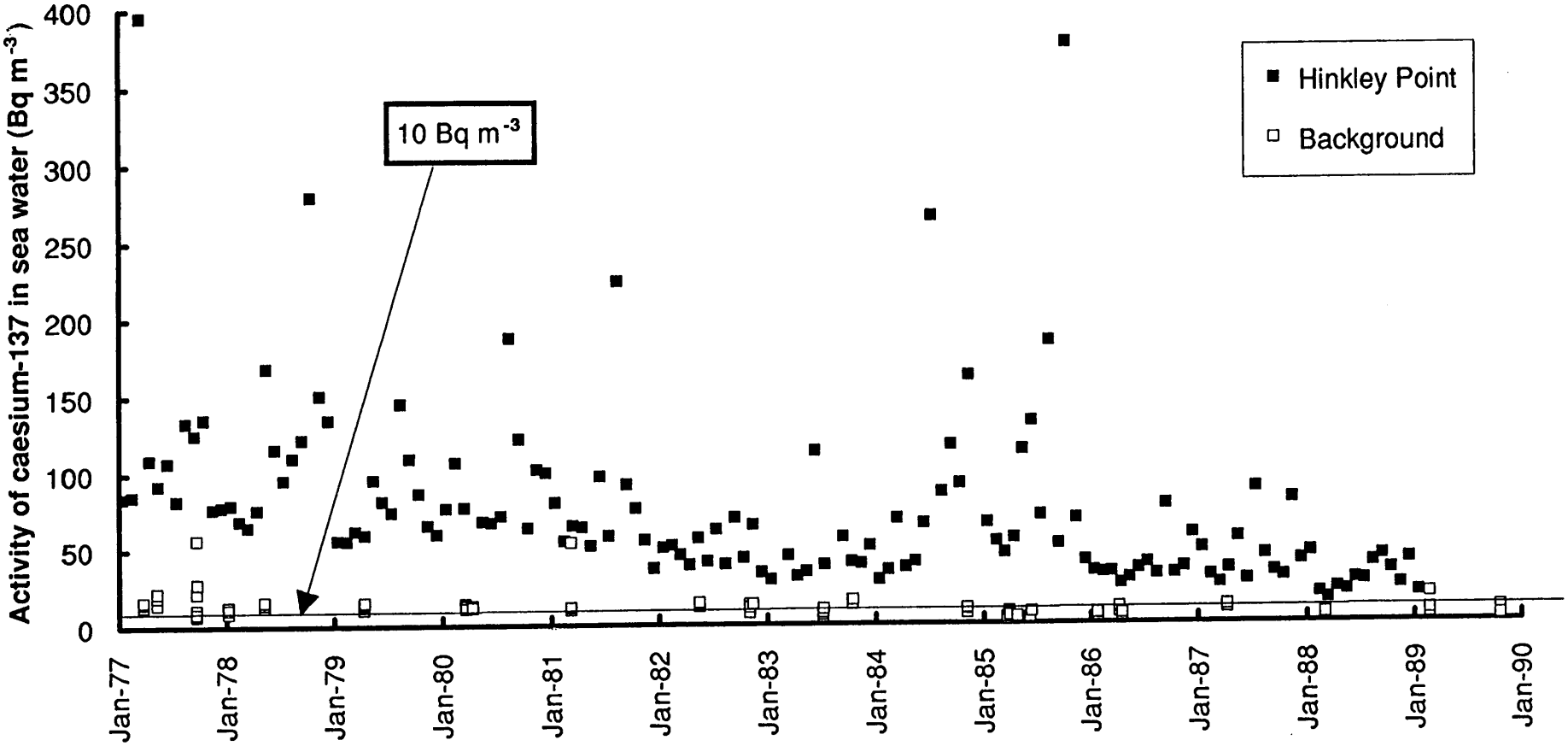

Figure 20. Caesium-137 in the sea water at Hinkley Point and background concentrations at the mouth of the Bristol Channel, 1977 to 1989

Figure 21. Quarterly discharges of caesium-137 from Hinkley Point, 1978 to 1988

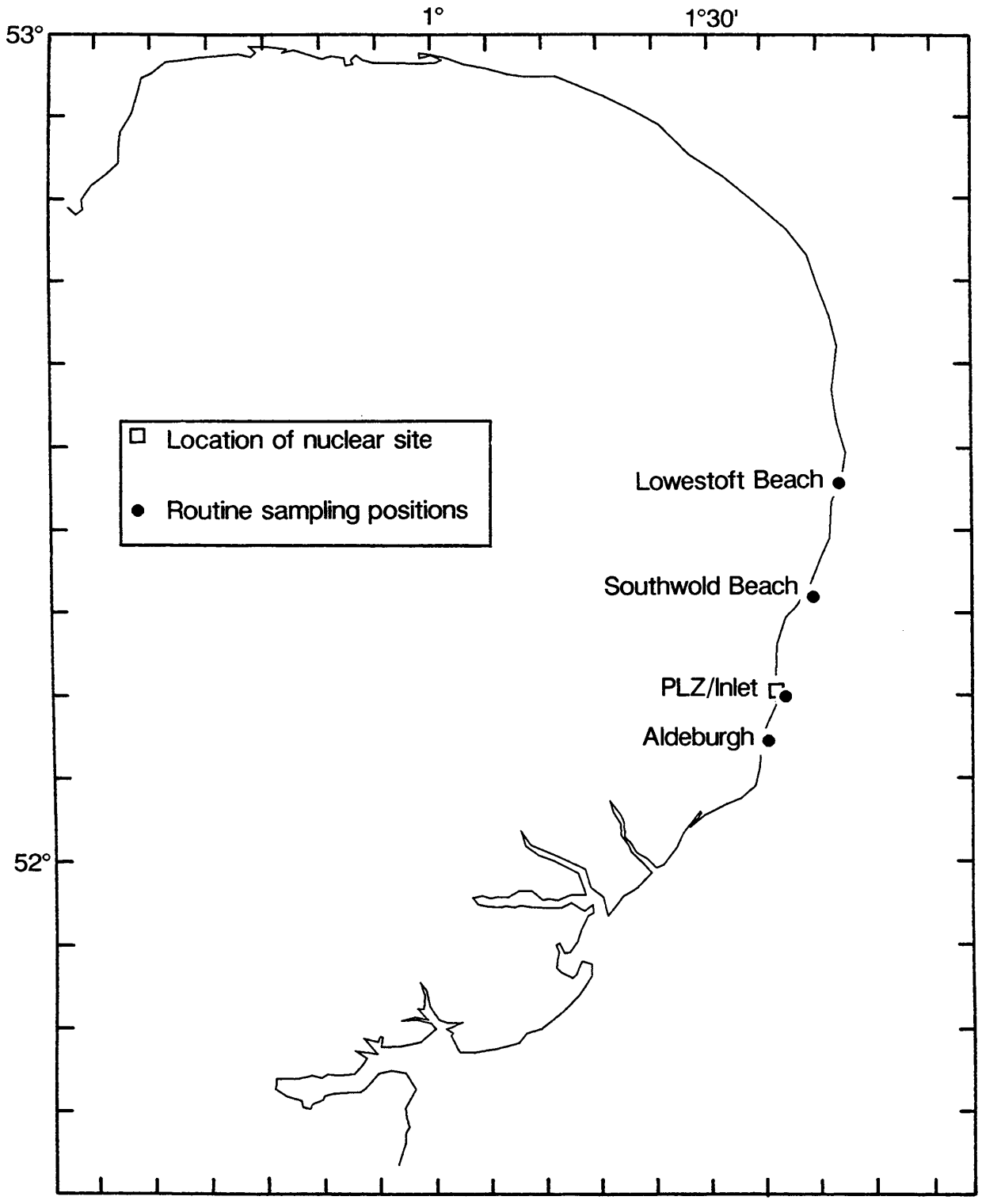

Figure 22. Sampling positions and location of the Nuclear Electric plc Sizewell site

Figure 23. Mean caesium-137 in sea water at Sizewell and annual background concentrations in the vicinity, 1982 to 1991

Figure 24. Quarterly discharges of caesium-137 from Sizewell, 1982 to 1991

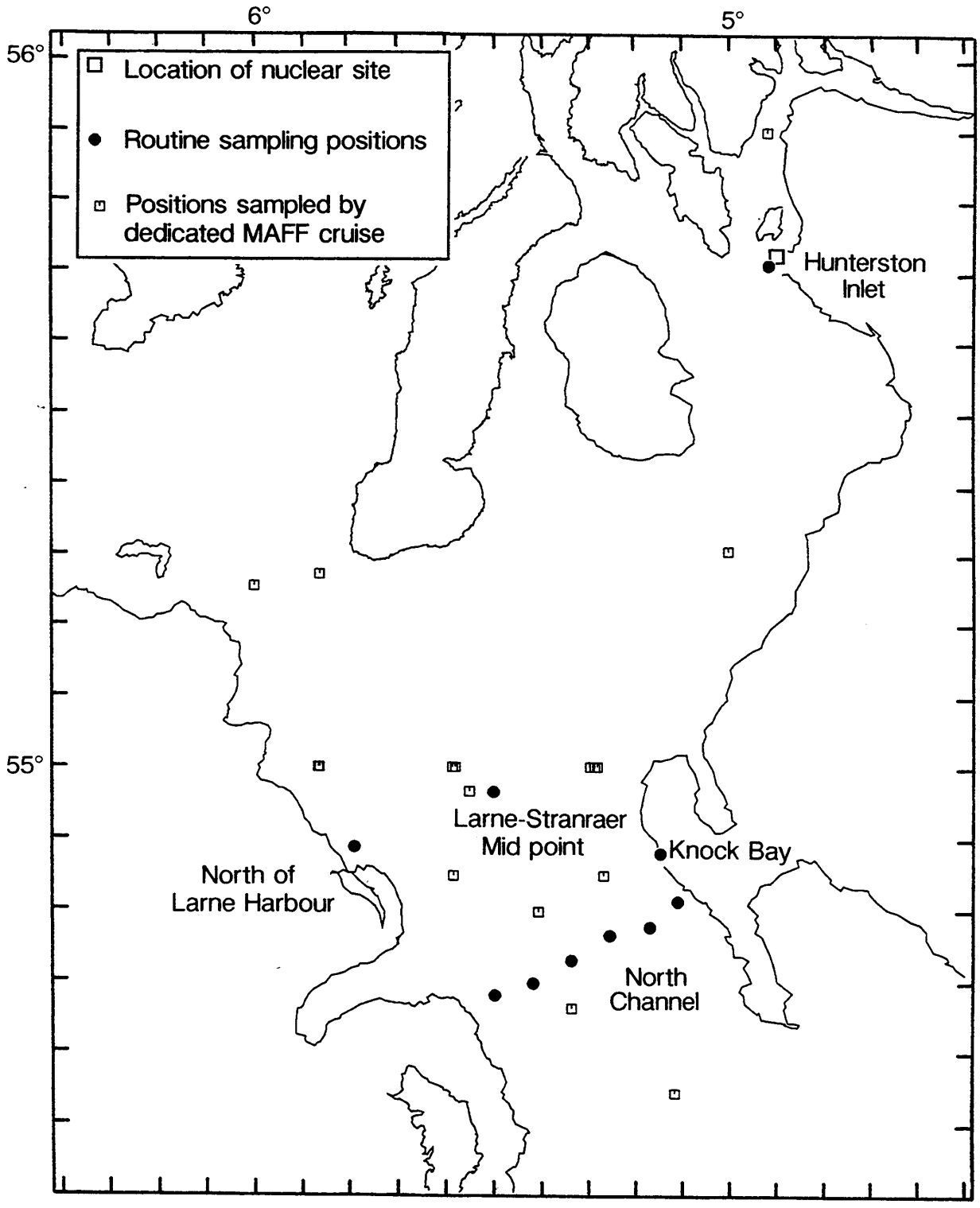

Figure 25. Sampling positions and location of the Scottish Nuclear Ltd Hunterston site

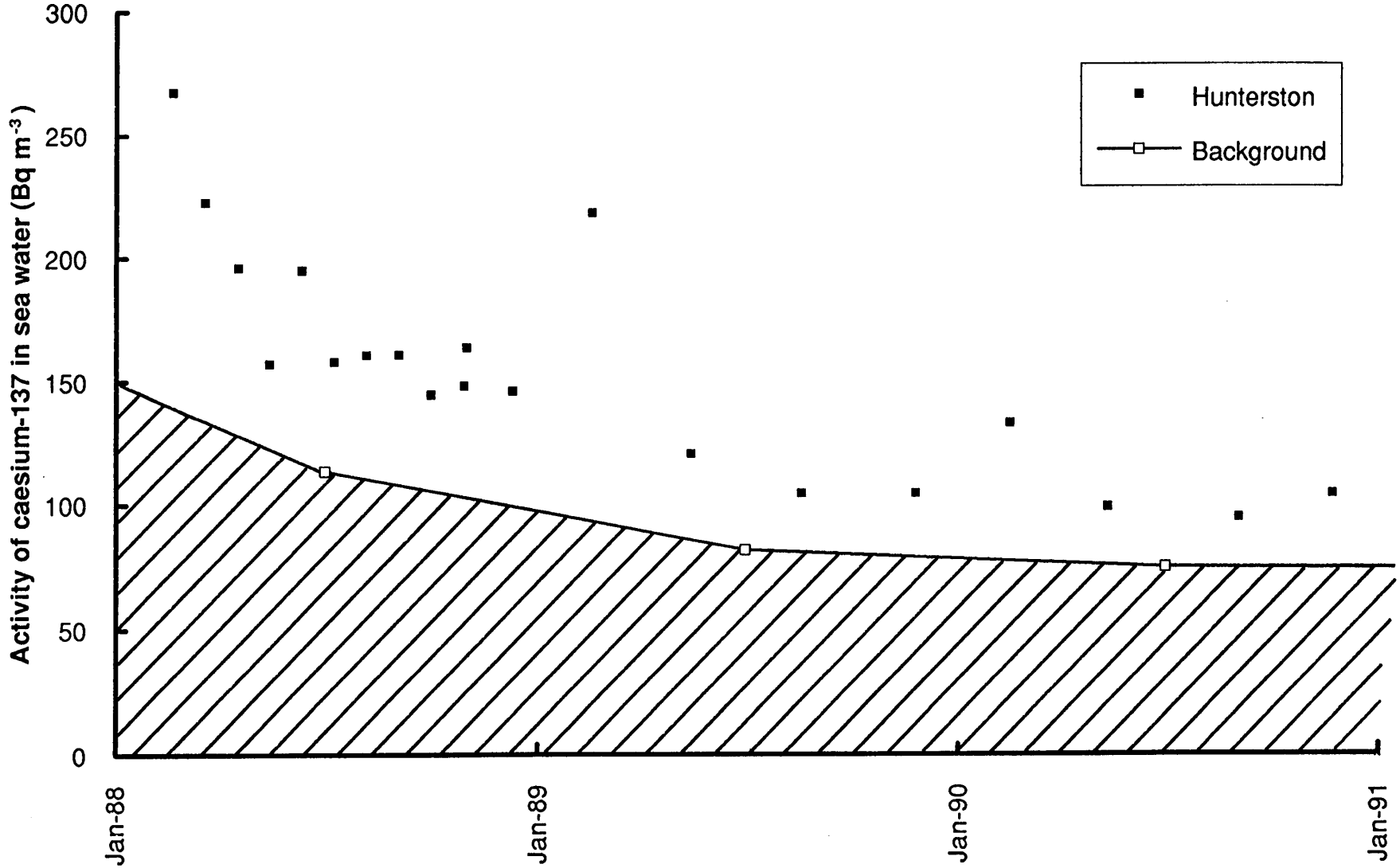

Figure 26. Caesium-137 in sea water at Hunterston and annual mean background concentrations in the North Channel, 1988 to 1990

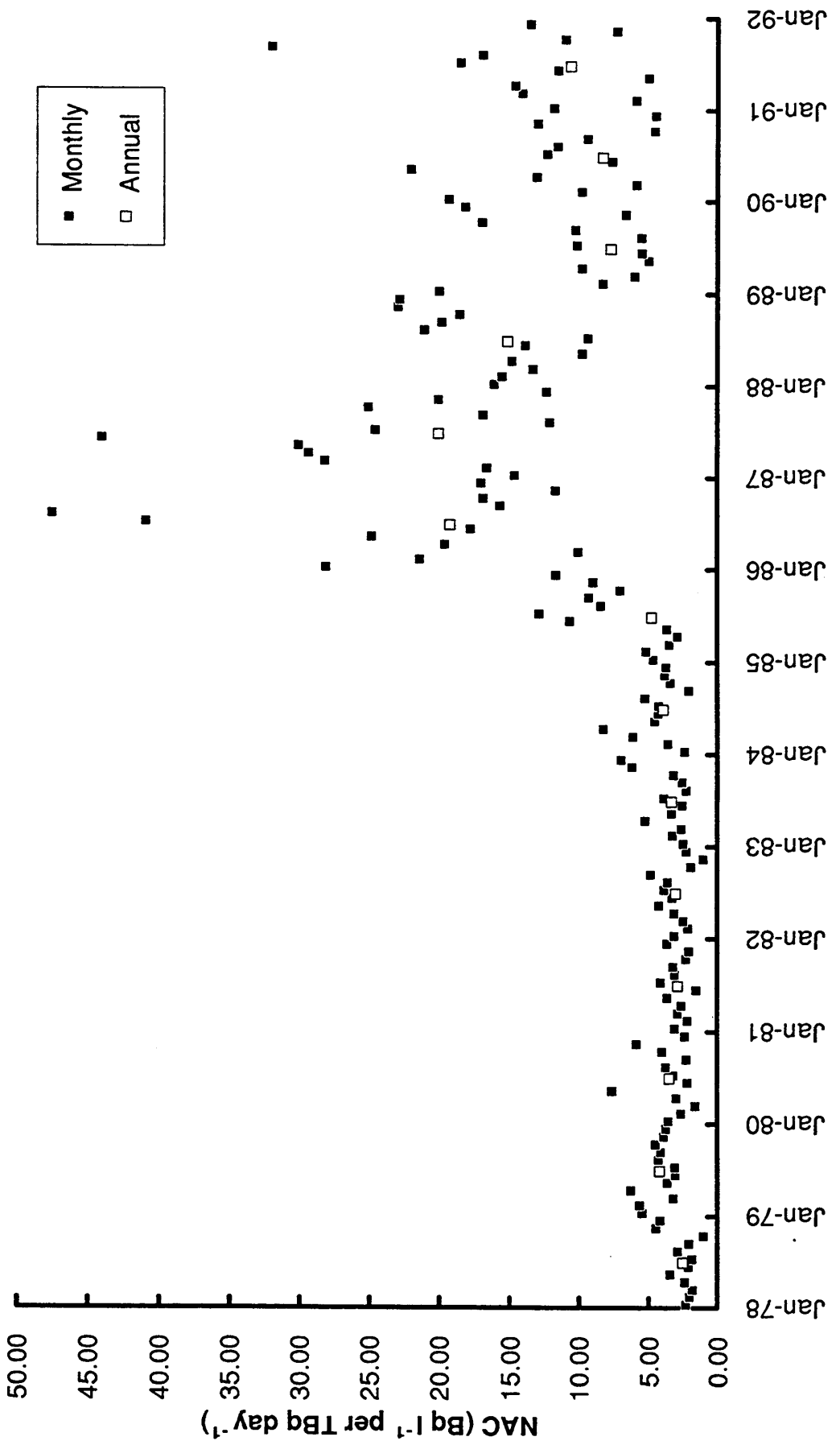

Figure 27. Normalised activity concentrations for caesium-137 in sea water at Sellafield, 1978 to 1991

Figure 28. Annual normalised activity concentrations for caesium-137 in sea water at Dounreay, 1983 to 1991

