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**STUK • SÄTEILYTURVAKESKUS**
**STRÅLSÄKERHETSCENTRALEN**
**RADIATION AND NUCLEAR SAFETY AUTHORITY**

Osoite/Address • Laippatie 4, 00880 Helsinki
Postiosoite / Postal address • PL / P.O.Box 14, FIN-00881 Helsinki, FINLAND
Puh./Tel. +358 9 759 881 • Fax +358 9 759 88 500 • www.stuk.fi

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Sold by:
STUK – Radiation and Nuclear safety Authority (STUK)
P.O.Box 14, FI-00881 Helsinki, Finland
Tel +358-9-759881
Fax +358-9-75988500

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**Key words:** environmental radioactivity, nuclear power plants, terrestrial environment, aquatic environment

# Abstract

Monitoring of the radioactive substances around Finnish nuclear power plants continued in 1999–2001 in accordance with the regular environmental monitoring programmes. Altogether some 1000 samples are analysed annually from the terrestrial and aquatic environs of the two power plants.

Trace amounts of activation products originating from airborne releases from the local power plants were detected in several air and deposition samples. At Loviisa, observations were made in five aerosol samples; at Olkiluoto in three samples during the reporting period. The concentrations were very low, being a few microbequerels per cubic metre. A similar pattern was tenable for the deposition samples, too. No traces of local discharge nuclides were detected in foodstuffs, drinking water or garden products. In mushrooms and wild berries picked from the Loviisa and Olkiluoto areas, only Chernobyl-derived cesium isotopes and natural $^{40}K$ were found.

Local discharge nuclides were more abundant in the aquatic environment, especially in samples of indicator organisms, sinking matter and sediments. The dominant artificial radionuclides in the vicinity of the power plants were still the caesium isotopes, especially $^{137}Cs$, originating from the Chernobyl accident. In seawater, elevated $^{3}H$ concentrations were more frequent at Loviisa, but no traces of other discharge nuclides were detected. In indicator organisms and sinking matter the concentrations of local discharge nuclides were somewhat higher and their distribution range was wider in the sea area off Olkiluoto. Small amounts of $^{60}Co$ originating from the local power plant were detected in sediments at a distance of about 15 km from the Olkiluoto NPP.

*IKÄHEIMONEN Tarja K, KLEMOLA Seppo, ILUS Erkki, VARTTI Vesa-Pekka, MATTILA Jukka. Suomen ydinvoimalaitosten ympäristön säteilyvalvonnan tulokset vuosilta 1999–2001. STUK-A218. Helsinki 2006, 112 s.*

**Avainsanat:** ympäristön radioaktiivisuus, ydinvoimalaitokset, maaympäristö, vesiympäristö

# Tiivistelmä

Suomen ydinvoimalaitosten ympäristön säteilyvalvonta jatkui vuosina 1999–2001 säännöllisten tarkkailuohjelmien mukaisesti. Kahden voimalaitospaikan maa- ja vesiympäristöistä otetaan ja analysoidaan yhteensä lähes tuhat näytettä vuodessa.

Pieniä määriä paikallisten voimalaitosten ilmapäästöistä peräisin olevia aktivoitumistuotteita havaittiin useissa lähialueelta otetuissa ilma- ja laskeumanäytteissä. Raportointijakson aikana havaintoja tehtiin viidestä Loviisan ja kolmesta Olkiluodon ilmanäytteestä. Radioaktiivisten aineiden pitoisuudet olivat erittäin pieniä; muutamia mikrobequerellejä kuutiometrissä ilmaa. Vastaavia havaintoja tehtiin myös laskeumanäytteissä. Elintarvikkeissa, talousvedessä ja puutarhatuotteissa ei esiintynyt paikallisista päästöistä lähtöisin olevia radioaktiivisia aineita.

Loviisan ja Olkiluodon voimalaitosten ympäristöistä kerätyissä sienissä ja luonnonmarjoissa esiintyi vain Tshernobylin onnettomuudesta peräisin olevia cesium-isotooppeja ja luonnon kalium-40:a.

Vesiympäristössä oli runsaammin paikallisista päästöistä peräisin olevia radioaktiivisia aineita; erityisesti ns. indikaattorikasveissa ja -eläimissä, jotka keräävät tehokkaasti näitä aineita, sekä pohjalle laskeutuvassa aineksessa ja pohjasedimenteissä. Merkittävimmät keinotekoiset radioaktiiviset aineet voimalaitosten ympäristönäytteissä olivat edelleen Tshernobylin onnettomuudesta peräisin olevat cesiumin isotoopit, erityisesti cesium-137. Kohonneita tritiumpitoisuuksia oli useammin Loviisan ympäristöstä otetuissa merivesinäytteissä, mutta muita paikallisia päästönuklideja niissä ei havaittu. Indikaattoriorganismeissa ja pohjalle laskeutuvassa aineksessa havaittujen paikallisten päästönuklidien pitoisuudet olivat Olkiluodossa jonkin verran suuremmat ja niitä havaittiin laajemmalla alueella kuin Loviisassa. Pieniä määriä koboltti-60:a havaittiin pohjasedimenteissä noin 15 kilometrin etäisyydellä Olkiluodon voimalaitoksesta.

# Contents

# 1 Introduction

There are four nuclear power plant (NPP) units in Finland: two pressurised water reactors at Loviisa (rated net electric power of each 448 MW) on the south coast, and two boiling water reactors at Olkiluoto (rated net electric power of each 840 MW) on the west coast (Fig. 1). The units at Loviisa were commissioned in 1977 and 1980, and those at Olkiluoto in 1978 and 1980.

Surveillance of radioactive substances in the vicinities of the NPPs is carried out under permanent monitoring programmes, in which some 1000 samples are taken annually from the two NPP sites. The aim is to confirm that the discharges from the power plants are within permissible release limits and to monitor their dispersion in the environment. Local circumstances and different spreading directions on land and sea have been taken into account in planning the sampling network.

In order to provide reference data, the programmes commenced one year before the first reactor went into operation. Radioecological background studies were started at Loviisa in 1966 and at Olkiluoto in 1972. Since 1976, the results have been published in the Annual Reports of STUK (the Radiation and Nuclear Safety Authority).

This report presents the results of the monitoring programmes in 1999–2001. Apart from annual refuelling and maintenance outages and some other short shutdowns, the power plants were in continuous commercial operation throughout the period.

The annual maintenance outages at the Loviisa power plant were in 1999 from 7 August to 16 September, in 2000 from 22 July to 14 September and in 2001 from 11 August to 23 September. Annual outages at the Olkiluoto plant were in 1999 from 2 to 25 May, in 2000 from 7 May to 4 June and in 2001 from 6 to 29 May. Otherwise, there were only some short breaks in operation.

The annual load factors of Loviisa reactors 1 and 2 were 91.0% and 93.2% in 1999, 84.8% and 91.0% in 2000, and 92.1% and 89.0% in 2001, respectively. The load factors for Olkiluoto reactors TVO I and TVO II were 96.9% and 96.6% in 1999, 95.7 and 95.5 in 2000, and 97.6% and 95.1% in 2001, respectively (STUK-B-YTO 202, 208, 216). This Report also provides the annual discharge data from both power stations during the report period.

The authors of the present report are each responsible for different parts of it. Tarja K. Ikäheimonen undertook the editing of the report and was responsible for pretreatment of samples and radiochemical analyses and for writing the chapters on deposition, terrestrial environment and foodstuffs together with Vesa-Pekka Vartti. Seppo Klemola was responsible for gammaspectrometric analyses and wrote the chapters on air, measurements of environmental gamma radiation and dose estimates. Erkki Ilus was responsible for planning and implementing the sampling programmes, and wrote the chapters on programmes, materials and methods, and aquatic environment together with Jukka Mattila.

# 2 Discharge data

Annual airborne and aquatic discharges (Bq) from Loviisa and Olkiluoto nuclear power stations in 1999–2001 are given below. Only radionuclides with a longer half-life than one week are reported.

## Loviisa

| | AIRBORNE | | | AQUATIC | | |
|---|---|---|---|---|---|---|
| **Nuclide** | **1999** | **2000** | **2001** | **1999** | **2000** | **2001** |
| H-3 | 1.9E+11 | 2.0E+11 | 1.8E+11 | 1.4E+13 | 1.1E+13 | 1.4E+13 |
| C-14 | 3.3E+11 | 2.8E+11 | 3.0E+11 | - | - | - |
| Cr-51 | - | 5.8E+06 | - | - | - | 6.6E+05 |
| Mn-54 | 1.2E+05 | 2.3E+06 | 5.8E+05 | 1.0E+06 | 6.6E+05 | 7.5E+06 |
| Co-58 | 7.2E+04 | 5.5E+06 | 1.1E+06 | 1.1E+06 | 2.2E+06 | 2.8E+06 |
| Fe-59 | - | - | - | - | - | 3.1E+03 |
| Co-60 | 7.6E+05 | 6.0E+06 | 1.0E+06 | 1.0E+07 | 2.7E+06 | 5.2E+08 |
| Sr-90 | - | - | - | 2.8E+03 | - | 2,7E+03 |
| Zr-95 | - | 7.7E+05 | - | - | - | 1.7E+04 |
| Nb-95 | - | 2.2E+06 | 8.1E+04 | - | - | 2.7E+04 |
| Ag-110m | 4.0E+06 | 1.9E+07 | 1.7E+07 | 1.4E+07 | 2.9E+07 | 1.2E+08 |
| Te-123m | - | 7.6E+04 | - | - | 5.1E+05 | - |
| Sb-124 | 3.8E+06 | 7.8E+06 | 3.9E+06 | 4.2E+07 | 2.2E+07 | 1.1E+08 |
| Sb-125 | - | - | - | - | - | 1.5E+08 |
| I-131 | 4.5E+07 | - | - | - | - | - |
| Cs-134 | 2.5E+04 | - | - | 8.4E+06 | 4.6E+06 | 5.6E+07 |
| Cs-137 | - | 9.9E+04 | - | 4.0E+07 | 3.8E+07 | 3.0E+08 |

## Olkiluoto

| Nuclide | AIRBORNE 1999 | 2000 | 2001 | AQUATIC 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| H-3 | 5.2E+11 | 4.6E+11 | 3.8E+11 | 1.1E+12 | 1.0E+12 | 9.0E+11 |
| C-14 | 7.6E+11 | 7.6E+11 | 8.7E+11 | - | - | - |
| Cr-51 | 7.3E+05 | 9.4E+05 | 2.6E+06 | 1.2E+08 | 7.7E+07 | 1.5E+08 |
| Mn-54 | 2.1E+05 | - | 2.0E+06 | 9.0E+07 | 4.9E+07 | 1.6E+07 |
| Co-58 | 1.1E+06 | 1.1E+06 | 5.4E+06 | 2.5E+08 | 1.1E+08 | 6.1E+07 |
| Fe-59 | - | - | - | 2.6E+06 | 2.9E+06 | 2.6E+06 |
| Co-60 | 3.4E+06 | 8.7E+06 | 2.1E+07 | 7.9E+08 | 5.0E+08 | 3.0E+08 |
| Sr-89 | 6.1E+05 | 1.7E+06 | - | 3.4E+06 | - | - |
| Sr-90 | 7.7E+04 | - | - | - | - | - |
| Zr-95 | - | 3.7E+05 | 1.7E+05 | 3.8E+06 | 6.8E+06 | 1.5E+07 |
| Nb-95 | - | 1.8E+05 | 1.7E+05 | 7.1E+06 | 1.4E+07 | 2.6E+07 |
| Sb-124 | - | - | 4.5E+05 | 3.2E+07 | 2.1E+07 | 2.4E+07 |
| Sb-125 | - | - | - | 3.0E+06 | 4.8E+06 | 1.8E+07 |
| Sn-125 | - | - | - | - | 7.8E+06 | - |
| I-131 | 1.4E+07 | 7.9E+07 | - | 1.0E+08 | 2.9E+07 | 6.5E+06 |
| Cs-134 | - | - | - | 7.1E+07 | 4.3E+07 | 5.5E+07 |
| Cs-136 | - | - | - | - | 3.6E+05 | - |
| Cs-137 | - | - | - | 3.2E+08 | 2.1E+08 | 1.9E+08 |
| Ce-141 | - | - | - | - | 2.3E+05 | - |

# 3 Monitoring programmes

The environmental monitoring programmes of the Loviisa and Olkiluoto nuclear power plants are revised every five years on the basis of previously obtained experience. The attached programme was taken into use from the beginning of 1998.

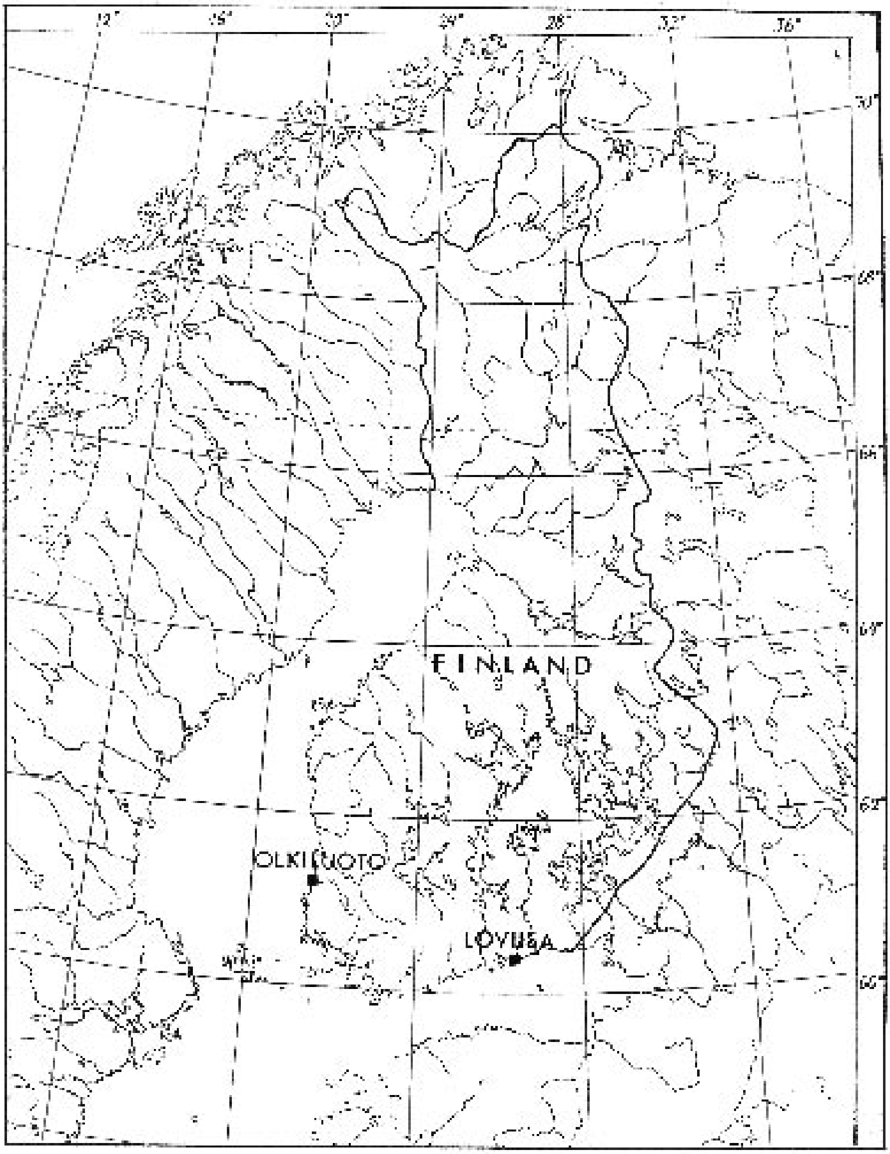



**Figure 1.** Location of Loviisa and Olkiluoto nuclear power stations.

# Programmes for monitoring radionuclides in the environs of Finnish nuclear power plants in 1998 – 2002

| Monitoring object | Type of measurements or samples and number of measurements or sampling stations | Measuring or sampling frequency | Analyses and frequencies |
|---|---|---|---|
| **1. External radiation** | a) Environmental dose rate meters at Loviisa (17) and Olkiluoto (14) at 0 - 10 km from the power plants | Continuous measurement and recording | Dose rate, min., max., mean, analogue plotter charts and/or digital hourly average values |
| | b) TLD dosemeter stations at Loviisa (10) and Olkiluoto (11) at 0 - 10 km from the power plants | Continuous measurement | Gamma dose, 4 times a year |
| | c) High-pressure ionization chamber measurements at TLD dosemeter stations | Once a year | Gamma dose, once a year |
| | d) Supplementary gamma-spectrometric measurements | Once every two years | Gamma spectrum, once every two years |
| **2. Airborne radioactive particles and iodine** | a) Air sample collectors at Loviisa (4) and Olkiluoto (4), at 0 - 10 km from the power plants. The collectors can collect airborne radioactive particles and iodine (also iodine in the form of organic compounds). | Continuous collection. Filters replaced twice a month; at one station once a week during refuelling | Gamma emitters, twice a month (once a week) |
| | b) Supplementary monitoring performed with a portable air sample collector | Once a week during refuelling | Gamma emitters, once a week during refuelling |
| **3. Deposition** | Rainwater collectors at Loviisa (4) and Olkiluoto (4), at 0 - 10 km from the power plants | Continuous collection | Gamma emitters, 12 and $^{3}H$, 4 - 12 times a year; $^{89}Sr$ and $^{90}Sr$, 4 times a year |

| | | | |
|---|---|---|---|
| **4. Soil** | Soil samples are drawn from the area of assumed maximum deposition to determine the accumulation of long-lived radionuclides | Once every four years | Gamma emitters and $^{90}$Sr, vertical distribution |
| **5. Terrestrial wild plants, natural products and game** | a) Reindeer lichen from 1 sampling site close to the power plants | Once a year | Gamma emitters, once a year |
| | b) Hair moss from 1 sampling site at Loviisa and Olkiluoto | Twice a year | Gamma emitters, twice a year; $^{89}$Sr and $^{90}$Sr, once a year |
| | c) Pine needles from 1 sampling site close to the power plants | Once a year after the refuelling | Gamma emitters, once a year |
| | d) Wild berries and mushrooms grown in the vicinities of the power plants | Once every four years | Gamma emitters |
| **6. Grazing grass** | Collective sample representing farms producing milk, at 0 - 10 km from the power plants | Twice a growing season | Gamma emitters, twice a growing season |
| **7. Milk** | a) Sample representing farms producing milk, at 0-10 km from the power plants | Once a week | $^{131}$I, twice a month during the grazing season, once a month during the fodder season; gamma emitters, once a month. |
| | b) Sample representing the whole production of the local dairy | Once a week | Gamma emitters, once a month; $^{89}$Sr, $^{90}$Sr, six times a year |
| **8. Garden produce** | a) Lettuce grown at 0 - 10 km from the power plants | Twice a growing season | Gamma emitters, twice a year |
| | b) Apples grown at Loviisa and black currants grown at Olkiluoto, at 0 - 10 km from the power plants | Once a year | Gamma emitter, once a year |

| | | | |
|---|---|---|---|
| **9. Grain** | Rye and wheat samples, grown at less than 20 km from the power plants | Once a year | Gamma emitters, once a year; $^{89}Sr$ and $^{90}Sr$, only from wheat |
| **10. Meat** | Beef samples from livestock raised at less than 40 km from the power plants. The samples represent the grazing season and the fodder season | Twice a year | Gamma emitters, twice a year |
| **11. Drinking water** | Samples of drinking water or raw water from the power plants and from the towns of Loviisa and Rauma | 4 times a year | Gamma emitters and $^{3}H$, 4 times a year; $^{89}Sr$ and $^{90}Sr$, twice a year |
| **12. Sea water** | Samples from 5 stations in the surrounding sea areas of the power plants | 3 - 4 times a year | Gamma emitters, $^{3}H$, $^{89}Sr$ and $^{90}Sr$, 3 – 4 times a year (Sr only from 2 stations) |
| **13. Bottom sediments** | a) Sinking matter collected by sediment traps at 4 stations in the surrounding sea areas of the power plants | Continuous collection | Gamma emitters, 4 times a year; $^{238}Pu$ and $^{239,240}Pu$, once a year from 2 stations |
| | b) Sediment samples are taken from several stations in the surrounding sea areas | Once every four years | Gamma emitters, $^{90}Sr$, $^{238}Pu$ and $^{239,240}Pu$, vertical distribution |
| **14. Aquatic indicator organisms** | a) Periphyton collected by 1 $m^2$ sampling plates close to the cooling water outlets of the power plants | Continuous collection during the growing season (May-September) | Gamma emitters, 4 times a growing season |
| | b) Filamentous green algae from 1 sampling site at Loviisa and Olkiluoto | Once a year | Gamma emitters, once a year |

| | | | |
|---|---|---|---|
| | c) *Fucus vesiculosus* from 5 sampling sites at Loviisa and Olkiluoto | Twice a year | Gamma emitters twice a year; $^{89}$Sr, $^{90}$Sr, $^{238}$Pu and $^{239,240}$Pu, from 2 sites once a year |
| | d) Submerged seed plants *Myriophyllum spicatum* and *Potamogeton pectinatus* from 1 sampling site at Loviisa and Olkiluoto | Once a year | Gamma emitters, once a year |
| | e) Crustacean *Saduria entomon* at Loviisa and bivalve molluscs *Macoma baltica* + *Mytilus edulis* at Olkiluoto from one sampling site | Once a year | Gamma emitters, once a year; $^{89}$Sr and $^{90}$Sr, from *Saduria* and *Macoma* once a year |
| **15. Wild fish** | Pike, perch, roach and Baltic herring from two sampling areas at Loviisa and Olkiluoto | Twice a year | Gamma emitters, twice a year; $^{89}$Sr and $^{90}$Sr, one perch and Baltic herring sample once a year |
| **16. Farmed fish** | Young salmon and other fish from the fish farm of Loviisa | 10 times a farming season | Gamma emitters, 10 times a year |
| Radioactivity in man is measured annually on about 12 persons living 1–10 km from either power plant. | | | |

The location of the sampling stations, sites and areas are shown in Figs 2–5. Soil and sediment surveys are carried out in both areas every four years. In 1999, the sediment survey was conducted at Olkiluoto and the soil survey (combined with that of mushrooms and wild berries) was arranged at Loviisa in 2000 and at Olkiluoto in 2001. The sampling points and areas used in these surveys are presented in Figs 6–8.

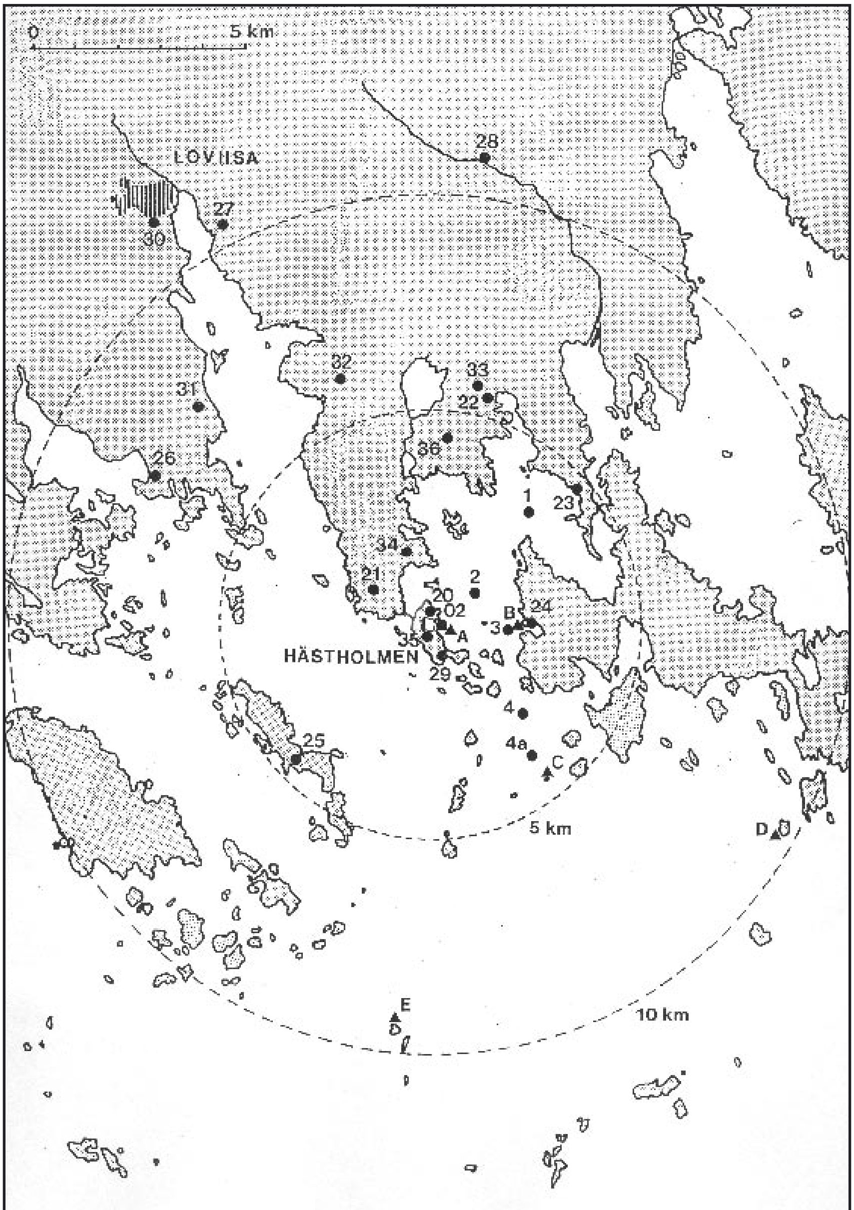



**Figure 2.** Sampling and measurement stations or sites in Loviisa: 20–29TLD dosemeters; 34 direct gammaspectrometric measurements; 21,24, 27, 33 air sample collectors, 33 supplementary air sampling, lettuce since 2000; 20, 24, 27, 33 rain water collectors; 20, 30 drinking water; 22 grazing grass, lettuce in 1999; 31 apple; 32 hair moss in 1999 and 2000; 35 reindeer lichen and pine needles;36 hair moss in 2001; 02, 1, 2, 4, R1 sea water; 1, 3, 4a, R1 sinking matter; A, B, C, D, E aquatic indicator organisms. Reference station R1 is located off the map, about 14 km west of the power plant.

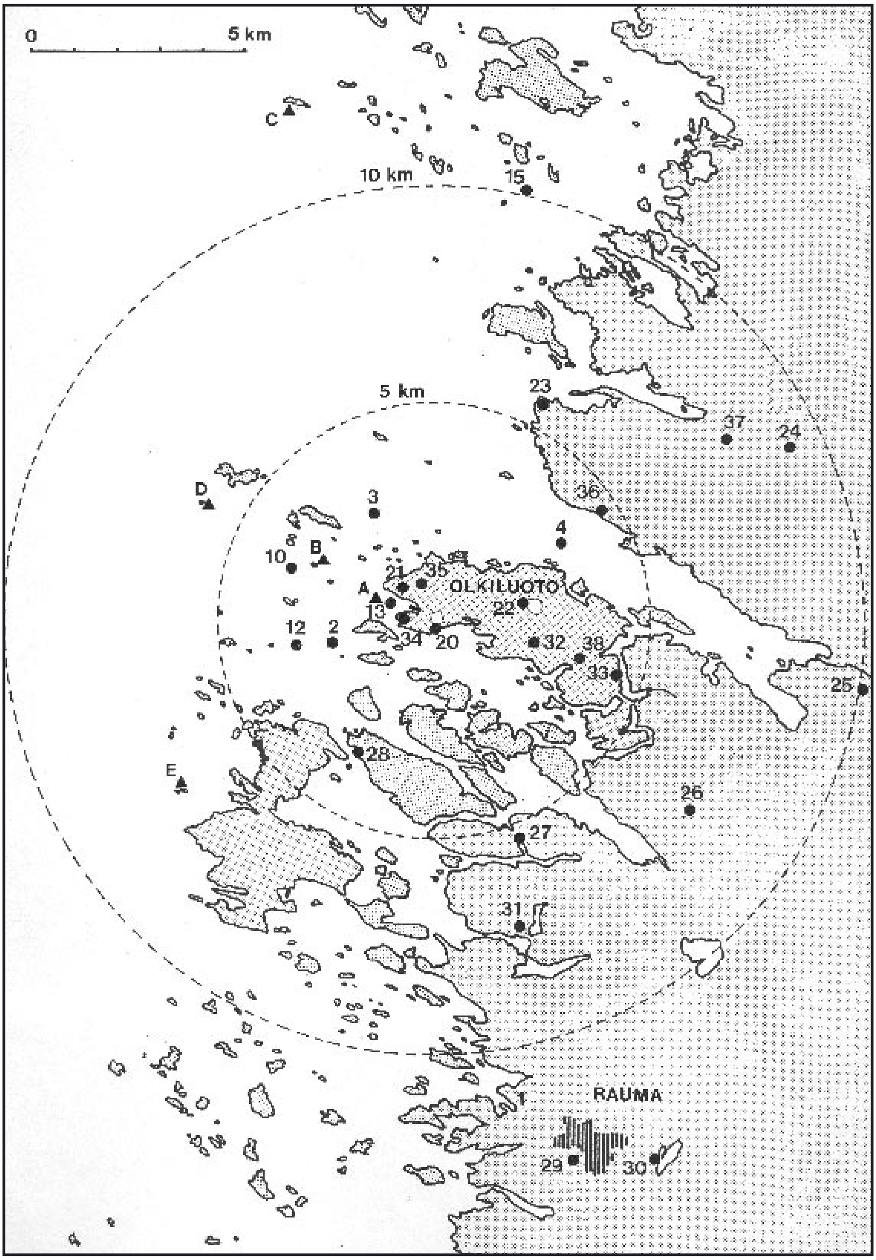



**Figure 3.** Sampling and measurement stations or sites in Olkiluoto:20–29, 34 TLD dosemeters; 38 direct gammaspectrometric measurements; 22, 26, 31, 37 air sample collectors; 33 supplementary air sampling; 21, 26, 31, 37 rainwater collectors; 22, 30 drinking water; 26 lettuce and black currant; 32 hair moss; 21 reindeer lichen and pine needles; 35 dumping ground for exempted waste; 2, 3, 10, 13, 15 sea water; 3, 4, 12, 15 sinking matter; A, B, C, D, E aquatic indicator organisms.