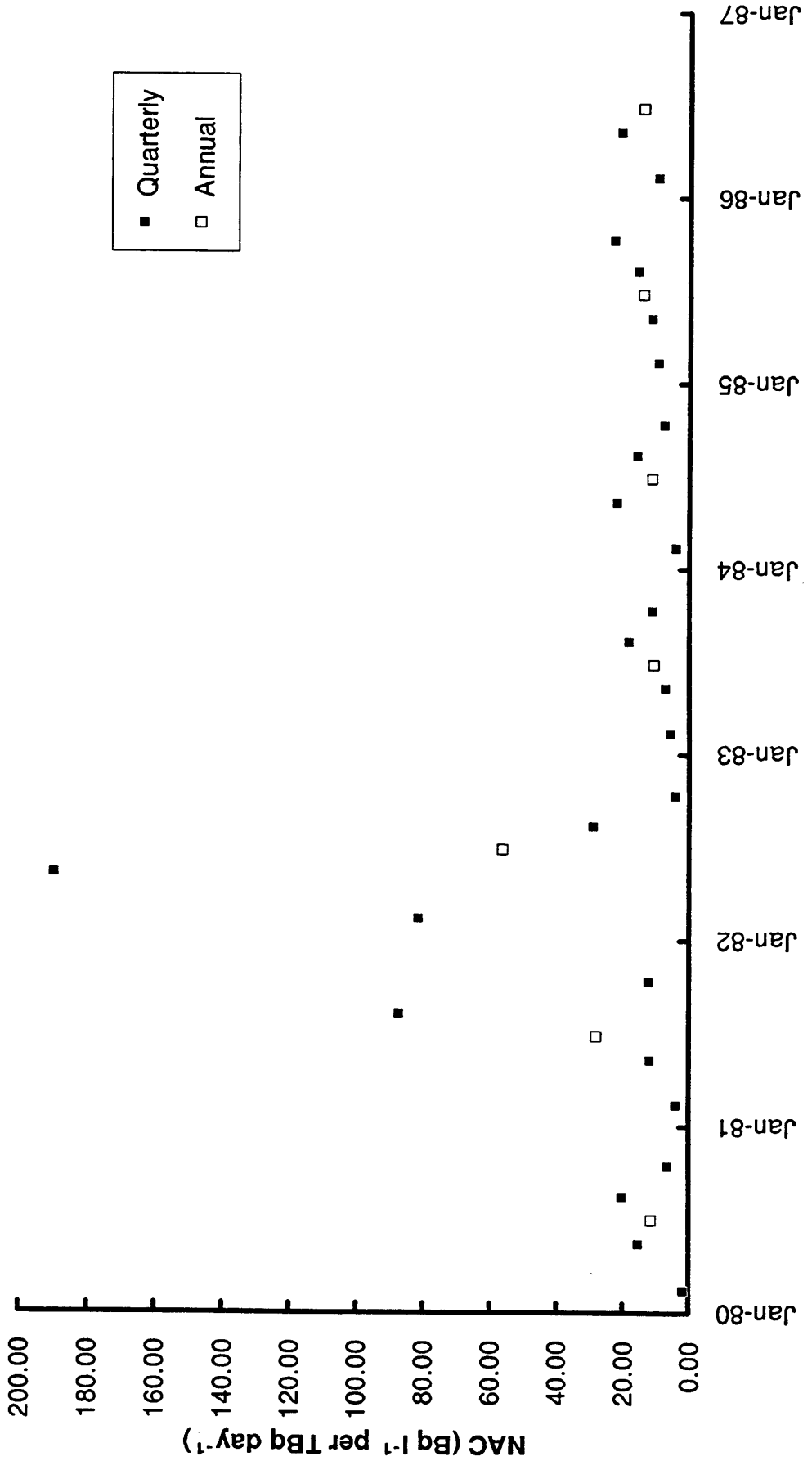

Figure 29. Normalised activity concentrations for caesium-137 in sea water at Berkeley/Oldbury, 1980 to 1986.

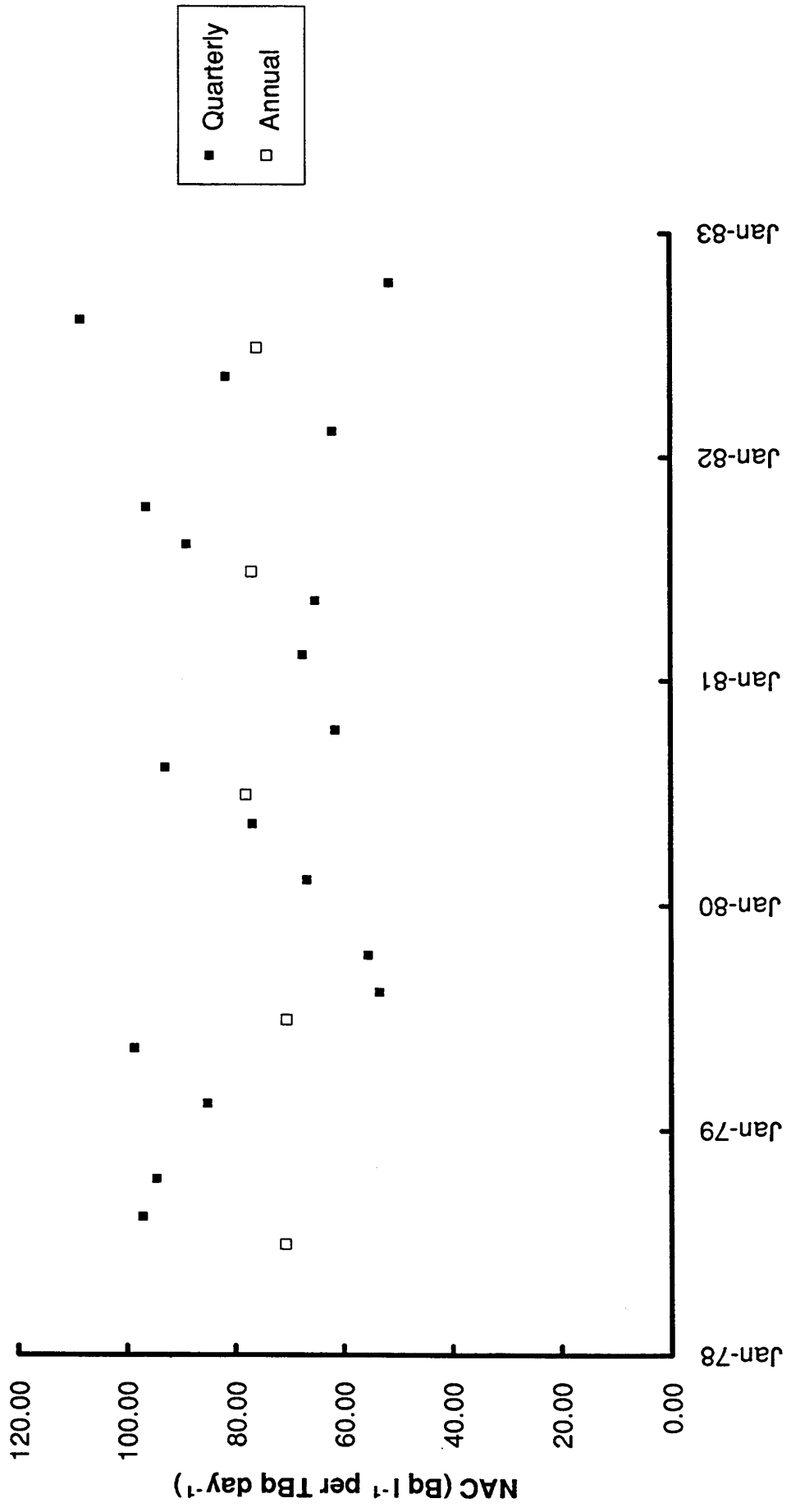

Figure 30. Normalised activity concentrations for caesium-137 in sea water at Bradwell, 1978 to 1982

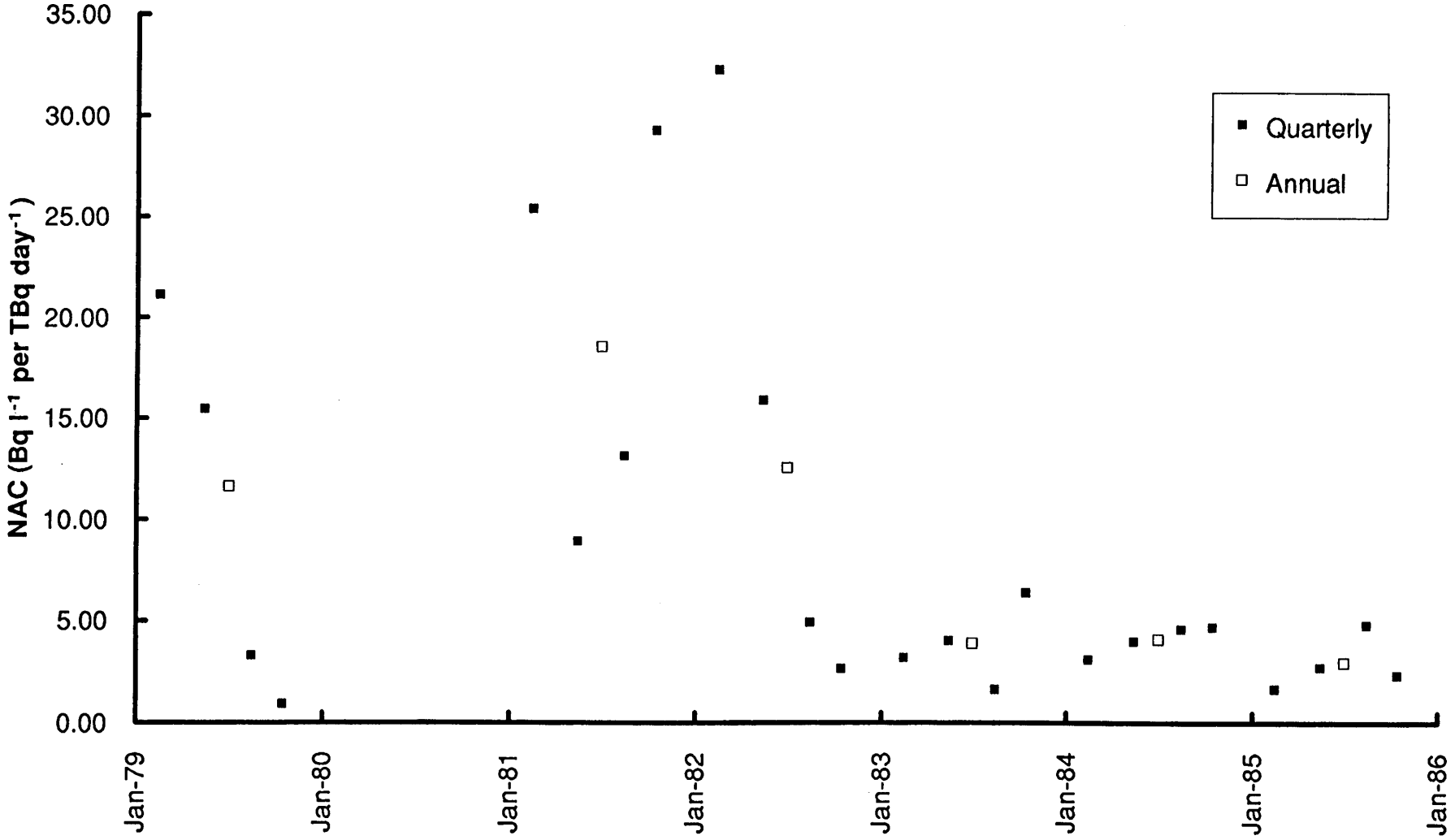

Figure 31. Normalised activity concentrations for caesium-137 in sea water at Dungeness, 1979 to 1985

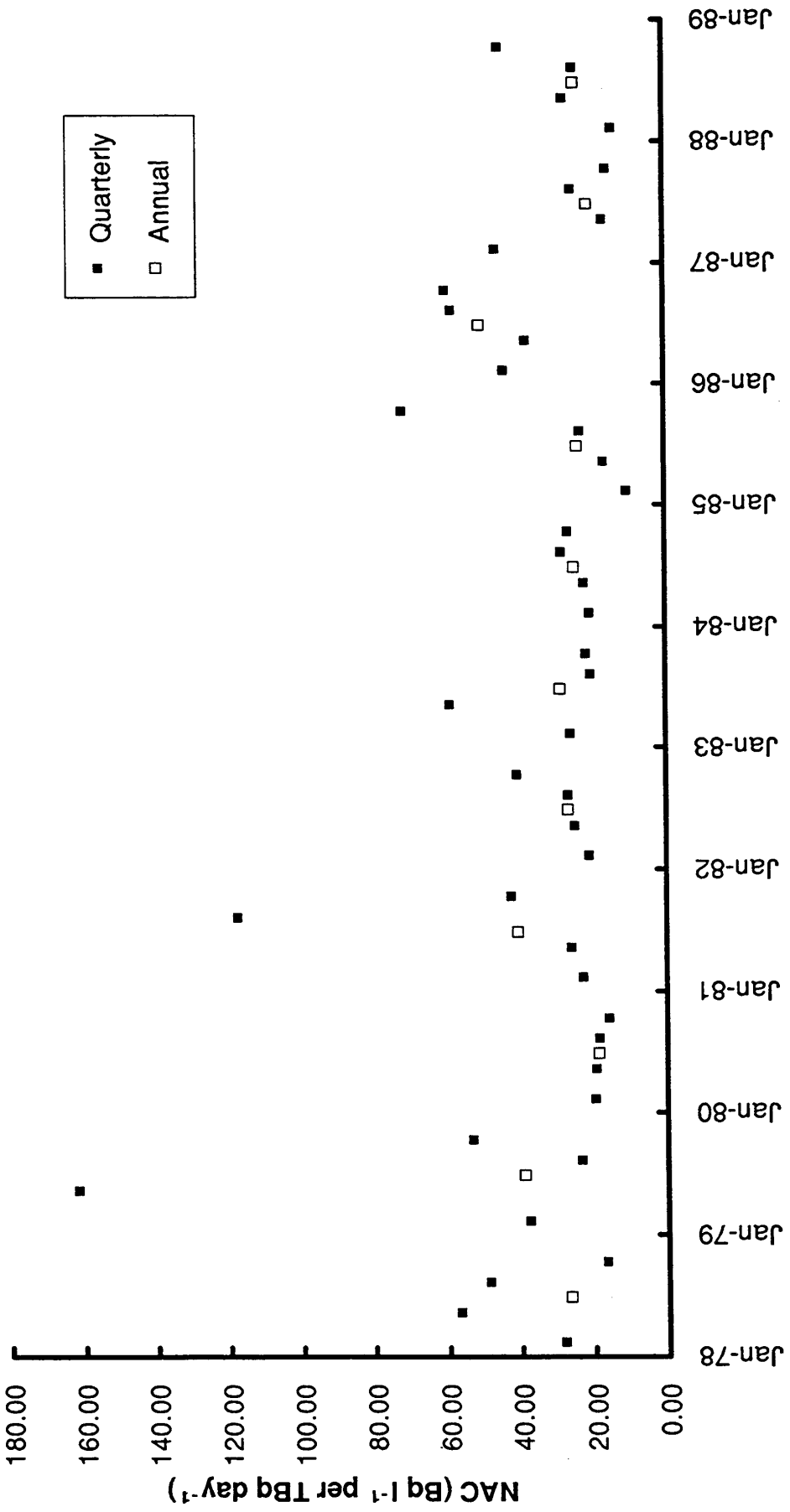

Figure 32. Normalised activity concentrations for caesium-137 in sea water at Hinkley Point, 1978 to 1988

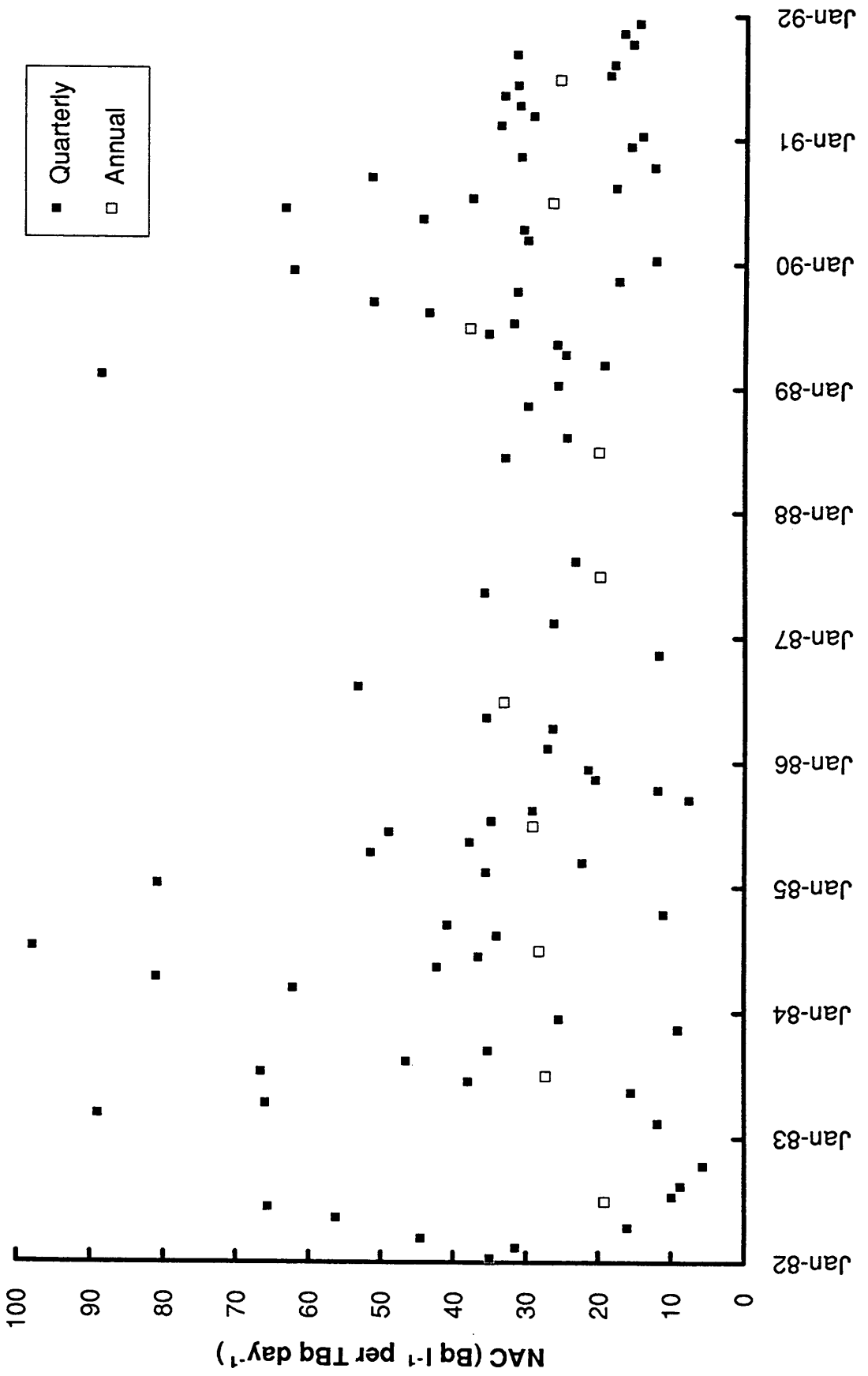

Figure 33. Normalised activity concentrations for caesium-137 in sea water at Sizewell, 1982 to 1991

ANNEX 1. BACKGROUND CONCENTRATIONS OF CAESIUM-137 IN SEA WATER IN THE VICINITY OF NUCLEAR SITES, OBTAINED BY DEDICATED CRUISES USING MAFF RESEARCH VESSELS

Annex 1.1 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Dounreay, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Cirolana 5/83	16	25/04/83	58:34:51N	3:45:18W	283.05
Cirolana 5/83	17	25/04/83	58:42:00N	5:00:00W	275.09
Cirolana 9/83	67	06/10/83	59:00:00N	4:00:00W	172.88
Cirolana 9/83	68	06/10/83	59:00:12N	3:39:45W	186.11
Cirolana 9/83	69	06/10/83	58:41:48N	3:22:12W	208.74
Cirolana 9/83	70	06/10/83	58:40:00N	4:00:00W	258.27
Cirolana 9/83	71	07/10/83	58:40:57N	5:00:39W	277.52
Cirolana 9/83	75	07/10/83	59:00:00N	5:00:00W	173.77
Cirolana 6/85	135	13/07/85	58:59:27N	4:59:27W	68.47
Cirolana 6/85	136	13/07/85	59:00:00N	4:00:00W	103.95
Cirolana 6/85	137	13/07/85	59:00:00N	3:30:00W	122.19
Cirolana 6/85	138	13/07/85	58:41:54N	3:22:06W	133.85
Cirolana 6/85	139	14/07/85	58:38:00N	3:45:06W	149.34
Cirolana 6/85	140	14/07/85	58:40:00N	4:00:00W	116.31
Cirolana 6/85	141	14/07/85	58:40:03N	4:59:18W	156.38
Clione 5/86	195	24/04/86	58:40:00N	4:59:48W	87.78
Clione 5/86	196	24/04/86	58:59:54N	5:00:09W	73.85
Clione 5/86	197	24/04/86	58:59:54N	3:59:54W	55.99
Clione 5/86	198	24/04/86	58:37:06N	3:59:21W	77.64
Clione 5/86	199	24/04/86	58:40:00N	3:29:27W	62.21
Clione 5/86	200	24/04/86	59:00:03N	3:30:00W	72.71
Corella 1/88	119	15/03/88	58:40:00N	4:59:48W	44.19
Corella 1/88	126	16/03/88	58:40:00N	4:00:00W	40.30
Corella 1/88	127	16/03/88	58:40:00N	3:30:00W	26.83
Corella 1/88	128	16/03/88	59:00:00N	3:30:00W	35.80
Cirolana 8/89	137	18/10/89	58:40:09N	5:00:00W	19.03
Cirolana 8/89	127	15/10/89	58:59:48N	3:29:57W	16.92
Cirolana 8/89	126	18/10/89	58:38:00N	3:45:12W	23.26
Cirolana 8/89	125	18/10/89	58:37:57N	3:29:45W	22.10
Corystes 11/91	143	22/11/91	58:40:02N	3:59:59W	21.21
Corystes 11/91	144	22/11/91	59:00:08N	3:59:17W	13.00

Annex 1.2 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Berkeley/Oldbury, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Corella 4/80	14	20/03/80	50:30:00N	5:54:30W	14.62
Corella 4/80	15	21/03/80	51:00:00N	5:57:18W	13.00
Corella 4/80	16	21/03/80	51:30:00N	5:52:00W	11.36
Corella 5/80	13	13/04/80	50:30:00N	6:00:00W	11.82
Corella 5/80	14	13/04/80	51:06:00N	6:00:00W	13.10
Corella 5/80	15	13/04/80	51:30:09N	5:57:27W	11.98
Corella 4/81	13	10/03/81	50:30:00N	6:00:00W	10.19
Corella 4/81	14	10/03/81	51:00:00N	6:00:00W	11.81
Corella 4/81	15	10/03/81	51:30:00N	6:00:00W	54.30
Cirolana 5/82	29	18/05/82	50:30:00N	6:40:00W	12.64
Cirolana 5/82	30	18/05/82	51:00:00N	6:30:00W	12.10
Cirolana 5/82	31	19/05/82	51:30:00N	6:15:00W	14.42
Corella 15/82	13	05/11/82	50:30:00N	6:00:00W	7.60
Corella 15/82	14	05/11/82	51:00:00N	6:00:00W	13.48
Corella 15/82	15	05/11/82	51:30:36N	6:00:18W	11.14
Corella 15/82	84	16/11/82	51:29:54N	6:30:06W	13.56
Corella 15/82	85	16/11/82	50:59:48N	6:19:12W	13.35
Cirolana 9/83	136	16/10/83	51:30:00N	6:00:00W	12.97
Cirolana 9/83	137	16/10/83	51:00:00N	6:00:12W	15.95
Cirolana 9/83	138	17/10/83	50:30:00N	5:59:54W	16.02
Clione 9/83	9	10/07/83	50:48:12N	5:32:42W	4.69
Clione 9/83	12	10/07/83	50:52:24N	6:05:42W	6.39
Clione 9/83	15	11/07/83	51:08:36N	5:44:18W	7.61
Clione 9/83	17	12/07/83	51:30:54N	5:55:18W	9.88
Clione 9/83	18	12/07/83	51:13:00N	6:13:48W	10.13
Clione 13/84	13	08/11/84	50:30:06N	6:00:06W	6.85
Clione 13/84	14	08/11/84	51:00:00N	6:00:00W	9.69
Clione 13/84	15	08/11/84	51:29:54N	6:00:39W	10.06
Clione 4/85	10	22/03/85	50:30:00N	5:46:18W	2.49
Clione 4/85	11	22/03/85	51:00:00N	5:47:54W	4.21
Clione 4/85	72	30/03/85	51:00:00N	6:06:42W	8.09
Clione 4/85	73	31/03/85	50:30:00N	6:04:30W	5.32
Clione 5/85	147	26/04/85	51:00:00N	5:58:30W	4.39
Clione 5/85	148	26/04/85	50:30:00N	5:52:54W	4.37
Clione 7/85	10	09/06/85	50:30:00N	6:00:00W	3.89
Clione 7/85	46	14/06/85	51:00:00N	6:00:00W	7.57
Clione 2/86	21	28/01/86	51:00:00N	6:00:00W	4.89
Clione 2/86	22	28/01/86	50:30:00N	6:00:06W	6.06
Clione 2/86	1	25/01/86	51:30:00N	5:52:12W	6.42
Clione 5/86	11	09/04/86	50:30:00N	5:50:30W	6.89
Clione 5/86	12	09/04/86	51:00:00N	5:52:00W	7.42
Clione 5/86	13	09/04/86	51:30:00N	5:34:00W	10.40
Clione 5/86	149	19/04/86	51:30:03N	5:59:54W	4.89
Clione 5/86	150	19/04/86	51:00:00N	6:00:09W	6.22

Annex 1.3 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Bradwell, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Cirolana 1/78	9	08/01/78	51:30:00N	1:43:00E	27.93
Cirolana 5/78	14	10/05/78	51:30:00N	2:00:00E	16.98
Cirolana 4/79	6	12/04/79	51:30:00N	1:45:00E	15.27
Cirolana 9/80	3	01/10/80	51:30:00N	1:35:00E	21.29
Corella 4/80	3	17/03/80	51:30:00N	1:43:00E	18.02
Corella 5/80	3	11/04/80	51:30:00N	1:42:12E	11.89
Corella 4/81	3	07/03/81	51:30:00N	1:46:39E	17.99
Cirolana 3/82	6	25/02/82	51:29:42N	2:00:24E	43.22
Corella 15/82	3	03/11/82	51:30:00N	1:42:24E	19.32
Corella 15/82	96	19/11/82	51:30:00N	1:39:24E	12.36

Annex 1.4 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Dungeness, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Cirolana 4/79	7	12/04/79	51:00:00N	1:20:00E	13.10
Cirolana 4/79	8	12/04/79	50:35:00N	0:30:00E	18.26
Corella 4/81	5	08/03/81	50:50:00N	1:00:00E	12.39
Cirolana 3/82	7	26/02/82	51:00:00N	1:14:00E	30.18
Cirolana 3/82	8	26/02/82	51:00:00N	1:45:00E	39.25
Cirolana 5/82	5	15/05/82	51:00:00N	1:19:54E	13.53
Cirolana 5/82	6	15/05/82	50:49:54N	1:00:06E	10.83
Corella 15/82	4	03/11/82	51:00:00N	1:19:30E	11.79
Corella 15/82	5	03/11/82	50:49:24N	1:00:00E	12.89
Corella 15/82	93	19/11/82	50:38:18N	0:00:12E	9.37
Corella 15/82	94	19/11/82	50:53:12N	1:00:00E	9.81
Cirolana 9/83	149	18/10/83	50:51:42N	1:00:00E	12.54
Cirolana 9/83	150	18/10/83	51:00:00N	1:16:00E	13.61
Clione 9/83	1	08/07/83	50:38:18N	0:29:30E	8.50
Clione 9/83	58	25/07/83	50:59:54N	1:30:12E	11.82
Cirolana 6/84	1	28/06/84	50:47:36N	0:55:42E	13.50
Clione 13/84	4	06/11/84	51:00:00N	1:18:54E	16.14
Clione 13/84	6	07/11/84	50:32:48N	0:00:00E	14.35
Cirolana 4/85	2	15/04/85	50:55:00N	1:10:00E	9.43
Cirolana 6/85	198	22/07/85	50:36:42N	0:00:00E	10.72
Cirolana 6/85	199	22/07/85	50:52:06N	1:00:06E	8.13
Clione 4/85	4	19/03/85	51:00:00N	1:18:42E	4.95
Clione 4/85	5	20/03/85	50:50:18N	1:00:00E	4.48
Clione 4/85	78	01/04/85	50:52:36N	1:00:00E	9.02
Clione 4/85	79	01/04/85	51:00:00N	1:14:30E	5.45
Clione 5/85	154	28/04/85	50:52:48N	1:00:00E	13.80
Clione 5/85	155	28/04/85	51:00:00N	1:14:42E	8.75
Clione 7/85	3	07/06/85	51:00:00N	1:19:00E	10.44
Clione 7/85	4	07/06/85	50:50:00N	1:00:00E	6.05

Annex 1.5 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Hinkley Point, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Cirolana 1/78	18	09/01/78	50:30:00N	6:00:00W	13.25
Cirolana 1/78	19	09/01/78	51:00:00N	6:00:00W	8.92
Cirolana 1/78	20	09/01/78	51:30:00N	6:00:00W	11.43
Cirolana 5/78	25	11/05/78	50:30:00N	6:00:00W	12.84
Cirolana 5/78	26	11/05/78	51:03:06N	6:14:54W	14.54
Cirolana 5/78	27	11/05/78	51:25:00N	6:00:00W	16.35
Cirolana 4/79	17	13/04/79	50:30:00N	5:30:00W	11.49
Cirolana 4/79	18	13/04/79	51:00:00N	5:00:00W	10.81
Cirolana 4/79	19	13/04/79	51:00:00N	6:00:00W	14.11
Cirolana 4/79	43	16/04/79	51:30:00N	6:00:00W	15.54
Corella 4/80	14	20/03/80	50:30:00N	5:54:30W	14.62
Corella 4/80	15	21/03/80	51:00:00N	5:57:18W	13.00
Corella 4/80	16	21/03/80	51:30:00N	5:52:00W	11.36
Corella 5/80	13	13/04/80	50:30:00N	6:00:00W	11.82
Corella 5/80	14	13/04/80	51:06:00N	6:00:00W	13.10
Corella 5/80	15	13/04/80	51:30:09N	5:57:27W	11.98
Corella 4/81	13	10/03/81	50:30:00N	6:00:00W	10.19
Corella 4/81	14	10/03/81	51:00:00N	6:00:00W	11.81
Corella 4/81	15	10/03/81	51:30:00N	6:00:00W	54.30
Cirolana 5/82	29	18/05/82	50:30:00N	6:40:00W	12.64
Cirolana 5/82	30	18/05/82	51:00:00N	6:30:00W	12.10
Cirolana 5/82	31	19/05/82	51:30:00N	6:15:00W	14.42
Corella 15/82	13	05/11/82	50:30:00N	6:00:00W	7.60
Corella 15/82	14	05/11/82	51:00:00N	6:00:00W	13.48
Corella 15/82	15	05/11/82	51:30:36N	6:00:18W	11.14
Corella 15/82	84	16/11/82	51:29:54N	6:30:06W	13.56
Corella 15/82	85	16/11/82	50:59:48N	6:19:12W	13.35
Cirolana 9/83	136	16/10/83	51:30:00N	6:00:00W	12.97
Cirolana 9/83	137	16/10/83	51:00:00N	6:00:12W	15.95
Cirolana 9/83	138	17/10/83	50:30:00N	5:59:54W	16.02
Clione 9/83	9	10/07/83	50:48:12N	5:32:42W	4.69
Clione 9/83	12	10/07/83	50:52:24N	6:05:42W	6.39
Clione 9/83	15	11/07/83	51:08:36N	5:44:18W	7.61
Clione 9/83	17	12/07/83	51:30:54N	5:55:18W	9.88
Clione 9/83	18	12/07/83	51:13:00N	6:13:48W	10.13
Clione 13/84	13	08/11/84	50:30:06N	6:00:06W	6.85
Clione 13/84	14	08/11/84	51:00:00N	6:00:00W	9.69
Clione 13/84	15	08/11/84	51:29:54N	6:00:39W	10.06
Clione 4/85	10	22/03/85	50:30:00N	5:46:18W	2.49
Clione 4/85	11	22/03/85	51:00:00N	5:47:54W	4.21
Clione 4/85	72	30/03/85	51:00:00N	6:06:42N	8.09
Clione 4/85	73	31/03/85	50:30:00N	6:04:30W	5.32
Clione 5/85	147	26/04/85	51:00:00N	5:58:30W	4.39
Clione 5/85	148	26/04/85	50:30:00N	5:52:54W	4.37
Clione 7/85	10	09/06/85	50:30:00N	6:00:00W	3.89
Clione 7/85	46	14/06/85	51:00:00N	6:00:00W	7.57
Clione 2/86	21	28/01/86	51:00:00N	6:00:00W	4.89
Clione 2/86	22	28/01/86	50:30:00N	6:00:06W	6.06
Clione 2/86	1	25/01/86	51:30:00N	5:52:12W	6.42
Clione 5/86	11	09/04/86	50:30:00N	5:50:30W	6.89
Clione 5/86	12	09/04/86	51:00:00N	5:52:00W	7.42
Clione 5/86	13	09/04/86	51:30:00N	5:34:00W	10.40
Clione 5/86	149	19/04/86	51:30:03N	5:59:54W	4.89
Clione 5/86	150	19/04/86	51:00:00N	6:00:09W	6.22
Clione 5/87	13	09/04/87	50:30:00N	6:00:06W	11.74
Clione 5/87	14	09/04/87	51:00:00N	6:00:00W	9.51
Clione 5/87	15	09/04/87	51:30:00N	6:00:00W	11.22
Corella 1/88	13	04/03/88	50:29:59N	6:00:00W	6.91
Corella 1/88	14	04/03/88	51:00:00N	5:59:50W	6.41
Corella 1/88	15	04/03/88	51:30:00N	5:59:57W	5.58

Annex 1.6 Background concentrations of caesium-137 in filtered sea water (Bq m^{-3}) in the vicinity of Hunterston, obtained by dedicated cruises using MAFF research vessels

Cruise	Station no.	Collection date	Position		Cs-137
			Latitude	Longitude	
Challenger 1/88	1	26/10/88	54:39:54N	5:20:12W	117.30
Challenger 1/88	3	30/10/88	55:18:03N	4:59:59W	114.21
Challenger 1/88	5	30/10/88	55:53:59N	4:55:07W	125.72
Corella 1/88	86	09/03/88	54:50:00N	5:35:00W	97.82
Corella 1/88	87	09/03/88	54:50:00N	5:16:00W	114.60
Corella 1/88	88	09/03/88	55:00:00N	5:17:06W	147.54
Corella 1/88	89	09/03/88	55:00:00N	5:35:05W	106.89
Corella 1/88	90	09/03/88	55:00:00N	5:52:00W	101.36
Challenger /89	35	11/12/89	54:47:00N	5:24:24W	130.15
Challenger /89	36	11/12/89	54:57:00N	5:33:00W	128.14
Challenger /89	37	11/12/89	55:16:00N	5:51:48W	102.21
Challenger /89	40	12/12/89	54:32:00N	5:07:00W	166.44
Corystes 3/89	91	28/02/89	54:50:00N	5:35:00W	52.41
Corystes 3/89	92	28/02/89	54:50:00N	5:16:00W	70.47
Corystes 3/89	93	28/02/89	55:00:00N	5:17:45W	83.71
Corystes 3/89	94	28/02/89	54:59:57N	5:34:45W	40.56
Corystes 3/89	95	28/02/89	55:00:03N	5:51:54W	22.93
Corystes 3/89	112	03/03/89	55:15:00N	6:00:06W	30.69
Cirolana 8/89	162	21/10/89	54:59:54N	5:51:48W	29.02
Cirolana 8/89	163	21/10/89	54:59:36N	5:34:45W	42.12
Cirolana 8/89	164	21/10/89	55:00:06N	5:16:48W	57.61

ANNEX 2. CAESIUM-137 DISCHARGED TO SEA FROM UK NUCLEAR SITES

Annex 2.1 Caesium-137 discharged to sea from BNFL Sellafield. Based on isotopic analyses of monthly bulked effluent samples

1991				
Month	No. of days in period	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
Jan-91	31	997	0.032	6782
Feb-91	28	1979	0.071	6782
Mar-91	31	810	0.026	6782
Apr-91	30	840	0.028	6782
May-91	31	2935	0.095	6782
Jun-91	30	1168	0.039	6782
Jul-91	31	732	0.024	6782
Aug-91	31	892	0.029	6782
Sep-91	30	480	0.016	6782
Oct-91	31	1288	0.042	6782
Nov-91	30	2396	0.080	6782
Dec-91	31	1051	0.034	6782
1st Quarter	90	3786	0.042	
2nd Quarter	91	4943	0.054	
3rd Quarter	92	2104	0.023	
4th Quarter	92	4735	0.051	
Annual	365	15568	0.043	

1990				
Month	No. of days in period	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
Jan-90	31	692	0.022	6782
Feb-90	28	1199	0.043	6782
Mar-90	31	1573	0.051	6782
Apr-90	30	812	0.027	6782
May-90	31	552	0.018	6782
Jun-90	30	2042	0.068	6782
Jul-90	31	1692	0.055	6782
Aug-90	31	1857	0.060	6782
Sep-90	30	1969	0.066	6782
Oct-90	31	6398	0.206	6782
Nov-90	30	1353	0.045	6782
Dec-90	31	3306	0.107	6782
1st Quarter	90	3464	0.038	
2nd Quarter	91	3406	0.037	
3rd Quarter	92	5518	0.060	
4th Quarter	92	11057	0.120	
Annual	365	23445	0.064	

1989				
Month	No. of days in period	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
Jan-89	31	736	0.024	5303
Feb-89	28	1415	0.051	5303
Mar-89	31	2729	0.088	5303
Apr-89	30	1615	0.054	5303
May-89	31	6188	0.200	5303
Jun-89	30	3537	0.118	5303
Jul-89	31	1680	0.054	5303
Aug-89	31	3430	0.111	5303
Sep-89	30	2617	0.087	5303
Oct-89	31	1444	0.047	5303
Nov-89	30	2392	0.080	5303
Dec-89	31	781	0.025	5303
1st Quarter	90	4880	0.054	
2nd Quarter	91	11340	0.125	
3rd Quarter	92	7727	0.084	
4th Quarter	92	4617	0.050	
Annual	365	28564	0.078	

1988				
Month	No. of days in period	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
Jan-88	31	819	0.026	5303
Feb-88	29	922	0.032	5303
Mar-88	31	810	0.026	5303
Apr-88	30	1076	0.036	5303
May-88	31	1920	0.062	5303
Jun-88	30	1220	0.041	5303
Jul-88	31	2072	0.067	5303
Aug-88	31	1287	0.042	5303
Sep-88	30	987	0.033	5303
Oct-88	31	990	0.032	5303
Nov-88	30	595	0.020	5303
Dec-88	31	555	0.018	5303
1st Quarter	91	2551	0.028	
2nd Quarter	91	4216	0.046	
3rd Quarter	92	4346	0.047	
4th Quarter	92	2140	0.023	
Annual	366	13253	0.036	