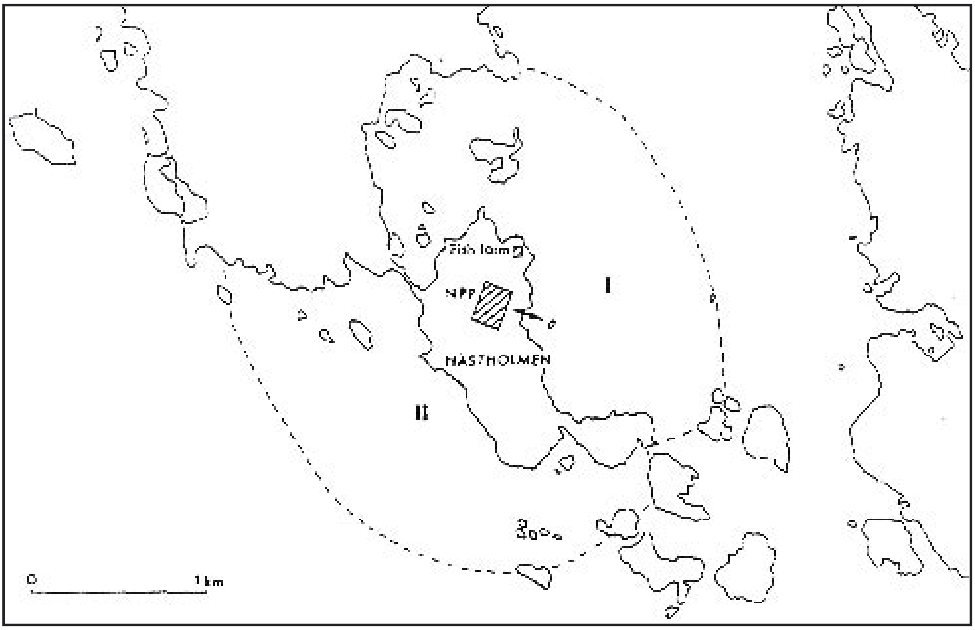



**Figure 4.** Fishing areas in Loviisa.

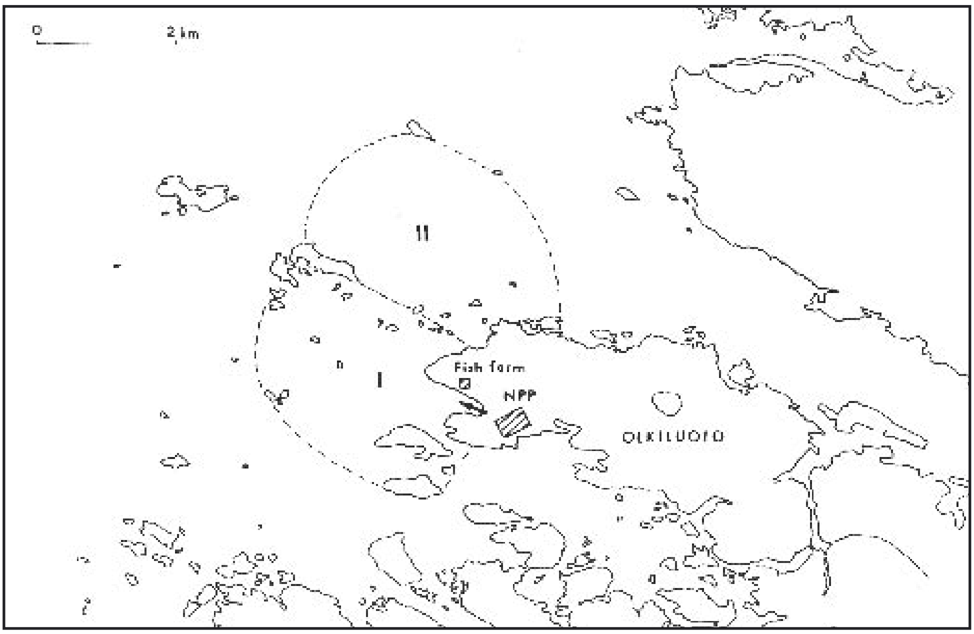



**Figure 5.** Fishing areas in Olkiluoto.

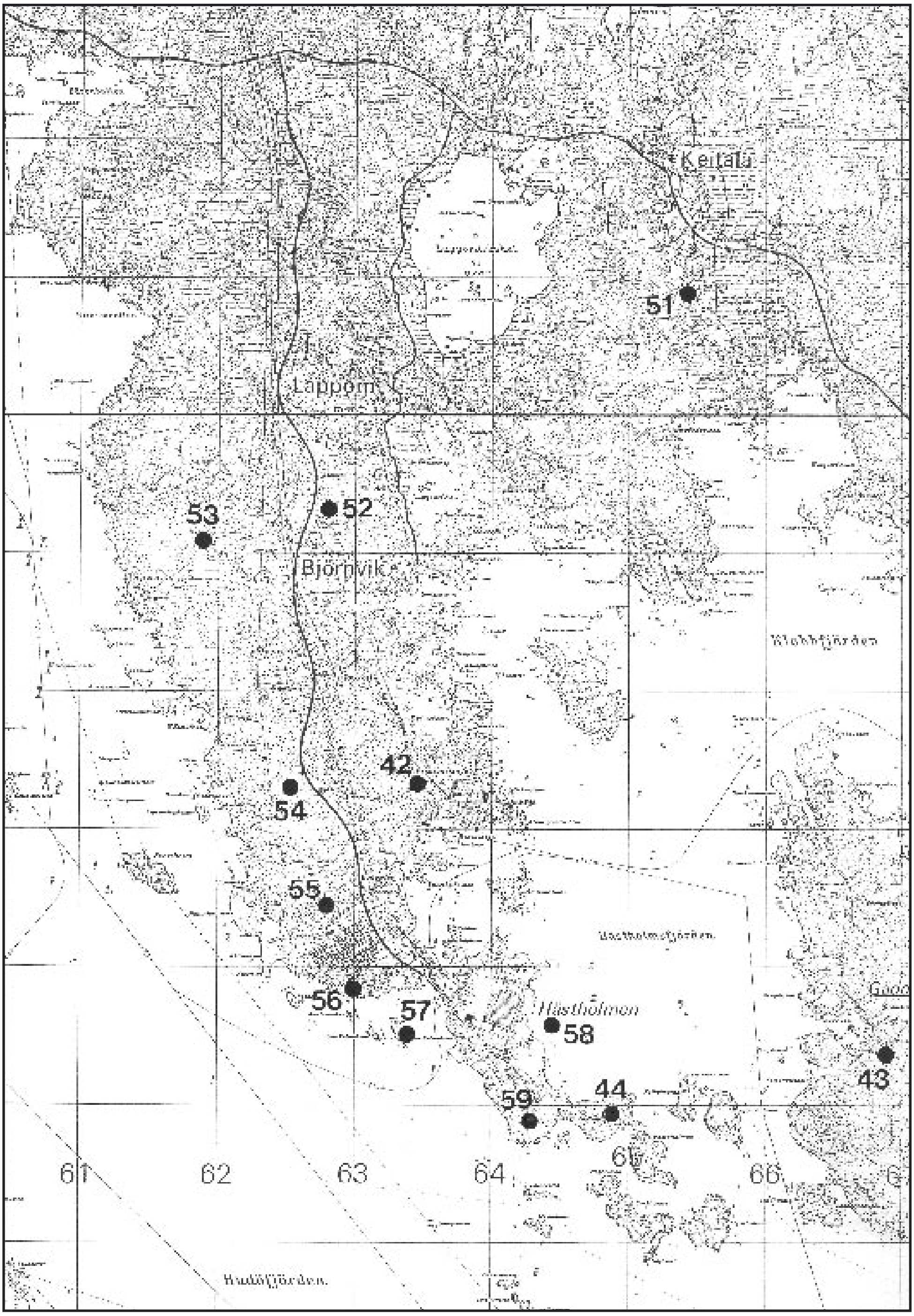



**Figure 6.** Sampling points and areas in the 2000 survey of soil, mushrooms and wild berries in Loviisa.

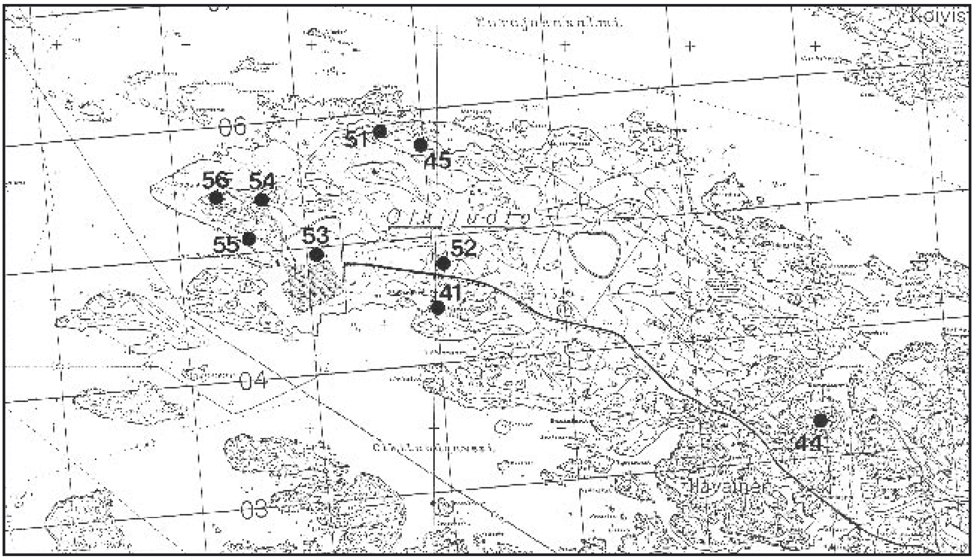



**Figure 7.** Sampling points and areas in the 2001 survey of soil, mushrooms and wild berries in Olkiluoto.

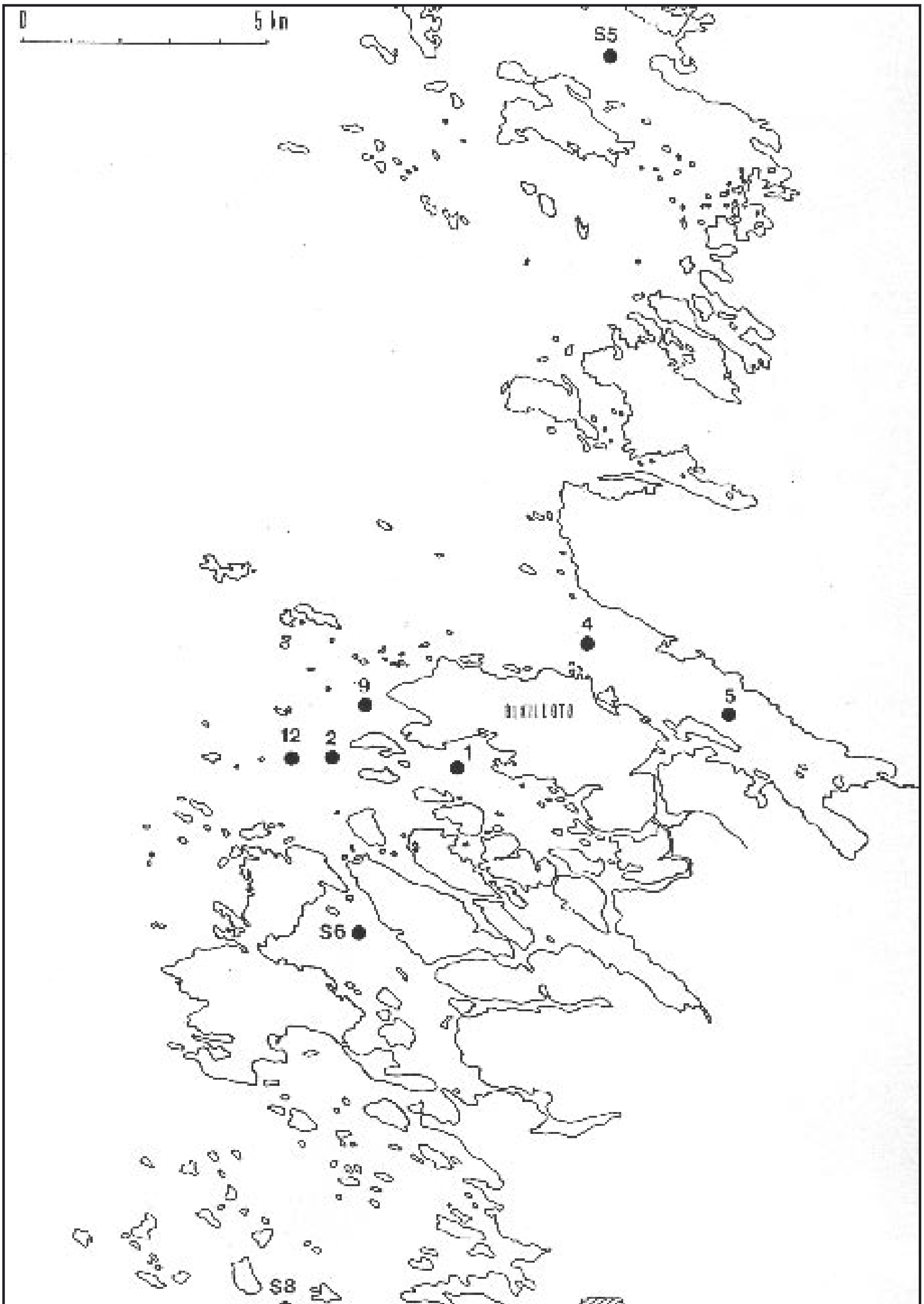



**Figure 8.** Sampling stations in the 1999 sediment survey in Olkiluoto.

# 4 Material and methods

The sampling and analysis methods used in the environmental monitoring at Loviisa and Olkiluoto have been described in our previous Annual Reports (STUK-A67, 1987, STUK-A79, 1989, STUK-A92, 1991, STUK-A102, 1992, STUK-A121, 1995, STUK-A157, 1998, STUK-A192, 2002, STUK-205, 2004). Only changes or additions to the earlier descriptions or deviations from the normal practice are given in this chapter. Detailed descriptions of the sampling, pre-treatment and analysis methods are available in Finnish in the TKO Handbooks 3.1.2 – 3.1.6.

The development of a uniform and modern quality system for the whole of STUK began in 1997 and the regulation was completed in 1999. The quality system is based on Total Quality Management (TQM) according to ISO standard 9004 (ISO 9004, 2000). A major step in continuous improvement was reached in 1999 when accreditation was awarded by FINAS (the Finnish Accreditation Service). Accredited fields of testing include tests of radiation safety and related environmental sampling, namely gammaspectrometric analyses, radiochemical analyses of tritium, radioactive strontium and transuranic elements in environmental, foodstuff and biological samples.

In order to determine the quality of the sampling and analysis methods, our laboratory has participated in several intercomparisons in recent years, conducted by different organizations, e.g. the International Atomic Energy Agency and its Marine Environment Laboratory, Nordic Nuclear Safety Research, Helsinki Commission, etc. Our results have been consistent with the reference values.

The overall uncertainty of the analysis results includes statistical, calibration and analytical uncertainties, but not the uncertainty due to sampling. It is expressed as relative error (%) in 1 $\sigma$ confidence level.

## 4.1 Air

Four high-volume air sample collectors are located adjacent to both of the power plants. Small changes in the location of two air samplers at Loviisa in 1998 were reported in our preceding Annual Report STUK-A205. The specifications of the stationary air samplers used in the environs of the power plants are presented in STUK-A121 and those of the supplementary air sampler in STUK-A102.

## 4.2 Deposition and terrestrial environment

Some changes in the location of two deposition collectors at Loviisa, and in the collector types in both areas (executed in 1998) were reported in our preceding

Annual Report STUK-A205. At present there are large-area collectors (1 $m^2$) situated at Station 20 in Loviisa and at Station 21 in Olkiluoto (STUK-A121, Figs 9a and 9b). Stainless steel collectors (0.05 $m^2$) for tritium samples are located at Stations 20 and 33 in Loviisa and at Stations 21 and 26 in Olkiluoto (STUK-A121, Fig 10a). The Ritva collectors (0.07 $m^2$) are located at Stations 24, 27 and 33 in Loviisa and at Stations 26, 31 and 37 in Olkiluoto (STUK-A205, Fig. 8).

Soil samples were taken with a traditional STUK soil sampler described in STUK-A121. Three or four parallel cores were taken at random from an area of 10 x 10 m, and the parallel slices were combined for analyses.

In the soil survey at Loviisa (2000), the sampling points were the same as in 1996 (Fig. 6). Sampling Sites 42 and 43 were small patches of old open fields or meadows with high grass (the ground has lain fallow for many years). Sampling Site 44 was even more in its natural state than the two above-mentioned. In August 2000, when the samples were taken, the ground at all the sampling sites was very wet. The soil props tended to stick to the walls of the sampling tube, and it was difficult to get them out. One therefore had to be satisfied with relatively short soil cores (maximum 20 cm). In general, the type of soil was similar to that in 1996 at each sampling site. There was a thick turf layer with roots of grass at the surface, and underneath there was clay, which became more rigid as the depth increased.

In the soil survey at Olkiluoto (2001), two of the three sampling points (41 and 44) were the same as in 1997, whereas Sampling Site 45 was new (Fig. 7). Sampling Site 41 is a small open patch in a forest of small spruce. Below a thin (3–4 cm) surface horizon of peat with roots of grass, the soil turned to silt and sand. Sampling Site 44 is a former small field or meadow in the woods which has been in a natural state for decades. Below a thin (4 cm) peat and root horizon the soil turned to clay and became stiffer as the depth increased. Sampling Site 45 is an open patch in a pine forest. The surface layers consisted of humus and the deeper layers (below 8 cm) of sand.

## 4.3 Aquatic environment

In the aquatic environment, the samples of filamentous green algae, submerged seed plants, the bladder-wrack *Fucus vesiculosus* and the common mussel *Mytilus edulis* were taken by SCUBA diving; *Macoma baltica* was taken with an Ekman-Birge grab and a benthos sieve, and *Saduria entomon* was caught with bait nets.

In June 1999, the anchoring of the periphyton collector in Loviisa failed, and the collector was not found at the end of June. A new collector was installed in the same place on 30 June. The lost collector was then found in the middle of July (Table XXa) from the opposite side of the Hästholmsfjärden bay. It had drifted ca. 2 km to the east of the proper sampling site.

Since the beginning of May 2001, the old 4-tubecollectors used in sampling of sinking matter at Loviisa have been replaced by 3-tubecollectors similar to those used at Olkiluoto (cf. STUK-A157, Fig. 8).

Some sediment traps disappeared during the winter period 1998–1999 at Loviisa and Olkiluoto. At Loviisa, the underwater buoys carrying the traps at the Loviisa 1 and Loviisa 3 Stations were not found in early May 1999. In the first case the reason was the high turbidity of water. The buoy was found later in May, but since new traps were installed at all the stations on 4 May, the sampling periods partly overlapped at this station in May 1999 (Table XXVIa). At Olkiluoto, the winter-buoys were not found at Olkiluoto 4, Olkiluoto 12 and Olkiluoto 15 Stations in April 1999. New traps were installed at all the stations on 27 April. The missing trap at Olkiluoto 12 Station was found on 11 May. Thus the sampling periods partly overlapped at this station in May 1999 (Table XXVIb).

In the 1999 sediment survey at Olkiluoto, the basic sampling stations (1, 4, 9 and 12) were the same as in the earlier surveys of 1987, 1991 and 1995. In 1995, the sampling network was extended to Stations S5, S6 and S8, which are situated at somewhat greater distances from the power plant. In addition, samples were taken at one new station (5) in 1999. The locations of the sampling stations are shown in Fig. 8. The ordinary samples were taken with a Gemini Twin Corer consisting of 2 parallel coring tubes with an inner diameter of 80 mm. The corer is described in Ilus et al. (2000). One haul (2 parallel cores) was regularly taken with the Gemini corer at each station. The cores were sectioned into 5 cm thick sub-samples and the parallel sub-samples were combined for analysis.

Furthermore, some additional samples were taken with the Gemini corer to examine the vertical distribution of radionuclides more exactly. At Olkiluoto 12 Station, two parallel cores were sectioned into 1 cm slices and the parallel sub-samples were combined. At Station 2, only one core was sectioned into 1 cm slides down to 30 cm.

At Stations 2, 4, 9 and 12 the type of sediment was relatively compact sulphidic clay with a relatively thin layer of soft mud on the surface. At Stations 1, 5, S5, S6 and S8 the sediment was relatively soft grey clay with a thin layer of soft mud on the surface. The surface layer was oxic at all the stations. The clay bottom was softest at Stations S6, S5, 12 and 2, and most solid at Stations 1, 5, 4 and 9.

# 5 Results and discussion

## 5.1 Air

The activity concentrations of the gamma-emitting nuclides detected in ground-level air at Loviisa are given in Tables Ia and Ib and those at Olkiluoto in Tables IIa and IIb. The radionuclide concentrations in the supplementary air samples at Loviisa and Olkiluoto are shown in Tables IIIa and IIIb, respectively.

Chernobyl-derived $^{137}$Cs was the dominant artificial radionuclide in the surface air in 1999–2001. It was detected in most of the samples. The observed concentrations ranged from 0.6 to 11 µBq m$^{-3}$ at Loviisa (Fig. 9) and from 0.8 to 44 µBq m$^{-3}$ at Olkiluoto (Fig. 10).

One filter from Olkiluoto contained about ten times more $^{137}$Cs than the annual average, while the other filters from the same period showed no similar increase. It is assumed that the increase was caused by an aerosol particle. Presuming that all the caesium activity comes from one particle, then the activity of this particle was about 1 Bq.

Concentrations of $^{134}$Cs were well below the detection limit, and the only observation (in 2000 at Olkiluoto) coincided with the highest $^{137}$Cs concentration. The ratio of the concentrations was typical for Chernobyl fallout in 2000.

Nuclides originating from the local power plant were detected in five aerosol samples at Loviisa. The most frequent of these observations were those of $^{110m}$Ag, which was detected three times, once per year in 1999–2001. Other radionuclides of local origin were $^{60}$Co and $^{131}$I, which were both detected once. All except one of these observations were made during the maintenance periods at the Loviisa plant. The frequency of observations of local releases decreased compared with the previous reporting period (STUK-A205) and the concentrations remained very low, being only a few microbecquerel per cubic metre.

At Olkiluoto, nuclides of local origin were detected in only three filters. All the observations were those of $^{60}$Co. Two of these observations were made during the maintenance periods at the Olkiluoto plant.

## 5.2 Deposition and terrestrial environment

Trace amounts (maximum 0.053 Bqm$^{-2}$) of $^{60}$Co were detected several times and those of $^{54}$Mn and $^{110m}$Ag less often during 1999–2001 in deposition samples from the large area collector at Loviisa (Table IVa). These nuclides originated from the local NPP. In analogous samples from Olkiluoto, $^{60}$Co was found less often and $^{54}$Mn was detected once in 2001 (Table IVb). Observations of $^{60}$Co in the large-area collectors at Loviisa and Olkiluoto after 1977 and 1981, respec-tively, are shown in Figs 11 and 12.

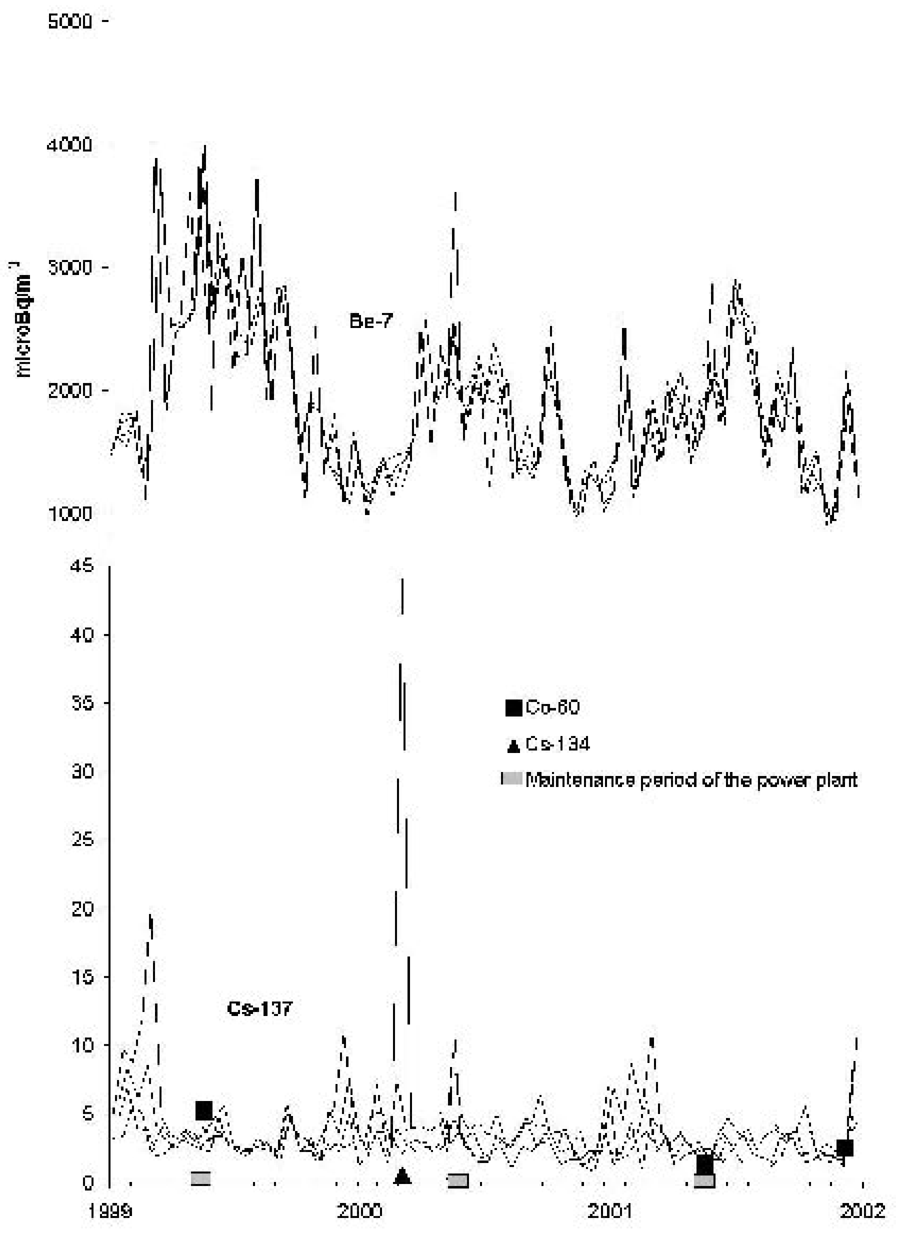



**Figure 9.** Concentrations of $^{7}$Be and artificial nuclides detected in ground-level air (μBq $m^{-3}$) at four sampling stations in the vicinity of Loviisa NPP in 1999–2001.

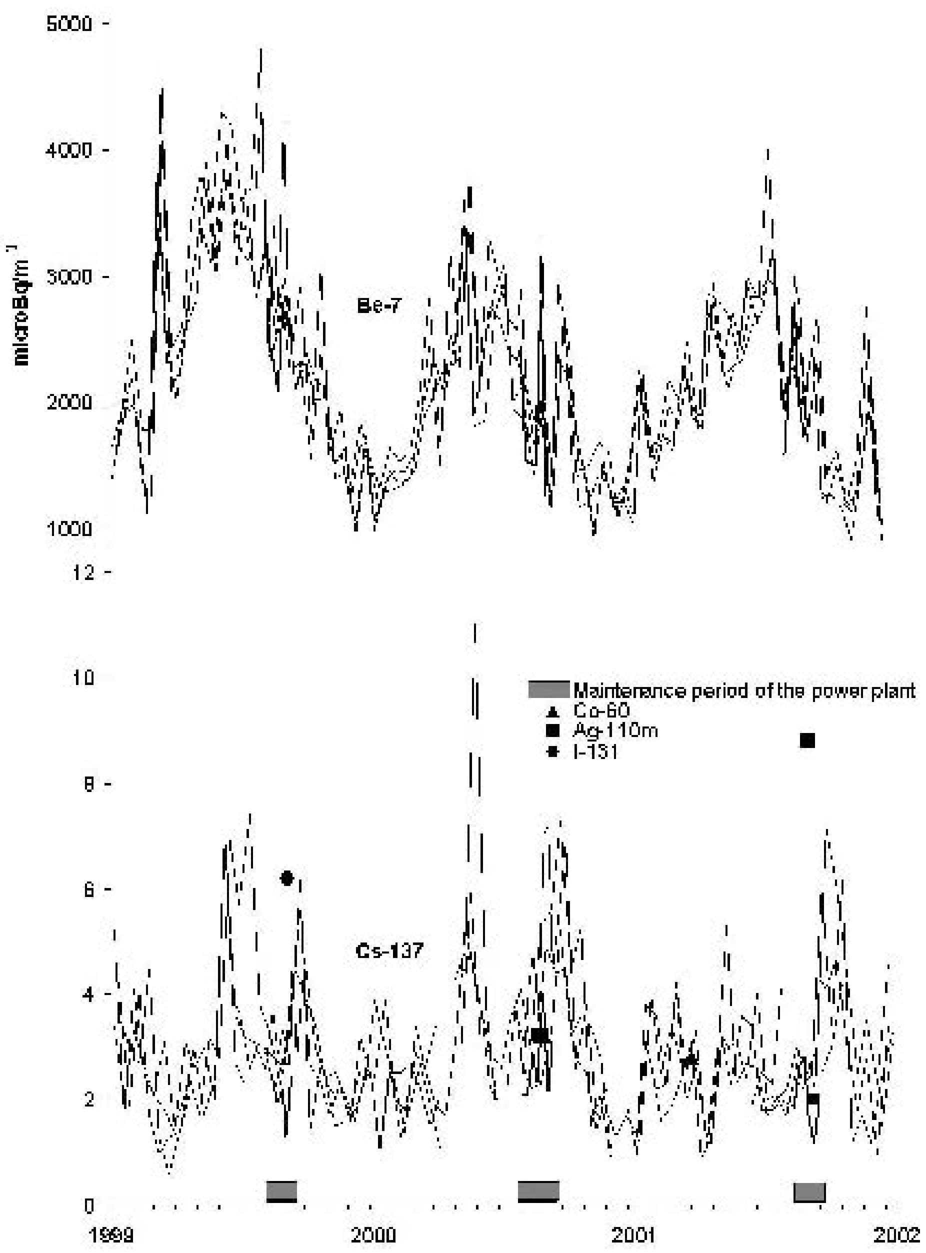



**Figure 10.** Concentrations of $^{7}Be$ and artificial nuclides detected in ground-level air at four sampling stations in the vicinity of Olkiluoto NPP in 1999–2001.

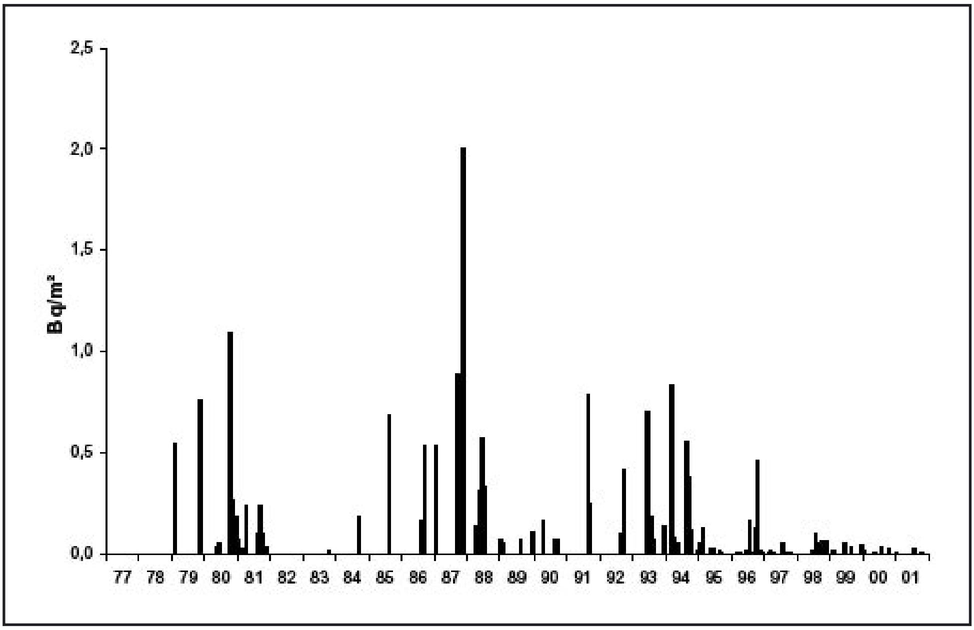



**Figure 11.** Observations of $^{60}Co$ in deposition samples at Station Loviisa 20 during 1977–2001.

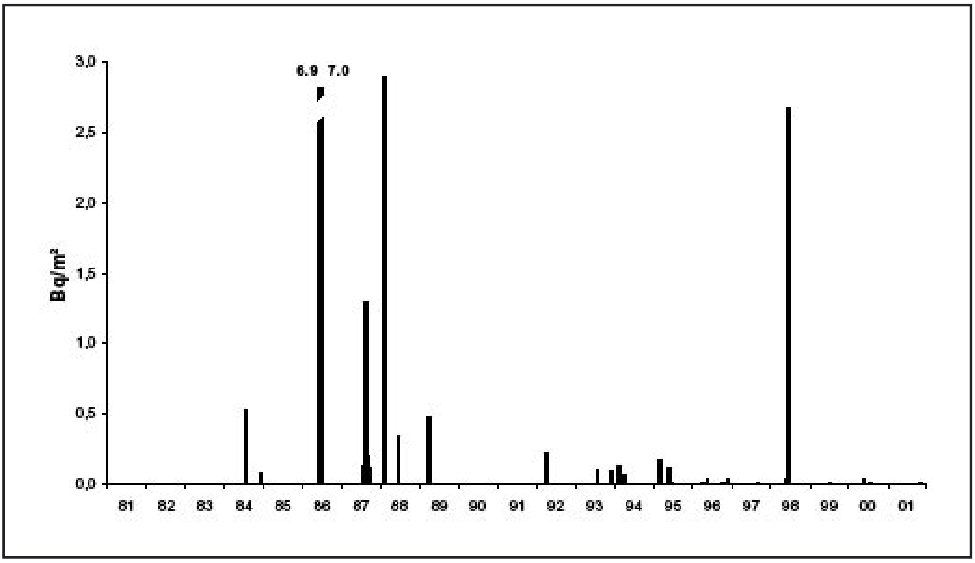



**Figure 12.** Observations of $^{60}Co$ in deposition samples at Station Olkiluoto 21 during 1981–2001.

Besides the observations of the global fallout and the Chernobyl fallout (1980, 1981 and 1986), $^{60}Co$ of local origin has been detected more often in Loviisa than in Olkiluoto during the entire period. The highest number of observations was in 1996; in 9 monthly samples at Loviisa and in 6 monthly samples at Olkiluoto (Fig. 13). Within each year, the highest number of observations was in the periods of August - September in Loviisa, and May - July in Olkiluoto (Fig. 14). These were the annual maintenance periods of the power plants. Traces of $^{60}Co$ were found in the samples collected with small area collectors at Stations Loviisa 27 and 33 in 1999 (Table VIa).

Slightly increased monthly average concentrations of tritium (4 - 8 Bq $l^{-1}$) were detected six times in the rainwater samples collected at Station 21 in Olkiluoto. All other tritium concentrations in rainwater at Olkiluoto and at Loviisa were below the detection limit (4 Bq $l^{-1}$).

The annual total deposition of $^{137}Cs$, calculated from the quarterly results of the quantitative 0.07 $m^2$ collectors varied at Loviisa and Olkiluoto from 2 to 5 Bq $m^{-2}$ (Tables VIa and VIb). The total amounts were smaller than in the previous two-year period (STUK-A205).

In the soil samples taken from Loviisa in 2000 (Table VIIa) and from Olkiluoto in 2001 (Table VIIb), the highest concentrations of the Chernobyl-

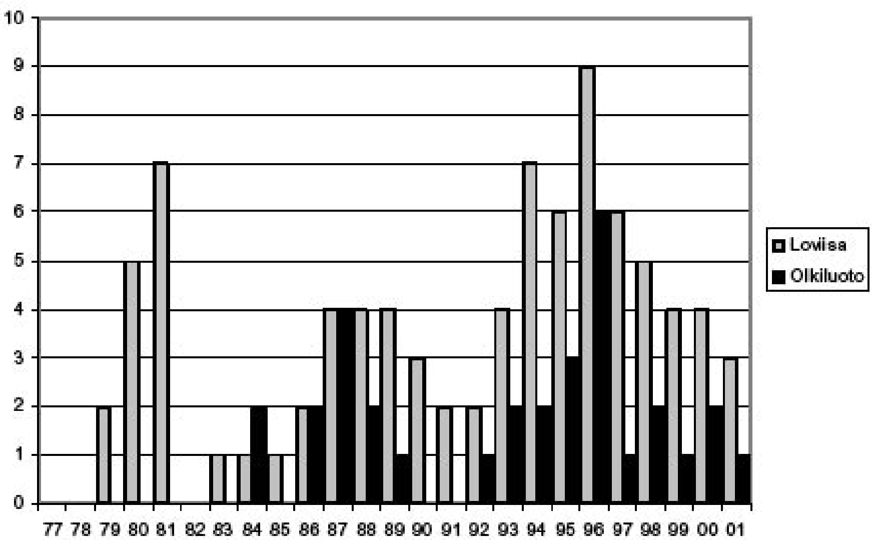



**Figure 13.** Number of yearly observations of $^{60}Co$ in deposition samples at Station Loviisa 20 during 1977 – 2001 and Station Olkiluoto 21 during 1981 – 1998.

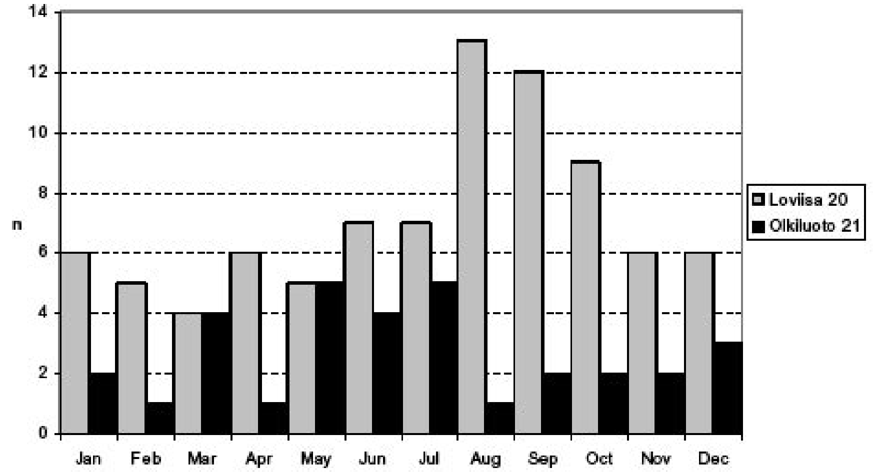



**Figure 14.** Number of monthly observations of $^{60}Co$ in deposition samples at Station Loviisa 20 during 1977 – 2001 and Station Olkiluoto 21 during 1981 – 1998.

derived $^{90}Sr$, $^{134}Cs$ and $^{137}Cs$ were located in the two uppermost layers (0 - 4 cm). The highest concentration of $^{137}Cs$ was 2300 Bq $kg^{-1}$ d.w. at Loviisa and 1100 Bq $kg^{-1}$ d.w. at Olkiluoto. A small amount (18.6 Bq $kg^{-1}$ d.w.) of $^{60}Co$ originating from the local nuclear power plant could also be found in one surface sample in Olkiluoto. The total amounts of $^{137}Cs$ varied between 7 500 and 39 400 $Bqm^{-2}$ in Loviisa and between 9 000 and 11 000 $Bqm^{-2}$ in Olkiluoto. The large variation in total amounts describes heterogeneous distribution of the Chernobyl fallout.

Generally, the amounts of $^{90}Sr$ were low in the hair moss samples varying from 2 to 8 Bq $kg^{-1}$ d.w. (Table VIII).The $^{137}Cs$ concentrations in hair moss were clearly higher in the Loviisa area than in the Olkiluoto area. At Loviisa, concentrations varied between 1000 and 2000 Bq $kg^{-1}$ d.w. and at Olkiluoto between 230 and 770, respectively. The sampling site of hair moss at Loviisa was changed in 2001 and the results from the new site were slightly higher than from the old sampling site.

$^{134}Cs$ and $^{137}Cs$ were the only artificial gamma-emitting radionuclides in grazing grass (Table IX). The occasional top values of $^{137}Cs$ in the grazing grass at Olkiluoto (15.1 Bq $kg^{-1}$ in 2000 and 24.4 Bq $kg^{-1}$ in 1998 (STUK-A205) are probably due to the patchiness of $^{137}Cs$ deposition in the area.

In lichen, which accumulates caesium directly from the air, the concentration of $^{137}Cs$ varied from 570 to 1000 Bq $kg^{-1}$ d.w. in the areas of Loviisa and Olkiluoto. NPP originating $^{60}Co$ was found in two lichen samples from Olkiluoto (1999 and 2000). The $^{137}Cs$ concentrations in pine needles were clearly lower, varying between 80 - 250 Bq kg$^{-1}$ d.w. (Table X).

The ditchwater samples taken from the exempted-waste dump at Olkiluoto contained $^{137}$Cs from the Chernobyl fallout. No local discharge nuclides from dumped waste were found (Table XI).

## 5.3 Foodstuffs

No traces of fresh releases from the NPPs were detected in the foodstuff samples. The artificial radionuclides detected were $^{90}$Sr, $^{134}$Cs and $^{137}$Cs, which originated from the Chernobyl accident and older global fallout.

In 1999, 2000 and 2001, the annual mean concentrations of $^{90}$Sr in milk samples from the 0–40 km zone at Loviisa and the entire output of the local dairy at Olkiluoto varied from 0.045 Bq l$^{-1}$ to 0.067 Bq l$^{-1}$ (Tables XIIa and XIIb). The amounts of $^{90}$Sr were approximately at the pre-Chernobyl level. The $^{137}$Cs contents in milk continued to decrease slowly. The annual means of $^{137}$Cs varied from 0.2 to 1.1 Bq l$^{-1}$, being higher in the Olkiluoto area. $^{134}$Cs could still be seen occasionally in milk from the Olkiluoto area in 1999 and 2000. $^{131}$I was not detected in the milk samples during 1999–2001 at either Loviisa or Olkiluoto. The concentrations of $^{90}$Sr and $^{137}$Cs were at the same level as in the rest of Finland.

The contents of $^{90}$Sr in drinking water (Tables XIVa and XIVb.) were at the same level as in the early 1980s, varying from 6 to 12 Bq m$^{-3}$. The $^{137}$Cs contents generally continued to decrease slowly or were at the same level as in the previous years (STUK-A205). A clear difference between $^{137}$Cs concentrations in drinking water from the Loviisa NPP (36 - 89 Bq m$^{-3}$) compared with that of Olkiluoto NPP (6 - 11 Bq m$^{-3}$) and the town of Rauma (5 - 11 Bq m$^{-3}$) have been found since the Chernobyl accident (STUK-A67). This is due to the type of soil, which is very clay-rich on the west coast of Finland (Olkiluoto and Rauma) and therefore effectively retains caesium in the soil. This phenomenon decreases the concentrations in surface waters. The water supply of the town of Loviisa is groundwater, which explains the lack or very low concentrations of artificial radionuclides in these samples.The concentrations of tritium in all the drinking water samples were below the detection limit (4 kBq m$^{-3}$).

The levels of $^{90}$Sr and $^{137}$Cs in cereals have not changed significantly since 1992. The concentrations varied between 0.15–0.21 and 0.42–1.36 Bq kg$^{-1}$ d.w., respectively (Table XV). The $^{137}$Cs contents in garden produce and beef (Tables XVI and XVII) generally showed a slightly decreasing trend compared with those of the previous years.

In mushrooms and wild berries picked from the Loviisa area in 2000 and from the Olkiluoto area in 2001, only Chernobyl-derived gammanuclides, $^{134}$Cs and $^{137}$Cs, were found (Tables XVIIIa and XVIIIb). As in general, the concentrations were highest in mushrooms of the genus *Hydnum*, *Boletus* and *Lactarius* being at the highest, 8500 Bq $kg^{-1}$ f.w., in *Hydnum rufescens* sampled from the Loviisa area. The concentrations in the most consumed berries, lingonberry and blueberry, varied between 15–49 Bq $kg^{-1}$ f.w.

Fish samples are discussed in Chapter 5.4.3.

## 5.4 Aquatic environment

### 5.4.1 Seawater

Tritium in seawater originates generally from atmospheric nuclear weapons tests conducted in the Northern Hemisphere in the late 1950s and early 1960s. The levels of fallout $^{3}H$ have continuously decreased, but tritium is still the most abundant radionuclide in seawater. Nevertheless, $^{3}H$ is also produced in nuclear reactors, and consequently it is the predominant radionuclide in both airborne and liquid discharges from nuclear power plants.

In Finnish coastal waters, the concentrations of fallout $^{3}H$ have decreased from about 10–15 kBq $m^{-3}$ to less than 5 kBq $m^{-3}$ between the late 1970s and late 1990s. Thus, local discharges have probably contributed to the values in excess of 4 kBq $m^{-3}$ in the Loviisa and Olkiluoto sea areas. In 1999–2001, the maximum concentration of $^{3}H$ was 41 kBq $m^{-3}$ in the discharge area of the Loviisa power plant and 16 kBq $m^{-3}$ at Olkiluoto (Tables XIXa and XIXb). Elevated $^{3}H$ concentrations were more frequent at Loviisa (Fig. 15), which is due to larger discharges, but also to slower exchange of water in the discharge area.

$^{137}Cs$ and $^{134}Cs$ originated mainly from the Chernobyl fallout and $^{90}Sr$ from the global fallout caused by the atmospheric nuclear weapons tests. Due to the short half-life (2.06 years), the concentrations of $^{134}Cs$ began to fall below the detection limit in 1997–1998 and in 1999 it was detected in only one additional seawater sample (Table XIXa).

In 2001, the mean activity concentration of $^{137}Cs$ in seawater was 41 (range 37–53 Bq $m^{-3}$) at Loviisa and 68 (57–79 Bq $m^{-3}$) at Olkiluoto. Since the Chernobyl accident (1986), the caesium concentrations have decreased more rapidly in Loviisa and in the whole Gulf of Finland than at Olkiluoto and in the Bothnian Sea. In Figure 16, Station LL3a represents the open sea off Loviisa and Station EB1 that off Olkiluoto. During 1986–2001, the decrease in $^{137}Cs$ values was about 91% at Loviisa, but only 76% at Olkiluoto. The main reason for the different decreasing rates of caesium is the more effective water exchange between the Gulf of Finland and the Baltic Proper than that between the Bothnian Sea and the Baltic Proper. In the Loviisa area the archipelago also retards the exchange of water more effectively than at Olkiluoto and consequently

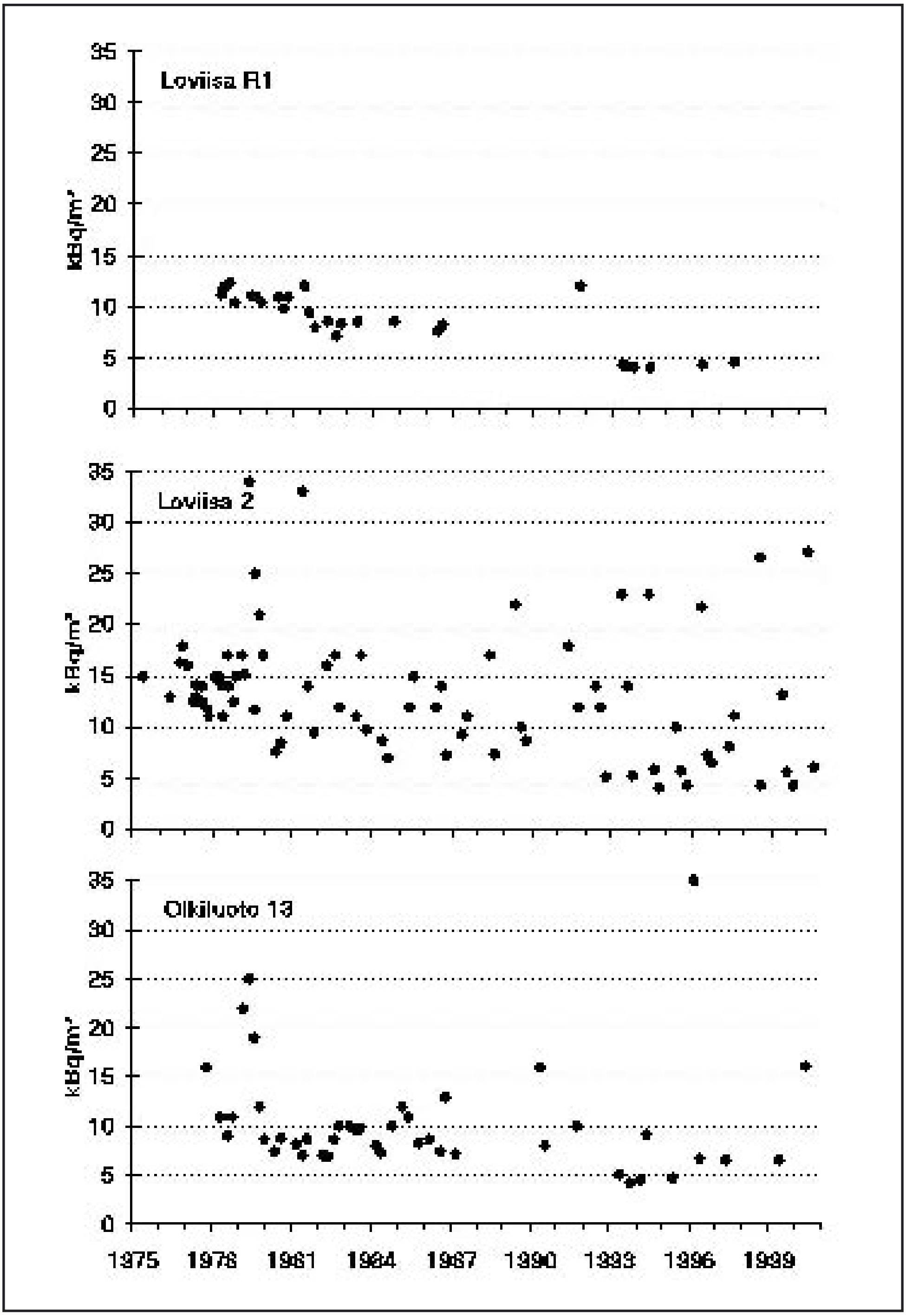



**Figure 15.** Tritium concentrations in seawater at stations Loviisa R1, Loviisa 2 and Olkiluoto 13 in 1976–2001 (detection limit 4 kBq $m^{-3}$).

the exit rate of caesium from seawater in the discharge area. The $^{90}Sr$ concentrations in seawater ranged from 11 to15 Bq $m^{-3}$ at Loviisa and from 8 to 18 Bq $m^{-3}$ at Olkiluoto.

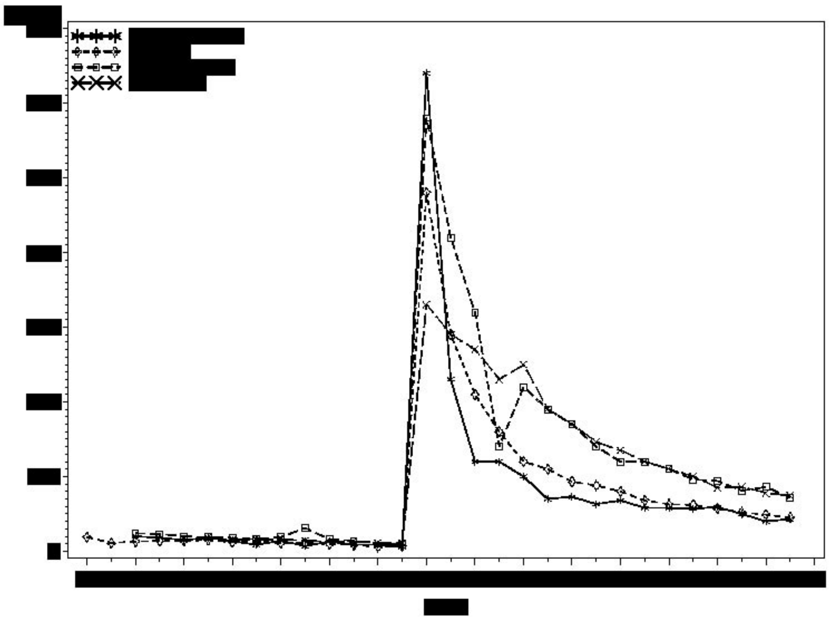


**Figure 16.** Late-summer mean concentrations of $^{137}Cs$ in surface sea water at Loviisa and Olkiluoto and the nearest offshore stations LL3a (Gulf of Finland) and EB 1 (Bothnian Sea) in 1972–2001.

### 5.4.2 Indicator organisms

The bladder-wrack, *Fucus vesiculosus,* and the filamentous green alga, *Cladophora glomerata*, have been used as aquatic indicator organisms in both areas for several years; the relict crustacean *Saduria entomon* has been used for the same purpose at Loviisa and the bivalve mussels *Mytilus edulis* and *Macoma baltica* at Olkiluoto. Since 1998, periphyton and the submerged seed plants *Myriophyllum spicatum* and *Potamogeton pectinatus* have been used as new indicator organisms for the monitoring programmes of both power plants. Indicator organisms effectively accumulate radionuclides from water and sediments, thus facilitating detection of small traces of radionuclides in the environment.

The activity concentrations of Chernobyl-derived caesium in indicator organisms continued to decrease in both areas. However, at Loviisa the caesium concentrations in *Fucus vesiculosus* have decreased more slowly than in seawater. Thus, the concentrations in *Fucus* were slightly higher at Loviisa than at Olkiluoto, although the concentrations in seawater are clearly lower at Loviisa. In 2001, the mean $^{137}Cs$ concentration of all *Fucus* samples collected at Loviisa was 46 (33–74) Bq $kg^{-1}$ dry wt. and 43 (34–56) Bq $kg^{-1}$ dry wt. at Olkiluoto (Tables XXc and XXIc). As before, there was a clear difference between the caesium values of the outermost and innermost sampling sites in both areas; the values were higher at the innermost sites. The potential contribution of the thermal effect caused by the cooling water of the power plants on the areal differences has been discussed in our previous reports, as has that of the low water-salinity, high turbidity and other hydrographic characteristics typical for the discharge areas (STUK-A102, STUK-A121). Nevertheless, the $^{137}Cs$ discharges from the power plants may also contribute to the concentrations in the vicinity of the discharge points.

Periphyton accumulates caesium more effectively than the other indicator organisms used in the monitoring programmes and according to the present data, *Fucus* seems to be the second best indicator of $^{137}Cs$. In 2001, the activity concentrations of $^{137}Cs$ in periphyton were 69–250 Bq $kg^{-1}$ dry wt. at Loviisa and 69–420 Bq $kg^{-1}$ dry wt. at Olkiluoto. In *Saduria* from Loviisa, the $^{137}Cs$ concentration was 22 Bq $kg^{-1}$ dry wt. and in *Macoma* from Olkiluoto 11 Bq $kg^{-1}$ dry wt. In *Mytilus* from Olkiluoto the $^{137}Cs$ concentration was about 5 Bq $kg^{-1}$ dry wt. (Table XXII).

In contrast to the caesium isotopes, $^{90}Sr$, $^{238}Pu$ and $^{239,240}Pu$ originate mainly from the nuclear weapons tests, and $^{40}K$ is of natural origin. In 1999–2001, the activity concentrations of $^{90}Sr$ in *Fucus* ranged from 6 to 13 Bq $kg^{-1}$ dry wt. and those of $^{239,240}Pu$ from 0.05 to 0.14 Bq $kg^{-1}$ dry wt. in both areas. $^{238}Pu$ was not detected. In a *Fucus* survey conducted during the early 1980s along the Finnish coast, the mean concentrations of $^{239,240}Pu$ were 0.26 and 0.15 Bq $kg^{-1}$ dry wt. in the Gulf of Finland and in the Bothnian Sea, respectively (STUK-B-TUTO 14, and 18).

The other radionuclides detected in the indicator organisms originate from local discharges; i.e. $^{51}Cr$, $^{54}Mn$, $^{58}Co$, $^{60}Co$, $^{110m}Ag$ and $^{124}Sb$ in Loviisa, and $^{54}Mn$, $^{58}Co$ and $^{60}Co$ in Olkiluoto.

The most abundantly detected local discharge nuclide in the indicator organisms was $^{60}Co$. The highest $^{60}Co$ concentration, 54 Bq $kg^{-1}$ dry wt., was measured in periphyton sampled near the cooling water outlet at Olkiluoto in 1999; since then the concentrations have noticeably decreased. At Loviisa, the highest $^{60}Co$ concentration in periphyton was 15 Bq $kg^{-1}$ dry wt.

Due to the lower discharges, the concentrations of $^{60}Co$, $^{54}Mn$ and $^{58}Co$ have significantly decreased in *Fucus* in both areas in recent years (Fig. 17). At the inner most Olkiluoto sampling site (A), the mean concentration of $^{60}Co$ in *Fucus* was 5.3 Bq $kg^{-1}$ dry wt., while it was 0.5 Bq $kg^{-1}$ dry wt. at the outer most sampling

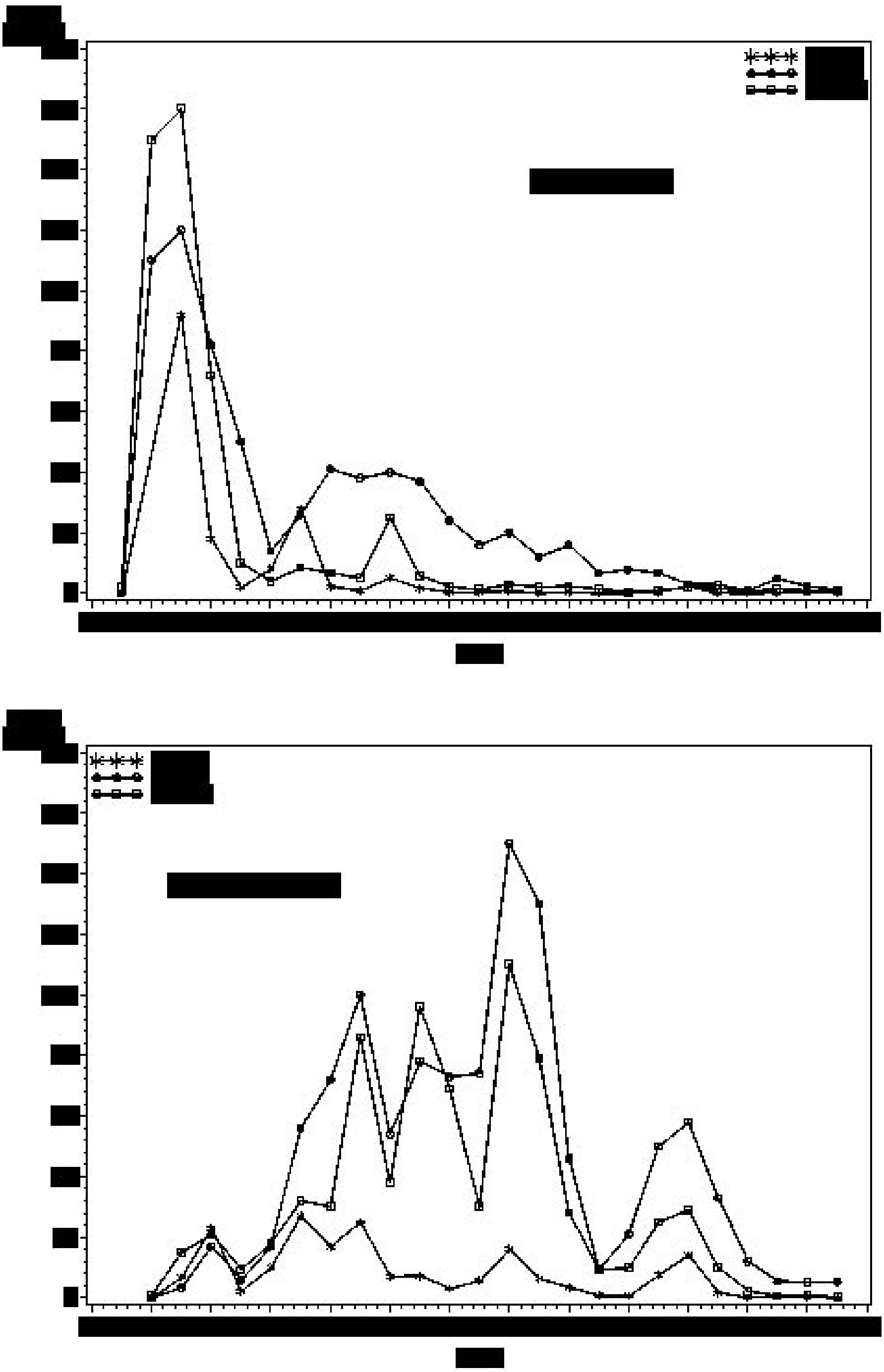


**Figure 17.** Annual mean concentrations of $^{54}$Mn, $^{58}$Co and $^{60}$Co in *Fucus vesiculosus* at sampling stations Loviisa A and Olkiluoto A in 1977–2001.

site (C). At Loviisa, the mean concentration of $^{60}Co$ at the inner most sampling site (A) was 2.7 Bq $kg^{-1}$ dry wt., but outside the Hästholmsfjärden Bay $^{60}Co$ was detected only once: 0.2 Bq $kg^{-1}$ dry wt. at sampling site C in 1999 (Table XXa).