Annex 2.1 continued. ***Caesium-137 discharged to sea from BNFL Sellafield. Based on isotopic analyses of monthly bulked effluent samples***

1987

Month	No. of days in period	Caesium-137 discharged (GBq)	Caesium-137 discharged (TBq day^{-1})	FLR no.
Jan-87	31	1106.0	0.036	5303
Feb-87	28	1319.0	0.047	5303
Mar-87	31	691.0	0.022	5303
Apr-87	30	591.0	0.020	5303
May-87	31	579.0	0.019	5303
Jun-87	30	492.0	0.016	5303
Jul-87	31	867.0	0.028	5303
Aug-87	31	1677.7	0.054	5303
Sep-87	30	1255.0	0.042	5303
Oct-87	31	909.5	0.029	5303
Nov-87	30	1057.5	0.035	5303
Dec-87	31	1254.4	0.040	5303
1st Quarter	90	3116.0	0.035	
2nd Quarter	91	1662.0	0.018	
3rd Quarter	92	3799.7	0.041	
4th Quarter	92	3221.4	0.035	
Annual	365	11799.1	0.032	

1986

Month	No. of days in period	Caesium-137 discharged (GBq)	Caesium-137 discharged (TBq day^{-1})	FLR no.
Jan-86	31	1070	0.035	5303
Feb-86	28	980	0.035	5303
Mar-86	31	3080	0.099	5303
Apr-86	30	1140	0.038	5303
May-86	31	1510	0.049	5303
Jun-86	30	1800	0.060	5303
Jul-86	31	877	0.028	5303
Aug-86	31	688	0.022	5303
Sep-86	30	1444	0.048	5303
Oct-86	31	2264	0.073	5303
Nov-86	30	1774	0.059	5303
Dec-86	31	1259	0.041	5303
1st Quarter	90	5130	0.057	
2nd Quarter	91	4450	0.049	
3rd Quarter	92	3009	0.033	
4th Quarter	92	5297	0.058	
Annual	365	17886	0.049	

1985

Month	No. of days in period	Caesium-137 discharged (GBq)	Caesium-137 discharged (TBq day^{-1})	FLR no.
Jan-85	31	36950	1.192	4453
Feb-85	28	36220	1.294	4453
Mar-85	31	56030	1.807	4453
Apr-85	30	79770	2.659	4453
May-85	31	61350	1.979	5303
Jun-85	30	10860	0.362	5303
Jul-85	31	7760	0.250	5303
Aug-85	31	9240	0.298	5303
Sep-85	30	8140	0.271	5303
Oct-85	31	8790	0.284	5303
Nov-85	30	5970	0.199	5303
Dec-85	31	4000	0.129	5303
1st Quarter	90	129200	1.436	
2nd Quarter	91	151980	1.670	
3rd Quarter	92	25140	0.273	
4th Quarter	92	18760	0.204	
Annual	365	325080	0.891	

1984

Month	No. of days in period	Caesium-137 discharged (Ci)	Caesium-137 discharged (GBq)	Caesium-137 discharged (TBq day^{-1})	FLR no.
Jan-84	31	1445	53465	1.725	4453
Feb-84	29	939	34743	1.198	4453
Mar-84	31	632	23384	0.754	4453
Apr-84	30	610	22570	0.752	4453
May-84	31	839	31043	1.001	4453
Jun-84	30	679	25123	0.837	4453
Jul-84	31	735	27195	0.877	4453
Aug-84	31	943	34891	1.126	4453
Sep-84	30	1547	57239	1.908	4453
Oct-84	31	1464	54168	1.747	4453
Nov-84	30	985	36445	1.215	4453
Dec-84	31	903	33411	1.078	4453
1st Quarter	91	3016	111592	1.226	
2nd Quarter	91	2128	78736	0.865	
3rd Quarter	92	3225	119325	1.297	
4th Quarter	92	3352	124024	1.348	
Annual	366	11721	433677	1.185	

Annex 2.1 continued. Caesium-137 discharged to sea from BNFL Sellafield. Based on isotopic analyses of monthly bulked effluent samples

1983

Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-83	31	3704	137048	4.421	4453
Feb-83	28	3380	125060	4.466	4453
Mar-83	31	3882	143634	4.633	4453
Apr-83	30	2557	94609	3.154	4453
May-83	31	2108	77996	2.516	4453
Jun-83	30	2797	103489	3.450	4453
Jul-83	31	2678	99086	3.196	4453
Aug-83	31	3048	112776	3.638	4453
Sep-83	30	3437	127169	4.239	4453
Oct-83	31	2559	94683	3.054	4453
Nov-83	30	1394	51578	1.719	4453
Dec-83	31	895	33115	1.068	4453
1st Quarter	90	10966	405742	4.508	
2nd Quarter	91	7462	276094	3.034	
3rd Quarter	92	9163	339031	3.685	
4th Quarter	92	4848	179376	1.950	
Annual	365	32439	1200243	3.288	

1982

Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-82	31	4673	172901	5.577	4453
Feb-82	28	4035	149295	5.332	4453
Mar-82	31	4245	157065	5.067	4453
Apr-82	30	4229	156473	5.216	4453
May-82	31	4262	157694	5.087	4453
Jun-82	30	4768	176416	5.881	4453
Jul-82	31	4921	182077	5.873	4453
Aug-82	31	5230	193510	6.242	4453
Sep-82	30	4331	160247	5.342	4453
Oct-82	31	4432	163984	5.290	4453
Nov-82	30	5104	188848	6.295	4453
Dec-82	31	3830	141710	4.571	4453
1st Quarter	90	12953	479261	5.325	
2nd Quarter	91	13259	490583	5.391	
3rd Quarter	92	14482	535834	5.824	
4th Quarter	92	13366	494542	5.375	
Annual	365	54060	2000220	5.480	

1981

Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-81	31	4238	156806	5.058	4453
Feb-81	28	4078	150886	5.389	4453
Mar-81	31	5185	191845	6.189	4453
Apr-81	30	5944	219928	7.331	4453
May-81	31	5236	193732	6.249	4453
Jun-81	30	6457	238909	7.964	4453
Jul-81	31	6240	230880	7.448	4453
Aug-81	31	7714	285418	9.207	4453
Sep-81	30	6018	222666	7.422	4453
Oct-81	31	4194	155178	5.006	4453
Nov-81	30	4242	156954	5.232	4453
Dec-81	31	4149	153513	4.952	4453
1st Quarter	90	13501	499537	5.550	
2nd Quarter	91	17637	652569	7.171	
3rd Quarter	92	19972	738964	8.032	
4th Quarter	92	12585	465645	5.061	
Annual	365	63695	2356715	6.457	

1980

Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-80	31	5245	194065	6.260	4453
Feb-80	29	5287	195619	6.745	4453
Mar-80	31	6165	228105	7.358	4453
Apr-80	30	12063	446331	14.878	4453
May-80	31	8677	321049	10.356	4453
Jun-80	30	9706	359122	11.971	4453
Jul-80	31	6963	257631	8.311	4453
Aug-80	31	5029	186073	6.002	4453
Sep-80	30	7109	263033	8.768	4453
Oct-80	31	5093	188441	6.079	4453
Nov-80	30	4310	159470	5.316	4453
Dec-80	31	4516	167092	5.390	4453
1st Quarter	91	16697	617789	6.789	
2nd Quarter	91	30446	1126502	12.379	
3rd Quarter	92	19101	706737	7.682	
4th Quarter	92	13919	515003	5.598	
Annual	366	80163	2966031	8.104	

Annex 2.1 continued. Caesium-137 discharged to sea from BNFL Sellafield. Based on isotopic analyses of monthly bulked effluent samples

1979					
Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-79	31	5512	203944	6.579	4453
Feb-79	28	5485	202945	7.248	4453
Mar-79	31	6178	228586	7.374	4453
Apr-79	30	4673	172901	5.763	4453
May-79	31	5842	216154	6.973	4453
Jun-79	30	7216	266992	8.900	4453
Jul-79	31	6504	240648	7.763	4453
Aug-79	31	4674	172938	5.579	4453
Sep-79	30	6312	233544	7.785	4453
Oct-79	31	7569	280053	9.034	4453
Nov-79	30	4857	179709	5.990	4453
Dec-79	31	4433	164021	5.291	4453
1st Quarter	90	17175	635475	7.061	
2nd Quarter	91	17731	656047	7.209	
3rd Quarter	92	17490	647130	7.034	
4th Quarter	92	16859	623783	6.780	
Annual	365	69255	2562435	7.020	

1978					
Month	No. of days in period	Caesium-137 discharged (Ci)	(GBq)	(TBq day^{-1})	FLR no.
Jan-78	31	5100	188700	6.087	4453
Feb-78	28	5673	209901	7.496	4453
Mar-78	31	8659	320383	10.335	4453
Apr-78	30	8062	298294	9.943	4453
May-78	31	8563	316831	10.220	4453
Jun-78	30	7166	265142	8.838	4453
Jul-78	31	10859	401783	12.961	4453
Aug-78	31	9197	340289	10.977	4453
Sep-78	30	9235	341695	11.390	4453
Oct-78	31	16858	623746	20.121	4453
Nov-78	30	13004	481148	16.038	4453
Dec-78	31	8107	299959	9.676	4453
1st Quarter	90	19432	718984	7.989	
2nd Quarter	91	23791	880267	9.673	
3rd Quarter	92	29291	1083767	11.780	
4th Quarter	92	37969	1404853	15.270	
Annual	365	110483	4087871	11.200	

Annex 2.2 Caesium-137 discharged to sea from AEA Technology, Dounreay. Based on isotopic analyses of monthly bulked effluent samples

Year/ Month	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1991			
Jan-91	168.4	0.00543	6603
Feb-91	190.9	0.00682	6603
Mar-91	629.9	0.02032	6603
Apr-91	637.3	0.02124	6603
May-91	233.9	0.00755	6603
Jun-91	457.2	0.01524	6603
Jul-91	898.7	0.02899	6603
Aug-91	89.6	0.00289	6603
Sep-91	63	0.00210	6603
Oct-91	18.4	0.00059	6603
Nov-91	56.6	0.00189	6603
Dec-91	87	0.00281	6603
Annual	3530.9	0.00967	
1990			
Jan-90	4	0.00013	6603
Feb-90	137.3	0.00490	6603
Mar-90	393.8	0.01270	6603
Apr-90	573.9	0.01913	6603
May-90	571.4	0.01843	6603
Jun-90	61.1	0.00204	6603
Jul-90	119.9	0.00387	6603
Aug-90	8.7	0.00028	6603
Sep-90	7.1	0.00024	6603
Oct-90	160.2	0.00517	6603
Nov-90	96.6	0.00322	6603
Dec-90	115.4	0.00372	6603
Annual	2249.4	0.00616	
1989			
Jan-89	564.20	0.01612	
Feb-89	251.52	0.00898	See below
Mar-89	196.04	0.00700	New Discharge
Apr-89	4.60	0.00016	Return Form
May-89	106.46	0.00304	
Jun-89	135.30	0.00467	
Jul-89	159.7	0.00515	5213
Aug-89	213.9	0.00690	5213
Sep-89	609.6	0.02032	5213
Oct-89	663.4	0.02140	6603
Nov-89	186.7	0.00622	6603
Dec-89	3.8	0.00012	6603
Annual	3095.2	0.00848	

Annex 2.2 continued. Caesium-137 discharged to sea from AEA Technology, Dounreay. Based on isotopic analyses of monthly bulked effluent samples

Year/ Month	No. of discharges	Inclusive dates from:-	to:-	No. of days in period	Volume (litres)	Caesium-137 discharged (Bq litre^{-1})	(GBq)	(TBq day^{-1})	FLR no.
1989									
Jan-89	69	01/01/89	04/02/89	35	1.300E+7	4.340E+4	564.2	0.01612	5213
Feb-89	53	05/02/89	04/03/89	28	9.080E+6	2.770E+4	251.5	0.00898	5213
Mar-89	37	05/03/89	01/04/89	28	5.995E+6	3.270E+4	196.0	0.00700	5213
Apr-89	35	02/04/89	29/04/89	28	5.980E+6	7.690E+2	4.6	0.00016	5213
May-89	44	30/04/89	03/06/89	35	6.654E+6	1.600E+4	106.5	0.00304	5213
Jun-89	30	04/06/89	02/07/89	29	4.215E+6	3.210E+4	135.3	0.00467	5213
Jul-89									
Aug-89									
Sep-89								See above	
Oct-89									
Nov-89									
Dec-89									
1988									
Jan-88	55	03/01/88	30/01/88	28	1.112E+7	1.530E+5	1700.7	0.06074	5213
Feb-88	68	31/01/88	05/03/88	35	1.157E+7	6.240E+4	721.7	0.02062	5213
Mar-88	52	06/03/88	02/04/88	28	6.962E+6	2.950E+4	205.4	0.00733	5213
Apr-88	33	03/04/88	30/04/88	28	5.685E+6	8.270E+3	47.0	0.00168	5213
May-88	69	01/05/88	04/06/88	35	1.181E+7	4.490E+3	53.0	0.00151	5213
Jun-88	54	05/06/88	02/07/88	28	1.150E+7	1.790E+4	205.8	0.00735	5213
Jul-88	59	03/07/88	30/07/88	28	1.229E+7	1.480E+4	181.8	0.00649	5213
Aug-88	68	31/07/88	03/09/88	35	1.294E+7	1.350E+4	174.7	0.00499	5213
Sep-88	58	04/09/88	01/10/88	28	1.307E+7	6.860E+3	89.7	0.00320	5213
Oct-88	73	02/10/88	05/11/88	35	1.515E+7	8.950E+3	135.6	0.00387	5213
Nov-88	60	06/11/88	03/12/88	28	1.261E+7	1.910E+4	240.9	0.00860	5213
Dec-88	56	04/12/88	31/12/88	28	1.160E+7	2.740E+4	317.8	0.01135	5213
Annual	705			364	1.363E+8		4074.1	0.01119	
1987									
Jan-87	37	04/01/87	31/01/87	28	5.580E+6	6.000E+4	334.8	0.01196	5213
Feb-87	48	01/02/87	28/02/87	28	7.670E+6	3.810E+3	29.2	0.00104	5213
Mar-87	71	01/03/87	04/04/87	35	1.271E+7	2.560E+4	325.4	0.00930	5213
Apr-87	53	05/04/87	02/05/87	28	7.250E+6	6.480E+3	47.0	0.00168	5213
May-87	56	03/05/87	30/05/87	28	7.900E+6	8.800E+4	695.2	0.02483	5213
Jun-87	68	31/05/87	04/07/87	35	1.146E+7	1.120E+5	1283.5	0.03667	5213
Jul-87	52	05/07/87	01/08/87	28	8.340E+6	5.200E+4	433.7	0.01549	5213
Aug-87	72	02/08/87	05/09/87	35	1.321E+7	6.640E+4	877.1	0.02506	5213
Sep-87	54	06/09/87	03/10/87	28	9.537E+6	4.350E+4	414.9	0.01482	5213
Oct-87	56	04/10/87	31/10/87	28	1.047E+7	6.320E+3	66.2	0.00236	5213
Nov-87	68	01/11/87	05/12/87	35	1.195E+7	3.930E+4	469.8	0.01342	5213
Dec-87	50	06/12/87	02/01/88	28	8.436E+6	1.110E+5	936.4	0.03344	5213
Annual	685			364	1.145E+8		5913.1	0.01624	

Annex 2.2 continued. Caesium-137 discharged to sea from AEA Technology, Dounreay. Based on isotopic analyses of monthly bulked effluent samples

Year/ Month	No. of discharges	Inclusive dates from:-	to:-	No. of days in period	Volume (litres)	Caesium-137 discharged (nCi litre^{-1})	(GBq)	(TBq day^{-1})	FLR no.
1986									
Jan-86	52	05/01/86	01/02/86	28	9.268E+6	4018	1377.8	0.04921	5213
Feb-86	46	02/02/86	01/03/86	28	6.077E+6	5180	1164.7	0.04160	5213
Mar-86	61	02/03/86	05/04/86	35	8.118E+6	405	121.6	0.00348	5213
Apr-86	31	06/04/86	03/05/86	28	4.058E+6	60	9.0	0.00032	5213
May-86	49	04/05/86	31/05/86	28	6.263E+6	14	3.2	0.00012	5213
Jun-86	62	01/06/86	05/07/86	35	8.346E+6	320	98.8	0.00282	5213
Jul-86	46	06/07/86	02/08/86	28	7.369E+6	2060	561.7	0.02006	5213
Aug-86	45	03/08/86	30/08/86	28	5.349E+6	1180	233.5	0.00834	5213
Sep-86	59	01/09/86	04/10/86	34	1.049E+7	1535.4	595.7	0.01752	5213
Oct-86	48	05/10/86	01/11/86	28	7.921E+6	2752	806.5	0.02881	5213
Nov-86	54	02/11/86	29/11/86	28	9.333E+6	2036	703.1	0.02511	5213
Dec-86	66	30/11/86	03/01/87	35	1.190E+7	960	422.7	0.01208	5213
Annual	619			363	9.449E+7		6098.5	0.01680	
1985									
Jan-85	57	06/01/85	02/02/85	28	1.086E+7	1370	550.7	0.01967	4513
Feb-85	50	03/02/85	02/03/85	28	8.642E+6	1710	546.8	0.01953	4513
Mar-85	54	03/03/85	30/03/85	28	7.946E+6	1420	417.5	0.01491	5213
Apr-85	70	31/03/85	04/05/85	35	1.243E+7	1581	726.9	0.02077	5213
May-85	54	05/05/85	01/06/85	28	7.931E+6	370	108.6	0.00388	5213
Jun-85	55	02/06/85	29/06/85	28	1.054E+7	991	386.4	0.01380	5213
Jul-85	68	30/06/85	03/08/85	35	1.250E+7	380	175.8	0.00502	5213
Aug-85	58	04/08/85	31/08/85	28	1.010E+7	1378	514.9	0.01839	5213
Sep-85	69	01/09/85	05/10/85	35	1.191E+7	1370	603.6	0.01724	5213
Oct-85	54	06/10/85	02/11/85	28	7.972E+6	6300	1858.3	0.06637	5213
Nov-85	57	03/11/85	30/11/85	28	1.188E+7	4374	1922.1	0.06865	5213
Dec-85	64	01/12/85	04/01/86	35	1.168E+7	8829	3816.5	0.10904	5213
Annual	710			364	1.244E+8		11628.0	0.03195	
1984									
Jan-84	71	01/01/84	04/02/84	35	1.200E+7	9300	4129.2	0.11798	4513
Feb-84	53	05/02/84	03/03/84	28	9.179E+6	4300	1460.4	0.05216	4513
Mar-84	54	04/03/84	31/03/84	28	9.996E+6	11600	4290.3	0.15322	4513
Apr-84	68	01/04/84	05/05/84	35	1.202E+7	10900	4846.1	0.13846	4513
May-84	54	06/05/84	02/06/84	28	8.735E+6	10550	3409.7	0.12178	4513
Jun-84	54	03/06/84	30/06/84	28	7.848E+6	7840	2276.5	0.08131	4513
Jul-84	68	01/07/84	04/08/84	35	1.177E+7	530	230.8	0.00659	4513
Aug-84	54	05/08/84	01/09/84	28	8.806E+6	900	293.2	0.01047	4513
Sep-84	55	02/09/84	29/09/84	28	9.433E+6	1190	415.3	0.01483	4513
Oct-84	76	30/09/84	03/11/84	35	1.501E+7	1360	755.5	0.02159	4513
Nov-84	57	04/11/84	01/12/84	28	1.050E+7	390	151.5	0.00541	4513
Dec-84	70	02/12/84	05/01/85	35	1.074E+7	1460	580.1	0.01657	4513
Annual	734			371	1.260E+8		22838.6	0.06156	