Periphyton has proved to be an excellent indicator organisms for caesium and most of the local discharge nuclides detected in environmental samples in Loviisa and Olkiluoto. *Myriophyllum* and *Potamogeton* seem to be at least equal to *Fucus* in efficiently accumulating local discharge nuclides. However, *Fucus* seems to be a better indicator for caesium than these seed plants. *Saduria* is a good indicator for $^{110m}Ag$ and $^{60}Co$. *Myriophyllum* and *Potamogeton* seemed to accumulate effectively $^{58}Co$ and *Mytilus* $^{60}Co$.

### 5.4.3 Fish

In fish samples caught from Loviisa and Olkiluoto, the caesium concentrations were consistent with those of seawater; the concentrations in all the fish species were somewhat higher at Olkiluoto than at Loviisa (Tables XXIII–XXIV). In general, the differences between the fish species were the same as previously; the concentrations were highest in perch and lowest in Baltic herring and roach/bream/ide.

In 2001, the highest $^{137}Cs$ concentration in perch was 44 Bq $kg^{-1}$ fresh wt. at Olkiluoto and 25 Bq $kg^{-1}$ fresh wt. at Loviisa. The activity concentrations of $^{90}Sr$, $^{134}Cs$ and $^{137}Cs$ in pike and Baltic herring in both areas were at the same level as on the Finnish coast in general (perch and roach are not monitored regularly). Local discharge nuclides were detected only once in fish samples caught from Loviisa and Olkiluoto in 1999–2001: 0.12 Bq $kg^{-1}$ fresh wt. of $^{60}Co$ in perch from Olkiluoto II in 1999.

In the samples of young salmon taken from the fish farm operating in association with the power plant at Loviisa, the activity concentrations of $^{137}Cs$ were clearly lower than in the free-living fish, and $^{134}Cs$ was no longer detected (Tables XXV). The highest $^{137}Cs$ concentration in farmed fish was 1.2 Bq $kg^{-1}$ fresh wt. It was stated earlier that the low concentrations are due to the low caesium contents of the feed used in the farm.

### 5.4.4 Sinking matter

Suspended particulate matter can be considered a non-living indicator of radionuclides in the aquatic environment as many radionuclides tend to adsorb to sinking particles. The affinity of caesium to clay particles is well known, but many other nuclides seem to have a similar tendency. Since many problems are involved in sampling of recently settled particles from the surface of the sediment, proper sediment samples are taken in the monitoring programmes only once every 4 years, and the less frequent sampling is replaced by continuous round-the-year collection of sinking matter.

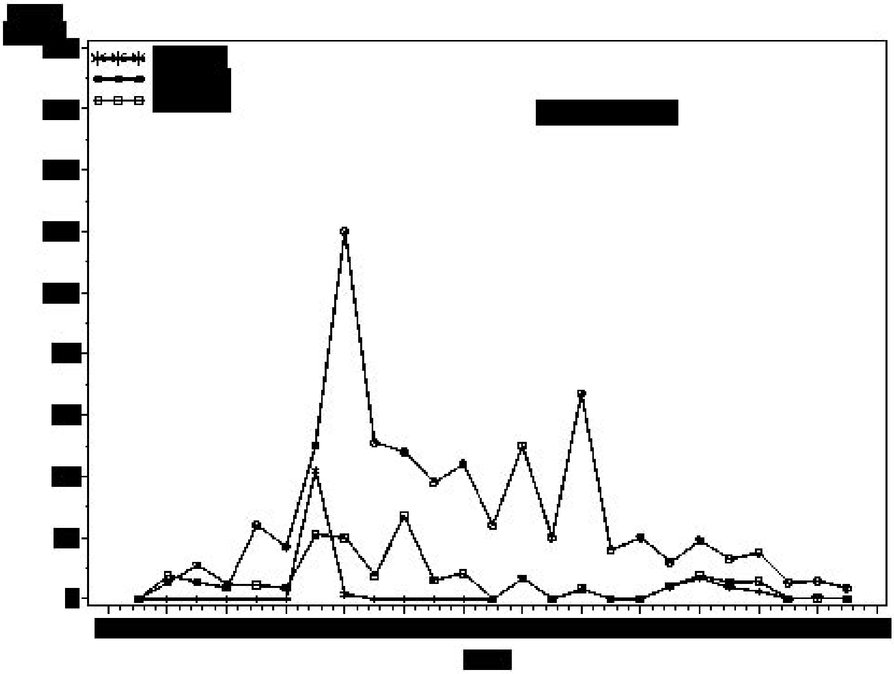
The activity concentrations of $^{137}$Cs and $^{134}$Cs were clearly higher in sinking matter than in the indicator organisms. In 2001, the mean concentration of $^{137}$Cs was 570 (310–820) Bq kg$^{-1}$ dry wt. at Hästholmsfjärden (Station 3) at Loviisa, 600 (430–720) Bq kg$^{-1}$ dry wt. at the Reference Station Loviisa R1 and 530 (470–590) Bq kg$^{-1}$ dry wt. at the Station Olkiluoto 12. (Tables XXVIa–XXVIb). The slightly higher values in the Loviisa area are due to the higher particle content in water there (STUK-A102).

$^{54}$Mn, $^{58}$Co, $^{60}$Co and $^{110m}$Ag found in sinking matter samples at Loviisa, and $^{60}$Co in Olkiluoto, originated from local discharges. $^{60}$Co was detected regularly in sinking matter collected in both areas, whereas $^{110m}$Ag, $^{54}$Mn and $^{58}$Co were detected in only a few samples collected at Loviisa 1, 3 and 4a Stations, which are located close to the power plant. The maximum concentration of $^{60}$Co was 64 Bq kg$^{-1}$ dry wt. in a sample collected at Olkiluoto 4 Station in July–September 2000. No traces of local discharges were detected at Loviisa R1 Reference Station, which is located about 14 km to the west of the Loviisa NPP. However, $^{60}$Co was regularly detected at the Olkiluoto 15 Station, located 10 km to the north of the Olkiluoto NPP. Long-term fluctuations of $^{54}$Mn, $^{58}$Co and $^{60}$Co in sinking matter collected during the open-water periods at the Loviisa 3 and Olkiluoto 2 Stations (12 since 1993) are illustrated in Fig. 18. During the last few years the concentrations have decreased significantly due to the reduced discharges (cf. Fig. 17).

The activity concentrations of $^{238}$Pu and $^{239,240}$Pu in sinking mater were < 0.04 Bq kg$^{-1}$ dry wt. and 0.58–1.3 Bq kg$^{-1}$ dry wt. at Loviisa, and < 0.26 and 1.2–1.8 Bq kg$^{-1}$ dry wt. at Olkiluoto, respectively (Table XXVII).

### 5.4.5 Bottom sediments

In addition to $^{40}$K (natural) and the fallout nuclides $^{90}$Sr, $^{238}$Pu and $^{239,240}$Pu (principally originating from the nuclear weapons tests), and $^{134}$Cs and $^{137}$Cs (principally originating from the Chernobyl accident), the sediment samples taken in 1999 at Olkiluoto, also contained smaller amounts of $^{60}$Co and $^{125}$Sb originating from local discharges (Tables XXVIII–XXIXa and b). $^{125}$Sb was detected in only two sediment slices, but $^{60}$Co was detected at all the sampling stations surveyed (Fig. 8).



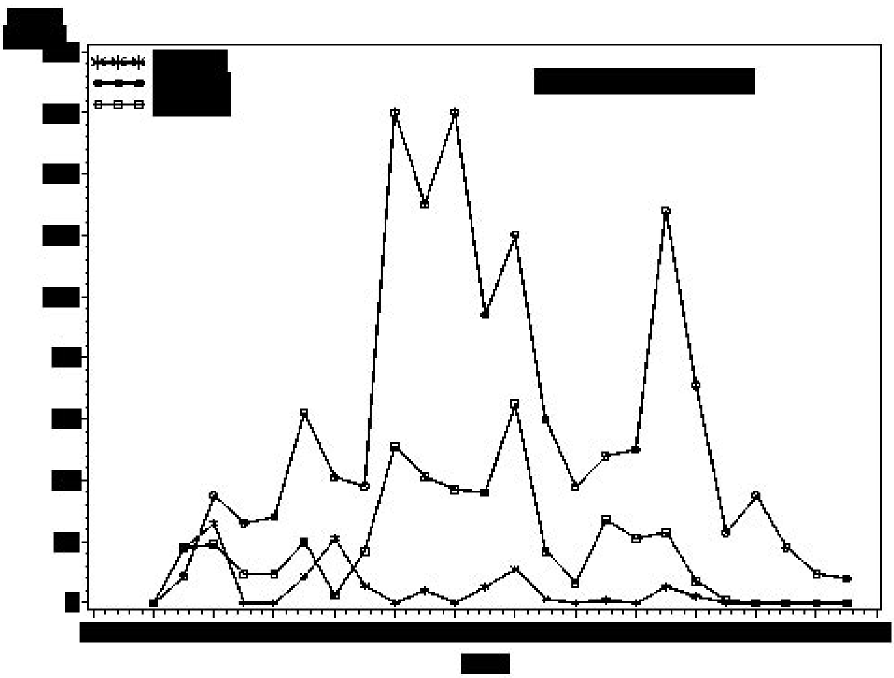


**Figure 18.** Mean concentrations of $^{54}$Mn, $^{58}$Co and $^{60}$Co in sinking matter at Stations Loviisa 3 and Olkiluoto 2/12 during the open-water periods in 1977–2001.

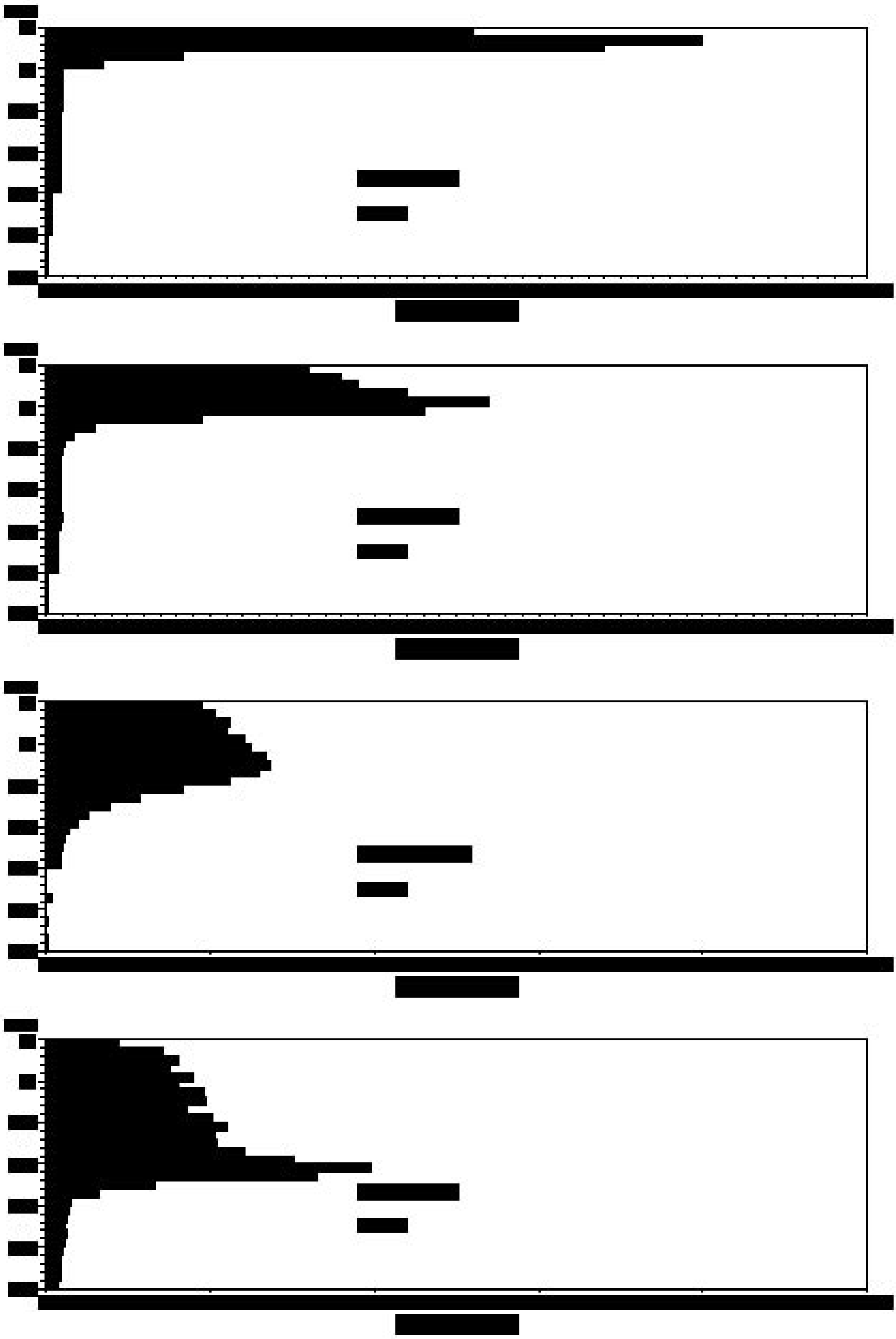


**Figure 19.** Vertical distribution of $^{137}Cs$ concentrations at the Stations Olkiluoto 2/12 in 1986–1999.

The peak values of caesium caused by the Chernobyl fallout occurred at most stations in the 5–10 cm sediment layer in the customary samples sectioned in 5-cm slices. Fig. 19 illustrates the vertical distribution of $^{137}Cs$ in 1-cm-slices at the Olkiluoto 2 /12 Station in 1986–1999. In 1999, the highest activity concentration of $^{137}Cs$ (1980 Bq $kg^{-1}$ dry wt.) was in the 15–16 cm sediment layer, which corresponds to a sedimentation rate of about 1.2 mm $y^{-1}$. At Olkiluoto 5 Station the peak was still in the upper most 0–5 cm layer.

The highest total amount of $^{137}Cs$ per $m^2$ was 42 600 Bq $m^{-2}$ at Station 2 and the lowest 10 500 Bq $m^{-2}$ at Station 5. In general, the total amounts had slightly increased after the previous survey (1995) at Stations 2, 4, 12, S6 and S8, but decreased at Stations 1, 9 and S5, which had slightly more solid surface sediments.

Small amounts of $^{60}Co$ were detected in sediments at all the stations studied. The highest activity concentrations observed were 74 Bq $kg^{-1}$ dry wt. in the 7–8 cm layer at Olkiluoto 2 Station (Table XXIXa) and 68 Bq $kg^{-1}$ dry wt. in the 5–10 cm layer at Olkiluoto 9 Station (Table XXVIII), which are located nearest to the power plant. At the most distant sampling stations, Olkiluoto S5 and S8, the highest activity concentrations of $^{60}Co$ were 2–3 Bq kg-1 dry wt. in the surface layers. As a whole, the amounts of $^{60}Co$ in sediments have remained the same or decreased slightly from those recorded in the previous survey in 1995.

Activity concentrations of $^{90}Sr$, $^{238}Pu$ and $^{239,240}Pu$ in the surface sediment samples taken from the Olkiluoto area in 1999 were 3–11 Bq $kg^{-1}$, < 0.15 Bq $kg^{-1}$ and 1.6–2.5 Bq $kg^{-1}$ dry wt., respectively. These values did not diverge from those typical for the Bothnian Sea.

## 5.5 Measurements of environmental gamma radiation

The results of the measurements made at the dosimeter stations in 1999–2001 are given in Tables XXXa and XXXb. The values ranged from 0.13 to 0.23 µSv $h^{-1}$ in the Loviisa area and from 0.09 to 0.16 µSv $h^{-1}$ in the Olkiluoto area. Table XXXI shows the fallout nuclides ($^{137}Cs$) observed in the spectrometric measurements of the gamma radiation in the open field locations. No fission products were observed during the direct spectroscopic measurements of atmospheric releases.

## 5.6 Dose estimates based on reported release data

The radiation doses to the public from the releases of the Finnish nuclear power plants were estimated with the VALTO computer model developed at STUK.

The calculations are based on the discharge and meteorological data reported to STUK by the power companies. The effective dose commitments in 1999–2001 are summarised in Table A.

The collective doses were calculated for the population residing within 80 km of the power plants. The dose estimates do not include $^{14}C$ releases, which are reported as calculated from energy output figures.

Individual doses to the hypothetical critical group since the beginning of power production by the NPPs are presented in Fig. 20. In 2001, the dose for the critical group at Loviisa increased about sixfold compared with the previous year. This is mainly due to the aquatic releases of $^{60}Co$, which increased by two orders of magnitude compared with the year 2000 (cf. Chapter 2).

**Table A.** The calculated effective dose commitments in 1999–2001.

| | | From airborne releases | From aquatic releases | Sum |
|---|---|---|---|---|
| **Individual dose (µSv)** | | | | |
| Loviisa | 1999 | 0.035 | 0.022 | 0.057 |
| | 2000 | 0.044 | 0.015 | 0.059 |
| | 2001 | 0.031 | 0.32 | 0.35 |
| Olkiluoto | 1999 | 0.026 | 0.084 | 0.11 |
| | 2000 | 0.023 | 0.053 | 0.076 |
| | 2001 | 0.017 | 0.036 | 0.053 |
| **Collective dose (manSv)** | | | | |
| Loviisa | 1999 | $1.5 \times 10^{-3}$ | $1.1 \times 10^{-5}$ | $1.5 \times 10^{-3}$ |
| | 2000 | $1.7 \times 10^{-3}$ | $7.5 \times 10^{-6}$ | $1.7 \times 10^{-3}$ |
| | 2001 | $1.3 \times 10^{-3}$ | $2.0 \times 10^{-4}$ | $1.5 \times 10^{-3}$ |
| Olkiluoto | 1999 | $2.4 \times 10^{-4}$ | $9.6 \times 10^{-5}$ | $3.4 \times 10^{-4}$ |
| | 2000 | $2.2 \times 10^{-4}$ | $6.1 \times 10^{-5}$ | $2.8 \times 10^{-4}$ |
| | 2001 | $2.4 \times 10^{-4}$ | $4.0 \times 10^{-5}$ | $2.8 \times 10^{-4}$ |

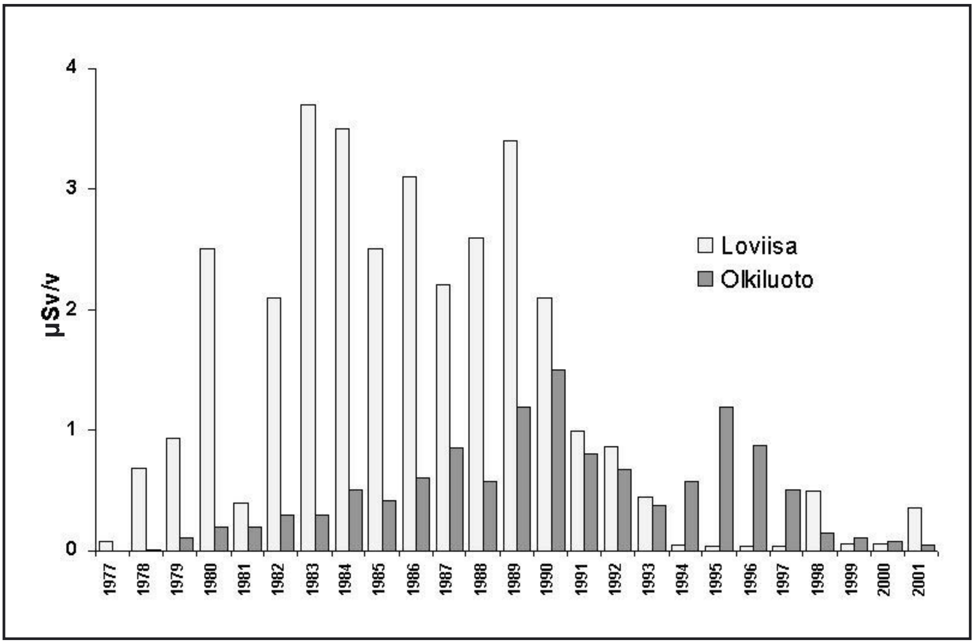



**Figure 20.** Average doses to critical groups in the vicinities of Finnish NPPs since beginning of power production.

# Acknowledgements

The authors are indebted to all the individuals and institutions that helped us in sampling. Our special thanks are due to our laboratory personnel, Marjaana Ahonen, Eija Haakana, Kari Huusela, Aimo Kemppainen and Timo Soinisto, who assisted in sampling, pretreatment of samples and in gammaspectrometric and radiochemical analyses.

# References

Ikäheimonen TK, Klemola S, Ilus E, Sjöblom K-L. Monitoring of radionuclides in the vicinities of Finnish nuclear power plants in 1991–1992. STUK-A121. Helsinki: Painatuskeskus Oy; 1995.

Ilus E, Ikäheimonen TK, Klemola S. Monitoring of radionuclides in the vicinities of Finnish nuclear power plants in 1995 and 1996. STUK-A192. Helsinki: Dark Oy; 2002.

Ilus E, Ilus T, Ikäheimonen TK, Niemistö L, Herrmann J, Suplinska M, Panteleev Y, Ivanova L, Gritchenko ZG, Neumann G. Intercomparison of sediment sampling devices using artificial radionuclides in the Baltic Sea sediments - The MOSSIE Report. Baltic Sea Environment Proceedings No. 80. Helsinki Commission; 2000.

Ilus E, Ojala J, Sjöblom K-L, Tuomainen K. Fucus vesiculosus as bioindicator of radioactivity in Finnish coastal waters. 1. Gulf of Finland. STUK-B-TUTO 14. Helsinki: Valtion Painatuskeskus, 1981.

Ilus E, Ojala J, Sjöblom K-L, Tuomainen K. Fucus vesiculosus as bioindicator of radioactivity in Finnish coastal waters. 2. Archipelago Sea and Gulf of Bothnia. STUK-B-TUTO 18. Helsinki: Valtion Painatuskeskus; 1983.

Ilus E, Sjöblom K-L, Aaltonen H, Klemola S, Arvela H. Monitoring of radioactivity in the environs of Finnish nuclear power stations in 1986. STUK-A67. Supplement 12 to Annual Report STUK-A55. Helsinki: Government Printing Centre; 1987.

Ilus E, Sjöblom K-L, Klemola S, Arvela H. Monitoring of radionuclides in the environs of Finnish nuclear power plants in 1989–1990. STUK-A102. Supplement 9 to Annual Report STUK-A89. Helsinki: Government Printing Centre; 1992.

International Organization for Standardization. ISO 9004:2000, Quality Management Systems - Guidance for Performance Improvement. 2000.

Klemola S, Ilus E, Sjöblom K-L, Arvela H, Blomqvist L. Monitoring of radionuclides in the environs of the Finnish nuclear power stations in 1988. STUK-A92. Supplement 3 to Annual Report STUK-A89. Helsinki: Finnish Government Printing Centre; 1991.

Klemola S, Ilus E, Ikäheimonen TK. Monitoring of radionuclides in the vicinities of Finnish nuclear power plants in 1993 and 1994. STUK-A157. Helsinki: Oy Edita Ab;1998.

Klemola S, Ilus E, Ikäheimonen TK. Monitoring of radionuclides in the vicinities of Finnish nuclear power plants in 1997 and 1998. STUK-A205. Helsinki: Dark Oy; 2004.

Sjöblom K-L, Klemola S, Ilus E, Arvela H, Blomqvist L. Monitoring of radioactivity in the environs of Finnish nuclear power stations in 1987. STUK-A79. Supplement 5 to Annual Report STUK-A74. Helsinki: Valtion Painatuskeskus; 1989.

Tossavainen K (ed.). Regulatory control of nuclear safety in Finland. Annual Report 1999. STUK-B-YTO 202. Helsinki: Oy Edita Ab; 2000.

Tossavainen K (ed.). Regulatory control of nuclear safety in Finland. Annual Report 2000. STUK-B-YTO 208. Helsinki: Oy Edita Ab; 2001.

Tossavainen K (ed.). Regulatory control of nuclear safety in Finland. Annual Report 2001. STUK-B-YTO 216. Helsinki: Oy Edita Ab; 2002.

**Table Ia.** The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 21 and Loviisa 27 sampling stations in 1999–2001 (μBq m$^{-3}$). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Loviisa 21 | | | | | | Loviisa 27 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sampling period | $^{7}$Be | | $^{131}$I | | $^{137}$Cs | | $^{7}$Be | | $^{137}$Cs | |
| 29.12.1998 - 12.1.1999 | 1660 | 3 | 0 | | 3.4 | 9 | 1400 | 3 | 5.2 | 9 |
| 12.1.1999 - 26.1.1999 | 1940 | 3 | 0 | | 2 | 14 | 1930 | 4 | 1.7 | 19 |
| 26.1.1999 - 9.2.1999 | 2490 | 3 | 0 | | 3.3 | 12 | 2200 | 3 | 4.1 | 9 |
| 9.2.1999 - 23.2.1999 | 1770 | 3 | 0 | | 2.6 | 15 | 1360 | 5 | 2.4 | 13 |
| 23.2.1999 - 9.3.1999 | 1790 | 4 | 0 | | 2.1 | 13 | 1270 | 5 | 2.1 | 19 |
| 9.3.1999 - 23.3.1999 | 4600 | 3 | 0 | | 3.1 | 21 | 4200 | 4 | 1.8 | 17 |
| 23.3.1999 - 6.4.1999 | 2430 | 3 | 0 | | 1.5 | 18 | 2090 | 5 | 1.4 | 32 |
| 6.4.1999 - 20.4.1999 | 2600 | 3 | 0 | | 2.1 | 8 | 2310 | 5 | 3.1 | 15 |
| 20.4.1999 - 4.5.1999 | 3500 | 3 | 0 | | 3.0 | 6 | 3000 | 5 | 2.6 | 13 |
| 4.5.1999 - 18.5.1999 | 3800 | 3 | 0 | | 1.7 | 22 | 3400 | 3 | 3.0 | 11 |
| 18.5.1999 - 1.6.1999 | 3500 | 5 | 0 | | 2.4 | 24 | 3100 | 3 | 2.0 | 26 |
| 1.6.1999 - 15.6.1999 | 4300 | 3 | 0 | | 7.0 | 7 | 3700 | 5 | 7.0 | 11 |
| 15.6.1999 - 29.6.1999 | 4200 | 3 | 0 | | 3.6 | 9 | 3700 | 5 | 2.7 | 21 |
| 29.6.1999 - 13.7.1999 | 3600 | 3 | 0 | | 3.2 | 9 | 3200 | 5 | 2.3 | 27 |
| 13.7.1999 - 27.7.1999 | 3700 | 3 | 0 | | 3.1 | 11 | 3100 | 5 | 0 | |
| 27.7.1999 - 10.8.1999 | 4800 | 3 | 0 | | 2.6 | 14 | 4300 | 3 | 2.9 | 21 |
| 10.8.1999 - 17.8.1999 | 2290 | 3 | 0 | | 3.7 | 12 | 2340 | 5 | 2.2 | 25 |
| 17.8.1999 - 24.8.1999 | 3400 | 3 | 0 | | 2.9 | 9 | | | | |
| 24.8.1999 - 31.8.1999 | 2770 | 3 | 0 | | 3.3 | 15 | 2830 | 5 | 2.9 | 15 |
| 31.8.1999 - 7.9.1999 | 4200 | 3 | 6.2 | 22 | 3.0 | 18 | | | | |
| 7.9.1999 - 14.9.1999 | 2890 | 3 | 0 | | 4.6 | 27 | 2240 | 5 | 4.5 | 9 |
| 14.9.1999 - 21.9.1999 | 2450 | 3 | 0 | | 2.8 | 10 | | | | |
| 21.9.1999 - 5.10.1999 | 2920 | 3 | 0 | | 4.7 | 5 | 2320 | 6 | 4.0 | 15 |
| 5.10.1999 - 19.10.1999 | 1760 | 5 | 0 | | 3.0 | 7 | 1560 | 3 | 3.4 | 9 |
| 19.10.1999 - 2.11.1999 | 3100 | 3 | 0 | | 2.4 | 7 | 2420 | 5 | 2.4 | 17 |
| 2.11.1999 - 16.11.1999 | 1610 | 6 | 0 | | 1.5 | 22 | 1530 | 3 | 2.5 | 8 |
| 16.11.1999 - 30.11.1999 | 1950 | 3 | 0 | | 1.6 | 20 | 1610 | 5 | 2.1 | 12 |
| 30.11.1999 - 14.12.1999 | 1350 | 3 | 0 | | 1.8 | 20 | 1210 | 5 | 1.6 | 19 |
| 14.12.1999 - 28.12.1999 | 1850 | 3 | 0 | | 2.4 | 14 | 1690 | 4 | 2.6 | 14 |
| 28.12.1999 - 11.1.2000 | 1520 | 5 | 0 | | 3.9 | 15 | 1460 | 3 | 2.4 | 15 |
| 11.1.2000 - 25.1.2000 | 1320 | 3 | 0 | | 3.0 | 7 | 1150 | 3 | 3.9 | 9 |
| 25.1.2000 - 8.2.2000 | 1650 | 3 | 0 | | 2.3 | 7 | 1450 | 3 | 2.0 | 10 |
| 8.2.2000 - 22.2.2000 | 1540 | 3 | 0 | | 1.4 | 25 | 1350 | 3 | 1.8 | 19 |
| 22.2.2000 - 7.3.2000 | 1630 | 4 | 0 | | 3.4 | 10 | 1410 | 4 | 2.9 | 24 |
| 7.3.2000 - 21.3.2000 | 2050 | 3 | 0 | | 2.6 | 11 | 1800 | 3 | 2.6 | 13 |
| 21.3.2000 - 4.4.2000 | 2820 | 3 | 0 | | 1.9 | 8 | 2450 | 5 | 3.4 | 12 |
| 4.4.2000 - 18.4.2000 | 1690 | 3 | 0 | | 1.7 | 18 | 1500 | 5 | 0 | |
| 18.4.2000 - 2.5.2000 | 2550 | 5 | 0 | | 3.1 | 22 | 3200 | 5 | 4.3 | 19 |
| 2.5.2000 - 16.5.2000 | 2280 | 5 | 0 | | 5.3 | 14 | 2400 | 3 | 4.8 | 9 |
| 16.5.2000 - 30.5.2000 | 3800 | 5 | 0 | | 4.2 | 16 | 3400 | 5 | 11 | 7 |
| 30.5.2000 - 13.6.2000 | 2210 | 5 | 0 | | 3.3 | 19 | 2090 | 3 | 3.8 | 19 |
| 13.6.2000 - 27.6.2000 | 3300 | 3 | 0 | | 2.2 | 12 | 2770 | 5 | 1.9 | 14 |

0 = below the detection limit

**Table Ia.** Continued.

<table>
<tr><th rowspan="2">Sampling period</th><th colspan="6">Loviisa 21</th><th colspan="6">Loviisa 27</th></tr>
<tr><th colspan="2">⁷Be</th><th colspan="2">110m Ag</th><th colspan="2">137Cs</th><th colspan="2">⁷Be</th><th colspan="2">110mAg</th><th colspan="2">137Cs</th></tr>
<tr><td>27.6.2000 - 11.7.2000</td><td>2990</td><td>5</td><td>0</td><td></td><td>2.2</td><td>16</td><td>2670</td><td>5</td><td>0</td><td></td><td>0</td><td></td></tr>
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<tr><td>25.7.2000 - 1.8.2000</td><td>2580</td><td>3</td><td>0</td><td></td><td>2.5</td><td>21</td><td rowspan="2">2310</td><td rowspan="2">6</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">3.0</td><td rowspan="2">22</td></tr>
<tr><td>1.8.2000 - 8.8.2000</td><td>2900</td><td>3</td><td>0</td><td></td><td>4.1</td><td>15</td></tr>
<tr><td>8.8.2000 - 15.8.2000</td><td>2120</td><td>3</td><td>0</td><td></td><td>4.8</td><td>14</td><td rowspan="2">1710</td><td rowspan="2">4</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">3.2</td><td rowspan="2">11</td></tr>
<tr><td>15.8.2000 - 22.8.2000</td><td>1930</td><td>3</td><td>0</td><td></td><td>3.7</td><td>16</td></tr>
<tr><td>22.8.2000 - 29.8.2000</td><td>1850</td><td>3</td><td>0</td><td></td><td>7.0</td><td>9</td><td rowspan="2">2060</td><td rowspan="2">6</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">4.9</td><td rowspan="2">15</td></tr>
<tr><td>29.8.2000 - 5.9.2000</td><td>3300</td><td>3</td><td>0</td><td></td><td>7.2</td><td>10</td></tr>
<tr><td>5.9.2000 - 12.9.2000</td><td>1480</td><td>3</td><td>0</td><td></td><td>4.5</td><td>8</td><td rowspan="2">1200</td><td rowspan="2">5</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">4.4</td><td rowspan="2">13</td></tr>
<tr><td>12.9.2000 - 19.9.2000</td><td>1170</td><td>5</td><td>0</td><td></td><td>5.4</td><td>20</td></tr>
<tr><td>19.9.2000 - 3.10.2000</td><td>2930</td><td>3</td><td>0</td><td></td><td>6.9</td><td>7</td><td>2380</td><td>5</td><td>0</td><td></td><td>4.5</td><td>17</td></tr>
<tr><td>3.10.2000 - 17.10.2000</td><td>2470</td><td>4</td><td>0</td><td></td><td>2.8</td><td>7</td><td>2150</td><td>4</td><td>0</td><td></td><td>2.6</td><td>8</td></tr>
<tr><td>17.10.2000 - 31.10.2000</td><td>1480</td><td>4</td><td>0</td><td></td><td>2.5</td><td>12</td><td>1170</td><td>6</td><td>0</td><td></td><td>3.8</td><td>19</td></tr>
<tr><td>31.10.2000 - 14.11.2000</td><td>1510</td><td>4</td><td>0</td><td></td><td>1.4</td><td>11</td><td>1220</td><td>5</td><td>0</td><td></td><td>1.7</td><td>19</td></tr>
<tr><td>14.11.2000 - 28.11.2000</td><td>1690</td><td>5</td><td>0</td><td></td><td>2.2</td><td>11</td><td>1420</td><td>5</td><td>0</td><td></td><td>1.8</td><td>21</td></tr>
<tr><td>28.11.2000 - 12.12.2000</td><td>1620</td><td>3</td><td>0</td><td></td><td>0</td><td></td><td>1360</td><td>4</td><td>0</td><td></td><td>1.3</td><td>14</td></tr>
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<tr><td>27.12.2000 - 9.1.2001</td><td>1520</td><td>4</td><td>0</td><td></td><td>1.0</td><td>19</td><td>1400</td><td>4</td><td>0</td><td></td><td>1.3</td><td>17</td></tr>
<tr><td>9.1.2001 - 23.1.2001</td><td>2260</td><td>3</td><td>0</td><td></td><td>3.1</td><td>5</td><td>2130</td><td>3</td><td>0</td><td></td><td>3.8</td><td>6</td></tr>
<tr><td>23.1.2001 - 6.2.2001</td><td>1670</td><td>5</td><td>0</td><td></td><td>2.2</td><td>24</td><td>1650</td><td>3</td><td>0</td><td></td><td>3.6</td><td>11</td></tr>
<tr><td>6.2.2001 - 20.2.2001</td><td>1680</td><td>3</td><td>0</td><td></td><td>2.3</td><td>7</td><td>1510</td><td>5</td><td>0</td><td></td><td>2.2</td><td>23</td></tr>
<tr><td>20.2.2001 - 6.3.2001</td><td>2180</td><td>3</td><td>0</td><td></td><td>4.0</td><td>9</td><td>1980</td><td>4</td><td>0</td><td></td><td>4.2</td><td>10</td></tr>
<tr><td>6.3.2001 - 20.3.2001</td><td>2020</td><td>3</td><td>0</td><td></td><td>2.0</td><td>16</td><td>1840</td><td>3</td><td>0</td><td></td><td>2.5</td><td>13</td></tr>
<tr><td>20.3.2001 - 3.4.2001</td><td>2480</td><td>3</td><td>0</td><td></td><td>2.6</td><td>7</td><td>2190</td><td>5</td><td>0</td><td></td><td>3.3</td><td>13</td></tr>
<tr><td>3.4.2001 - 17.4.2001</td><td>1810</td><td>5</td><td>0</td><td></td><td>1.3</td><td>18</td><td>1790</td><td>6</td><td>0</td><td></td><td>1.1</td><td>29</td></tr>
<tr><td>17.4.2001 - 30.4.2001</td><td>2860</td><td>4</td><td>0</td><td></td><td>2.9</td><td>7</td><td>2730</td><td>3</td><td>0</td><td></td><td>2.5</td><td>7</td></tr>
<tr><td>30.4.2001 - 15.5.2001</td><td>2810</td><td>3</td><td>0</td><td></td><td>3.0</td><td>10</td><td>2460</td><td>5</td><td>0</td><td></td><td>5.3</td><td>10</td></tr>
<tr><td>15.5.2001 - 29.5.2001</td><td>2700</td><td>3</td><td>0</td><td></td><td>3.1</td><td>10</td><td>2110</td><td>3</td><td>0</td><td></td><td>2.3</td><td>14</td></tr>
<tr><td>29.5.2001 - 12.6.2001</td><td>2400</td><td>3</td><td>0</td><td></td><td>2.4</td><td>10</td><td>2360</td><td>3</td><td>0</td><td></td><td>2.7</td><td>10</td></tr>
<tr><td>12.6.2001 - 26.6.2001</td><td>3000</td><td>3</td><td>0</td><td></td><td>4.0</td><td>8</td><td>2930</td><td>3</td><td>0</td><td></td><td>2.6</td><td>11</td></tr>
<tr><td>26.6.2001 - 10.7.2001</td><td>2850</td><td>3</td><td>0</td><td></td><td>2.0</td><td>8</td><td>2630</td><td>5</td><td>0</td><td></td><td>1.7</td><td>25</td></tr>
<tr><td>10.7.2001 - 24.7.2001</td><td>2980</td><td>3</td><td>0</td><td></td><td>2.1</td><td>8</td><td>4000</td><td>5</td><td>0</td><td></td><td>2.0</td><td>14</td></tr>
<tr><td>24.7.2001 - 7.8.2001</td><td>2910</td><td>5</td><td>0</td><td></td><td>1.7</td><td>23</td><td>2760</td><td>5</td><td>0</td><td></td><td>2.2</td><td>18</td></tr>
<tr><td>7.8.2001 - 14.8.2001</td><td>1880</td><td>5</td><td>0</td><td></td><td>2.4</td><td>29</td><td rowspan="2">2040</td><td rowspan="2">3</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">3.0</td><td rowspan="2">13</td></tr>
<tr><td>14.8.2001 - 21.8.2001</td><td>2360</td><td>3</td><td>0</td><td></td><td>3.0</td><td>19</td></tr>
<tr><td>21.8.2001 - 28.8.2001</td><td>3000</td><td>5</td><td>0</td><td></td><td>3.8</td><td></td><td rowspan="2">2670</td><td rowspan="2">3</td><td rowspan="2">8.8</td><td rowspan="2">6</td><td rowspan="2">2.5</td><td rowspan="2">15</td></tr>
<tr><td>28.8.2001 - 4.9.2001</td><td>2750</td><td>3</td><td>0</td><td></td><td>2.7</td><td>18</td></tr>
<tr><td>4.9.2001 - 11.9.2001</td><td>1980</td><td>3</td><td>2.0</td><td>15</td><td>2.2</td><td>11</td><td rowspan="2">1700</td><td rowspan="2">5</td><td rowspan="2">0</td><td rowspan="2"></td><td rowspan="2">3.0</td><td rowspan="2">15</td></tr>
<tr><td>11.9.2001 - 18.9.2001</td><td>2300</td><td>3</td><td>0</td><td></td><td>4.3</td><td>16</td></tr>
</table>

0 = below the detection limit

**Table Ia.** Continued.

| Sampling period | Loviisa 21 | | | | | Loviisa 27 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $^{7}Be$ | | $^{110m}Ag$ | $^{137}Cs$ | | $^{7}Be$ | | $^{110m}Ag$ | $^{137}Cs$ | |
| 18.9.2001 - 2.10.2001 | 2690 | 3 | 0 | 4.1 | 9 | 2350 | 3 | 0 | 7.2 | 6 |
| 2.10.2001 - 16.10.2001 | 1440 | 3 | 0 | 4.7 | 5 | 1210 | 6 | 0 | 6.0 | 8 |
| 16.10.2001 - 30.10.2001 | 1630 | 6 | 0 | 3.1 | 14 | 1510 | 5 | 0 | 4.4 | 14 |
| 30.10.2001 - 13.11.2001 | 1210 | 3 | 0 | 1.8 | 17 | 1170 | 3 | 0 | 2.5 | 15 |
| 13.11.2001 - 27.11.2001 | 1550 | 3 | 0 | 2.8 | 7 | 1290 | 5 | 0 | 3.5 | 10 |
| 27.11.2001 - 11.12.2001 | 2750 | 3 | 0 | 1.0 | 22 | 2320 | 5 | 0 | 2.3 | 17 |
| 11.12.2001 - 28.12.2001 | 1110 | 5 | 0 | 3.4 | 9 | 1090 | 6 | 0 | 4.6 | 8 |

0 = below the detection limit

**Table Ib.** The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 33 and Loviisa 24 sampling stations in 1999–2001 (μBq m$^{-3}$). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Sampling period | | | Loviisa 33 | | | | Loviisa 24 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $^{7}$Be | | $^{137}$Cs | | $^{7}$Be | | $^{137}$Cs | |
| 5.1.1999 | - | 19.1.1999 | 1600 | 4 | 3.6 | 21 | 1660 | 3 | 4.2 | 21 |
| 19.1.1999 | - | 2.2.1999 | 2030 | 3 | 3.0 | 10 | 1960 | 3 | 1.9 | 16 |
| 2.2.1999 | - | 16.2.1999 | 1920 | 3 | 2.7 | 6 | 1870 | 4 | 4.1 | 19 |
| 16.2.1999 | - | 2.3.1999 | 1130 | 3 | 4.5 | 19 | 1180 | 3 | 1.7 | 19 |
| 2.3.1999 | - | 16.3.1999 | 3900 | 3 | 1.3 | 21 | 3700 | 3 | 1.0 | 15 |
| 16.3.1999 | - | 30.3.1999 | 2490 | 3 | 0.6 | 26 | 2320 | 3 | 1.3 | 11 |
| 30.3.1999 | - | 13.4.1999 | 2010 | 5 | 1.4 | 17 | 2330 | 5 | 1.4 | 21 |
| 13.4.1999 | - | 27.4.1999 | 2710 | 3 | 2.1 | 16 | 2610 | 3 | 2.4 | 14 |
| 27.4.1999 | - | 11.5.1999 | 3200 | 5 | 0 | | 2810 | 3 | 1.7 | 21 |
| 11.5.1999 | - | 25.5.1999 | 3900 | 3 | 1.9 | 14 | 3700 | 5 | 3.2 | 14 |
| 25.5.1999 | - | 8.6.1999 | 3100 | 5 | 0 | | 3000 | 5 | 2.8 | 19 |
| 8.6.1999 | - | 22.6.1999 | 4100 | 3 | 3.9 | 8 | 3800 | 5 | 6.9 | 10 |
| 22.6.1999 | - | 6.7.1999 | 3100 | 5 | 3.7 | 19 | 3300 | 7 | 5.7 | 10 |
| 6.7.1999 | - | 20.7.1999 | 3700 | 3 | 2.6 | 9 | 3400 | 5 | 7.4 | 8 |
| 20.7.1999 | - | 3.8.1999 | 2830 | 3 | 3.1 | 12 | 2830 | 3 | 3.8 | 9 |
| 3.8.1999 | - | 17.8.1999 | 3300 | 5 | 2.9 | 19 | 3200 | 5 | 3.3 | 22 |
| 17.8.1999 | - | 31.8.1999 | 2720 | 3 | 2.7 | 10 | 2480 | 5 | 2.3 | 17 |
| 31.8.1999 | - | 14.9.1999 | 2980 | 3 | 2.7 | 13 | 2840 | 5 | 3.2 | 24 |
| 14.9.1999 | - | 28.9.1999 | 2100 | 5 | 6.2 | 9 | 2120 | 3 | 5.6 | 12 |
| 28.9.1999 | - | 12.10.1999 | 2330 | 5 | 1.4 | 21 | 2410 | 6 | 2.7 | 15 |
| 12.10.1999 | - | 26.10.1999 | 2020 | 5 | 2.7 | 10 | 2180 | 5 | 2.3 | 8 |
| 26.10.1999 | - | 9.11.1999 | 2040 | 3 | 2.2 | 8 | 2090 | 6 | 1.7 | 16 |
| 9.11.1999 | - | 23.11.1999 | 1520 | 3 | 2.0 | 14 | 1400 | 3 | 2.3 | 23 |
| 23.11.1999 | - | 7.12.1999 | 1640 | 4 | 1.8 | 11 | 1440 | 3 | 1.6 | 10 |
| 7.12.1999 | - | 21.12.1999 | 950 | 6 | 2.6 | 17 | 1040 | 4 | 3.2 | 14 |
| 21.12.1999 | - | 4.1.2000 | 1640 | 5 | 2.4 | 16 | 1740 | 3 | 2.4 | 9 |
| 4.1.2000 | - | 18.1.2000 | 990 | 5 | 1.1 | 20 | 1070 | 3 | 1.0 | 26 |
| 18.1.2000 | - | 1.2.2000 | 1380 | 3 | 2.7 | 14 | 1300 | 6 | 2.5 | 27 |
| 1.2.2000 | - | 15.2.2000 | 1460 | 3 | 1.3 | 12 | 1320 | 6 | 2.5 | 16 |
| 15.2.2000 | - | 29.2.2000 | 1450 | 3 | 1.9 | 9 | 1360 | 5 | 2.7 | 14 |
| 29.2.2000 | - | 14.3.2000 | 1620 | 3 | 2.7 | 13 | 1470 | 6 | 2.2 | 31 |
| 14.3.2000 | - | 28.3.2000 | 2040 | 3 | 1.9 | 14 | 1900 | 5 | 1.5 | 24 |
| 28.3.2000 | - | 11.4.2000 | 2330 | 3 | 1.1 | 14 | 2080 | 6 | 2.1 | 18 |
| 11.4.2000 | - | 25.4.2000 | 2060 | 5 | 0 | | 2280 | 3 | 0 | |
| 25.4.2000 | - | 9.5.2000 | 2480 | 3 | 4.3 | 10 | 2310 | 3 | 2.9 | 14 |
| 9.5.2000 | - | 23.5.2000 | 3600 | 3 | 4.8 | 10 | 3400 | 5 | 5.9 | 9 |
| 23.5.2000 | - | 6.6.2000 | 1880 | 5 | 3.8 | 9 | 1810 | 6 | 3.1 | 14 |
| 6.6.2000 | - | 20.6.2000 | 2470 | 3 | 2.2 | 15 | 1870 | 5 | 2.9 | 17 |
| 20.6.2000 | - | 4.7.2000 | 2880 | 3 | 1.9 | 16 | 2710 | 3 | 2.6 | 14 |

0 = below the detection limit

**Table Ib.** Continued.

| Sampling period | | | Loviisa 33 | | | | | | Loviisa 24 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $^{7}Be$ | | $^{60}Co$ | | $^{137}Cs$ | | $^{7}Be$ | | $^{110m}Ag$ | | $^{137}Cs$ | |
| 4.7.2000 | - | 18.7.2000 | 3100 | 5 | 0 | | 0 | | 2950 | 5 | 0 | | 3.5 | 20 |
| 18.7.2000 | - | 1.8.2000 | 1950 | 5 | 0 | | 2.8 | 20 | 2010 | 5 | 0 | | 4.1 | 12 |
| 1.8.2000 | - | 15.8.2000 | 1870 | 5 | 0 | | 2.2 | 17 | 2160 | 3 | 0 | | 3.0 | 10 |
| 15.8.2000 | - | 29.8.2000 | 1440 | 5 | 0 | | 2.3 | 26 | 1680 | 3 | 3.2 | 13 | 5.3 | 7 |
| 29.8.2000 | - | 12.9.2000 | 2040 | 4 | 0 | | 3.3 | 10 | 1910 | 5 | 0 | | 5.6 | 9 |
| 12.9.2000 | - | 26.9.2000 | 1340 | 5 | 0 | | 5.2 | 14 | 1410 | 5 | 0 | | 7.3 | 9 |
| 26.9.2000 | - | 10.10.2000 | 2680 | 3 | 0 | | 3.2 | 9 | 2690 | 3 | 0 | | 4.5 | 5 |
| 10.10.2000 | - | 24.10.2000 | 1900 | 3 | 0 | | 3.6 | 11 | 1370 | 6 | 0 | | 5.3 | 20 |
| 24.10.2000 | - | 7.11.2000 | 1430 | 3 | 0 | | 3.4 | 19 | 1500 | 3 | 0 | | 1.5 | 11 |
| 7.11.2000 | - | 21.11.2000 | 920 | 6 | 0 | | 2.8 | 22 | 990 | 6 | 0 | | 2.1 | 26 |
| 21.11.2000 | - | 5.12.2000 | 1550 | 5 | 0 | | 1.1 | 21 | 1490 | 5 | 0 | | 0.9 | 28 |
| 5.12.2000 | - | 19.12.2000 | 1180 | 5 | 0 | | 0 | | 1220 | 5 | 0 | | 0 | |
| 19.12.2000 | - | 2.1.2001 | 1340 | 4 | 0 | | 1.5 | 10 | 1220 | 5 | 0 | | 1.0 | 25 |
| 2.1.2001 | - | 16.1.2001 | 1110 | 5 | 0 | | 1.2 | 26 | 1040 | 6 | 0 | | 0 | |
| 16.1.2001 | - | 30.1.2001 | 2260 | 4 | 0 | | 4.0 | 5 | 2230 | 4 | 0 | | 2.7 | 6 |
| 30.1.2001 | - | 13.2.2001 | 1560 | 3 | 0 | | 2.5 | 7 | 1350 | 5 | 0 | | 1.6 | 21 |
| 13.2.2001 | - | 27.2.2001 | 1740 | 3 | 0 | | 3.4 | 9 | 1740 | 3 | 0 | | 1.9 | 17 |
| 27.2.2001 | - | 13.3.2001 | 1680 | 3 | 0 | | 2.7 | 12 | 1610 | 3 | 0 | | 2.4 | 11 |
| 13.3.2001 | - | 27.3.2001 | 2270 | 3 | 2.8 | 9 | 2.8 | 6 | 2330 | 3 | 0 | | 3.1 | 7 |
| 27.3.2001 | - | 10.4.2001 | 1880 | 5 | 0 | | 0 | | 1900 | 3 | 0 | | 0.9 | 22 |
| 10.4.2001 | - | 24.4.2001 | 1800 | 6 | 0 | | 1.2 | 22 | 1910 | 3 | 0 | | 1.3 | 14 |
| 24.4.2001 | - | 8.5.2001 | 2950 | 3 | 0 | | 3.1 | 6 | 2790 | 3 | 0 | | 3.2 | 7 |
| 8.5.2001 | - | 22.5.2001 | 2320 | 3 | 0 | | 2.3 | 11 | 2220 | 3 | 0 | | 2.9 | 11 |
| 22.5.2001 | - | 5.6.2001 | 2720 | 3 | 0 | | 3.6 | 9 | 2280 | 5 | 0 | | 0 | |
| 5.6.2001 | - | 19.6.2001 | 2420 | 4 | 0 | | 3.4 | 10 | 2340 | 5 | 0 | | 1.9 | 26 |
| 19.6.2001 | - | 3.7.2001 | 2850 | 3 | 0 | | 1.8 | 16 | 2620 | 5 | 0 | | 2.5 | 20 |
| 3.7.2001 | - | 17.7.2001 | 2820 | 5 | 0 | | 1.8 | 24 | 2730 | 5 | 0 | | 2.3 | 28 |
| 17.7.2001 | - | 31.7.2001 | 3200 | 3 | 0 | | 2.0 | 14 | 3200 | 3 | 0 | | 4.1 | 10 |
| 31.7.2001 | - | 14.8.2001 | 1990 | 5 | 0 | | 1.9 | 13 | 1960 | 5 | 0 | | 0 | |
| 14.8.2001 | - | 28.8.2001 | 2270 | 5 | 0 | | 2.5 | 14 | 2360 | 5 | 0 | | 2.2 | 27 |
| 28.8.2001 | - | 11.9.2001 | 1990 | 5 | 0 | | 0 | | 1970 | 5 | 0 | | 2.5 | 20 |
| 11.9.2001 | - | 25.9.2001 | 2430 | 5 | 0 | | 2.5 | 15 | 2430 | 5 | 0 | | 6.1 | 8 |
| 25.9.2001 | - | 9.10.2001 | 1240 | 5 | 0 | | 3.0 | 10 | 1280 | 6 | 0 | | 3.4 | 12 |
| 9.10.2001 | - | 23.10.2001 | 1310 | 3 | 0 | | 4.2 | 5 | 1270 | 5 | 0 | | 6.2 | 9 |
| 23.10.2001 | - | 6.11.2001 | 1230 | 5 | 0 | | 0 | | 1170 | 6 | 0 | | 1.2 | 21 |
| 6.11.2001 | - | 19.11.2001 | 1140 | 3 | 0 | | 2.1 | 9 | 920 | 5 | 0 | | 1.7 | 20 |
| 19.11.2001 | - | 4.12.2001 | 1530 | 6 | 0 | | 0 | | 1520 | 5 | 0 | | 1.2 | 34 |
| 4.12.2001 | - | 18.12.2001 | 2210 | 5 | 0 | | 1.5 | 25 | 2030 | 6 | 0 | | 2.4 | 27 |
| 18.12.2001 | - | 2.1.2002 | 1020 | 5 | 0 | | 3.1 | 9 | 900 | 5 | 0 | | 3.3 | 12 |

0 = below the detection limit

**Table IIa.** The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 22 and Olkiluoto 31 sampling stations in 1999–2001 (μBq m$^{-3}$). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Sampling period | Olkiluoto 22 | | | | | | | Olkiluoto 31 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $^{7}$Be | | $^{60}$Co | $^{134}$Cs | | $^{137}$Cs | | $^{7}$Be | | $^{137}$Cs | |
| 29.12.1998 - 13.1.1999 | 1480 | 3 | | 0 | | 4.7 | 15 | 1520 | 3 | 3.2 | 10 |
| 13.1.1999 - 28.1.1999 | 1820 | 3 | | 0 | | 9.7 | 4 | 1740 | 3 | 3.3 | 8 |
| 28.1.1999 - 10.2.1999 | 1810 | 4 | | 0 | | 8.8 | 5 | 1770 | 3 | 5.6 | 6 |
| 10.2.1999 - 24.2.1999 | 1350 | 3 | | 0 | | 12.0 | 9 | 1330 | 5 | 5.0 | 20 |
| 24.2.1999 - 10.3.1999 | 1540 | 3 | | 0 | | 20.0 | 7 | 1570 | 3 | 2.1 | 17 |
| 10.3.1999 - 25.3.1999 | 3800 | 3 | | 0 | | 4.7 | 15 | 3700 | 3 | 4.1 | 8 |
| 25.3.1999 - 7.4.1999 | 2510 | 5 | | 0 | | 3.4 | 17 | 2550 | 5 | 3.1 | 17 |
| 7.4.1999 - 21.4.1999 | 2560 | 3 | | 0 | | 3.0 | 6 | 2510 | 3 | 3.1 | 7 |
| 21.4.1999 - 5.5.1999 | 3600 | 3 | | 0 | | 3.3 | 8 | 2570 | 3 | 2.7 | 12 |
| 5.5.1999 - 12.5.1999 | 2800 | 5 | | 0 | | 0 | | 3400 | 3 | 2.4 | 14 |
| 12.5.1999 - 19.5.1999 | 3900 | 5 | | 0 | | 4.1 | 17 | | | | |
| 19.5.1999 - 26.5.1999 | 3900 | 3 | | 0 | | 3.6 | 14 | 2540 | 5 | 2.3 | 15 |
| 26.5.1999 - 2.6.1999 | 1850 | 3 | | 0 | | 2.6 | 13 | | | | |
| 2.6.1999 - 16.6.1999 | 3400 | 3 | | 0 | | 4.8 | 7 | 3100 | 5 | 3.9 | 14 |
| 16.6.1999 - 30.6.1999 | 2990 | 3 | | 0 | | 2.5 | 11 | 2950 | 3 | 2.7 | 11 |
| 30.6.1999 - 14.7.1999 | 2500 | 3 | | 0 | | 2.6 | 10 | 2280 | 5 | 2.2 | 17 |
| 14.7.1999 - 28.7.1999 | 2370 | 5 | | 0 | | 2.4 | 23 | 2290 | 3 | 1.9 | 18 |
| 28.7.1999 - 11.8.1999 | 3800 | 3 | | 0 | | 2.6 | 17 | 3700 | 5 | 3.2 | 26 |
| 11.8.1999 - 25.8.1999 | 2160 | 3 | | 0 | | 2.9 | 8 | 1920 | 5 | 2.6 | 13 |
| 25.8.1999 - 8.9.1999 | 2810 | 5 | | 0 | | 1.9 | 19 | 2830 | 3 | 2.2 | 9 |
| 8.9.1999 - 23.9.1999 | 2850 | 3 | | 0 | | 5.0 | 6 | 2780 | 3 | 5.7 | 7 |
| 23.9.1999 - 6.10.1999 | 1930 | 3 | | 0 | | 3.7 | 13 | 1730 | 5 | 3.3 | 16 |
| 6.10.1999 - 20.10.1999 | 1210 | 3 | | 0 | | 3.1 | 6 | 1100 | 3 | 3.2 | 13 |
| 20.10.1999 - 3.11.1999 | 2490 | 3 | | 0 | | 2.4 | 12 | 2530 | 5 | 1.7 | 12 |
| 3.11.1999 - 17.11.1999 | 1320 | 4 | | 0 | | 3.8 | 8 | 1370 | 4 | 1.9 | 12 |
| 17.11.1999 - 1.12.1999 | 1810 | 3 | | 0 | | 5.6 | 11 | 1640 | 3 | 2.7 | 15 |
| 1.12.1999 - 16.12.1999 | 1070 | 6 | | 0 | | 11.0 | 7 | 1050 | 6 | 2.6 | 18 |
| 15.12.1999 - 29.12.1999 | 1650 | 5 | | 0 | | 4.4 | 10 | 1590 | 3 | 2.9 | 12 |
| 29.12.1999 - 12.1.2000 | 1220 | 5 | | 0 | | 2.8 | 22 | 1220 | 4 | 3.1 | 8 |
| 12.1.2000 - 27.1.2000 | 1260 | 3 | | 0 | | 5.2 | 6 | 1110 | 5 | 3.8 | 16 |
| 27.1.2000 - 10.2.2000 | 1450 | 3 | | 0 | | 4.9 | 7 | 1430 | 3 | 3.6 | 7 |
| 9.2.2000 - 23.2.2000 | 1250 | 6 | | 0 | | 2.7 | 15 | 1130 | 5 | 3.2 | 20 |
| 23.2.2000 - 8.3.2000 | 1220 | 6 | | 0.21 | 24 | 44 | 7 | 1420 | 3 | 2.1 | 13 |
| 8.3.2000 - 22.3.2000 | 1430 | 5 | | 0 | | 4.0 | 15 | 1500 | 3 | 2.6 | 9 |
| 22.3.2000 - 5.4.2000 | 2530 | 4 | | 0 | | 4.1 | 7 | 2460 | 3 | 2.0 | 14 |
| 5.4.2000 - 19.4.2000 | 1530 | 6 | | 0 | | 3.8 | 10 | 1550 | 6 | 0 | |
| 19.4.2000 - 3.5.2000 | 2360 | 5 | | 0 | | 4.3 | 13 | 2310 | 5 | 5.1 | 14 |