Annex 2.2 continued. Caesium-137 discharged to sea from AEA Technology, Dounreay. Based on isotopic analyses of monthly bulked effluent samples

Year/ Month	No. of discharges	Inclusive dates from:-	to:-	No. of days in period	Volume (litres)	Caesium-137 discharged (nCi litre^{-1})	(GBq)	(TBq day^{-1})	FLR no.
1983									
Jan-83	61	02/01/83	05/02/83	35	1.172E+7	9200	3988.1	0.11395	4513
Feb-83	47	06/02/83	05/03/83	28	8.801E+6	2200	716.4	0.02559	4513
Mar-83	44	06/03/83	02/04/83	28	8.159E+6	2000	603.8	0.02156	4513
Apr-83	40	03/04/83	30/04/83	28	7.046E+6	410	106.9	0.00382	4513
May-83	51	01/05/83	04/06/83	35	8.623E+6	2100	670.0	0.01914	4513
Jun-83	36	05/06/83	02/07/83	28	6.361E+6	280	65.9	0.00235	4513
Jul-83	46	03/07/83	30/07/83	28	7.530E+6	165	46.0	0.00164	4513
Aug-83	66	31/07/83	03/09/83	35	1.070E+7	11000	4354.9	0.12443	4513
Sep-83	51	04/09/83	01/10/83	28	7.820E+6	11400	3298.5	0.11780	4513
Oct-83	68	02/10/83	05/11/83	35	1.080E+7	10000	3996.0	0.11417	4513
Nov-83	54	06/11/83	03/12/83	28	8.700E+6	10000	3219.0	0.11496	4513
Dec-83	54	04/12/83	31/12/83	28	9.031E+6	6300	2105.1	0.07518	4513
Annual	618			364	1.053E+8		23170.6	0.06366	
1982									
Jan-82	54	03/01/82	30/01/82	28	1.100E+7	3600	1465.2	0.05233	4513
Feb-82	43	31/01/82	27/02/82	28	7.179E+6	3390	900.5	0.03216	4513
Mar-82	65	28/02/82	03/04/82	35	1.150E+7	6700	2850.9	0.08145	4513
Apr-82	51	04/04/82	01/05/82	28	9.145E+6	2900	981.3	0.03504	4513
May-82	54	02/05/82	29/05/82	28	1.030E+7	2300	876.5	0.03130	4513
Jun-82	61	30/05/82	03/07/82	35	1.100E+7	1700	691.9	0.01977	4513
Jul-82	52	04/07/82	31/07/82	28	1.010E+7	2300	859.5	0.03070	4513
Aug-82	71	01/08/82	04/09/82	35	1.400E+7	3000	1554.0	0.04440	4513
Sep-82	57	05/09/82	02/10/82	28	1.155E+7	3300	1409.6	0.05034	4513
Oct-82	39	03/10/82	30/10/82	28	7.420E+6	170	46.7	0.00167	4513
Nov-82	61	31/10/82	04/12/82	35	1.224E+7	1610	729.3	0.02084	4513
Dec-82	48	05/12/82	01/01/83	28	9.941E+6	190	69.9	0.00250	4513
Annual	656			364	1.254E+8		12435.2	0.03416	

Annex 2.3 Caesium-137 discharged to sea from Nuclear Electric plc, Berkeley. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (kBq m^{-3})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1986									
1st	01/01/86	31/03/86	90	14/02/86	14600	2462	35.95	0.000399	5167
2nd	01/04/86	30/06/86	91	15/05/86	18500	2346	43.40	0.000477	5167
3rd	01/07/86	30/09/86	92	15/08/86	20400	2447	49.92	0.000543	5167
4th	01/10/86	31/12/86	92	15/11/86	18200	2401	43.70	0.000475	5167
Annual			365			9656	172.96	0.000474	
1985									
1st	01/01/85	31/03/85	90	15/02/85	18300	2388	43.70	0.000486	5167
2nd	01/04/85	30/06/85	91	15/05/85	16000	2496	39.94	0.000439	5167
3rd	01/07/85	30/09/85	92	15/08/85	15400	1961	30.20	0.000328	5167
4th	01/10/85	31/12/85	92	15/11/85	10800	1950	21.06	0.000229	5167
Annual			365			8795	134.90	0.000370	
1984									
1st	01/01/84	31/03/84	91	15/02/84	14100	2854	40.24	0.000442	4317
2nd	01/04/84	30/06/84	91	15/05/84	12000	1862	22.34	0.000246	4317
3rd	01/07/84	30/09/84	92	15/08/84	17900	2223	39.79	0.000433	4317
4th	01/10/84	31/12/84	92	15/11/84	38000	3136	119.17	0.001295	5167
Annual			366			10075	221.55	0.000605	
1983									
1st	01/1/83	31/03/83	90	15/02/83	24470	3232	79.09	0.000879	4317
2nd	01/4/83	30/06/83	91	15/05/83	19350	2480	47.99	0.000527	4317
3rd	01/7/83	30/09/83	92	15/08/83	29000	2852	82.71	0.000899	4317
4th	01/10/83	31/12/83	92	15/11/83	23000	3312	76.18	0.000828	4317
Annual			365			11876	285.96	0.000783	
1982									
1st	01/01/82	31/03/82	90	14/02/82	16600	2879	47.79	0.000531	4317
2nd	01/04/82	30/06/82	91	15/05/82	35910	3067	110.14	0.001210	4317
3rd	01/07/82	30/09/82	92	15/08/82	23120	2612	60.39	0.000656	4317
4th	01/10/82	31/12/82	92	15/11/82	25910	3535	91.59	0.000996	4317
Annual			365			12093	309.91	0.000849	
1981									
1st	01/01/81	31/03/81	90	15/02/81	80080	3544	283.80	0.003153	4317
2nd	01/04/81	30/06/81	91	15/05/81	42800	3235	138.46	0.001522	4317
3rd	01/07/81	30/09/81	92	15/08/81	35100	3729	130.89	0.001423	4317
4th	01/10/81	31/12/81	92	15/11/81	25570	3336	85.30	0.000927	4317
Annual			365			13844	638.45	0.001749	
1980									
1st	01/01/80	31/03/80	91	15/02/80	58090	3703	215.11	0.002364	4317
2nd	01/04/80	30/06/80	91	15/05/80	77700	3470	269.62	0.002963	4317
3rd	01/07/80	30/09/80	92	15/08/80	78995	2948	232.88	0.002531	4317
4th	01/10/80	31/12/80	92	15/11/80	89700	3558	319.15	0.003469	4317
Annual			366			13679	1036.76	0.002833	

Annex 2.4 Caesium-137 discharged to sea from Nuclear Electric plc, Oldbury. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (kBq m^{-3})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1986									
1st	01/01/86	31/03/86	90	14/02/86	7590	4413	33.49	0.0003722	5362
2nd	01/04/86	30/06/86	91	15/05/86	6480	4476	29.00	0.0003187	5362
3rd	01/07/86	30/09/86	92	15/08/86	6100	4908	29.94	0.0003254	5362
4th	01/10/86	31/12/86	92	15/11/86	3260	6646	21.67	0.0002355	5362
Annual			365			20443	114.10	0.0003126	
1985									
1st	01/01/85	31/03/85	90	15/02/85	27200	4118	112.01	0.0012446	5362
2nd	01/04/85	30/06/85	91	15/05/85	27900	4479	124.96	0.0013732	5362
3rd	01/07/85	30/09/85	92	15/08/85	22800	4924	112.27	0.0012203	5362
4th	01/10/85	31/12/85	92	15/11/85	12200	5147	62.79	0.0006825	5362
Annual			365			18668	412.03	0.0011289	
1984									
1st	01/01/84	31/03/84	91	15/02/84	21200	5509	116.79	0.0012834	4367
2nd	01/04/84	30/06/84	91	15/05/84	26500	3327	88.17	0.0009689	4367
3rd	01/07/84	30/09/84	92	15/08/84	39200	5755	225.60	0.0024521	4367
4th	01/10/84	31/12/84	92	15/11/84	39800	5629	224.03	0.0024352	4367
Annual			366			20220	654.59	0.0017885	
1983									
1st	01/01/83	31/03/83	90	14/02/83	53000	4256	225.57	0.0025063	4367
2nd	01/04/83	30/06/83	91	15/05/83	31050	4949	153.67	0.0016886	4367
3rd	01/07/83	30/09/83	92	15/08/83	24000	6053	145.27	0.0015790	4367
4th	01/10/83	31/12/83	92	15/11/83	28000	4667	130.68	0.0014204	4367
Annual			365			19925	655.18	0.0017950	
1982									
1st	01/01/82	31/03/82	90	14/02/82	22000	4302	94.64	0.0010516	4367
2nd	01/04/82	30/06/82	91	15/05/82	31000	5245	162.60	0.0017868	4367
3rd	01/07/82	30/09/82	92	15/08/82	28000	4506	126.17	0.0013714	4367
4th	01/10/82	31/12/82	92	15/11/82	41000	4201	172.24	0.0018722	4367
Annual			365			18254	555.65	0.0015223	
1981									
1st	01/01/81	31/03/81	90	14/02/81	22000	4545	99.99	0.0011110	4367
2nd	01/04/81	30/06/81	91	15/05/81	39000	5604	218.56	0.0024017	4367
3rd	01/07/81	30/09/81	92	15/08/81	20000	5509	110.18	0.0011976	4367
4th	01/10/81	31/12/81	92	15/11/81	25000	5829	145.73	0.0015840	4367
Annual			365			21487	574.45	0.0015738	
1980									
1st	01/01/80	31/03/80	91	15/02/80	12950	5234	67.78	0.0007448	4367
2nd	01/04/80	30/06/80	91	15/05/80	9990	6650	66.43	0.0007300	4367
3rd	01/07/80	30/09/80	92	15/08/80	11000	6924	76.16	0.0008279	4367
4th	01/10/80	31/12/80	92	15/11/80	12580	5769	72.57	0.0007888	4367
Annual			366			24577	282.95	0.0007731	

Annex 2.5 Caesium-137 discharged to sea from Nuclear Electric plc, Bradwell. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (kBq m^{-3})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1982									
1st	01/01/82	31/03/82	90	14/02/82	32250	4130	133.19	0.001480	4307
2nd	01/04/82	30/06/82	91	15/05/82	33080	4470	147.87	0.001625	4307
3rd	01/07/82	30/09/82	92	15/08/82	30420	4210	128.07	0.001392	4307
4th	01/10/82	31/12/82	92	15/11/82	37330	4300	160.52	0.001745	4307
Annual			365			17110	569.65	0.001561	
1981									
1st	01/01/81	31/03/81	90	14/02/81	92450	4390	405.86	0.004510	4307
2nd	01/04/81	30/06/81	91	15/05/81	93370	5380	502.33	0.005520	4307
3rd	01/07/81	30/09/81	92	15/08/81	133900	3740	500.79	0.005443	4307
4th	01/10/81	31/12/81	92	15/11/81	46880	4100	192.21	0.002089	4307
Annual			365			17610	1601.18	0.004387	
1980									
1st	01/01/80	31/03/80	91	14/02/80	21500	5290	113.74	0.001250	4307
2nd	01/04/80	30/06/80	91	15/05/80	42365	5280	223.69	0.002458	4307
3rd	01/07/80	30/09/80	92	15/08/80	61000	4370	266.57	0.002898	4307
4th	01/10/80	31/12/80	92	15/11/80	107855	4590	495.05	0.005381	4307
Annual			366			19530	1099.05	0.003003	

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (nCi $litre^{-1}$)	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1979									
1st	01/01/79	31/03/79	90	14/02/79	808.2	3780	113.03	0.001256	4307
2nd	01/04/79	30/06/79	91	15/05/79	1050	4190	162.78	0.001789	4307
3rd	01/07/79	30/09/79	92	15/08/79	1650	4130	252.14	0.002741	4307
4th	01/10/79	31/12/79	92	15/11/79	1415	4140	216.75	0.002356	4307
Annual			365			16240	744.70	0.002040	
1978									
1st	01/01/78	31/03/78	90	14/02/78	2600	4260	409.81	0.004553	4307
2nd	01/04/78	30/06/78	91	15/05/78	2100	4350	338.00	0.003714	4307
3rd	01/07/78	30/09/78	92	15/08/78	1520	4170	234.52	0.002549	4307
4th	01/10/78	31/12/78	92	15/11/78	1495	3860	213.52	0.002321	4307
Annual			365			16640	1195.84	0.003276	

Annex 2.6 Caesium-137 discharged to sea from Nuclear Electric plc, Dungeness 'A'. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (kBq m^{-3})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1985									
1st	01/01/85	31/03/85	90	15/02/85	39600	4254	168.46	0.001872	5347
2nd	01/04/85	30/06/85	91	15/05/85	49600	4797	237.93	0.002615	5347
3rd	01/07/85	30/09/85	92	15/08/85	51500	4821	248.28	0.002699	5347
4th	01/10/85	31/12/85	92	15/11/85	56000	4900	274.40	0.002983	5347
Annual			365			18772	929.07	0.002545	
1984									
1st	01/01/84	31/03/84	91	15/02/84	58100	3090	179.53	0.001973	4327
2nd	01/04/84	30/06/84	91	15/05/84	62300	3717	231.57	0.002545	4327
3rd	01/07/84	30/09/84	92	15/08/84	63400	3772	239.14	0.002599	4327
4th	01/10/84	31/12/84	92	15/11/84	56500	3885	219.50	0.002386	4327
Annual			366			14464	869.75	0.002376	
1983									
1st	01/01/83	31/03/83	90	15/02/83	46000	2968	136.53	0.001517	4327
2nd	01/04/83	30/06/83	91	15/05/83	39170	2996	117.35	0.001290	4327
3rd	01/07/83	30/09/83	92	15/08/83	51000	3361	171.41	0.001863	4327
4th	01/10/83	31/12/83	92	15/11/83	50000	2981	149.05	0.001620	4327
Annual			365			12306	574.34	0.001574	
1982									
1st	01/01/82	31/03/82	90	14/02/82	43000	3320	142.76	0.001586	4327
2nd	01/04/82	30/06/82	91	15/05/82	38000	3580	136.04	0.001495	4327
3rd	01/07/82	30/09/82	92	15/08/82	68000	2566	174.49	0.001897	4327
4th	01/10/82	31/12/82	92	15/11/82	71000	2843	201.85	0.002194	4327
Annual			365			12309	655.14	0.001795	
1981									
1st	01/01/81	31/03/81	90	14/02/81	57000	3420	194.94	0.002166	4327
2nd	01/04/81	30/06/81	91	15/05/81	68000	3330	226.44	0.002488	4327
3rd	01/07/81	30/09/81	92	15/08/81	70000	3140	219.80	0.002389	4327
4th	01/10/81	31/12/81	92	15/11/81	59000	3045	179.66	0.001953	4327
Annual			365			12935	820.84	0.002249	

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (nCi $litre^{-1}$)	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1979									
1st	01/01/79	31/03/79	90	14/02/79	1300	4140	199.13	0.002213	4327
2nd	01/04/79	30/06/79	91	15/05/79	1010	3614	135.06	0.001484	4327
3rd	01/07/79	30/09/79	92	15/08/79	1832	3355	227.42	0.002472	4327
4th	01/10/79	31/12/79	92	15/11/79	1650	3957	241.57	0.002626	4327
Annual			365			15066	803.18	0.002200	

Annex 2.7 Caesium-137 discharged to sea from Nuclear Electric plc, Hinkley Point 'A'. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (kBq m^{-3})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1988									
1st	01/01/88	31/03/88	91	14/02/88	38900	2851	110.90	0.001219	5137
2nd	01/04/88	30/06/88	91	15/05/88	13600	3407	46.34	0.000509	5137
3rd	01/07/88	30/09/88	92	15/08/88	25400	3942	100.13	0.001088	5137
4th	01/10/88	31/12/88	92	15/11/88	12700	3805	48.32	0.000525	5137
Annual			366			14005	305.69	0.000835	
1987									
1st	01/01/87	31/03/87	90	14/02/87	13900	3574	49.68	0.000552	5137
2nd	01/04/87	30/06/87	91	15/05/87	42200	3874	163.48	0.001797	5137
3rd	01/07/87	30/09/87	92	15/08/87	47300	3522	166.59	0.001811	5137
4th	01/10/87	31/12/87	92	15/11/87	75000	3206	240.45	0.002614	5137
Annual			365			14176	620.20	0.001699	
1986									
1st	01/01/86	31/03/86	90	14/02/86	11700	4195	49.08	0.000545	5137
2nd	01/04/86	30/06/86	91	15/05/86	10600	4657	49.36	0.000542	5137
3rd	01/07/86	30/09/86	92	15/08/86	17300	3651	63.16	0.000687	5137
4th	01/10/86	31/12/86	92	15/11/86	10400	3944	41.02	0.000446	5137
Annual			365			16447	202.63	0.000555	
1985									
1st	01/01/85	31/03/85	90	15/02/85	98900	4032	398.76	0.004431	5137
2nd	01/04/85	30/06/85	91	15/05/85	87700	5671	497.35	0.005465	5137
3rd	01/07/85	30/09/85	92	15/08/85	87500	4221	369.34	0.004015	5137
4th	01/10/85	31/12/85	92	15/11/85	47000	4158	195.43	0.002124	5137
Annual			365			18082	1460.88	0.004002	
1984									
1st	01/01/84	31/03/84	91	15/02/84	31100	4911	152.73	0.001678	4347A
2nd	01/04/84	30/06/84	91	15/05/84	38700	4036	156.19	0.001716	4347A
3rd	01/07/84	30/09/84	92	15/08/84	115000	4143	476.45	0.005179	4347A
4th	01/10/84	31/12/84	92	15/11/84	113000	3601	406.91	0.004423	5137
Annual			366			16691	1192.28	0.003258	
1983									
1st	01/01/83	31/03/83	90	15/02/83	21550	4418	95.21	0.001058	4347
2nd	01/04/83	30/06/83	91	15/05/83	16070	4792	77.01	0.000846	4347
3rd	01/07/83	30/09/83	92	15/08/83	46000	3733	171.72	0.001867	4347
4th	01/10/83	31/12/83	92	15/11/83	30000	4786	143.58	0.001561	4347A
Annual			365			17729	487.51	0.001336	
1982									
1st	01/01/82	310/3/82	90	15/02/82	33710	4991.64	168.27	0.001870	4347
2nd	01/04/82	30/06/82	91	15/05/82	29320	4472.8	131.14	0.001441	4347
3rd	01/07/82	30/09/82	92	15/08/82	32830	4976	163.36	0.001776	4347
4th	01/10/82	31/12/82	92	15/11/82	18080	4745	85.79	0.000932	4347
Annual			365			19185.44	548.56	0.001503	
1981									
1st	01/01/81	31/03/81	90	15/02/81	24810	9046	224.43	0.002494	4347
2nd	01/04/81	30/06/81	91	15/05/81	29830	7186	214.36	0.002356	4347
3rd	01/07/81	30/09/81	92	15/08/81	15580	5775	89.97	0.000978	4347
4th	01/10/81	31/12/81	92	15/11/81	21280	4751	101.10	0.001099	4347
Annual			365			26758	629.87	0.001726	

Annex 2.7 continued. Caesium-137 discharged to sea from Nuclear Electric plc, Hinkley Point 'A'. Based on isotopic analyses of quarterly bulked effluent samples