0 = below the detection limit

**Table IIa.** Continued.

| Sampling period | Olkiluoto 22 | | | | Olkiluoto 31 | |
|---|---|---|---|---|---|---|
| | $^{7}Be$ | $^{60}Co$ | $^{134}Cs$ | $^{137}Cs$ | $^{7}Be$ | $^{137}Cs$ |
| 3.5.2000 - 10.5.2000 | 1980 3 | | 0 | 2.1 22 | 2110 5 | 2.7 11 |
| 10.5.2000 - 17.5.2000 | 2500 5 | | 0 | 7.8 16 | | |
| 17.5.2000 - 24.5.2000 | 2290 5 | | 0 | 7.9 11 | 1960 5 | 3.7 16 |
| 24.5.2000 - 31.5.2000 | 1970 4 | | 0 | 4.7 13 | | |
| 31.5.2000 - 14.6.2000 | 2040 3 | | 0 | 3.9 5 | 1770 5 | 2.5 25 |
| 14.6.2000 - 28.6.2000 | 2280 4 | | 0 | 4.4 7 | 2210 3 | 1.5 13 |
| 28.6.2000 - 12.7.2000 | 1920 3 | 0 | | 3.3 9 | 1210 3 | 1.5 16 |
| 12.7.2000 - 26.7.2000 | 1900 3 | 0 | | 5.0 7 | 1760 5 | 3.5 16 |
| 26.7.2000 - 9.8.2000 | 2100 3 | 0 | | 2.4 9 | 2070 3 | 2.6 10 |
| 9.8.2000 - 23.8.2000 | 1400 5 | 0 | | 3.1 21 | 1310 5 | 3.3 16 |
| 23.8.2000 - 6.9.2000 | 1700 3 | 0 | | 4.5 6 | 1470 5 | 4.7 15 |
| 6.9.2000 - 20.9.2000 | 1370 3 | 0 | | 2.6 10 | 1360 3 | 4.1 8 |
| 20.9.2000 - 4.10.2000 | 2350 3 | 0 | | 3.6 8 | 2120 5 | 4.2 8 |
| 4.10.2000 - 18.10.2000 | 1850 5 | 0 | | 2.1 25 | 1940 4 | 3.6 7 |
| 18.10.2000 - 1.11.2000 | 1460 3 | 0 | | 4.1 7 | 1280 6 | 3.8 14 |
| 1.11.2000 - 15.11.2000 | 970 6 | 0 | | 1.8 18 | 1020 6 | 2.2 15 |
| 15.11.2000 - 30.11.2000 | 1350 5 | 0 | | 1.1 16 | 1240 5 | 1.3 25 |
| 30.11.2000 - 13.12.2000 | 1420 3 | 0 | | 0.8 27 | 1440 4 | 1.7 16 |
| 13.12.2000 - 27.12.2000 | 1080 4 | 0 | | 2.9 9 | 1010 5 | 4.5 9 |
| 27.12.2000 - 10.1.2001 | 1200 5 | 0 | | 6.9 8 | 1180 6 | 1.2 29 |
| 10.1.2001 - 24.1.2001 | 2500 5 | 0 | | 4.6 9 | 2600 5 | 2.4 13 |
| 24.1.2001 - 7.2.2001 | 1190 5 | 0 | | 8.7 5 | 1120 6 | 4.4 15 |
| 7.2.2001 - 21.2.2001 | 1440 5 | 0 | | 5.3 11 | 1440 5 | 1.0 34 |
| 21.2.2001 - 7.3.2001 | 1910 3 | 0 | | 11.0 8 | 1850 3 | 4.7 7 |
| 7.3.2001 - 21.3.2001 | 1550 5 | 0 | | 3.9 11 | 1440 5 | 3.6 14 |
| 21.3.2001 - 4.4.2001 | 1920 5 | 0 | | 2.6 11 | 2020 5 | 2.8 13 |
| 4.4.2001 - 18.4.2001 | 2150 3 | 0 | | 3.6 9 | 1890 5 | 3.5 17 |
| 18.4.2001 - 2.5.2001 | 1430 3 | 0 | | 2.6 10 | 1410 3 | 2.7 11 |
| 2.5.2001 - 10.5.2001 | 1910 3 | 0 | | 2.4 14 | 1660 5 | 2.9 18 |
| 10.5.2001 - 16.5.2001 | 1690 3 | 0 | | 2.0 17 | | |
| 16.5.2001 - 23.5.2001 | 2270 5 | 0 | | 0 | 2120 5 | 1.6 22 |
| 23.5.2001 - 30.5.2001 | 1960 3 | 0 | | 2.2 18 | | |
| 30.5.2001 - 13.6.2001 | 1880 3 | 0 | | 3.5 8 | 1720 5 | 1.7 20 |
| 13.6.2001 - 27.6.2001 | 2740 3 | 0 | | 4.7 4 | 2400 5 | 3.4 10 |
| 27.6.2001 - 11.7.2001 | 2550 5 | 0 | | 3.7 10 | 2860 3 | 3.4 9 |
| 11.7.2001 - 25.7.2001 | 2470 3 | 0 | | 3.1 5 | 2190 5 | 3.9 9 |
| 25.7.2001 - 8.8.2001 | 1970 5 | 0 | | 2.7 16 | 1820 5 | 2.4 22 |
| 8.8.2001 - 22.8.2001 | 1550 5 | 0 | | 0 | 1340 5 | 3.5 16 |
| 22.8.2001 - 5.9.2001 | 2160 5 | 0 | | 4.2 18 | 2050 5 | 3.9 13 |

0 = below the detection limit

**Table IIa.** Continued.

| Sampling period | Olkiluoto 22 | | | | | | | | Olkiluoto 31 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $^{7}$Be | | $^{60}$Co | | $^{134}$Cs | | $^{137}$Cs | | $^{7}$Be | | $^{137}$Cs | |
| 5.9.2001 - 19.9.2001 | 1890 | 3 | 0 | | | | 3.1 | 8 | 1790 | 5 | 2.8 | 13 |
| 19.9.2001 - 3.10.2001 | 1910 | 5 | 0 | | | | 4.0 | 10 | 1750 | 5 | 3.8 | 12 |
| 3.10.2001 - 18.10.2001 | 1350 | 5 | 0 | | | | 1.5 | 20 | 1140 | 6 | 5.5 | 12 |
| 18.10.2001 - 31.10.2001 | 1510 | 4 | 0 | | | | 1.7 | 18 | 1500 | 3 | 2.7 | 11 |
| 31.10.2001 - 14.11.2001 | 980 | 5 | 0 | | | | 2.8 | 15 | 910 | 5 | 2.0 | 22 |
| 14.11.2001 - 29.11.2001 | 940 | 5 | 0 | | | | 2.5 | 9 | 1020 | 4 | 1.8 | 13 |
| 29.11.2001 - 12.12.2001 | 2170 | 5 | 2.5 | 11 | | | 1.1 | 28 | 1990 | 5 | 1.7 | 27 |
| 12.12.2001 - 27.12.2001 | 1510 | 3 | 0 | | | | 8.6 | 6 | 1300 | 5 | 5.1 | 12 |

0 = below the detection limit

**Table IIb.** The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 26 and Olkiluoto 37 sampling stations in 1999–2001 ($\mu Bq\ m^{-3}$). Relative uncertainties ($1\sigma$) include both statistical and calibration uncertainty.

| Sampling period | Olkiluoto 22 | | | | | | Olkiluoto 31 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $^{7}Be$ | | $^{60}Co$ | | $^{137}Cs$ | | $^{7}Be$ | | $^{60}Co$ | | $^{137}Cs$ | |
| 8.1.1999 - 20.1.1999 | 1620 | 3 | | | 5.8 | 16 | 1620 | 3 | 0 | | 4.7 | 17 |
| 20.1.1999 - 3.2.1999 | 1540 | 4 | | | 8.3 | 14 | 1640 | 3 | 0 | | 7.0 | 14 |
| 3.2.1999 - 17.2.1999 | 1830 | 5 | | | 6.1 | 17 | 1790 | 5 | 0 | | 3.8 | 14 |
| 17.2.1999 - 3.3.1999 | 1110 | 4 | | | 8.5 | 15 | 1070 | 4 | 0 | | 3.9 | 10 |
| 3.3.1999 - 17.3.1999 | 4000 | 3 | | | 4.2 | 7 | 4000 | 3 | 0 | | 2.0 | 19 |
| 17.3.1999 - 31.3.1999 | 1900 | 3 | | | 3.0 | 13 | 1800 | 6 | 0 | | 2.1 | 27 |
| 31.3.1999 - 14.4.1999 | 2470 | 5 | | | 2.4 | 18 | 2460 | 5 | 0 | | 3.0 | 16 |
| 14.4.1999 - 28.4.1999 | 2550 | 3 | | | 3.6 | 8 | 2530 | 3 | 0 | | 3.9 | 10 |
| 28.4.1999 - 12.5.1999 | 2650 | 5 | | | 3.0 | 11 | 2700 | 5 | 0 | | 3.5 | 16 |
| 12.5.1999 - 26.5.1999 | 4000 | 3 | | | 3.5 | 10 | 3700 | 5 | 5.2 | 11 | 2.9 | 18 |
| 26.5.1999 - 9.6.1999 | 2710 | 3 | | | 4.7 | 7 | 2580 | 5 | 0 | | 3.3 | 14 |
| 9.6.1999 - 23.6.1999 | 3100 | 3 | | | 5.6 | 7 | 3100 | 3 | 0 | | 3.3 | 11 |
| 23.6.1999 - 7.7.1999 | 2590 | 3 | | | 2.6 | 9 | 2130 | 5 | 0 | | 0 | |
| 7.7.1999 - 21.7.1999 | 3100 | 3 | | | 2.3 | 13 | 3100 | 3 | 0 | | 1.6 | 11 |
| 21.7.1999 - 4.8.1999 | 2530 | 5 | | | 2.3 | 23 | 2380 | 5 | 0 | | 0 | |
| 4.8.1999 - 18.8.1999 | 2900 | 5 | | | 1.6 | 25 | 2780 | 5 | 0 | | 2.4 | 21 |
| 19.8.1999 - 31.8.1999 | 1860 | 5 | | | 2.3 | 11 | 1940 | 5 | 0 | | 2.3 | 12 |
| 31.8.1999 - 15.9.1999 | 2820 | 3 | | | 2.6 | 10 | 2780 | 3 | 0 | | 1.5 | 27 |
| 15.9.1999 - 29.9.1999 | 2310 | 5 | | | 4.6 | 8 | 2330 | 5 | 0 | | 5.0 | 13 |
| 29.9.1999 - 13.10.1999 | 1520 | 4 | | | 2.3 | 18 | 1550 | 5 | 0 | | 2.2 | 11 |
| 13.10.1999 - 27.10.1999 | 1890 | 3 | | | 2.3 | 12 | 1930 | 5 | 0 | | 3.2 | 13 |
| 27.10.1999 - 11.11.1999 | 1810 | 4 | | | 1.7 | 15 | 1810 | 3 | 0 | | 1.5 | 15 |
| 11.11.1999 - 24.11.1999 | 1400 | 4 | | | 5.3 | 8 | 1390 | 3 | 0 | | 2.9 | 16 |
| 24.11.1999 - 8.12.1999 | 1230 | 4 | | | 3.6 | 8 | 1310 | 3 | 0 | | 2.2 | 10 |
| 8.12.1999 - 22.12.1999 | 1090 | 5 | | | 7.6 | 10 | 1080 | 6 | 0 | | 4.9 | 11 |
| 22.12.1999 - 5.1.2000 | 1400 | 4 | | | 3.5 | 15 | 1470 | 4 | 0 | | 1.3 | 18 |
| 5.1.2000 - 19.1.2000 | 960 | 5 | | | 2.2 | 18 | 1080 | 3 | 0 | | 1.8 | 20 |
| 19.1.2000 - 2.2.2000 | 1390 | 3 | | | 7.2 | 5 | 1330 | 3 | 0 | | 3.7 | 7 |
| 2.2.2000 - 16.2.2000 | 1260 | 4 | | | 2.2 | 10 | 1430 | 5 | 0 | | 1.5 | 29 |
| 16.2.2000 - 1.3.2000 | 1380 | 4 | | | 7.4 | 12 | 1480 | 4 | 0 | | 4.0 | 18 |
| 1.3.2000 - 15.3.2000 | 1450 | 4 | | | 3.8 | 8 | 1490 | 3 | 0 | | 2.7 | 9 |
| 15.3.2000 - 29.3.2000 | 1660 | 3 | | | 3.0 | 8 | 1640 | 3 | 0 | | 3.0 | 10 |
| 29.3.2000 - 11.4.2000 | 2560 | 3 | | | 2.6 | 9 | 2580 | 3 | 0 | | 2.9 | 10 |
| 11.4.2000 - 26.4.2000 | 1880 | 3 | | | 2.5 | 12 | 1870 | 3 | 0 | | 2.0 | 8 |
| 26.4.2000 - 10.5.2000 | 2090 | 5 | | | 3.1 | 17 | 2080 | 5 | 0 | | 2.7 | 22 |
| 10.5.2000 - 24.5.2000 | 2420 | 5 | | | 4.7 | 12 | 2570 | 5 | 0 | | 4.6 | 12 |
| 24.5.2000 - 7.6.2000 | 1590 | 6 | | | 3.1 | 10 | 1760 | 5 | 0 | | 2.8 | 17 |
| 7.6.2000 - 21.6.2000 | 2120 | 3 | | | 3.6 | 5 | 2050 | 5 | 0 | | 1.9 | 14 |

0 = below the detection limit

**Table IIb.** Continued.

| Sampling period | Olkiluoto 22 | | | | | | Olkiluoto 31 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $^{7}$Be | | $^{60}$Co | | $^{137}$Cs | | $^{7}$Be | | $^{60}$Co | | $^{137}$Cs | |
| 21.6.2000 - 6.7.2000 | 1900 | 4 | | | 1.9 | 11 | 1880 | 5 | 0 | | 1.8 | 24 |
| 6.7.2000 - 18.7.2000 | 2390 | 3 | 0 | | 2.2 | 13 | 2220 | 5 | | | 0 | |
| 18.7.2000 - 2.8.2000 | 2160 | 3 | 0 | | 3.1 | 10 | 1940 | 5 | | | 2.5 | 12 |
| 2.8.2000 - 16.8.2000 | 1290 | 6 | 0 | | 2.5 | 18 | 1420 | 3 | | | 1.1 | 17 |
| 16.8.2000 - 30.8.2000 | 1390 | 5 | 0 | | 4.2 | 10 | 1440 | 5 | | | 2.6 | 13 |
| 30.8.2000 - 13.9.2000 | 1350 | 5 | 0 | | 4.4 | 10 | 1270 | 5 | | | 2.3 | 19 |
| 13.9.2000 - 27.9.2000 | 1530 | 3 | 0 | | 6.4 | 6 | 1500 | 3 | | | 2.9 | 9 |
| 27.9.2000 - 11.10.2000 | 2500 | 3 | 0 | | 3.6 | 7 | 2510 | 3 | | | 2.8 | 9 |
| 11.10.2000 - 25.10.2000 | 1720 | 3 | 0 | | 2.1 | 13 | 1560 | 6 | | | 1.4 | 23 |
| 25.10.2000 - 8.11.2000 | 1030 | 6 | 0 | | 2.5 | 19 | 1090 | 5 | | | 1.7 | 21 |
| 8.11.2000 - 23.11.2000 | 980 | 5 | 0 | | 3.7 | 16 | 980 | 5 | | | 1.7 | 22 |
| 23.11.2000 - 5.12.2000 | 1330 | 5 | 0 | | 1.6 | 23 | 1310 | 5 | | | 2.3 | 19 |
| 5.12.2000 - 20.12.2000 | 1210 | 4 | 0 | | 2.7 | 8 | 1290 | 3 | | | 2.3 | 6 |
| 20.12.2000 - 3.1.2001 | 1350 | 4 | 0 | | 6.9 | 11 | 1240 | 5 | | | 2.2 | 10 |
| 3.1.2001 - 17.1.2001 | 1550 | 3 | 0 | | 1.7 | 13 | 1560 | 5 | | | 2.0 | 17 |
| 17.1.2001 - 31.1.2001 | 2060 | 4 | 0 | | 2.0 | 23 | 1980 | 3 | | | 3.1 | 9 |
| 31.1.2001 - 14.2.2001 | 1240 | 5 | 0 | | 2.9 | 9 | 1210 | 5 | | | 3.4 | 10 |
| 14.2.2001 - 28.2.2001 | 1880 | 3 | 0 | | 3.7 | 9 | 1680 | 5 | | | 5.9 | 12 |
| 28.2.2001 - 14.3.2001 | 1390 | 3 | 0 | | 2.6 | 9 | 1420 | 3 | | | 2.2 | 14 |
| 14.3.2001 - 28.3.2001 | 2070 | 3 | 0 | | 3.0 | 8 | 1990 | 3 | | | 3.4 | 9 |
| 28.3.2001 - 11.4.2001 | 1620 | 5 | 0 | | 1.2 | 23 | 1690 | 5 | | | 1.8 | 28 |
| 11.4.2001 - 25.4.2001 | 2040 | 4 | 0 | | 2.0 | 14 | 1840 | 5 | | | 3.0 | 17 |
| 25.4.2001 - 10.5.2001 | 1550 | 6 | 0 | | 2.3 | 20 | 1750 | 3 | | | 2.1 | 10 |
| 10.5.2001 - 23.5.2001 | 1890 | 5 | 1.4 | 20 | 1.3 | 30 | 2010 | 3 | | | 2.5 | 12 |
| 23.5.2001 - 6.6.2001 | 2170 | 3 | 0 | | 2.3 | 13 | 2100 | 5 | | | 2.2 | 18 |
| 6.6.2001 - 20.6.2001 | 1810 | 3 | 0 | | 3.5 | 9 | 1720 | 5 | | | 1.5 | 28 |
| 20.6.2001 - 4.7.2001 | 2850 | 3 | 0 | | 2.5 | 6 | 2930 | 3 | | | 2.4 | 7 |
| 4.7.2001 - 18.7.2001 | 2640 | 5 | 0 | | 3.5 | 8 | 2500 | 5 | | | 0 | |
| 18.7.2001 - 1.8.2001 | 2530 | 3 | 0 | | 2.1 | 11 | 2170 | 5 | | | 0 | |
| 1.8.2001 - 15.8.2001 | 1470 | 6 | 0 | | 1.8 | 25 | 1480 | 5 | | | 0 | |
| 15.8.2001 - 29.8.2001 | 1910 | 5 | 0 | | 1.5 | 14 | 1870 | 4 | | | 1.2 | 22 |
| 29.8.2001 - 12.9.2001 | 1660 | 5 | 0 | | 3.4 | 18 | 1640 | 5 | | | 1.8 | 27 |
| 12.9.2001 - 26.9.2001 | 2350 | 5 | 0 | | 3.5 | 13 | 2290 | 5 | | | 3.7 | 14 |
| 26.9.2001 - 10.10.2001 | 1250 | 3 | 0 | | 2.0 | 12 | 1160 | 5 | | | 0 | |
| 10.10.2001 - 24.10.2001 | 1180 | 5 | 0 | | 2.2 | 20 | 1350 | 5 | | | 3.7 | 12 |
| 24.10.2001 - 7.11.2001 | 1230 | 6 | 0 | | 2.2 | 19 | 1200 | 4 | | | 1.7 | 13 |
| 7.11.2001 - 22.11.2001 | 940 | 5 | 0 | | 2.0 | 20 | 910 | 5 | | | 1.5 | 17 |
| 22.11.2001 - 5.12.2001 | 1620 | 4 | 0 | | 1.9 | 13 | 1390 | 5 | | | 1.7 | 21 |
| 5.12.2001 - 19.12.2001 | 1880 | 5 | 0 | | 3.4 | 13 | 2010 | 3 | | | 3.3 | 10 |
| 19.12.2001 - 2.1.2002 | 1090 | 6 | 0 | | 11.0 | 7 | 1080 | 4 | | | 4.4 | 7 |

0 = below the detection limit

**Table IIIa.** The concentration of gamma-emitting radionuclides in supplementary samples of ground-level air at the Loviisa 33 sampling station in 1999 – 2001 (μBq m$^{-3}$). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Sampling period | | | $^{7}$Be | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| 9.8. | - | 16.8. | 2380 | 5 | 2.47 | 8 |
| 16.8. | - | 23.8. | 2360 | 5 | 1.96 | 13 |
| 23.8. | - | 30.8. | 2090 | 3 | 2.21 | 6 |
| 30.8. | - | 6.9. | 2760 | 3 | 1.31 | 8 |
| 6.9. | - | 14.9. | 2620 | 3 | 2.45 | 5 |
| **2000** | | | | | | |
| 26.7. | - | 31.7. | 2330 | 3 | 2.13 | 8 |
| 31.7. | - | 7.8. | 2450 | 3 | 2.11 | 7 |
| 7.8. | - | 14.8. | 1550 | 5 | 2.90 | 11 |
| 14.8. | - | 21.8. | 1520 | 3 | 2.32 | 7 |
| 21.8. | - | 28.8. | 1510 | 3 | 4.0 | 5 |
| 28.8. | - | 4.9. | 2810 | 3 | 2.16 | 7 |
| 4.9. | - | 11.9. | 1270 | 5 | 3.1 | 15 |
| **2001** | | | | | | |
| 9.8. | - | 13.8. | 1600 | 3 | 1.85 | 8 |
| 13.8. | - | 20.8. | 2140 | 3 | 2.60 | 6 |
| 20.8. | - | 27.8. | 2790 | 3 | 2.84 | 5 |
| 27.8. | - | 3.9. | 2020 | 3 | 1.72 | 7 |
| 3.9. | - | 11.9. | 1730 | 3 | 1.19 | 10 |
| 11.9. | - | 18.9. | 1920 | 3 | 2.01 | 7 |

**Table IIIb.** The concentration of gamma-emitting radionuclides in supplementary samples of ground-level air at the Olkiluoto 33 sampling station in 1999–2001 ($\mu$Bq m$^{-3}$). Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| Sampling period | | | $^{7}$Be | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| 3.5. | - | 10.5. | 2600 | 3 | 3.3 | 5 |
| 10.5. | - | 17.5. | 4000 | 3 | 2.56 | 10 |
| 17.5. | - | 24.5. | 4000 | 3 | 2.85 | 6 |
| 24.5. | - | 26.5. | 2790 | 3 | 0 | |
| **2000** | | | | | | |
| 2.5. | - | 8.5. | 1940 | 5 | 4.0 | 9 |
| 8.5. | - | 15.5. | 2860 | 3 | 8.2 | 4 |
| 15.5. | - | 22.5. | 3600 | 5 | 10.4 | 5 |
| 22.5. | - | 29.5. | 2100 | 3 | 4.1 | 6 |
| 29.5. | - | 5.6. | 1570 | 3 | 2.47 | 7 |
| **2001** | | | | | | |
| 8.5. | - | 14.5. | 2210 | 3 | 2.08 | 8 |
| 14.5. | - | 21.5. | 2200 | 3 | 2.40 | 6 |
| 21.5. | - | 28.5. | 2870 | 3 | 2.41 | 9 |
| 28.5. | - | 31.5. | 2170 | 5 | 0 | |

0 = below the detection limit

**Table IVa.** Monthly deposits of gamma-emitting nuclides at the Loviisa 20 sampling station (Bq m$^{-2}$) in 1999–2001. Area of the collector is 1 m$^2$. Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| Month | $^{7}$Be | | $^{54}$Mn | | $^{60}$Co | | $^{110m}$Ag | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1999** | | | | | | | | | | |
| January | 39 | 3 | 0 | | 0 | | 0 | | 0.107 | 5 |
| February | 52 | 3 | 0 | | 0.018 | 14 | 0 | | 0.35 | 3 |
| March | 26 | 3 | 0 | | 0 | | 0 | | 0.078 | 7 |
| April | 88 | 3 | 0 | | 0 | | 0 | | 0.31 | 3 |
| May | 27 | 5 | 0 | | 0 | | 0 | | 0.261 | 6 |
| June | 78 | 5 | 0 | | 0.053 | 13 | 0 | | 0.48 | 6 |
| July | 73 | 5 | 0 | | 0 | | 0 | | 0.49 | 5 |
| August | 112 | 5 | 0 | | 0.038 | 19 | 0 | | 0.94 | 5 |
| September | 29 | 5 | 0 | | 0 | | 0 | | 0.159 | 7 |
| October | 92 | 5 | 0 | | 0 | | 0 | | 0.42 | 6 |
| November | 60 | 3 | 0 | | 0 | | 0 | | 0.158 | 5 |
| December | 82 | 3 | 0.042 | 11 | 0.044 | 9 | 0 | | 0.31 | 4 |
| Annual total | | | | | | | | | 4.08 | |
| **2000** | | | | | | | | | | |
| January | 37 | 3 | 0.008 | 22 | 0.022 | 8 | 0 | | 0.095 | 4 |
| February | 31 | 5 | 0 | | 0 | | 0 | | 0.090 | 7 |
| March | 28 | 5 | 0 | | 0 | | 0 | | 0.38 | 7 |
| April | 85 | 3 | 0 | | 0 | | 0 | | 0.200 | 5 |
| May | 91 | 3 | 0 | | 0.011 | 16 | 0 | | 0.47 | 3 |
| June | 94 | 3 | 0 | | 0 | | 0 | | 0.67 | 3 |
| July | 243 | 3 | 0 | | 0.036 | 12 | 0 | | 0.67 | 4 |
| August | 46 | 3 | 0 | | 0 | | 0.023 | 10 | 0.146 | 4 |
| September | 9.6 | 3 | 0 | | 0 | | 0 | | 0.118 | 4 |
| October | 97 | 5 | 0 | | 0.034 | 13 | 0.032 | 19 | 0.164 | 9 |
| November | 173 | 3 | 0 | | 0 | | 0.088 | 15 | 0.154 | 4 |
| December | 42 | 5 | 0 | | 0 | | 0 | | 0.091 | 11 |
| Annual total | | | | | | | | | 3.24 | |
| **2001** | | | | | | | | | | |
| January | 50 | 3 | 0 | | 0.011 | 22 | 0 | | 0.153 | 4 |
| February | 36 | 5 | 0 | | 0 | | 0 | | 0.186 | 8 |
| March | 32 | 3 | 0 | | 0 | | 0 | | 0.105 | 7 |
| April | 57 | 3 | 0 | | 0 | | 0 | | 0.121 | 5 |
| May | 56 | 3 | 0 | | 0 | | 0 | | 0.277 | 3 |
| June | 88 | 3 | 0 | | 0 | | 0 | | 0.39 | 4 |
| July | 144 | 3 | 0 | | 0.029 | 7 | 0 | | 0.50 | 3 |
| August | 76 | 5 | 0 | | 0 | | 0.035 | 15 | 0.228 | 5 |
| September | 121 | 5 | 0 | | 0 | | 0 | | 0.174 | 6 |
| October | 46 | 5 | 0 | | 0.016 | 17 | 0 | | 1.01 | 5 |
| November | 41 | 3 | 0 | | 0 | | 0 | | 0.34 | 4 |
| December | 21 | 3 | 0 | | 0 | | 0 | | 0.129 | 4 |
| Annual total | | | | | | | | | 3.61 | |

0 = below the detection limit

**Table IVb**. Monthly deposits of gamma-emitting nuclides at the Olkiluoto 21 sampling station (Bq m$^{-2}$) in 1999–2001. Area of the collector is 1 m$^2$. Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| Month | $^{7}$Be | | $^{54}$Mn | | $^{60}$Co | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|
| **1999** | | | | | | | | |
| January | 83 | 3 | 0 | | 0 | | 0.155 | 6 |
| February | 41 | 3 | 0 | | 0 | | 0.143 | 6 |
| March | 59 | 3 | 0 | | 0 | | 0.105 | 8 |
| April | 53 | 3 | 0 | | 0 | | 0.168 | 4 |
| May | 39 | 3 | 0 | | 0 | | 0.198 | 3 |
| June | 97 | 3 | 0 | | 0 | | 0.49 | 3 |
| July | 95 | 3 | 0 | | 0.011 | 16 | 0.273 | 3 |
| August | 63 | 3 | 0 | | 0 | | 0.185 | 4 |
| September | 18 | 5 | 0 | | 0 | | 0.181 | 7 |
| October | 104 | 3 | 0 | | 0 | | 0.213 | 4 |
| November | 76 | 5 | 0 | | 0 | | 0.183 | 6 |
| December | 73 | 3 | 0 | | 0 | | 0.244 | 5 |
| Annual total | | | | | | | 2.54 | |
| **2000** | | | | | | | | |
| January | 33 | 3 | 0 | | 0 | | 0.141 | 4 |
| February | 39 | 5 | 0 | | 0 | | 0.127 | 7 |
| March | 41 | 3 | 0 | | 0 | | 0.166 | 5 |
| April | 61 | 3 | 0 | | 0 | | 0.111 | 6 |
| May | 104 | 5 | 0 | | 0.040 | 11 | 0.49 | 5 |
| June | 72 | 3 | 0 | | 0 | | 0.51 | 4 |
| July | 204 | 3 | 0 | | 0.010 | 25 | 0.45 | 4 |
| August | 70 | 3 | 0 | | 0 | | 0.237 | 4 |
| September | 9.1 | 5 | 0 | | 0 | | 0.045 | 10 |
| October | 71 | 3 | 0 | | 0 | | 0.284 | 3 |
| November | 109 | 3 | 0 | | 0 | | 0.224 | 3 |
| December | 51 | 3 | 0 | | 0 | | 0.088 | 6 |
| Annual total | | | | | | | 2.86 | |
| **2001** | | | | | | | | |
| January | 36 | 5 | 0 | | 0 | | 0.098 | 8 |
| February | 22 | 3 | 0 | | 0 | | 0.151 | 5 |
| March | 30 | 3 | 0 | | 0 | | 0.087 | 8 |
| April | 103 | 3 | 0 | | 0 | | 0.145 | 4 |
| May | 35 | 3 | 0 | | 0 | | 0.123 | 5 |
| June | 24 | 3 | 0 | | 0 | | 0.37 | 4 |
| July | 47 | 5 | 0 | | 0 | | 0.39 | 5 |
| August | 107 | 5 | 0 | | 0 | | 0.30 | 5 |
| September | 89 | 5 | 0 | | 0 | | 0.264 | 5 |
| October | 62 | 5 | 0 | | 0 | | 0.214 | 5 |
| November | 35 | 3 | 0.010 | 23 | 0.022 | 15 | 0.33 | 4 |
| December | 30 | 3 | 0 | | 0 | | 0.090 | 4 |
| Annual total | | | | | | | 2.56 | |

0 = below the detection limi

**Table V.** Quarterly deposits of $^{90}Sr$ at the Loviisa 20 and Olkiluoto 21 sampling stations (Bq $m^{-2}$) in 1999–2001. Area of the collector is 1 $m^2$. The uncertainties (1σ) include statistical, calibration and analytical uncertainty.

| | | | Loviisa | | Olkiluoto | |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| Jan | - | Mar | 0.052 | 6 | < 0.03 | |
| Apr | - | Jun | 0.036 | 15 | < 0.03 | |
| Jun | - | Sep | 0.081 | 10 | < 0.03 | |
| Sep | - | Dec | < 0.03 | | 0.057 | 6 |
| **2000** | | | | | | |
| Jan | - | Mar | < 0.03 [a] | | < 0.03 | |
| Apr | - | Jun | < 0.03 | | 0.035 | 7 |
| Jul | - | Sep | 0.072 | 10 | 0.070 | 25 |
| Oct | - | Dec | 0.035 | 7 | 0.062 | 10 |
| **2001** | | | | | | |
| Jan | - | Mar | < 0.03 | | < 0.03 | |
| Apr | - | Jun | 0.038 | 9 | < 0.03 | |
| Jul | - | Sep | 0.085 | 20 | 0.070 | 10 |
| Oct | - | Dec | 0.060 | 10 | 0.090 | 10 |