Year/ Quarter	Inclusive dates from:-	to:-	No. of days in period	Decay of individual nuclides corrected to :-	Specific activity (nCi litre^{-1})	Volume discharged (cubic metres)	Caesium-137 discharged (GBq)	(TBq day^{-1})	FLR no.
1980									
1st	01/01/80	31/03/80	91	15/02/80	1650	5811	354.76	0.003898	4347
2nd	01/04/80	30/06/80	91	15/05/80	1250	5865	271.26	0.002981	4347
3rd	01/07/80	30/09/80	92	15/08/80	2955	5317	581.33	0.006319	4347
4th	01/10/80	31/12/80	92	15/11/80	1500	8211	455.71	0.004953	4347
Annual			366			25204	1663.06	0.004544	
1979									
1st	01/01/79	31/03/79	90	14/02/79	530	5851	114.74	0.001275	4347
2nd	01/04/79	30/06/79	91	15/05/79	163.2	6453.2	38.97	0.000428	4347
3rd	01/07/79	30/09/79	92	15/08/79	1745	6050	390.62	0.004246	4347
4th	01/10/79	31/12/79	92	15/11/79	580	4904	105.24	0.001144	4347
Annual			365			23258	649.56	0.001780	
1978									
1st	01/01/78	31/03/78	90	15/02/78	940	5589	194.39	0.002160	4347
2nd	01/04/78	30/06/78	91	16/05/78	1000	4779	176.82	0.001943	4347
3rd	01/07/78	30/09/78	92	15/08/78	954	5320	187.79	0.002041	4347
4th	01/10/78	31/12/78	92	15/11/78	2800	9487	982.85	0.010683	4347
Annual			365			25175	1541.85	0.004224	
1977									
1st	010/1/77	31/03/77	90	14/02/77			0.00	0	347
2nd	01/04/77	30/06/77	91	15/05/77			0.00	0	347
3rd	01/07/77	30/09/77	92	15/08/77	1320	5502	268.72	0.002921	4347
4th	01/10/77	31/12/77	92	15/11/77	1000	5536	204.83	0.002226	4347
Annual			365			11038	473.55	0.001297	

Annex 2.8 Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'. Based, respectively, on analyses of effluent samples from each discharge, and monthly or quarterly bulked effluent samples

1991

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	02/01/91	15.9	39.70
	09/01/91	15.1	
	14/01/91	11	
	22/01/91	10.6	
	28/01/91	8.3	
Feb.	04/02/91	9	20.80
	16/02/91	11.4	
	18/02/91	8.3	
	28/02/91	6.4	
Mar.	06/03/91	9.7	23.80
	15/03/91	13.3	
	20/03/91	6.4	
	27/03/91	9.3	
Apr.	09/04/91	18.9	23.00
	15/04/91	7.3	
	24/04/91	11.4	
May	03/05/91	4.9	14.20
	14/05/91	8	
	17/05/91	7.9	
	24/05/91	7.1	
June	06/06/91	13.9	25.70
	14/06/91	7.6	
	19/06/91	7.5	
	27/06/91	11.6	
July	06/07/91	6	23.80
	10/07/91	6.9	
	15/07/91	6	
	21/07/91	7.1	
	25/07/91	7.1	
	30/07/91	7.1	
Aug.	06/08/91	9.4	18.3
	13/08/91	4.2	
	15/08/91	7.7	
	20/08/91	6.5	
	28/08/91	5.4	
	30/08/91	9.6	
Sept.	05/09/91	6.5	15.4
	12/09/91	6	
	18/09/91	8.9	
	23/09/91	8.3	
Oct.	01/10/91	9.579	19.7
	08/10/91	8.274	
	19/10/91	6.9138	
	21/10/91	7.6032	
	22/10/91	0	
	30/10/91	4.7124	
Nov.	08/11/91	9	17.6
	11/11/91	2.8	
	22/11/91	8.3	
	27/11/91	14.4	
Dec.	10/12/91	17.9	15.9
	19/12/91	13.6	
	24/12/91	10.8	

Annual discharge of caesium-137 = 257.9 GBq

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1990

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	02/01/90	7	13.60	Aug.	07/08/90	9.3	19.6
	09/01/90	3.9			11/08/90	2.9	
	09/01/90	3.9			14/08/90	5.3	
	23/01/90	12			21/08/90	6.6	
	25/01/90	2.4			28/08/90	8.2	
Feb.	01/02/90	8.5	16.40		31/08/90	8.2	
	07/02/90	8.1		Sept.	10/09/90	8.7	12.5
	14/02/90	7.7			12/09/90	9.8	
	24/02/90	5.5			24/09/90	10.2	
	27/02/90	11.7			28/09/90	8.2	
Mar.	14/03/90	1.5	10.40	Oct.	03/10/90	12.1	37.3
	20/03/90	4.3			08/10/90	10.5	
	21/03/90	3.6			16/10/90	15.1	
	29/03/90	12.1			25/10/90	15.2	
Apr.	05/04/90	5	14.60	Nov.	01/11/90	12.6	25.5
	11/04/90	7.6			05/11/90	17	
	18/04/90	13.8			13/11/90	11.1	
	25/04/90	5.8			29/11/90	2.1	
May	01/05/90	4.6	15.20	Dec.	05/12/90	8.8	27.7
	09/05/90	10.9			10/12/90	11.2	
	15/05/90	4.4			17/12/90	10.4	
	23/05/90	6.3			24/12/90	13.1	
	31/05/90	6					
June	06/06/90	8	10.70				
	11/06/90	5.1		Annual discharge of caesium-137 = 217 GBq			
	19/06/90	5.7					
	20/06/90	3.5					
	27/06/90	4.4					
July	03/07/90	3.2	13.50				
	10/07/90	0.7					
	16/07/90	9.1					
	21/07/90	4.8					
	24/07/90	2.7					
	30/07/90	5.6					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1989

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	04/01/89	15.9	15.89
	09/01/89	6.3	
	18/01/89	13.1	
	30/01/89	1.5	
Feb.	13/02/89	10.8	15.88
	17/02/89	12.3	
	24/02/89	5.9	
	28/02/89	5.3	
Mar.	14/03/89	9.2	8.37
	20/03/89	6.6	
	28/03/89	8.5	
Apr.	03/04/89	8	19.98
	07/04/89	12.2	
	11/04/89	6.2	
	18/04/89	7.5	
	21/04/89	4.7	
	25/04/89	5.6	
May	03/05/89	11.4	16.81
	10/05/89	5.7	
	14/05/89	5.9	
	19/05/89	7.7	
	25/05/89	7.3	
June	03/06/89	4.9	16.09
	05/06/89	5.4	
	09/06/89	7.5	
	13/06/89	4.7	
	16/06/89	5.1	
	24/06/89	4.2	
July	01/07/89	9.9	17.94
	04/07/89	4.1	
	11/07/89	7	
	17/07/89	3.4	
	21/07/89	8	
	29/07/89	5.6	
Aug.	02/08/89	4.9	13.20
	12/08/89	8.7	
	18/08/89	6.6	
	30/08/89	6.1	
Sept.	07/09/89	9.1	10.75
	11/09/89	5.5	
	12/09/89	1.7	
	14/09/89	2.6	
	19/09/89	1.6	
	22/09/89	1.9	
	25/09/89	2	
	27/09/89	2	
	29/09/89	2.2	
Oct.	05/10/89	1.6	8.60
	06/10/89	1.9	
	16/10/89	4.4	
	20/10/89	5.2	
Nov.	01/11/89	9.8	8.50
	03/11/89	3	
	08/11/89	1.4	
	11/11/89	2	
	13/11/89	1.6	
	23/11/89	1.6	
Dec.	01/12/89	7.2	12.50
	11/12/89	6.7	
	18/12/89	4.6	
	23/12/89	9.1	

Annual discharge of caesium-137 = 164.5 GBq

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1988

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	05/01/88	14.5		Aug.	01/08/88	12	58.5
	07/01/88	5.3			12/08/88	5.1	
	11/01/88	6.6			17/08/88	4.7	
	20/01/88	10			26/08/88	8.6	
	22/01/88	5.3		Sept.	02/09/88	10.3	
	26/01/88	4.3			12/09/88	7.9	
Feb.	01/02/88	4.8	62		21/09/88	8.2	
	05/02/88	11.6			26/09/88	14.9	
	09/02/88	5.4		Oct.	07/10/88	13.3	
	16/02/88	7.3			12/10/88	13.3	
	20/02/88	3.8			22/10/88	9.2	
	27/02/88	13.4			26/10/88	8	
Mar.	03/03/88	6		Nov.	08/11/88	17	62.6
	07/03/88	5.6			14/11/88	9.8	
	15/03/88	11.4			24/11/88	18.7	
	19/03/88	4.5			28/11/88	8.4	
	23/03/88	6.1		Dec.	06/12/88	10.7	
	29/03/88	5.6			14/12/88	14.8	
Apr.	05/04/88	8.7			22/12/88	7.8	
	12/04/88	8.3					
	16/04/88	3.2					
	22/04/88	4.3		Annual discharge of caesium-137 = 225.3 GBq			
	27/04/88	8.4					
May	06/05/88	7.88	42.2				
	12/05/88	5.73					
	23/05/88	10.7					
	27/05/88	4.04					
June	03/06/88	12.6					
	13/06/88	7.9					
	21/06/88	2.7					
	25/06/88	1.9					
July	06/07/88	11.6					
	11/07/88	8.5					
	21/07/88	10.1					
	26/07/88	6.3					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1987

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	05/01/87	29.96		Aug.	05/08/87	19.5	109
	07/01/87	17.64			10/08/87	11.2	
	16/01/87	16.72			14/08/87	12.4	
	21/01/87	17.85			19/08/87	14.2	
	27/01/87	14.66			28/08/87	16.8	
Feb.	09/02/87	12.1	85.1	Sept.	01/09/87	8.4	
	14/02/87	14.48			07/09/87	12.4	
	20/02/87	13.12			17/09/87	21.1	
Mar.	02/03/87	12.6			21/09/87	9.1	
	10/03/87	16.2			28/09/87	14.3	
	18/03/87	11.3		Oct.	05/10/87	7.5	
	30/03/87	23.1			13/10/87	15.8	
Apr.	08/04/87	10.5			20/10/87	8.9	
	14/04/87	8.8			23/10/87	9	
	21/04/87	18.1			29/10/87	21.1	
	29/04/87	12.8		Nov.	04/11/87	9	90
May	12/05/87	16.97	90.4		11/11/87	12	
	22/05/87	11.71			21/11/87	19.3	
June	01/06/87	20.53			25/11/87	9.4	
	06/06/87	11		Dec.	01/12/87	11.1	
	09/06/87	7.85			09/12/87	16.8	
	15/06/87	6.14			19/12/87	11.5	
	20/06/87	16.79			23/12/87	6	
	24/06/87	9.76					
July	01/07/87	12.7					
	03/07/87	4.61		Annual discharge of caesium-137 = 374.5 GBq			
	10/07/87	12.77					
	13/07/87	8.23					
	21/07/87	10.81					
	23/07/87	9.21					
	29/07/87	7.86					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1986

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	09/01/86	22.29		Aug.	06/08/86	11.15	95
	14/01/86	32.65			15/08/86	12.45	
	21/01/86	11.54			19/08/86	17.32	
	28/01/86	15.25			27/08/86	11.55	
	31/01/86	14.68			30/08/86	9.34	
Feb.	07/02/86	25.87	120	Sept.	06/09/86	12.51	
	11/02/86	13.9			09/09/86	17.97	
	18/02/86	15.32			18/09/86	11.68	
	25/02/86	20.76			22/09/86	12.18	
Mar.	03/03/86	14.06		Oct.	01/10/86	14.22	
	10/03/86	14.7			07/10/86	9.02	
	18/03/86	24.17			09/10/86	8.63	
	24/03/86	8			15/10/86	11.25	
Apr.	01/04/86	14.97			20/10/86	10.44	
	07/04/86	18.94			24/10/86	12.02	
	11/04/86	11.96			31/10/86	10.08	
	15/04/86	7.64		Nov.	04/11/86	12.12	90.7
	16/04/86	8.94			10/11/86	9.02	
	22/04/86	6.8			14/11/86	10.3	
	25/04/86	6.76			21/11/86	8.55	
	29/04/86	9.11		Dec.	04/12/86	6.17	
May	03/05/86	8.14	122		08/12/86	7.61	
	12/05/86	15.18			16/12/86	13.52	
	20/05/86	13.05			22/12/86	10.92	
	28/05/86	19.06					
June	03/06/86	10.8					
	09/06/86	17.23		Annual discharge of caesium-137 = 427.7 GBq			
	18/06/86	16.47					
	26/06/86	11.65					
July	03/07/86	8.18					
	10/07/86	8.37					
	17/07/86	11.18					
	23/07/86	19.72					
	28/07/86	10.32					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1985

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	09/01/85	26.6		Aug.	05/08/85	18.36	99.33
	16/01/85	22.73			13/08/85	23.7	
	21/01/85	13.23			21/08/85	22.8	
	25/01/85	24.93		Sept	02/09/85	20.2	
Feb.	04/02/85	21.56	199		04/09/85	20	
	14/02/85	12.49			12/09/85	22.06	
	16/02/85	20.99			19/09/85	23.53	
	25/02/85	16.71			27/09/85	12.26	
Mar.	01/03/85	21.77		Oct.	04/10/85	20.14	
	08/03/85	25.98			10/10/85	15.93	
	14/03/85	17.41			15/10/85	18.12	
	25/03/85	21.98			22/10/85	12.25	
Apr.	03/04/85	16.81			26/10/85	10.96	
	09/04/85	16.43		Nov.	01/11/85	16	165
	15/04/85	27.29			09/11/85	13.13	
	19/04/85	13.61			14/11/85	14.89	
	26/04/85	17.02			19/11/85	16.91	
May	02/05/85	17.1	178.7		26/11/85	14.38	
	07/05/85	16.3		Dec.	04/12/85	15.35	
	14/05/85	16.2			09/12/85	12.9	
	18/05/85	5.1			16/12/85	17.33	
	22/05/85	15.3			23/12/85	24.32	
	28/05/85	16.4			30/12/85	24.05	
June	03/06/85	18.97					
	11/06/85	20.58					
	15/06/85	18.91		Annual discharge of caesium-137 = 642.03 GBq			
	21/06/85	15.76					
	27/06/85	13.76					
July	08/07/85	26.64					
	15/07/85	24.73					
	24/07/85	19.34					
	31/07/85	14.75					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1984

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	10/01/84	20.3		Aug.	02/08/84	9.9	231
	18/01/84	18.1			09/08/84	16.5	
	27/01/84	9.66			16/08/84	30.8	
Feb.	01/02/84	14.5	66.1		29/08/84	26.8	
	10/02/84	10		Sept.	05/09/84	32.7	
	15/02/84	7.6			11/09/84	26.2	
	23/02/84	12.2			22/09/84	30.4	
Mar.	05/03/84	11			28/09/84	28.1	
	07/03/84	3.05		Oct.	06/10/84	20.9	
	09/03/84	2.8			15/10/84	29.6	
	14/03/84	1.69			22/10/84	28.6	
	19/03/84	2.93			29/10/84	31	
	27/03/84	8.8		Nov.	07/11/84	39.4	24.8
Apr.	02/04/84	14.2			15/11/84	32.1	
	11/04/84	11.3			26/11/84	34	
	13/04/84	3.8			30/11/84	13	
	16/04/84	8.5		Dec.	17/12/84	23.53	
	18/04/84	3.4			19/12/84	28.81	
	20/04/84	3.3			22/12/84	16.49	
	25/04/84	4.7			31/12/84	31.41	
May	03/05/84	11.8	105				
	06/05/84	9.7					
	08/05/84	3.2		Annual discharge of caesium-137 = 426.90 GBq			
	11/05/84	4.8					
	15/05/84	4.8					
	16/05/84	2.9					
	21/05/84	6.3					
	29/05/84	10.3					
June	04/06/84	15.4					
	11/06/84	14.2					
	24/06/84	3.19					
	25/06/84	11.5					
	28/06/84	12					
July	02/07/84	20.4					
	11/07/84	13.3					
	16/07/84	13.9					
	24/07/84	26.2					
	30/07/84	13.1					

Annex 2.8 continued. Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'

1983

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	11/01/83	21.83		Aug.	03/08/83	26.5	164.42
	20/01/83	15.91			08/08/83	18.9	
	26/01/83	14.43			22/08/83	35.2	
	31/01/83	12.58			30/08/83	28.3	
Feb.	10/02/83	16.2	82	Sept.	08/09/83	31.2	
	15/02/83	8.6			16/09/83	23	
	26/02/83	20.4			21/09/83	10.7	
Mar.	04/03/83	13.32			26/09/83	19.5	
	16/03/83	21.09		Oct.	04/10/83	27.1	
	26/03/83	13.32			10/10/83	21.4	
Apr.	11/04/83	16.28			18/10/83	21.2	
	14/04/83	14.43			24/10/83	21.1	
	26/04/83	13.69		Nov.	01/11/83	16.6	157.38
May	04/05/83	13.32	88		09/11/83	26.1	
	12/05/83	11.84			15/11/83	12.9	
	19/05/83	15.17			24/11/83	25.8	
	31/05/83	22.57		Dec.	02/12/83	15.6	
June	13/06/83	21.8			09/12/83	14.5	
	21/06/83	12.2			22/12/83	21.7	
	28/06/83	18.5			30/12/83	13.9	
July	05/07/83	12.6					
	06/07/83	8.88					
	06/07/83	5.18		Annual discharge of caesium-137 = 491.8 GBq			
	07/07/83	5.92					
	08/07/83	7.03					
	19/07/83	13.7					
	22/07/83	21.5					
	25/07/83	14.8					

Annex 2.8 continued. ***Total non-tritium activity and caesium-137 discharged to sea from Nuclear Electric plc, Sizewell 'A'***

1982

Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)	Month	Date of discharge	Non-tritium activity (GBq)	Monthly/quarterly caesium-137 activity (GBq)
Jan.	08/01/82	15.54		Aug.	06/08/82	29.97	169.76
	18/01/82	25.16			13/08/82	28.12	
	27/01/82	18.5			23/08/82	29.97	
Feb.	08/02/82	32.93	119.6	Sept.	08/09/82	44.4	
	19/02/82	30.34			13/09/82	33.3	
Mar.	01/03/82	24.79			20/09/82	29.23	
	10/03/82	22.94		Oct.	05/10/82	18.5	
	16/03/82	18.13			07/10/82	24.79	
	25/03/82	23.68			14/10/82	27.75	
Apr.	03/04/82	22.2			19/10/82	24.42	
	14/04/82	27.01			29/10/82	20.35	
	23/04/82	24.42		Nov.	05/11/82	24.42	169.02
	28/04/82	24.42			10/11/82	15.17	
May	06/05/82	17.76	162.25		17/11/82	20.35	
	12/05/82	20.35			26/11/82	22.2	
	21/05/82	23.68		Dec.	06/12/82	17.39	
	26/05/82	19.98			13/12/82	24.79	
June	03/06/82	18.13			23/12/82	15.17	
	09/06/82	16.65			29/12/82	23.68	
	18/06/82	14.06					
	22/06/82	30.34					
	29/06/82	13.69		Annual discharge of caesium-137 = 620.63 GBq			
July	09/07/82	30.71					
	19/07/82	24.79					
	27/07/82	21.09					

ANNEX 3. NORMALISED ACTIVITY CONCENTRATIONS FOR CAESIUM-137 IN SEA WATER

Annex 3.1 Normalised Activity Concentrations (NACs) for Sellafield

A. Relating the monthly concentration of caesium-137 in seawater from: (i) Seascale and (ii) St Bees-W to the contemporary discharge of caesium-137 in a month.

Month/ Year	Concentration of caesium-137 at (i) Seascale (Bq m^{-3})	Concentration of caesium-137 at (ii) St Bees-W (Bq m^{-3})	Mean concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC :- Seascale (Bq $litre^{-1}$ per TBq day^{-1})	St Bees-W	Mean
Jan-78	15026.63	12820.46	13923.55	6.087	2.47	2.11	2.29
Feb-78	14945.30	15391.63	15168.47	7.496	1.99	2.05	2.02
Mar-78	11144.03	25784.45	18464.24	10.335	1.08	2.49	1.79
Apr-78	27057.88	19890.83	23474.36	9.943	2.72	2.00	2.36
May-78	41936.91	28126.88	35031.90	10.220	4.10	2.75	3.43
Jun-78	28209.91	9240.53	18725.22	8.838	3.19	1.05	2.12
Jul-78	26983.40	20915.25	23949.33	12.961	2.08	1.61	1.85
Aug-78	38430.42	25130.70	31780.56	10.977	3.50	2.29	2.90
Sep-78	33176.01	13722.78	23449.40	11.390	2.91	1.20	2.06
Oct-78	20556.39	20332.05	20444.22	20.121	1.02	1.01	1.02
Nov-78	50280.04	93627.02	71953.53	16.038	3.14	5.84	4.49
Dec-78	39489.36	41678.28	40583.82	9.676	4.08	4.31	4.19
Jan-79	54071.60	18155.90	36113.75	6.579	8.22	2.76	5.49
Feb-79	54855.30	27692.20	41273.75	7.248	7.57	3.82	5.69
Mar-79	29223.20	18557.80	23890.50	7.374	3.96	2.52	3.24
Apr-79	50555.80	22245.60	36400.70	5.763	8.77	3.86	6.32
May-79	22244.90	28782.70	25513.80	6.973	3.19	4.13	3.66
Jun-79	30058.60	24828.90	27443.75	8.900	3.38	2.79	3.08
Jul-79	33620.00	14345.80	23982.90	7.763	4.33	1.85	3.09
Aug-79	24767.50	23149.60	23958.55	5.579	4.44	4.15	4.29
Sep-79	43695.30	20896.90	32296.10	7.785	5.61	2.68	4.15
Oct-79	38230.20	43850.60	41040.40	9.034	4.23	4.85	4.54
Nov-79	22906.10	24200.50	23553.30	5.990	3.82	4.04	3.93
Dec-79	23940.00	15909.60	19924.80	5.291	4.52	3.01	3.77
Jan-80	22139.30	22935.10	22537.20	6.260	3.54	3.66	3.60
Feb-80	27452.00	8439.75	17945.88	6.745	4.07	1.25	2.66
Mar-80	10501.40	13398.30	11949.85	7.358	1.43	1.82	1.62
Apr-80	76114.60	13484.70	44799.65	14.878	5.12	0.91	3.01
May-80	130519.00	28311.10	79415.05	10.356	12.60	2.73	7.67
Jun-80	28573.80	23838.20	26206.00	11.971	2.39	1.99	2.19
Jul-80	36142.40	17104.60	26623.50	8.311	4.35	2.06	3.20
Aug-80	23586.80	21616.80	22601.80	6.002	3.93	3.60	3.77
Sep-80	21627.80	18055.20	19841.50	8.768	2.47	2.06	2.26
Oct-80	27549.40	21473.50	24511.45	6.079	4.53	3.53	4.03
Nov-80	48109.40	14508.90	31309.15	5.316	9.05	2.73	5.89
Dec-80	12198.90	13057.90	12628.40	5.390	2.26	2.42	2.34
Jan-81	14852.00	16686.80	15769.40	5.058	2.94	3.30	3.12
Feb-81	16958.40	6400.55	11679.48	5.389	3.15	1.19	2.17
Mar-81	23127.00	12456.80	17791.90	6.189	3.74	2.01	2.87
Apr-81	24933.70	13286.80	19110.25	7.331	3.40	1.81	2.61
May-81	20181.90	25606.70	22894.30	6.249	3.23	4.10	3.66
Jun-81	11398.10	13471.60	12434.85	7.964	1.43	1.69	1.56
Jul-81	47888.10	14008.60	30948.35	7.448	6.43	1.88	4.16
Aug-81	36170.98	20674.30	28422.64	9.207	3.93	2.25	3.09
Sep-81	19117.70	28423.21	23770.46	7.422	2.58	3.83	3.20
Oct-81	11401.06	11404.71	11402.89	5.006	2.28	2.28	2.28
Nov-81	10960.11	10507.49	10733.80	5.232	2.09	2.01	2.05
Dec-81	21272.08	15004.70	18138.39	4.952	4.30	3.03	3.66

A. Relating the monthly concentration of caesium-137 in seawater from: (i) Seascale and (ii) St Bees-W to the contemporary discharge of caesium-137 in a month.

Month/ Year	Concentration of caesium-137 at (i) Seascale (Bq m^{-3})	Concentration of caesium-137 at (ii) St Bees-W (Bq m^{-3})	Mean concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC :- Seascale (Bq $litre^{-1}$ per TBq day^{-1})	St Bees-W	Mean
Jan-82	11340.04	23687.92	17513.98	5.577	2.03	4.25	3.14
Feb-82		11434.90	11434.90	5.332		2.14	2.14
Mar-82	10923.52	14316.79	12620.16	5.067	2.16	2.83	2.49
Apr-82	22227.66	10478.97	16353.32	5.216	4.26	2.01	3.14
May-82	20994.06	22521.15	21757.61	5.087	4.13	4.43	4.28
Jun-82	13032.20	25894.64	19463.42	5.881	2.22	4.40	3.31
Jul-82	15517.28	30390.67	22953.98	5.873	2.64	5.17	3.91
Aug-82	24769.18	20664.44	22716.81	6.242	3.97	3.31	3.64
Sep-82	33716.62	18126.66	25921.64	5.342	6.31	3.39	4.85
Oct-82	11525.92	8739.22	10132.57	5.290	2.18	1.65	1.92
Nov-82	6121.92	6865.29	6493.60	6.295	0.97	1.09	1.03
Dec-82	10460.45	10212.75	10336.60	4.571	2.29	2.23	2.26
Jan-83	12687.22	9057.33	10872.28	4.421	2.87	2.05	2.46
Feb-83	19878.71	9252.60	14565.66	4.466	4.45	2.07	3.26
Mar-83	12985.39	11376.11	12180.75	4.633	2.80	2.46	2.63
Apr-83	18856.61	14464.01	16660.31	3.154	5.98	4.59	5.28
May-83	9492.97	7211.86	8352.42	2.516	3.77	2.87	3.32
Jun-83	10667.82	6956.87	8812.35	3.450	3.09	2.02	2.55
Jul-83	14134.11	10829.63	12481.87	3.196	4.42	3.39	3.91
Aug-83	9895.00	6512.23	8203.62	3.638	2.72	1.79	2.26
Sep-83	12030.69	9455.45	10743.07	4.239	2.84	2.23	2.53
Oct-83	9428.18	10062.39	9745.29	3.054	3.09	3.29	3.19
Nov-83	14918.39	6418.20	10668.29	1.719	8.68	3.73	6.21
Dec-83	7401.70	7509.45	7455.58	1.068	6.93	7.03	6.98
Jan-84	4170.19	4007.61	4088.90	1.725	2.42	2.32	2.37
Feb-84	4851.21	3742.70	4296.96	1.198	4.05	3.12	3.59
Mar-84	5690.94	3543.96	4617.45	0.754	7.54	4.70	6.12
Apr-84	8501.92	3913.23	6207.58	0.752	11.30	5.20	8.25
May-84	6215.72	2922.37	4569.05	1.001	6.21	2.92	4.56
Jun-84	4834.03	2393.69	3613.86	0.837	5.77	2.86	4.32
Jul-84	4555.02	2948.60	3751.81	0.877	5.19	3.36	4.28
Aug-84	7000.49	4846.37	5923.43	1.126	6.22	4.31	5.26
Sep-84	5435.95	2419.29	3927.62	1.908	2.85	1.27	2.06
Oct-84	5770.57	6090.72	5930.65	1.747	3.30	3.49	3.39
Nov-84	4721.13	4576.30	4648.72	1.215	3.89	3.77	3.83
Dec-84	2506.92	5567.52	4037.22	1.078	2.33	5.17	3.75
Jan-85	8126.12	2978.97	5552.55	1.192	6.82	2.50	4.66
Feb-85	6600.58	6852.40	6726.49	1.294	5.10	5.30	5.20
Mar-85	8258.40	4377.40	6317.90	1.807	4.57	2.42	3.50
Apr-85	7841.20	7513.00	7677.10	2.659	2.95	2.83	2.89
May-85	10170.00	4401.70	7285.85	1.979	5.14	2.22	3.68
Jun-85	4462.70	3267.10	3864.90	0.362	12.33	9.03	10.68
Jul-85	3771.00	2683.60	3227.30	0.250	15.06	10.72	12.89
Aug-85	2807.30	2231.40	2519.35	0.298	9.42	7.49	8.45
Sep-85	2753.90	2297.80	2525.85	0.271	10.15	8.47	9.31
Oct-85	2500.30	1492.40	1996.35	0.284	8.82	5.26	7.04
Nov-85	2389.80	1188.10	1788.95	0.199	12.01	5.97	8.99
Dec-85	1696.20	1322.50	1509.35	0.129	13.15	10.25	11.70

Annex 3.1 continued. Normalised Activity Concentrations (NACs) for Sellafield

A. Relating the monthly concentration of caesium-137 in seawater from: (i) Seascale and (ii) St Bees-W to the contemporary discharge of caesium-137 in a month.

Month/ Year	Concentration of caesium-137 at (i) Seascale ($Bq\ m^{-3}$)	Concentration of caesium-137 at (ii) St Bees-W ($Bq\ m^{-3}$)	Mean concentration of caesium-137 ($Bq\ m^{-3}$)	Caesium-137 discharged ($TBq\ day^{-1}$)	NAC :- Seascale ($Bq\ litre^{-1}$ per $TBq\ day^{-1}$)	St Bees-W	Mean
Jan-86	1045.90	895.22	970.56	0.035	30.30	25.94	28.12
Feb-86	827.27	671.83	749.55	0.035	23.64	19.20	21.42
Mar-86	1075.30	925.28	1000.29	0.099	10.82	9.31	10.07
Apr-86	831.86	660.35	746.10	0.038	21.89	17.38	19.63
May-86	1426.20	994.31	1210.26	0.049	29.28	20.41	24.85
Jun-86	1203.00	934.18	1068.59	0.060	20.05	15.57	17.81
Jul-86	1335.10	980.23	1157.67	0.028	47.19	34.65	40.92
Aug-86	1124.30	981.51	1052.91	0.022	50.66	44.23	47.44
Sep-86	864.62	648.11	756.37	0.048	17.96	13.46	15.71
Oct-86	1279.80	1191.00	1235.40	0.073	17.52	16.31	16.92
Nov-86	952.65	434.77	693.71	0.059	16.11	7.35	11.73
Dec-86	624.33	760.78	692.56	0.041	15.37	18.73	17.05
Jan-87	506.66	539.57	523.12	0.036	14.20	15.12	14.66
Feb-87	773.96	795.99	784.98	0.047	16.43	16.90	16.66
Mar-87	570.51	686.65	628.58	0.022	25.59	30.80	28.20
Apr-87	681.56	475.02	578.29	0.020	34.60	24.11	29.35
May-87	729.68	393.45	561.57	0.019	39.07	21.07	30.07
Jun-87	908.20	534.41	721.31	0.016	55.38	32.59	43.98
Jul-87	765.06	610.22	687.64	0.028	27.36	21.82	24.59
Aug-87	634.02	681.00	657.51	0.054	11.72	12.58	12.15
Sep-87	681.60	732.68	707.14	0.042	16.29	17.51	16.90
Oct-87	708.36	762.34	735.35	0.029	24.14	25.98	25.06
Nov-87	771.88	643.91	707.90	0.035	21.90	18.27	20.08
Dec-87	511.93	487.94	499.94	0.040	12.65	12.06	12.35
Jan-88	409.34	443.18	426.26	0.026	15.49	16.77	16.13
Feb-88	523.35	466.14	494.75	0.032	16.46	14.66	15.56
Mar-88	389.90	306.65	348.28	0.026	14.92	11.74	13.33
Apr-88	598.72	465.57	532.15	0.036	16.69	12.98	14.84
May-88	723.07	489.18	606.13	0.062	11.67	7.90	9.79
Jun-88	651.53	478.78	565.16	0.041	16.02	11.77	13.90
Jul-88	653.65	599.41	626.53	0.067	9.78	8.97	9.37
Aug-88	950.14	799.23	874.69	0.042	22.89	19.25	21.07
Sep-88	674.81	629.79	652.30	0.033	20.51	19.14	19.83
Oct-88	622.60	562.49	592.55	0.032	19.50	17.61	18.55
Nov-88	469.73	440.30	455.02	0.020	23.68	22.20	22.94
Dec-88	432.50	384.70	408.60	0.018	24.16	21.49	22.82
Jan-89	455.07	495.55	475.31	0.024	19.17	20.87	20.02
Feb-89	414.21	424.14	419.18	0.051	8.20	8.39	8.29
Mar-89	531.72	527.10	529.41	0.088	6.04	5.99	6.01
Apr-89	649.33	405.17	527.25	0.054	12.06	7.53	9.79
May-89	1022.01	983.27	1002.64	0.200	5.12	4.93	5.02
Jun-89	833.24	458.57	645.91	0.118	7.07	3.89	5.48
Jul-89	710.40	389.63	550.02	0.054	13.11	7.19	10.15
Aug-89	573.46	653.02	613.24	0.111	5.18	5.90	5.54
Sep-89	947.06	846.19	896.63	0.087	10.86	9.70	10.28
Oct-89	735.28	842.02	788.65	0.047	15.79	18.08	16.93
Nov-89	475.81	585.05	530.43	0.080	5.97	7.34	6.65
Dec-89	427.42	485.77	456.60	0.025	16.97	19.28	18.12

Annex 3.1 continued. Normalised Activity Concentrations (NACs) for Sellafield

A. Relating the monthly concentration of caesium-137 in seawater from: (i) Seascale and (ii) St Bees-W to the contemporary discharge of caesium-137 in a month.

Month/ Year	Concentration of caesium-137 at (i) Seascale (Bq m^{-3})	Concentration of caesium-137 at (ii) St Bees-W (Bq m^{-3})	Mean concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC :- Seascale (Bq $litre^{-1}$ per TBq day^{-1})	St Bees-W	Mean
Jan-90	371.17	490.13	430.65	0.022	16.63	21.96	19.29
Feb-90	477.10	360.38	418.74	0.043	11.14	8.42	9.78
Mar-90	297.54	298.25	297.90	0.051	5.86	5.88	5.87
Apr-90	415.85	289.58	352.72	0.027	15.36	10.70	13.03
May-90	466.95	317.73	392.34	0.018	26.22	17.84	22.03
Jun-90	532.87	505.88	519.38	0.068	7.83	7.43	7.63
Jul-90	799.55	541.27	670.41	0.055	14.65	9.92	12.28
Aug-90	700.83	681.06	690.95	0.060	11.70	11.37	11.53
Sep-90	783.30	447.50	615.40	0.066	11.93	6.82	9.38
Oct-90	989.44	890.90	940.17	0.206	4.79	4.32	4.56
Nov-90	684.52	482.99	583.75	0.045	15.18	10.71	12.94
Dec-90	621.36	334.47	477.91	0.107	5.83	3.14	4.48
Jan-91	357.37	402.80	380.09	0.032	11.11	12.52	11.82
Feb-91	449.94	385.72	417.83	0.071	6.37	5.46	5.91
Mar-91	379.17	355.50	367.34	0.026	14.51	13.61	14.06
Apr-91	446.74	370.92	408.83	0.028	15.96	13.25	14.60
May-91	665.64	281.62	473.63	0.095	7.03	2.97	5.00
Jun-91	495.49	400.34	447.92	0.039	12.73	10.28	11.50
Jul-91	408.73	463.64	436.19	0.024	17.31	19.64	18.47
Aug-91	501.87	470.30	486.09	0.029	17.44	16.34	16.89
Sep-91	503.58	518.13	510.86	0.016	31.47	32.38	31.93
Oct-91	513.46	398.72	456.09	0.042	12.36	9.60	10.98
Nov-91	518.95	645.96	582.46	0.080	6.50	8.09	7.29
Dec-91	483.88	429.36	456.62	0.034	14.27	12.66	13.47
				Mean NAC	10.13	8.26	9.17
				S.D.	9.45	7.93	8.55
				Mean NAC for 1978 to 1982			3.24
				S.D.			1.29

B. Relating the annual mean concentration of caesium-137 in seawater from: (i) Seascale and (ii) St Bees-W to the contemporary discharge of caesium-137 in a year.

Year	Concentration of caesium-137 at (i) Seascale ($Bq\ m^{-3}$)	Concentration of caesium-137 at (ii) St Bees-W ($Bq\ m^{-3}$)	Mean concentration of caesium-137 ($Bq\ m^{-3}$)	Caesium-137 discharged ($TBq\ day^{-1}$)	NAC :- Seascale ($Bq\ litre^{-1}$ per $TBq\ day^{-1}$)	St Bees-W	Mean
1978	28936.36	27221.74	28079.05	11.200	2.58	2.43	2.51
1979	35680.71	23551.34	29616.03	7.020	5.08	3.35	4.22
1980	38709.57	18018.67	28364.12	8.104	4.78	2.22	3.50
1981	21521.76	15661.02	18591.39	6.457	3.33	2.43	2.88
1982	16420.80	16944.45	16682.63	5.480	3.00	3.09	3.04
1983	12698.07	9092.18	10895.12	3.288	3.86	2.76	3.31
1984	5354.51	3914.36	4634.44	1.185	4.52	3.30	3.91
1985	5114.79	3383.86	4249.33	0.891	5.74	3.80	4.77
1986	1049.19	839.80	944.50	0.049	21.41	17.14	19.27
1987	686.95	611.93	649.44	0.032	21.25	18.93	20.09
1988	591.61	505.45	548.53	0.036	16.34	13.96	15.15
1989	626.63	583.51	605.07	0.078	8.01	7.46	7.73
1990	595.04	470.01	532.53	0.064	9.26	7.32	8.29
1991	477.07	426.92	451.99	0.043	11.19	10.01	10.60
				Mean NAC	8.60	7.01	7.81
				S.D.	6.57	5.80	6.17
				Mean NAC for 1978 to 1982			3.23
				S.D.			0.66

Annex 3.2 Normalised Activity Concentrations (NACs) for Dounreay

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from Sandside Bay to the contemporary discharge of caesium-137 in a year (from quarterly isotopic analyses).

Year	Mean concentration of caesium-137 at Sandside Bay (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1983	385.32	220	165.32	0.06366	2.60
1984	285.65	120	165.65	0.06156	2.69
1985	251.71	130	121.71	0.03195	3.81
1986	106.90	100	6.90	0.01680	0.41
1987	193.39	40	153.39	0.01624	9.44
1988	119.73	40	79.73	0.01119	7.12
1989	50.82	20	30.82	0.00848	3.63
1990	27.60	20	7.60	0.00616	1.23
1991	30.34	20	10.34	0.00967	1.07
				Mean NAC	3.56
				S.D.	2.97

Annex 3.3 Normalised Activity Concentrations (NACs) for Berkeley and Oldbury

A. Relating the background adjusted, quarterly mean concentration of caesium-137 in sea water from the cooling water inlets to the contemporary discharge of caesium-137 in a quarter (from quarterly isotopic analyses).