[a]= monthly sample from February missing

**Table VIa.** Quarterly deposits of gamma-emitting nuclides at the Loviisa sampling stations (Bq m$^{-2}$) in 1999–2001. Area of the collector is 0.07 m$^2$. The uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| | $^{7}$Be | | $^{60}$Co | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| Loviisa 24 | | | | | | |
| Jan - Mar | - | | - | | - | |
| Apr - Jun | 192 | 3 | 0 | | 1.40 | 4 |
| Jul - Sep | 193 | 5 | 0 | | 1.60 | 7 |
| Oct - Dec | 172 | 3 | 0 | | 1.21 | 5 |
| | | | **Annual total** | | **4.21** | |
| Loviisa 33 | | | | | | |
| Jan - Mar | 208 | 4 | 0 | | 1.22 | 10 |
| Apr - Jun | 249 | 3 | 0.76 | 7 | 0.76 | 8 |
| Jul - Sep | 248 | 3 | 0 | | 1.13 | 8 |
| Oct - Dec | 256 | 5 | 0 | | 0.75 | 10 |
| | | | **Annual total** | | **3.85** | |
| Loviisa 27 | | | | | | |
| Jan - Mar | - | | - | | - | |
| Mar - Jun | 199 | 5 | 0.60 | 11 | 0.74 | 12 |
| Jun - Oct | 350 | 3 | 0 | | 2.28 | 7 |
| Oct - Dec | 300 | 3 | 0 | | 0.80 | 9 |
| | | | **Annual total** | | **3.81** | |
| **2000** | | | | | | |
| Loviisa 24 | | | | | | |
| Jan - Mar | 52 | 6 | 0 | | 0.69 | 11 |
| Apr - Jun | 270 | 5 | 0 | | 1.96 | 6 |
| Jul - Sep | 201 | 5 | 0 | | 1.65 | 11 |
| Sep - Dec | 294 | 5 | 0 | | 0.81 | 15 |
| | | | **Annual total** | | **5.11** | |
| Loviisa 33 | | | | | | |
| Jan - Mar | 125 | 3 | 0 | | 0.46 | 8 |
| Apr - Jun | 340 | 3 | 0 | | 1.63 | 6 |
| Jul - Sep | 166 | 5 | 0 | | 0.65 | 13 |
| Oct - Dec | 340 | 5 | 0 | | 0.39 | 29 |
| | | | **Annual total** | | **3.12** | |
| Loviisa 27 | | | | | | |
| Jan - Mar | 113 | 4 | 0 | | 0.69 | 12 |
| Apr - Jun | 320 | 5 | 0 | | 1.70 | 6 |
| Jul - Sep | 165 | 6 | 0 | | 1.65 | 8 |
| Oct - Dec | 370 | 5 | 0 | | 0.48 | 13 |
| | | | **Annual total** | | **4.52** | |

0 = below the detection limit
- = not analysed

**Table VIa.** Continued.

| | | | $^{7}Be$ | | $^{60}Co$ | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|
| **2001** | | | | | | | |
| Loviisa 24 | | | | | | | |
| Jan | - | Mar | 82 | 6 | 0 | 0.44 | 14 |
| Apr | - | Jun | 228 | 5 | 0 | 0.83 | 11 |
| Jul | - | Sep | 390 | 5 | 0 | 1.57 | 13 |
| Oct | - | Dec | 85 | 3 | 0 | 1.03 | 5 |
| | | | | | **Annual total** | **3.87** | |
| Loviisa 33 | | | | | | | |
| Jan | - | Mar | 115 | 4 | 0 | 0.35 | 13 |
| Apr | - | Jun | 263 | 3 | 0 | 0.70 | 6 |
| Jul | - | Sep | 420 | 3 | 0 | 1.26 | 7 |
| Oct | - | Dec | 121 | 3 | 0 | 0.56 | 7 |
| | | | | | **Annual total** | **2.87** | |
| Loviisa 27 | | | | | | | |
| Jan | - | Mar | 119 | 5 | 0 | 0.30 | 30 |
| Apr | - | Jun | 234 | 5 | 0 | 0.85 | 11 |
| Jul | - | Sep | 370 | 5 | 0 | 1.39 | 11 |
| Oct | - | Dec | 111 | 4 | 0 | 0.58 | 13 |
| | | | | | **Annual total** | **3.12** | |

0 = below the detection limit

**Table VIb.** Quarterly deposits of gamma-emitting nuclides at the Olkiluoto sampling stations (Bq m$^{-2}$) in 1999–2001. Area of the collector is 0.07 m$^2$. The uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| | $^{7}$Be | | $^{137}$Cs | |
|---|---|---|---|---|
| **1999** | | | | |
| Olkiluoto 31 | | | | |
| Jan - Mar | 141 | 6 | 0.85 | 14 |
| Apr - Jun | 220 | 3 | 0.78 | 7 |
| Jul - Sep | 101 | 5 | 0.45 | 13 |
| Oct - Dec | 224 | 3 | 1.36 | 7 |
| | **Annual total** | | **3.44** | |
| Olkiluoto 26 | | | | |
| Jan - Mar | 212 | 5 | 0.34 | 19 |
| Apr - Jun | 209 | 3 | 0.72 | 10 |
| Jul - Sep | 176 | 3 | 0.74 | 9 |
| Oct - Dec | 340 | 3 | 0.80 | 6 |
| | **Annual total** | | **2.60** | |
| Olkiluoto 37 | | | | |
| Jan - Mar | 169 | 5 | 0.33 | 16 |
| Apr - Jun | 222 | 5 | 0.59 | 11 |
| Jul - Sep | 166 | 3 | 0.49 | 13 |
| Oct - Dec | 202 | 4 | 0.40 | 14 |
| | **Annual total** | | **1.81** | |
| **2000** | | | | |
| Olkiluoto 31 | | | | |
| Jan - Mar | 92 | 3 | 0.97 | 7 |
| Apr - Jun | 249 | 3 | 1.26 | 5 |
| Jul - Sep | 860 | 5 | 2.20 | 7 |
| Oct , Dec | 90 | 6 | 0.38 | 19 |
| | **Annual total** | | **4.82** | |
| Olkiluoto 26 | | | | |
| Jan - Mar | 139 | 5 | 0.84 | 8 |
| Apr - Jun | 275 | 3 | 1.34 | 4 |
| Jul - Sep | 188 | 5 | 0.69 | 16 |
| Oct - Dec | 252 | 5 | 0.38 | 23 |
| | **Annual total** | | **0.38** | |
| Olkiluoto 37 | | | | |
| Jan - Mar | 123 | 5 | 0.33 | 23 |
| Apr - Jun | 235 | 5 | 1.11 | 10 |
| Jul - Sep | 710 | 3 | 2.30 | 5 |
| Oct - Dec | 213 | 5 | 0.36 | 21 |
| | **Annual total** | | **4.10** | |

0 = below the detection limit

**Table VIb.** Continued.

| | | | $^{7}$Be | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **2001** | | | | | | |
| Olkiluoto 31 | | | | | | |
| Jan | - | Mar | 69 | 8 | 0 | |
| Apr | - | Jun | 141 | 5 | 0.61 | 11 |
| Jul | - | Sep | 151 | 3 | 0.71 | 11 |
| Oct | - | Dec | 117 | 4 | 0.77 | 10 |
| | | | **Annual total** | | **2.09** | |
| Olkiluoto 26 | | | | | | |
| Jan | - | Mar | 95 | 7 | 0.57 | 26 |
| Apr | - | Jun | 163 | 3 | 0.83 | 6 |
| Jul | - | Sep | 282 | 5 | 1.11 | 13 |
| Oct | - | Dec | 126 | 5 | 0.87 | 11 |
| | | | **Annual total** | | **3.38** | |
| Olkiluoto 37 | | | | | | |
| Jan | - | Mar | 84 | 6 | 0 | |
| Apr | - | Jun | 130 | 6 | 0.75 | 19 |
| Jul | - | Sep | 275 | 5 | 0.45 | 23 |
| Oct | - | Dec | 117 | 4 | 0.54 | 11 |
| | | | **Annual total** | | **1.74** | |

0 = below the detection limit

**Table VIIa.** The amounts of $^{90}Sr$ and gamma-emitting nuclides in soil samples taken from the vicinity of the Loviisa nuclear power station in 2000 (Bq kg$^{-1}$ dry weight). The relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Station | Sampling depth cm | $^{40}K$ | | $^{90}Sr$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|
| **Loviisa 42** | | | | | | | | | |
| | 0-2 | 320 | 5 | 30 | 5 | 14.2 | 7 | 2290 | 4 |
| | 2-4 | 700 | 8 | 12.6 | 5 | 7.2 | 5 | 1190 | 3 |
| | 4-6 | 820 | 4 | 7.5 | 5 | 1.08 | 13 | 238 | 4 |
| | 6-8 | 830 | 4 | - | | 0 | | 59 | 4 |
| | 8-10 | 870 | 8 | - | | 0 | | 27.2 | 4 |
| | 10-15 | 860 | 3 | - | | 0 | | 11.3 | 3 |
| | 15-20 | 930 | 3 | - | | 0 | | 5.2 | 4 |
| | 20-23 | 940 | 8 | - | | 0 | | 4.9 | 6 |
| | | | | | | Total Bq m$^{-2}$ 15700 | | | |
| **Loviisa 43** | | | | | | | | | |
| | 0-2 | 560 | 4 | 7.7 | 5 | 5.5 | 6 | 820 | 4 |
| | 2-4 | 710 | 4 | 3.3 | 6 | 6.6 | 7 | 1060 | 4 |
| | 4-6 | 740 | 8 | 2.88 | 6 | 5.1 | 6 | 770 | 3 |
| | 6-8 | 760 | 8 | - | | 5.4 | 6 | 930 | 3 |
| | 8-10 | 800 | 4 | - | | 1.71 | 11 | 213 | 4 |
| | 10-15 | 820 | 3 | - | | 0.33 | 21 | 36 | 4 |
| | 15-20 | 860 | 8 | - | | 0 | | 20.0 | 4 |
| | | | | | | Total Bq m$^{-2}$ 39400 | | | |
| **Loviisa 44** | | | | | | | | | |
| | 0-2 | 269 | 9 | 11.0 | 5 | 5.3 | 12 | 760 | 3 |
| | 2-4 | 710 | 4 | 6.4 | 5 | 3.4 | 9 | 570 | 4 |
| | 4-6 | 880 | 8 | 3.3 | 5 | 0 | | 47 | 4 |
| | 6-8 | 850 | 4 | - | | 0 | | 16.2 | 5 |
| | 8-10 | 870 | 8 | - | | 0 | | 15.3 | 4 |
| | 10-15 | 910 | 4 | - | | 0 | | 12.7 | 4 |
| | 15-20 | 890 | 4 | - | | 0 | | 5.0 | 6 |
| | | | | | | Total Bq m$^{-2}$ 7500 | | | |

0 = below the detection limit
- = not analysed

**Table VIIb.** The amounts of $^{90}Sr$ and gamma-emitting nuclides in soil samples taken from the vicinity of the Olkiluoto nuclear power station in 2001 (Bq kg$^{-1}$ dry weight). The relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Station | $^{40}K$ | | $^{60}Co$ | | $^{90}Sr$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 41** | | | | | | | | | | |
| 0-2 | 310 | 4 | 0 | | 10.3 | 7 | 3.2 | 7 | 770 | 4 |
| 2-4 | 560 | 4 | 0 | | 2.00 | 6 | 1.14 | 12 | 241 | 4 |
| 4-6 | 700 | 8 | 0 | | 0.67 | 7 | 0 | | 62 | 3 |
| 6-8 | 700 | 4 | 0 | | - | | 0 | | 17.8 | 5 |
| 8-10 | 690 | 4 | 0 | | - | | 0 | | 9.8 | 5 |
| 10-15 | 710 | 4 | 0 | | - | | 0 | | 4.5 | 4 |
| 15-20 | 760 | 3 | 0 | | - | | 0 | | 1.76 | 5 |
| 20-25 | 800 | 4 | 0 | | - | | 0 | | 4.9 | 5 |
| 25-28 | 860 | 8 | 0 | | - | | 0 | | 2.17 | 5 |
| | | | | | | | Total Bq m$^{-2}$ 9000 | | | |
| **Olkiluoto 45** | | | | | | | | | | |
| 0-2 | 232 | 5 | 18.6 | 3 | 16.1 | 5 | 4.7 | 11 | | 4 |
| 2-4 | 273 | 9 | 0 | | 17.0 | 5 | 1.15 | 15 | 480 | 3 |
| 4-6 | 247 | 8 | 0 | | 16.6 | 5 | 0.81 | 14 | 155 | 3 |
| 6-8 | 480 | 4 | 0 | | - | | 0 | | 93 | 4 |
| 8-10 | 660 | 8 | 0 | | - | | 0 | | 27.3 | 4 |
| 10-15 | 720 | 4 | 0 | | - | | 0 | | 6.1 | 4 |
| | | | | | | | Total Bq m$^{-2}$ 11000 | | | |
| **Olkiluoto 44** | | | | | | | | | | |
| 0-2 | 490 | 8 | 0 | | 5.3 | 6 | 1.91 | 7 | 380 | 3 |
| 2-4 | 510 | 4 | 0 | | 3.6 | 6 | 1.57 | 12 | 360 | 4 |
| 4-6 | 580 | 4 | 0 | | 2.26 | 6 | 0.93 | 15 | 195 | 4 |
| 6-8 | 680 | 8 | 0 | | - | | 0.54 | 26 | 82 | 3 |
| 8-10 | 720 | 8 | 0 | | - | | 0 | | 29.4 | 4 |
| 10-15 | 700 | 3 | 0 | | - | | 0 | | 11.7 | 4 |
| 15-20 | 680 | 3 | 0 | | - | | 0 | | 2.43 | 6 |
| 20-25 | 740 | 4 | 0 | | - | | 0 | | 1.29 | 11 |
| | | | | | | | Total Bq m$^{-2}$ 10300 | | | |

0 = below the detection limit
- = not analysed

**Table VIII.** $^{90}Sr$ and gamma-emitting nuclides in hair moss at Loviisa and Olkiluoto in 1999–2001 (Bq $kg^{-1}$ dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | $^{7}Be$ | | $^{40}K$ | | $^{90}Sr$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Loviisa 32** | | | | | | | | | | |
| 26.5.1999 | 320 | 5 | 272 | 4 | - | | 10.2 | 3 | 1100 | 3 |
| 23.9.1999 | 340 | 4 | 320 | 4 | 2.61 | 8 | 10.4 | 3 | 1220 | 3 |
| 24.5.2000 | 248 | 4 | 242 | 4 | - | | 7.4 | 3 | 1010 | 3 |
| 29.9.2000 | 297 | 4 | 340 | 4 | 1.65 | 7 | 7.2 | 3 | 1180 | 4 |
| **Loviisa 36** | | | | | | | | | | |
| 30.5.2001 | 286 | 4 | 206 | 3 | - | | 9.7 | 3 | 1940 | 3 |
| 19.9.2001 | 380 | 4 | 256 | 3 | 3.0 | 5 | 9.1 | 4 | 2000 | 3 |
| **Olkiluoto 32** | | | | | | | | | | |
| 15.6.1999 | 184 | 5 | 268 | 3 | - | | 7.0 | 4 | 770 | 3 |
| 5.10.1999 | 226 | 4 | 254 | 4 | 7.8 | 8 | 4.5 | 6 | 520 | 3 |
| 13.6.2000 | 275 | 4 | 260 | 4 | - | | 2.81 | 9 | 450 | 4 |
| 28.9.2000 | 164 | 4 | 262 | 3 | 5.7 | 6 | 1.59 | 4 | 255 | 3 |
| 18.6.2001 | 194 | 4 | 236 | 4 | - | | 1.63 | 7 | 350 | 4 |
| 1.10.2001 | 246 | 4 | 219 | 4 | 3.9 | 5 | 1.03 | 8 | 228 | 3 |

- = not analysed

**Table IX.** Gamma-emitting nuclides in grazing grass in a zone extending 10 km from the Loviisa and Olkiluoto power plants in 1999–2001 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| | $^{7}$Be | | $^{40}$K | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **Loviisa** | | | | | | |
| 1.7.1999 | 45 | 7 | 760 | 3 | 2.62 | 10 |
| 26.8.1999 | 178 | 4 | 460 | 4 | 0.92 | 14 |
| 30.6.2000 | 56 | 5 | 730 | 4 | 2.93 | 7 |
| 28.8.2000 | 102 | 5 | 880 | 4 | 1.80 | 13 |
| 5.7.2001 | 32 | 6 | 760 | 4 | 2.27 | 6 |
| 28.8.2001 | 108 | 4 | 730 | 3 | 1.27 | 12 |
| **Olkiluoto** | | | | | | |
| 15.6.1999 | 23.6 | 7 | 900 | 4 | 5.5 | 6 |
| 8.8.1999 | 86 | 5 | 530 | 4 | 2.86 | 7 |
| 7.6.2000 | 26.2 | 7 | 830 | 4 | 15.1 | 4 |
| 16.8.2000 | 56 | 5 | 950 | 4 | 0.92 | 13 |
| 6.6.2001 | 13.4 | 7 | 930 | 4 | 0.51 | 13 |
| 15.8.2001 | 79 | 5 | 950 | 4 | 0.79 | 22 |

**Table X.** Gamma-emitting nuclides in pine needle and lichen samples at Loviisa and Olkiluoto in 1999–2001 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Date | Dry matter % | $^{7}$Be | | $^{40}$K | | $^{60}$Co | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pine needles** | | | | | | | | | | | |
| Loviisa | | | | | | | | | | | |
| 22.9.1999 | 46.6 | 26.4 | 7 | 181 | 4 | 0 | | 1.17 | 7 | 126 | 3 |
| 28.9.2000 | 43.6 | 44 | 5 | 167 | 3 | 0 | | 1.10 | 7 | 173 | 3 |
| 20.9.2001 | 42.1 | 50 | 5 | 148 | 4 | 0 | | 1.22 | 7 | 248 | 3 |
| Olkiluoto | | | | | | | | | | | |
| 22.6.1999 | 50.2 | 37 | 8 | 105 | 4 | 0 | | 1.01 | 3 | 101 | 3 |
| 6.7.2000 | 64.4 | 60 | 5 | 108 | 5 | 0 | | 0.91 | 14 | 129 | 4 |
| 26.6.2001 | 52.4 | 27.8 | 5 | 116 | 4 | 0 | | 0.44 | 14 | 79 | 3 |
| **Reindeer lichen** | | | | | | | | | | | |
| Loviisa | | | | | | | | | | | |
| 22.9.1999 | 73.5 | 134 | 4 | 49 | 5 | 0 | | 6.0 | 4 | 690 | 3 |
| 28.9.2000 | 30.9 | 188 | 4 | 55 | 6 | 0 | | 6.4 | 4 | 1010 | 4 |
| 28.8.2001 | 29.0 | 213 | 4 | 51 | 7 | 0 | | 3.4 | 5 | 770 | 4 |
| Olkiluoto | | | | | | | | | | | |
| 30.6.1999 | 66.5 | 163 | 3 | 37 | 6 | 0.32 | 15 | 5.2 | 3 | 580 | 3 |
| 5.7.2000 | 85.8 | 159 | 4 | 30 | 4 | 0.199 | 9 | 6.8 | 4 | 1030 | 3 |
| 24.7.2001 | 88.3 | 106 | 4 | 35 | 6 | 0 | | 2.67 | 4 | 570 | 3 |

0 = below the detection limit

**Table XI.** Gamma-emitting radionuclides in the water of the ditch around dumping ground of Olkiluoto in 1999–2001 (Bq m$^{-3}$). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Date | $^{40}$K | | $^{137}$Cs | |
|---|---|---|---|---|
| 28.04.1999 | 590 | 6 | 4.4 | 15 |
| 29.09.1999 | 1480 | 3 | 4.6 | 13 |
| 11.05.2000 | 1130 | 6 | 2.58 | 25 |
| 15.11.2000 | 540 | 6 | 1.60 | 24 |
| 10.05.2001 | 630 | 5 | 5.3 | 11 |
| 25.09.2001 | 880 | 3 | 3.3 | 15 |

**Table XIIa.** $^{137}Cs$ in monthly milk samples (Bq $l^{-1}$) from Loviisa area in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Within a 10 km radius of the power nuclear plant | | Sampling routes within about 40 km radius of the nuclear power plant | |
|---|---|---|---|---|
| | $^{137}Cs$ | | $^{137}Cs$ | |
| **1999** | | | | |
| Jan | 0.298 | 3 | 0.165 | 4 |
| Feb | 0.268 | 5 | 0.164 | 6 |
| Mar | 0.169 | 5 | 0.293 | 6 |
| Apr | 0.289 | 3 | 0.165 | 4 |
| May | 0.230 | 6 | 0.097 | 8 |
| Jun | 0.43 | 5 | 0.269 | 5 |
| Jul | 0.64 | 5 | 0.48 | 5 |
| Aug | 0.69 | 5 | 0.258 | 5 |
| Sep | 0.297 | 6 | 0.187 | 4 |
| Oct | 0.48 | 4 | 0.176 | 6 |
| Nov | 0.35 | 6 | 0.45 | 5 |
| Dec | 0.30 | 5 | 0.176 | 6 |
| Mean | 0.369 | | 0.241 | |
| **2000** | | | | |
| Jan | 0.35 | 6 | 0.39 | 3 |
| Feb | 0.254 | 6 | 0.52 | 3 |
| Mar | 0.244 | 5 | 0.187 | 6 |
| Apr | 0.38 | 3 | 0.219 | 5 |
| May | 0.34 | 3 | 0.225 | 3 |
| Jun | 0.177 | 4 | 0.203 | 5 |
| Jul | 0.32 | 5 | 0.168 | 7 |
| Aug | 0.251 | 7 | 0.278 | 6 |
| Sep | 0.285 | 7 | 0.183 | 8 |
| Oct | 0.235 | 6 | 0.138 | 8 |
| Nov | 0.185 | 8 | 0.31 | 7 |
| Dec | 0.33 | 6 | 0.229 | 8 |
| Mean | 0.279 | | 0.254 | |
| **2001** | | | | |
| Jan | 0.37 | 7 | 0.204 | 5 |
| Feb | 0.297 | 7 | 0.261 | 7 |
| Mar | 0.122 | 11 | 0.159 | 10 |
| Apr | 0.151 | 8 | 0.193 | 6 |
| May | 0.218 | 7 | 0.124 | 9 |
| Jun | 0.185 | 8 | 0.161 | 9 |
| Jul | 0.218 | 8 | 0.248 | 7 |
| Aug | 0.217 | 8 | 0.187 | 7 |
| Sep | 0.236 | 7 | 0.218 | 7 |
| Oct | 0.235 | 8 | 0.140 | 8 |
| Nov | 0.40 | 4 | 0.094 | 11 |
| Dec | 0.209 | 4 | 0.163 | 9 |
| Mean | 0.238 | | 0.179 | |

**Table XIIb.** $^{134}Cs$ and $^{137}Cs$ in monthly milk samples (Bq $l^{-1}$) from Olkiluoto area in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Within a 10 km radius of the power nuclear plant | | | | Sampling routes within about 40 km radius of the nuclear power plant | | | |
|---|---|---|---|---|---|---|---|---|
| | $^{134}Cs$ | | $^{137}Cs$ | | $^{134}Cs$ | | $^{137}Cs$ | |
| **1999** | | | | | | | | |
| Jan | 0.010 | 25 | 0.53 | 3 | 0 | | 1.02 | 3 |
| Feb | 0 | | 0.65 | 3 | 0 | | 0.89 | 3 |
| Mar | 0.012 | 26 | 0.51 | 5 | 0.015 | 14 | 0.84 | 3 |
| Apr | 0 | | 0.34 | 5 | 0 | | 0.85 | 5 |
| May | 0 | | 0.36 | 5 | 0 | | 0.85 | 5 |
| Jun | 0 | | 0.97 | 5 | 0.010 | 24 | 1.08 | 3 |
| Jul | 0 | | 0.96 | 3 | 0.014 | 26 | 1.16 | 4 |
| Aug | 0 | | 0.91 | 3 | 0.013 | 15 | 1.14 | 3 |
| Sep | 0 | | 0.37 | 6 | 0.009 | 23 | 1.16 | 5 |
| Oct | 0 | | 0.49 | 5 | 0.010 | 22 | 1.34 | 3 |
| Nov | 0 | | 0.72 | 3 | 0 | | 1.29 | 5 |
| Dec | 0 | | 0.40 | 3 | 0.014 | 16 | 1.07 | 3 |
| Mean | | | 0.60 | | | | 1.06 | |
| **2000** | | | | | | | | |
| Jan | 0 | | 0.44 | 3 | 0 | | 1.23 | 5 |
| Feb | 0 | | 0.55 | 3 | 0 | | 1.24 | 5 |
| Mar | 0 | | 0.40 | 6 | 0.009 | 22 | 1.40 | 3 |
| Apr | 0 | | 0.36 | 6 | 0 | | 1.48 | 5 |
| May | 0 | | 0.39 | 3 | 0 | | 1.20 | 3 |
| Jun | 0 | | 0.62 | 4 | 0.012 | 13 | 1.31 | 4 |
| Jul | 0 | | 0.73 | 5 | 0 | | 1.00 | 3 |
| Aug | 0 | | 0.63 | 5 | 0 | | 1.11 | 4 |
| Sep | 0 | | 0.49 | 5 | 0 | | 0.80 | 5 |
| Oct | 0 | | 0.30 | 4 | 0 | | 0.98 | 5 |
| Nov | 0 | | 0.283 | 8 | 0 | | 0.81 | 5 |
| Dec | 0 | | 0.33 | 7 | 0 | | 1.04 | 4 |
| Mean | | | 0.46 | | | | 1.13 | |
| **2001** | | | | | | | | |
| Jan | 0 | | 1.40 | 3 | 0 | | 0.93 | 5 |
| Feb | 0 | | 0.198 | 7 | 0 | | 1.05 | 4 |
| Mar | 0 | | 0.264 | 6 | 0 | | 1.17 | 5 |
| Apr | 0 | | 0.48 | 6 | 0 | | 1.00 | 5 |
| May | 0 | | 0.200 | 6 | 0 | | 1.00 | 5 |
| Jun | 0 | | 0.39 | 5 | 0 | | 0.95 | 5 |
| Jul | 0 | | 0.83 | 5 | 0 | | 1.14 | 5 |
| Aug | 0 | | 0.90 | 5 | 0 | | 1.11 | 5 |
| Sep | 0 | | 0.30 | 6 | 0 | | 1.04 | 5 |
| Oct | 0 | | 0.183 | 8 | 0 | | 0.97 | 5 |
| Nov | 0 | | 0.162 | 5 | 0 | | 0.92 | 5 |
| Dec | 0 | | 0.39 | 6 | 0 | | 1.37 | 3 |
| Mean | | | 0.475 | | | | 1.05 | |

0 = below the detection limit
* = analytical error included

**Table XIII**. $^{90}Sr$ in bi-monthly milk samples (Bq $l^{-1}$) from Loviisa and Olkiluoto areas in 1999–2001. Relative uncertainties (1$\sigma$) include both statistical, calibration and analytical uncertainty.

| | | | Loviisa | | Olkiluoto | |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| Jan | - | Feb | 0.043 | 13 | 0.052 | 9 |
| Mar | - | Apr | 0.043 | 10 | 0.052 | 10 |
| May | - | Jun | 0.057 | 20 | 0.088 | 20 |
| Jul | - | Aug | 0.076 | 20 | 0.086 | 15 |
| Sep | - | Oct | 0.044 | 8 | 0.065 | 7 |
| Nov | - | Dec | 0.042 | 7 | 0.057 | 8 |
| Mean | | | 0.051 | | 0.067 | |
| **2000** | | | | | | |
| Jan | - | Feb | 0.038 | 8 | 0.049 | 8 |
| Mar | - | Apr | 0.041 | 7 | 0.053 | 7 |
| May | - | Jun | 0.04 | 7 | 0.066 | 7 |
| Jul | - | Aug | 0.077 | 8 | 0.065 | 8 |
| Sep | - | Oct | 0.037 | 7 | 0.063 | 7 |
| Nov | - | Dec | 0.035 | 7 | 0.046 | 7 |
| Mean | | | 0.045 | | 0.057 | |
| **2001** | | | | | | |
| Jan | - | Feb | 0.037 | 7 | 0.057 | 8 |
| Mar | - | Apr | 0.066 | 12 | 0.082 | 12 |
| May | - | Jun | 0.09 | 12 | 0.054 | 12 |
| Jul | - | Aug | 0.06 | 6 | 0.088 | 6 |
| Sep | - | Oct | 0.04 | 6 | 0.054 | 7 |
| Nov | - | Dec | 0.04 | 7 | 0.053 | 7 |
| Mean | | | 0.056 | | 0.065 | |

**Table XIVa.** $^{90}Sr$ and gamma-emitting radionuclides (Bq m$^{-3}$) in drinking water sampled in the waterworks serving the Loviisa power plant and Town of Loviisa in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Date | $^{40}K$ | | $^{90}Sr$* | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|
| **Town of Loviisa**[a] | | | | | | | | |
| 4.3.1999 | 177 | 3 | - | | 0 | | 0 | |
| 28.5.1999 | 100 | 7 | 0.87 | 15 | 0 | | 0 | |
| 31.8.1999 | 131 | 7 | - | | 0 | | 0 | |
| 29.11.1999 | 134 | 4 | 1.92 | 6 | 0 | | 0 | |
| 29.2.2000 | 158 | 5 | - | | 0 | | 0 | |
| 30.5.2000 | 149 | 9 | 0 | | 0 | | 0 | |
| 31.8.2000 | 173 | 5 | - | | 0 | | 0 | |
| 1.12.2000 | 190 | 5 | 0 | | 0 | | 0 | |
| 27.2.2001 | 130 | 10 | - | | 0 | | 0 | |
| 1.6.2001 | 125 | 10 | 0 | | 0 | | 0 | |
| 31.8.2001 | 188 | 8 | - | | 0 | | 0 | |
| 30.11.2001 | 149 | 6 | 0 | | 0 | | 0 | |
| **Loviisa power plant**[a] | | | | | | | | |
| 4.3.1999 | 77 | 4 | - | | 0.89 | 8 | 74 | 3 |
| 28.5.1999 | 70 | 7 | 6.5 | 5 | 0 | | 44 | 3 |
| 31.8.1999 | 70 | 7 | - | | 0.86 | 14 | 71 | 5 |
| 29.11.1999 | 68 | 7 | 6.9 | 5 | 0.60 | 16 | 63 | 3 |
| 29.2.2000 | 77 | 7 | - | | 0 | | 89 | 3 |
| 30.5.2000 | 65 | 12 | 6.5 | 5 | 0 | | 57 | 5 |
| 31.8.2000 | 67 | 11 | - | | 0 | | 71 | 5 |
| 1.12.2000 | 65 | 12 | 7.3 | 5 | 0 | | 51 | 5 |
| 27.2.2001 | 74 | 7 | - | | 0 | | 52 | 3 |
| 1.6.2001 | 58 | 10 | 5.6 | 7 | 0 | | 36 | 5 |
| 31.8.2001 | 59 | 8 | - | | 0.40 | 24 | 51 | 5 |
| 30.11.2001 | 63 | 12 | 7.1 | 5 | 0 | | 46 | 5 |

* = analytical error included
0 = below the detection limit
\- = not analysed
[a] = tap water