Year/ Quarter	Mean * concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged # (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1980					
1st Quarter	15.81	10	5.81	0.003109	1.87
2nd Quarter	67.29	10	57.29	0.003693	15.51
3rd Quarter	78.22	10	68.22	0.003359	20.31
4th Quarter	38.21	10	28.21	0.004258	6.63
1981					
1st Quarter	27.47	10	17.47	0.004264	4.10
2nd Quarter	56.74	10	46.74	0.003923	11.91
3rd Quarter	238.47	10	228.47	0.002620	87.19
4th Quarter	40.98	10	30.98	0.002511	12.34
1982					
1st Quarter	138.92	10	128.92	0.001583	81.46
2nd Quarter	578.03	10	568.03	0.002997	189.53
3rd Quarter	68.70	10	58.70	0.002028	28.95
4th Quarter	22.00	10	12.00	0.002868	4.18
1983					
1st Quarter	28.84	10	18.84	0.003385	5.57
2nd Quarter	26.09	10	16.09	0.002216	7.26
3rd Quarter	55.40	10	45.40	0.002478	18.32
4th Quarter	35.00	10	25.00	0.002248	11.12
1984					
1st Quarter	16.90	10	6.90	0.001726	4.00
2nd Quarter	36.73	10	26.73	0.001214	22.01
3rd Quarter	55.98	10	45.98	0.002885	15.94
4th Quarter	38.48	10	28.48	0.003730	7.63
1985					
1st Quarter	26.65	10	16.65	0.001730	9.62
2nd Quarter	30.88	10	20.88	0.001812	11.52
3rd Quarter	34.42	10	24.42	0.001549	15.77
4th Quarter	30.89	10	20.89	0.000911	22.92
1986					
1st Quarter	17.45	10	7.45	0.000772	9.65
2nd Quarter	26.62	10	16.62	0.000796	20.89
3rd Quarter				0.000868	
4th Quarter				0.000710	
				Mean NAC	24.85
				S.D.	39.42

** Caesium-137 in sea water from Berkeley Inlet (1980-2), Oldbury Inlet (1985-6) and Oldbury (1981-4)*

 # Combined discharges for Berkeley and Oldbury

Annex 3.3 Normalised Activity Concentrations (NACs) for Berkeley and Oldbury

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from the cooling water inlets to the contemporary discharge of caesium-137 in a year (from quarterly isotopic analyses).

Year	Mean * concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged # (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1980	51.55	10	41.55	0.003606	11.52
1981	103.70	10	93.70	0.003323	28.20
1982	143.16	10	133.16	0.002371	56.15
1983	37.57	10	27.57	0.002578	10.69
1984	37.14	10	27.14	0.002394	11.34
1985	31.36	10	21.36	0.001498	14.25
1986	21.12	10	11.12	0.000786	14.13
				Mean NAC	20.90
				S.D.	16.68

** Caesium-137 in sea water from Berkeley Inlet (1980-2), Oldbury Inlet (1985-6) and Oldbury (1981-4).*

 # Combined discharges for Berkeley and Oldbury.

Annex 3.4 Normalised Activity Concentrations (NACs) for Bradwell

A. Relating the background adjusted, quarterly mean concentration of caesium-137 in sea water from Waterside to the contemporary discharge of caesium-137 in a quarter (from quarterly isotopic analyses).

Quarter/ Year	Mean concentration of caesium-137 at Waterside (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq l^{-1} per TBq day^{-1})
1978					
1st Quarter				0.004553	
2nd Quarter				0.003714	
3rd Quarter	267.52	20	247.52	0.002549	97.10
4th Quarter	239.56	20	219.56	0.002321	94.61
1979					
1st Quarter	126.93	20	106.93	0.001256	85.14
2nd Quarter	196.62	20	176.62	0.001789	98.73
3rd Quarter	166.34	20	146.34	0.002741	53.40
4th Quarter	150.81	20	130.81	0.002356	55.52
1980					
1st Quarter	103.59	20	83.59	0.001250	66.88
2nd Quarter	209.06	20	189.06	0.002458	76.91
3rd Quarter	289.49	20	269.49	0.002898	93.01
4th Quarter	350.71	20	330.71	0.005381	61.46
1981					
1st Quarter	324.72	20	304.72	0.004510	67.57
2nd Quarter	379.94	20	359.94	0.005520	65.20
3rd Quarter	503.87	20	483.87	0.005443	88.89
4th Quarter	221.19	20	201.19	0.002089	96.30
1982					
1st Quarter	111.66	20	91.66	0.001480	61.94
2nd Quarter	152.59	20	132.59	0.001625	81.60
3rd Quarter	170.76	20	150.76	0.001392	108.30
4th Quarter	109.74	20	89.74	0.001745	51.44
				Mean NAC	78.00
				S.D.	17.95

Annex 3.4 Normalised Activity Concentrations (NACs) for Bradwell

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from Waterside to the contemporary discharge of caesium-137 in a year (from quarterly isotopic analyses).

Year	Mean concentration of caesium-137 at Waterside (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1978	252.10	20	232.10	0.003276	70.84
1979	163.96	20	143.96	0.002040	70.56
1980	254.59	20	234.59	0.003003	78.12
1981	357.43	20	337.43	0.004387	76.92
1982	138.42	20	118.42	0.001561	75.88
				Mean NAC	74.46
				S.D.	3.53

Annex 3.5 Normalised Activity Concentrations (NACs) for Dungeness

A. Relating the background adjusted, quarterly mean concentration of caesium-137 in sea water from the cooling water inlet to the contemporary discharge of caesium-137 in a quarter (from quarterly isotopic analyses).

Year/ Quarter	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1979					
1st Quarter	56.73	10	46.73	0.002213	21.12
2nd Quarter	32.96	10	22.96	0.001484	15.47
3rd Quarter	18.14	10	8.14	0.002472	3.29
4th Quarter	12.43	10	2.43	0.002626	0.93
1981					
1st Quarter	64.98	10	54.98	0.002166	25.38
2nd Quarter	32.25	10	22.25	0.002488	8.94
3rd Quarter	41.39	10	31.39	0.002389	13.14
4th Quarter	67.15	10	57.15	0.001953	29.26
1982					
1st Quarter	61.23	10	51.23	0.001586	32.30
2nd Quarter	33.79	10	23.79	0.001495	15.92
3rd Quarter	19.34	10	9.34	0.001897	4.92
4th Quarter	15.78	10	5.78	0.002194	2.64
1983					
1st Quarter	14.85	10	4.85	0.001517	3.20
2nd Quarter	15.20	10	5.20	0.001290	4.03
3rd Quarter	13.05	10	3.05	0.001863	1.64
4th Quarter	20.38	10	10.38	0.001620	6.41
1984					
1st Quarter	16.12	10	6.12	0.001973	3.10
2nd Quarter	20.21	10	10.21	0.002545	4.01
3rd Quarter	21.97	10	11.97	0.002599	4.61
4th Quarter	21.26	10	11.26	0.002386	4.72
1985					
1st Quarter	13.10	10	3.10	0.001872	1.66
2nd Quarter	17.13	10	7.13	0.002615	2.73
3rd Quarter	23.01	10	13.01	0.002699	4.82
4th Quarter	16.93	10	6.93	0.002983	2.32
				Mean NAC	9.02
				S.D.	9.33

Annex 3.5 Normalised Activity Concentrations (NACs) for Dungeness

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from the cooling water inlet to the contemporary discharge of caesium-137 in a year (from quarterly isotopic analyses).

Year	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1979	35.60	10	25.60	0.002200	11.63
1981	51.71	10	41.71	0.002249	18.55
1982	32.54	10	22.54	0.001795	12.56
1983	16.13	10	6.13	0.001574	3.89
1984	19.77	10	9.77	0.002376	4.11
1985	17.55	10	7.55	0.002545	2.96
				Mean NAC	8.95
				S.D.	6.28

Annex 3.6 Normalised Activity Concentrations (NACs) for Hinkley Point

A. Relating the background adjusted, quarterly mean concentration of caesium-137 in sea water from the cooling water inlet to the contemporary discharge of caesium-137 in a quarter (from quarterly isotopic analyses).

Year/ Quarter	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1978					
1st Quarter	71.28	10	61.28	0.002160	28.37
2nd Quarter	120.45	10	110.45	0.001943	56.84
3rd Quarter	109.42	10	99.42	0.002041	48.71
4th Quarter	188.34	10	178.34	0.010683	16.69
1979					
1st Quarter	58.09	10	48.09	0.001275	37.72
2nd Quarter	79.23	10	69.23	0.000428	161.67
3rd Quarter	109.90	10	99.90	0.004246	23.53
4th Quarter	70.92	10	60.92	0.001144	53.26
1980					
1st Quarter	87.24	10	77.24	0.003898	19.81
2nd Quarter	67.99	10	57.99	0.002981	19.45
3rd Quarter	127.44	10	117.44	0.006319	18.59
4th Quarter	88.88	10	78.88	0.004953	15.93
1981					
1st Quarter	67.30	10	57.30	0.002494	22.98
2nd Quarter	71.40	10	61.40	0.002356	26.06
3rd Quarter	125.23	10	115.23	0.000978	117.82
4th Quarter	56.56	10	46.56	0.001099	42.37
1982					
1st Quarter	49.58	10	39.58	0.001870	21.17
2nd Quarter	46.06	10	36.06	0.001441	25.02
3rd Quarter	57.59	10	47.59	0.001776	26.80
4th Quarter	47.92	10	37.92	0.000932	40.67
1983					
1st Quarter	37.52	10	27.52	0.001058	26.01
2nd Quarter	59.97	10	49.97	0.000846	59.05
3rd Quarter	48.21	10	38.21	0.001867	20.47
4th Quarter	44.02	10	34.02	0.001561	21.80
1984					
1st Quarter	44.77	10	34.77	0.001678	20.72
2nd Quarter	48.03	10	38.03	0.001716	22.16
3rd Quarter	156.31	10	146.31	0.005179	28.25
4th Quarter	126.90	10	116.90	0.004423	26.43
1985					
1st Quarter	55.49	10	45.49	0.004431	10.27
2nd Quarter	100.93	10	90.93	0.005465	16.64
3rd Quarter	102.52	10	92.52	0.004015	23.05
4th Quarter	162.08	10	152.08	0.002124	71.60

Annex 3.6 continued. Normalised Activity Concentrations (NACs) for Hinkley Point

A. Relating the background adjusted, quarterly mean concentration of caesium-137 in sea water from the cooling water inlet to the contemporary discharge of caesium-137 in a quarter (from quarterly isotopic analyses).

Year/ Quarter	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1986					
1st Quarter	33.87	10	23.87	0.000545	43.78
2nd Quarter	30.51	10	20.51	0.000542	37.80
3rd Quarter	49.90	10	39.90	0.000687	58.12
4th Quarter	42.71	10	32.71	0.000446	73.36
1987					
1st Quarter	35.29	10	25.29	0.000552	45.82
2nd Quarter	39.84	10	29.84	0.001797	16.61
3rd Quarter	55.63	10	45.63	0.001811	25.20
4th Quarter	50.78	10	40.78	0.002614	15.60
1988					
1st Quarter	26.95	10	16.95	0.001219	13.91
2nd Quarter	23.88	10	13.88	0.000509	27.27
3rd Quarter	36.78	10	26.78	0.001088	24.61
4th Quarter	33.54	10	23.54	0.000525	44.82
				Mean NAC	36.29
				S.D.	28.04

Annex 3.6 Normalised Activity Concentrations (NACs) for Hinkley Point

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from the cooling water inlet to the contemporary discharge of caesium-137 in a year (from quarterly isotopic analyses).

Year	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1978	122.37	10	112.37	0.004224	26.60
1979	79.53	10	69.53	0.001780	39.07
1980	95.15	10	85.15	0.004544	18.74
1981	80.12	10	70.12	0.001726	40.63
1982	50.29	10	40.29	0.001503	26.81
1983	48.34	10	38.34	0.001336	28.71
1984	91.01	10	81.01	0.003258	24.87
1985	105.26	10	95.26	0.004002	23.80
1986	39.25	10	29.25	0.000555	52.68
1987	45.38	10	35.38	0.001699	20.82
1988	30.29	10	20.29	0.000835	24.29
				Mean NAC	29.73
				S.D.	10.20

Annex 3.7 Normalised Activity Concentrations (NACs) for Sizewell

A. Relating the background adjusted, monthly mean concentration of caesium-137 in sea water from the Sizewell area to the discharge of caesium-137 estimated for the 28 day period prior to the date of sample collection.

Month/ Year	Mean * concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
Jan-82	169.07	110	59.07	0.00169	34.95
Feb-82	158.43	110	48.43	0.00154	31.45
Mar-82	179.95	110	69.95	0.00157	44.55
Apr-82	134.73	110	24.73	0.00154	16.06
May-82	213.98	110	103.98	0.00185	56.21
Jun-82	219.54	110	109.54	0.00167	65.59
Jul-82	129.09	110	19.09	0.00192	9.94
Aug-82	130.2	110	20.2	0.00232	8.71
Sep-82	101.54	110	-8.46	0.0024	
Oct-82	118.92	110	8.92	0.00159	5.61
Nov-82	105.02	110	-4.98	0.00183	
Dec-82	51.87	110	-58.13	0.00183	
Jan-83	51.04	110	-58.96	0.00041	
Feb-83	123.06	110	13.06	0.0011	11.87
Mar-83	180.29	110	70.29	0.00079	88.97
Apr-83	166.04	110	56.04	0.00085	65.93
May-83	121.79	110	11.79	0.00076	15.51
Jun-83	154.42	110	44.42	0.00117	37.97
Jul-83	205.2	110	95.2	0.00143	66.57
Aug-83	202.16	110	92.16	0.00198	46.55
Sep-83	179.52	110	69.52	0.00197	35.29
Oct-83	106.73	110	-3.27	0.00177	
Nov-83	128.24	110	18.24	0.00201	9.07
Dec-83	143.67	110	33.67	0.00132	25.51
Jan-84	74.82	100	-25.18	0.00123	
Feb-84	58.07	100	-41.93	0.00101	
Mar-84	136.67	100	36.67	0.00059	62.15
Apr-84	174.57	100	74.57	0.00092	81.05
May-84	140.57	100	40.57	0.00096	42.26
Jun-84	139.89	100	39.89	0.00109	36.60
Jul-84	255.55	100	155.55	0.00159	97.83
Aug-84	164.1	100	64.1	0.00188	34.10
Sep-84	200.15	100	100.15	0.00245	40.88
Oct-84	119.17	100	19.17	0.00173	11.08
Nov-84	88.83	100	-11.17	0.00027	
Dec-84	42.55	100	-57.45	0.00013	
Jan-85	128.39	50	78.39	0.00097	80.81
Feb-85	123.89	50	73.89	0.00208	35.52
Mar-85	116.19	50	66.19	0.00297	22.29
Apr-85	123.52	50	73.52	0.00143	51.41
May-85	123.01	50	73.01	0.00193	37.83
Jun-85	139.88	50	89.88	0.00184	48.85
Jul-85	87.88	50	37.88	0.00109	34.75
Aug-85	81.78	50	31.78	0.00109	29.16
Sep-85	59.19	50	9.19	0.00121	7.60
Oct-85	66.31	50	16.31	0.00143	11.41
Nov-85	82.93	50	32.93	0.0017	19.37
Dec-85	80.39	50	30.39	0.00171	17.77

Annex 3.7 continued. Normalised Activity Concentrations (NACs) for Sizewell

A. Relating the background adjusted, monthly mean concentration of caesium-137 in sea water from the Sizewell area to the discharge of caesium-137 estimated for the 28 day period prior to the date of sample collection.

Month/ Year	Mean * concentration of caesium-137 ($Bq\ m^{-3}$)	Background concentration of caesium-137 ($Bq\ m^{-3}$)	Background adjusted concentration of caesium-137 ($Bq\ m^{-3}$)	Caesium-137 discharged ($TBq\ day^{-1}$)	NAC ($Bq\ litre^{-1}$ per $TBq\ day^{-1}$)
Feb-86	92.18	50	42.18	0.00156	27.04
Apr-86	90.77	50	40.77	0.00155	26.30
May-86	93.24	50	43.24	0.00122	35.44
Aug-86	104.22	50	54.22	0.00102	53.16
Nov-86	63.27	50	13.27	0.00113	11.74
Feb-87	74.4	50	24.4	0.00093	26.24
May-87	86.46	50	36.46	0.00102	35.75
Aug-87	81.09	50	31.09	0.00134	23.20
Jun-88	33.82	18	15.82	0.00048	32.96
Aug-88	33.91	18	15.91	0.00065	24.48
Nov-88	40.4	18	22.4	0.00075	29.87
Jan-89	30.34	18	12.34	0.00048	25.71
Feb-89	53.41	18	35.41	0.0004	88.53
Mar-89	27.65	18	9.65	0.0005	19.30
Apr-89	33.02	18	15.02	0.00061	24.62
May-89	32.99	18	14.99	0.00058	25.84
Jun-89	38.08	18	20.08	0.00057	35.23
Jul-89	31.7	18	13.7	0.00043	31.86
Aug-89	38.01	18	20.01	0.00046	43.50
Sep-89	46.63	18	28.63	0.00056	51.13
Oct-89	28.03	18	10.03	0.00032	31.34
Nov-89	22.85	18	4.85	0.00028	17.32
Dec-89	37.87	18	19.87	0.00032	62.09
Jan-90	16.8	12	4.8	0.00039	12.31
Feb-90	8.55	12	-3.45	0.00058	
Mar-90	20.07	12	8.07	0.00027	29.89
Apr-90	26.64	12	14.64	0.00048	30.50
May-90	40.82	12	28.82	0.00065	44.34
Jun-90	36.67	12	24.67	0.00039	63.26
Jul-90	22.13	12	10.13	0.00027	37.52
Aug-90	21.61	12	9.61	0.00054	17.80
Sep-90	43.85	12	31.85	0.00062	51.37
Oct-90	21.88	12	9.88	0.00079	12.51
Nov-90	50.51	12	38.51	0.00125	30.81
Dec-90	23.65	12	11.65	0.00074	15.74
Jan-91	28.2	10	18.2	0.00128	14.22
Feb-91	45.33	10	35.33	0.00105	33.65
Mar-91	33.91	10	23.91	0.00082	29.16
Apr-91	38.55	10	28.55	0.00092	31.03
May-91	30.89	10	20.89	0.00063	33.16
Jun-91	29.43	10	19.43	0.00062	31.34
Jul-91	25.47	10	15.47	0.00083	18.64
Aug-91	24.11	10	14.11	0.00078	18.09
Sep-91	24.47	10	14.47	0.00046	31.46
Oct-91	20.23	10	10.23	0.00066	15.50
Nov-91	16.01	10	6.01	0.00036	16.69
Dec-91	19.52	10	9.52	0.00065	14.65
				Mean NAC	34.06
				S.D.	20.12

** Caesium-137 in sea water from the cooling water inlet, Sizewell Beach, Aldeburgh, Southwold and Lowestoft*

Annex 3.7 Normalised Activity Concentrations (NACs) for Sizewell

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from the Sizewell area to the contemporary discharge of caesium-137 in a year.

Year	Mean * concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1982	142.61	110	32.61	0.00170	19.18
1983	146.85	110	36.85	0.00135	27.35
1984	132.91	100	32.91	0.00117	28.22
1985	101.11	50	51.11	0.00176	29.06
1986	88.73	50	38.73	0.00117	33.06
1987	70.32	50	20.32	0.00103	19.80
1988	30.30	18	12.30	0.00062	19.99
1989	35.05	18	17.05	0.00045	37.83
1990	27.76	12	15.76	0.00059	26.51
1991	28.01	10	18.01	0.00071	25.49
				Mean NAC	26.65
				S.D.	5.99

** Caesium-137 in sea water from the cooling water inlet, Sizewell Beach, Aldeburgh, Southwold and Lowestoft*

Annex 3.8 Normalised Activity Concentrations (NACs) for Hunterston

B. Relating the background adjusted, annual mean concentration of caesium-137 in sea water from the station cooling water inlet to the contemporary discharge of caesium-137 in a year.

Year	Mean concentration of caesium-137 (Bq m^{-3})	Background concentration of caesium-137 (Bq m^{-3})	Background adjusted concentration of caesium-137 (Bq m^{-3})	Caesium-137 discharged (TBq day^{-1})	NAC (Bq $litre^{-1}$ per TBq day^{-1})
1988	176.79	120	56.79	0.00167	34.08
1989	137.15	100	37.15	0.00093	39.88
1990	107.89	90	17.89	0.00041	43.54
				Mean NAC	39.16
				S.D.	4.77

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