**Table XIVb.** $^{90}$Sr and gamma-emitting radionuclides (Bq m$^{-3}$) in drinking water sampled in the waterworks serving the Olkiluoto power plant towns of Rauma in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Date | $^{40}$K | | $^{90}$Sr* | | $^{137}$Cs | |
|---|---|---|---|---|---|---|
| **Town of Rauma**[a] | | | | | | |
| 7.1.1999 | 96 | 10 | 8.9 | 4 | 7.7 | 8 |
| 14.4.1999 | 103 | 6 | - | | 7.8 | 5 |
| 7.7.1999 | 85 | 7 | 10.4 | 5 | 7.5 | 5 |
| 6.10.1999 | 158 | 5 | - | | 6.1 | 6 |
| 5.1.2000 | 108 | 6 | 10.3 | 6 | 6.7 | 5 |
| 10.4.2000 | 105 | 7 | - | | 7.6 | 7 |
| 18.7.2000 | 116 | 8 | 9.2 | 6 | 10.4 | 7 |
| 4.10.2000 | 89 | 6 | - | | 5.0 | 8 |
| 3.1.2001 | 88 | 6 | 10.0 | 6 | 11.2 | 6 |
| 17.4.2001 | 102 | 10 | - | | 5.5 | 10 |
| 4.7.2001 | 83 | 7 | 9.0 | 10 | 4.5 | 9 |
| 10.10.2001 | 148 | 5 | - | | 8.7 | 7 |
| **Olkiluoto power plant**[a] | | | | | | |
| 7.1.1999 | 91 | 6 | 11.5 | 4 | 7.9 | 5 |
| 14.4.1999 | 83 | 7 | - | | 6.4 | 5 |
| 7.7.1999 | 80 | 8 | 11.0 | 5 | 8.3 | 6 |
| 6.10.1999 | 92 | 7 | - | | 11.3 | 6 |
| 5.1.2000 | 101 | 8 | 10.4 | 6 | 10.4 | 6 |
| 10.4.2000 | 100 | 10 | - | | 7.6 | 8 |
| 18.7.2000 | 92 | 9 | 8.3 | 6 | 10.4 | 7 |
| 4.10.2000 | 85 | 12 | - | | 7.0 | 9 |
| 3.1.2001 | 95 | 8 | 9.0 | 6 | 6.5 | 8 |
| 17.4.2001 | 92 | 7 | - | | 6.6 | 7 |
| 4.7.2001 | 92 | 11 | 7.8 | 10 | 6.4 | 10 |
| 10.10.2001 | 88 | 8 | - | | 6.0 | 9 |

* = analytical error included
- = not analysed
[a] = raw water

**Table XV.** $^{90}Sr$ and gamma-emitting radionuclides in cereals in the vicinity of Loviisa and Olkiluoto in 1999–2001 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Dry matter % | $^{40}K$ | | $^{90}Sr$* | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|
| **Loviisa** | | | | | | | |
| 1999 | | | | | | | |
| Rye | 88.9 | 133 | 5 | - | | 1.36 | 6 |
| Wheat | 92.9 | 125 | 5 | 0.19 | 7 | 0.58 | 6 |
| 2000 | | | | | | | |
| Rye | 93.1 | 172 | 4 | - | | 0.96 | 3 |
| Wheat | 93.4 | 144 | 4 | 0.15 | 7 | 0.77 | 5 |
| 2001 | | | | | | | |
| Rye | 91.3 | 158 | 5 | - | | 0.44 | 9 |
| Wheat | 92.0 | 158 | 4 | 0.23 | 7 | 0.53 | 4 |
| **Olkiluoto** | | | | | | | |
| 1999 | | | | | | | |
| Rye | - | - | | - | | - | |
| Wheat | - | - | | - | | - | |
| 2000 | | | | | | | |
| Rye | 92.3 | 172 | 4 | - | | 0.52 | 4 |
| Wheat | 92.0 | 152 | 3 | 0.21 | 7 | 0.29 | 7 |
| 2001 | | | | | | | |
| Rye | 86.8 | 146 | 5 | - | | 0.42 | 8 |
| Wheat | 88.3 | 130 | 4 | 0.19 | 7 | 0.157 | 8 |

* = analytical error included
- = not analysed

**Table XVI.** Gamma-emitting radionuclides in lettuce, apple and black currant samples in 1999–2001 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Dry matter % | $^{7}$Be | | $^{40}$K* | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|
| **Lettuce** | | | | | | | |
| Loviisa 33 | | | | | | | |
| 15.7.1999 | 8.1 | 93 | 4 | 2340 | 4 | 1.75 | 7 |
| 26.8.1999 | 7.2 | 136 | 5 | 1850 | 3 | 3.9 | 7 |
| 30.6.2000 | 4.3 | 107 | 4 | 2020 | 4 | 22.7 | 3 |
| 28.8.2000 | 8.2 | 56 | 5 | 1290 | 4 | 7.8 | 4 |
| 13.7.2001 | 6.4 | 55 | 10 | 1580 | 4 | 9.3 | 7 |
| 28.8.2001 | 6.6 | 63 | 7 | 1710 | 5 | 3.9 | 9 |
| Olkiluoto 26 | | | | | | | |
| 26.7.1999 | 4.5 | 43 | 8 | 2420 | 5 | 4.8 | 8 |
| 8.9.1999 | 6.0 | 20.2 | 5 | 1740 | 3 | 5.1 | 4 |
| 11.7.2000 | 5.6 | 23.4 | 5 | 2060 | 4 | 2.84 | 4 |
| 6.9.2000 | 7.4 | 52 | 6 | 1760 | 5 | 2.19 | 9 |
| 23.7.2001 | 4.7 | 61 | 4 | 2150 | 4 | 5.6 | 5 |
| 6.9.2001 | 7.5 | 186 | 4 | 1700 | 4 | 6.8 | 5 |
| **Apple** | | | | | | | |
| Loviisa 31 | | | | | | | |
| 15.9.1999 | 14.6 | 2.73 | 15 | 248 | 5 | 0.48 | 11 |
| 13.9.2000 | 5.8 | 3.6 | 8 | 320 | 4 | 0.50 | 6 |
| 20.9.2001 | 16.0 | 3.9 | 9 | 350 | 4 | 0.283 | 10 |
| **Black currant** | | | | | | | |
| Olkiluoto 26 | | | | | | | |
| 26.7.1999 | 16.3 | 18.4 | 7 | 1360 | 4 | 1.89 | 6 |
| 15.8.2000 | 14.4 | 7.3 | 6 | 540 | 4 | 1.00 | 5 |
| 15.8.2001 | 13.5 | 14.7 | 12 | 1490 | 3 | 1.74 | 10 |

**Table XVII.** Gamma-emitting radionuclides in beef in the Loviisa and Olkiluoto areas in 1999–2001 (Bq $kg^{-1}$ fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | $^{40}K$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|
| **Loviisa** | | | | | | |
| 1999 | | | | | | |
| spring | 75 | 5 | 0 | | 0.73 | 5 |
| autumn | 87 | 4 | 0 | | 0.58 | 3 |
| 2000 | | | | | | |
| spring | 88 | 5 | 0 | | 0.71 | 5 |
| autumn | 102 | 4 | 0 | | 0.62 | 4 |
| 2001 | | | | | | |
| spring | 90 | 5 | 0 | | 1.67 | 6 |
| autumn | 94 | 4 | 0 | | 0.71 | 3 |
| **Olkiluoto** | | | | | | |
| 1999 | | | | | | |
| spring | 73 | 3 | 0 | | 0.67 | 5 |
| autumn | 83 | 4 | 0.015 | 30 | 1.34 | 3 |
| 2000 | | | | | | |
| spring | 86 | 3 | 0.029 | 12 | 3.7 | 4 |
| autumn | 86 | 4 | 0 | | 0.50 | 4 |
| 2001 | | | | | | |
| spring | 96 | 4 | 0 | | 0.55 | 4 |
| autumn | 90 | 5 | 0 | | 2.11 | 5 |

0 = below the detection limit

**Table XVIIIa.** The amounts of gamma-emitting radionuclides in mushrooms and wild berries taken from the vicinity of the Loviisa nuclear power plant in 2000 (Bq kg$^{-1}$ fresh weight). For sampling sites see Fig. 6. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Specie | Sampling area | Date | $^{40}K$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|
| *Hydnum repandum* | 51 | 24.8. | 145 | 6 | 1.31 | 8 | 218 | 5 |
| *Hydnum rufescens* | 59 | 15.8. | 148 | 9 | 55 | 4 | 8500 | 3 |
| Boletus<br>*Boletus variegatus* | 55 | 14.8. | 62 | 8 | 6.3 | 4 | 960 | 3 |
| Cepe<br>*Boletus edulis* | 52 | 15.8. | 800 | 8 | 0.84 | 4 | 153 | 3 |
| Rufous milk-cap<br>*Lactarius rufus* | 54 | 14.8. | 780 | 8 | 3.7 | 4 | 600 | 3 |
| Wooly milk cap<br>*Lactarius torminosus* | 55 | 14.8. | 810 | 4 | 4.3 | 6 | 630 | 4 |
| Lingonberry<br>*Vaccinium vitis-idaea* | 53 | 24.8. | 29 | 8 | 0.192 | 12 | 23.6 | 3 |
| Blueberry | 56 | 16.8. | 25 | 8 | 0.091 | 16 | 15.1 | 3 |
| *Vaccinium myrtillus* | 59 | 16.8 | 25 | 4 | 0.283 | 8 | 41 | 4 |
| Rowanberry | 57 | 14.8. | 86 | 8 | 0 | | 2.99 | 4 |
| *Sorbus aucuparia* | 58 | 16.8 | 76 | 4 | 0 | | 1.34 | 6 |

0 = below the detection limit

**Table XVIIIb.** The amounts of gamma-emitting radionuclides in mushrooms and wild berries taken from the vicinity of the Olkiluoto nuclear power plant in 2001 (Bq $kg^{-1}$ fresh weight). For sampling sites see Fig. 7. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Specie | Sampling area | Date | $^{40}K$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|
| Chantharelle *Cantharellus cibarius* | 52 | 21.8. | 115 | 3 | 0.213 | 14 | 60 | 5 |
| Ringed boletus *Suillus luteus* | 56 | 21.8. | 67 | 7 | 0.42 | 14 | 94 | 5 |
| Cepe *Boletus edulis* | 51 | 21.8. | 64 | 7 | 0.37 | 17 | 78 | 5 |
| Wooly milk cap *Lactarius torminosus* | 56 | 11.9. | 56 | 4 | 0.56 | 7 | 126 | 5 |
| *Lactarius trivialis* | 56 | 11.9. | 42 | 4 | 4.1 | 5 | 870 | 4 |
| Lingonberry *Vaccinium vitis-idaea* | 56 | 20.8. | 30 | 4 | 0.280 | 11 | 48 | 4 |
| Blueberry *Vaccinium myrtillus* | 56 | 20.8. | 26 | 8 | 0.253 | 8 | 49 | 3 |
| Raspberry *Rubus idaeus* | 54 | 21.8. | 56 | 8 | 0 | | 2.17 | 5 |
| Rose hip *Rosa sp.* | 53 | 21.8. | 195 | 4 | 0 | | 0.58 | 8 |
| Buckthornberry *Hippophae rhamnoides* | 55 | 21.8. | 57 | 8 | 0 | | 0.31 | 12 |

0 = below the detection limit

**Table XIXa.** $^{3}H$, $^{90}Sr$ and gamma-emitting radionuclides (Bq m$^{-3}$) in sea water samples at Loviisa in 1999–2001. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

| Sampling station | Date | Salinity ‰ | $^{3}H$ | | $^{40}K$ | | $^{90}Sr$* | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| 02 | 15.3.1999[a] | 4.29 | 49 000 | 6 | 1700 | 4 | 12.9 | 5 | 55 | 4 |
| | 26.5.1999 | 4.38 | 6 200 | 8 | 1680 | 3 | 14.0 | 6 | 48 | 3 |
| | 3.8.1999 | 4.74 | 0 | | 1710 | 3 | 13.7 | 5 | 51 | 4 |
| | 5.10.1999 | 4.63 | 0 | | 1700 | 3 | 14.5 | 6 | 50 | 3 |
| | 21.3.2000 | 4.40 | 4 100 | 10 | 1910 | 5 | 13.3 | 6 | 56 | 5 |
| | 22.5.2000 | 4.32 | 8 500 | 10 | 1660 | 3 | 10.6 | 5 | 46 | 4 |
| | 9.8.2000 | 4.36 | 0 | | 1800 | 4 | 12.0 | 8 | 51 | 4 |
| | 18.10.2000 | 4.29 | 0 | | 1500 | 4 | 12.7 | 5 | 46 | 4 |
| | 28.3.2001 | 4.07 | 6 400 | 16 | 1440 | 3 | 11.5 | 6 | 38 | 4 |
| | 16.5.2001 | 3.99 | 4 800 | 16 | 1600 | 4 | 14.2 | 5 | 44 | 4 |
| | 2.8.2001 | 4.67 | 0 | | 1700 | 3 | 11.7 | 15 | 42 | 4 |
| | 3.10.2001 | 4.04 | 0 | | 1400 | 4 | 13.6 | 5 | 39 | 5 |
| 1 | 25.5.1999 | 3.71 | 16 900 | 5 | 1310 | 4 | - | | 44 | 4 |
| | 3.8.1999 | 4.88 | 9 400 | 7 | 1680 | 3 | - | | 58 | 3 |
| | 5.10.1999 | 4.57 | 0 | | 1630 | 3 | - | | 52 | 4 |
| | 22.5.2000 | 3.96 | 5 900 | 12 | 1460 | 3 | - | | 42 | 4 |
| | 9.8.2000 | 4.10 | 7 800 | 10 | 1450 | 3 | - | | 54 | 3 |
| | 18.10.2000 | 3.92 | 4 100 | 20 | 1610 | 4 | - | | 57 | 5 |
| | 16.5.2001 | 3.59 | 10 800 | 9 | 1250 | 4 | - | | 33 | 4 |
| | 1.8.2001 | 3.84 | 6 800 | 12 | 1470 | 3 | - | | 53 | 3 |
| | 3.10.2001 | 3.89 | 4 920 | 20 | 1330 | 3 | - | | 42 | 4 |
| 2 | 25.5.1999 | 3.80 | 13 200 | 5 | 1260 | 4 | - | | 40 | 4 |
| | 3.8.1999 | 4.96 | 5 700 | 10 | 1910 | 4 | - | | 57 | 4 |
| | 5.10.1999 | 4.62 | 4 400 | 15 | 1820 | 3 | - | | 54 | 4 |
| | 22.5.2000 | 4.30 | 27 200 | 8 | 1650 | 3 | - | | 46 | 4 |
| | 9.8.2000 | 4.16 | 6 100 | 13 | 1500 | 3 | - | | 47 | 3 |
| | 18.10.2000 | 4.22 | 0 | | 1690 | 4 | - | | 53 | 5 |
| | 16.5.2001 | 3.87 | 9 400 | 19 | 1530 | 4 | - | | 39 | 4 |
| | 1.8.2001 | 3.91 | 6 000 | 14 | 1570 | 3 | - | | 48 | 4 |
| | 3.10.2001 | 3.87 | 4 700 | 20 | 1740 | 5 | - | | 44 | 6 |
| 4 | 25.5.1999 | 3.99 | 41 000 | 4 | 1680 | 5 | - | | 49 | 5 |
| | 3.8.1999 | 4.61 | 0 | | 1600 | 3 | - | | 50 | 4 |
| | 5.10.1999 | 4.63 | 0 | | 1810 | 4 | - | | 54 | 4 |
| | 22.5.2000 | 4.31 | 10 600 | 9 | 1630 | 3 | - | | 46 | 4 |
| | 9.8.2000 | 4.29 | 0 | | 1620 | 4 | - | | 48 | 4 |
| | 18.10.2000 | 3.95 | 0 | | 1550 | 4 | - | | 48 | 4 |
| | 16.5.2001 | 3.86 | 5 700 | 14 | 1430 | 4 | - | | 37 | 5 |
| | 1.8.2001 | 4.07 | 0 | | 1350 | 3 | - | | 39 | 4 |
| | 3.10.2001 | 3.96 | 4 400 | 20 | 1570 | 3 | - | | 40 | 4 |

[a] in addition $^{134}Cs$: 1.63 (27)
0 = below the detection limit 4000 Bq
- = not analysed
* = analytical error included

**Table XIXa.** Continued.

| Sampling station | Date | Salinity ‰ | $^{3}H$ | | $^{40}K$ | | $^{90}Sr$* | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| R1 | 26.5.1999 | 3.66 | 0 | | 1310 | 3 | 12.4 | 6 | 37 | 4 |
| | 2.8.1999 | 5.08 | 0 | | 1810 | 3 | 14.1 | 5 | 44 | 4 |
| | 5.10.1999 | 4.67 | 0 | | 1760 | 4 | 11.6 | 6 | 54 | 4 |
| | 22.5.2000 | 4.32 | 0 | | 1530 | 4 | 10.6 | 5 | 43 | 4 |
| | 9.8.2000 | 4.43 | 0 | | 1540 | 3 | 12.5 | 8 | 46 | 3 |
| | 19.10.2000 | 4.41 | 0 | | 1600 | 4 | 14.0 | 5 | 45 | 4 |
| | 15.5.2001 | 3.72 | 0 | | 1480 | 4 | 13.5 | 5 | 37 | 5 |
| | 8.8.2001 | 4.44 | 0 | | 1680 | 3 | 11.7 | 10 | 44 | 4 |
| | 3.10.2001 | 3.96 | 0 | | 1630 | 4 | 14.4 | 5 | 44 | 4 |

[a] in addition $^{134}Cs$: 1.63 (27)
0 = below the detection limit 4000 Bq
- = not analysed
* = analytical error included

**Table XIXb.** $^{3}H$, $^{90}Sr$ and gamma-emitting radionuclides (Bq m$^{-3}$) in sea water samples at Olkiluoto in 1999–2001. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

| Sampling station | Date | Salinity ‰ | $^{3}H$ | | $^{40}K$ | | $^{90}Sr$* | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 11.3.1999 | 5.64 | 0 | | 2360 | 4 | 14.4 | 5 | 91 | 5 |
| | 19.5.1999 | 5.13 | 6 700 | 8 | 1940 | 3 | 17.9 | 6 | 76 | 3 |
| | 5.8.1999 | 5.73 | 0 | | 2000 | 3 | 15.4 | 5 | 87 | 3 |
| | 18.10.1999 | 5.47 | 0 | | 1990 | 3 | 12.7 | 5 | 78 | 3 |
| | 10.3.2000 | 5.29 | 0 | | 1960 | 4 | 12.5 | 6 | 71 | 4 |
| | 16.5.2000 | 5.05 | 16 100 | 7 | 1720 | 3 | 8.8 | 5 | 65 | 4 |
| | 3.8.2000 | 5.55 | 0 | | 2160 | 4 | 12.2 | 8 | 86 | 4 |
| | 18.10.2000 | 5.72 | 0 | | 2030 | 3 | 13.2 | 5 | 72 | 3 |
| | 9.3.2001 | 5.56 | 0 | | 1980 | 4 | 13.7 | 6 | 63 | 4 |
| | 13.5.2001 | 5.06 | 0 | | 2050 | 4 | 13.2 | 5 | 69 | 4 |
| | 7.8.2001 | 5.48 | 0 | | 2060 | 4 | 14.7 | 10 | 78 | 4 |
| | 23.10.2001 | 5.44 | 0 | | 2140 | 3 | 14.8 | 5 | 73 | 3 |
| 10 | 19.5.1999 | 5.21 | 0 | | 1990 | 3 | - | | 81 | 3 |
| | 5.8.1999 | 5.73 | 0 | | 2210 | 4 | - | | 91 | 4 |
| | 18.10.1999 | 5.45 | 0 | | 2010 | 4 | - | | 82 | 4 |
| | 16.5.2000 | 4.86 | 0 | | 1620 | 3 | - | | 62 | 3 |
| | 3.8.2000 | 5.53 | 0 | | 2080 | 3 | - | | 77 | 3 |
| | 18.10.2000 | 5.74 | 0 | | 2070 | 3 | - | | 73 | 3 |
| | 13.5.2001 | 5.05 | 0 | | 1840 | 4 | - | | 60 | 4 |
| | 7.8.2001 | 5.47 | 0 | | 1980 | 3 | - | | 74 | 4 |
| | 23.10.2000 | 5.43 | 0 | | 2410 | 4 | - | | 75 | 5 |

0 = below the detection limit 4000 Bq
- = not analysed
* = analytical error included

**Table XIXb.** Continued.

| Sampling station | Date | Salinity ‰ | $^{3}H$ | $^{40}K$ | | $^{90}Sr$* | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 19.5.1999 | 5.15 | 0 | 1820 | 3 | - | | 72 | 3 |
| | 5.8.1999 | 5.73 | 0 | 2180 | 3 | - | | 86 | 3 |
| | 18.10.1999 | 5.46 | 0 | 2280 | 4 | - | | 95 | 5 |
| | 16.5.2000 | 5.01 | 0 | 1840 | 3 | - | | 70 | 3 |
| | 3.8.2000 | 5.56 | 0 | 2010 | 3 | - | | 75 | 3 |
| | 18.10.2000 | 5.74 | 0 | 1960 | 3 | - | | 72 | 3 |
| | 13.5.2001 | 4.62 | 0 | 1900 | 4 | - | | 65 | 4 |
| | 7.8.2001 | 5.46 | 0 | 1920 | 4 | - | | 68 | 4 |
| | 23.10.2001 | 5.47 | 0 | 2310 | 4 | - | | 78 | 5 |
| 3 | 19.5.1999 | 4.98 | 0 | 2050 | 4 | - | | 82 | 4 |
| | 5.8.1999 | 5.71 | 0 | 2040 | 3 | - | | 81 | 3 |
| | 18.10.1999 | 5.36 | 0 | 1790 | 3 | - | | 71 | 3 |
| | 16.5.2000 | 3.99 | 0 | 1500 | 4 | - | | 57 | 5 |
| | 3.8.2000 | 5.51 | 0 | 1810 | 3 | - | | 72 | 3 |
| | 18.10.2000 | 5.73 | 0 | 1970 | 4 | - | | 70 | 4 |
| | 13.5.2001 | 5.03 | 0 | 1830 | 4 | - | | 59 | 5 |
| | 7.8.2001 | 5.46 | 0 | 1920 | 3 | - | | 69 | 4 |
| | 23.10.2001 | 5.27 | 0 | 2120 | 3 | - | | 63 | 4 |
| 15 | 19.5.1999 | 5.21 | 0 | 1910 | 3 | 14.3 | 6 | 77 | 3 |
| | 5.8.1999 | 5.71 | 0 | 2050 | 4 | 12.4 | 5 | 87 | 4 |
| | 18.10.1999 | 5.40 | 0 | 1870 | 3 | 12.7 | 5 | 77 | 3 |
| | 16.5.2000 | 5.02 | 0 | 1800 | 3 | 7.7 | 5 | 71 | 3 |
| | 3.8.2000 | 5.54 | 0 | 2080 | 4 | 13.3 | 8 | 82 | 3 |
| | 18.10.2000 | 5.57 | 0 | 2080 | 4 | 13.9 | 5 | 75 | 4 |
| | 13.5.2001 | 5.07 | 0 | 1630 | 4 | 13.6 | 5 | 57 | 4 |
| | 7.8.2001 | 5.46 | 0 | 2120 | 4 | 12.2 | 5 | 79 | 4 |
| | 23.10.2001 | 5.22 | 0 | 1910 | 3 | 14.0 | 5 | 62 | 4 |

0 = below the detection limit 4000 Bq
- = not analysed
* = analytical error included

**Table XXa.** $^{90}Sr$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Loviisa in 1999. Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| | Date | $^{40}K$ | | $^{54}Mn$ | | $^{58}Co$ | | $^{60}Co$ | | $^{90}Sr$ | | $^{110m}Ag$ | | $^{124}Sb$ | | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | $^{239,240}Pu$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | | | | | | | | | | | | |
| Loviisa A | 4.5. - 15.7.[a] | 500 | 3 | 0 | | 0 | | 4.9 | 8 | - | | 0 | | 0 | | 3.7 | 12 | 360 | 3 | - | - | |
| | 30.6. - 4.8. | 670 | 6 | 9.6 | 11 | 0 | | 8.5 | 9 | - | | 0 | | 0 | | 2.36 | 29 | 390 | 3 | - | - | |
| | 4.8. - 27.8. | 660 | 5 | 2.53 | 15 | 1.89 | 21 | 15.2 | 4 | - | | 12.8 | 3 | 8.0 | 14 | 3.9 | 10 | 370 | 3 | - | - | |
| | 27.8. - 6.10. | 500 | 6 | 4.4 | 11 | 4.5 | 12 | 7.8 | 6 | - | | 1.55 | 18 | 0 | | 2.46 | 18 | 350 | 5 | - | - | |
| *Cladophora glomerata* | | | | | | | | | | | | | | | | | | | | | | |
| Loviisa A | 29.6. | | 4 | 0.34 | 24 | 0 | | 1.73 | 5 | - | | 0 | | 0 | | 0.42 | 15 | 47 | 4 | - | - | |
| *Fucus vesiculosus* | | | | | | | | | | | | | | | | | | | | | | |
| Loviisa A | 19.5. | 810 | 3 | 1.97 | 4 | 0.25 | 14 | 6.9 | 3 | - | | 0.48 | 14 | 0 | | 0.84 | 6 | 87 | 3 | - | - | |
| | 10.8. | 840 | 3 | 0.86 | 9 | 0 | | 2.60 | 3 | 12.7 | 10 | 0.30 | 25 | 0 | | 0.48 | 10 | 52 | 3 | 0 | 0.118 | 12 |
| Loviisa B | 19.5. | 690 | 3 | 1.06 | 11 | 0 | | 5.3 | 3 | - | | 0.37 | 19 | 0 | | 0.66 | 12 | 66 | 3 | - | - | |
| | 10.8. | 710 | 4 | 0.43 | 17 | 0 | | 1.67 | 4 | - | | 0 | | 0 | | 0.44 | 13 | 43 | 3 | - | - | |
| Loviisa C | 19.5. | 490 | 4 | 0 | | 0 | | 0.20 | 21 | - | | 0 | | 0 | | 0.42 | 12 | 43 | 3 | - | - | |
| | 11.8. | 770 | 3 | 0 | | 0 | | 0 | | - | | 0 | | 0 | | 0.32 | 15 | 40 | 3 | - | - | |
| Loviisa D | 18.5. | 800 | 3 | 0 | | 0 | | 0 | | - | | 0 | | 0 | | 0.41 | 10 | 46 | 3 | - | - | |
| | 12.8. | 900 | 3 | 0 | | 0 | | 0 | | - | | 0 | | 0 | | 0.56 | 12 | 46 | 3 | - | - | |
| Loviisa E | 18.5. | 630 | 4 | 0 | | 0 | | 0 | | - | | 0 | | 0 | | 0.29 | 21 | 40 | 3 | - | - | |
| | 12.8. | 700 | 4 | 0 | | 0 | | 0 | | 9.3 | 10 | 0 | | 0 | | 0.35 | 9 | 34 | 3 | 0 | 0.065 | 15 |
| *Myriophyllum spicatus* | | | | | | | | | | | | | | | | | | | | | | |
| Loviisa A | 10.8. | 490 | 3 | 0.66 | 24 | 0 | | 2.12 | 6 | - | | 0 | | 0 | | 0 | | 18 | 3 | - | - | |
| *Potamogeton pectinatus* | | | | | | | | | | | | | | | | | | | | | | |
| Loviisa A | 10.8. | 670 | 3 | 0.38 | 29 | 0 | | 2.34 | 5 | - | | 0 | | 0 | | 0 | | 19.3 | 3 | - | - | |

0 = below the detection limit
- = not analysed
[a] = the collection plate had drifted 2 km to the east, see p. xx

**Table XXb.** $^{90}Sr$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Loviisa in 2000. Relative uncertainties (1σ) include both statistical and calibration uncertainty

| | Date | $^{40}K$ | $^{54}Mn$ | $^{58}Co$ | $^{60}Co$ | $^{90}Sr$ | $^{110m}Ag$ | $^{124}Sb$ | $^{134}Cs$ | $^{137}Cs$ | $^{238}Pu$ | $^{239,240}Pu$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | | |
| Loviisa A | 18.5. - 30.6. | 590 3 | 1.46 23 | 0 | 3.9 7 | - | 0 | 0 | 2.6 11 | 380 3 | - | - |
| | 30.6. - 27.7.[a] | 670 5 | 9.0 13 | 25.8 7 | 14.7 7 | - | 8.8 10 | 6.0 17 | 3.1 22 | 410 3 | - | - |
| | 27.7. - 30.8.[b] | 680 4 | 10.2 7 | 17.5 6 | 13.4 5 | - | 58 3 | 8.9 8 | 0 | 109 5 | - | - |
| | 30.8. - 28.9.[c] | 470 5 | 5.5 8 | 9.3 6 | 13.4 4 | - | 15.2 6 | 5.1 6 | 2.27 10 | 340 3 | - | - |
| *Cladophora glomerata* | | | | | | | | | | | | |
| Loviisa A | 30.6. | 1000 4 | 0 | 0 | 0.68 13 | - | 0 | 0 | 0 | 27.8 4 | - | - |
| *Fucus vesiculosus* | | | | | | | | | | | | |
| Loviisa A | 19.5. | 870 3 | 0.95 9 | 0 | 2.20 4 | - | 0.31 18 | 0 | 0.68 9 | 76 3 | - | - |
| | 16.8. | 800 4 | 0.82 22 | 1.69 11 | 2.40 6 | 11.7 7 | 4.6 4 | 0 | 0.30 30 | 49 5 | 0 | 0.078 15 |
| Loviisa B | 19.5. | 690 3 | 0.41 17 | 0 | 1.21 4 | - | 0 | 0 | 0.45 11 | 54 3 | - | - |
| | 16.8. | 700 4 | 0 | 0 | 0.76 8 | - | 1.57 4 | 0 | 0.27 20 | 37 3 | - | - |
| Loviisa C | 19.5. | 720 3 | 0 | 0 | 0 | - | 0 | 0 | 0.33 11 | 42 3 | - | - |
| | 15.8. | 810 4 | 0 | 0 | 0 | - | 0 | 0 | 0.29 14 | 38 3 | - | - |
| Loviisa D | 17.5. | 800 4 | 0 | 0 | 0 | - | 0 | 0 | 0.35 11 | 45 3 | - | - |
| | 15.8. | 950 3 | 0 | 0 | 0 | - | 0 | 0 | 0.21 22 | 38 2 | - | - |
| Loviisa E | 17.5. | 650 3 | 0 | 0 | 0 | - | 0 | 0 | 0.22 14 | 35 3 | - | - |
| | 15.8. | 850 3 | 0 | 0 | 0 | 7.9 7 | 0 | 0 | 0.28 19 | 37 3 | 0 | 0.078 18 |
| *Myriophyllum spicatum* | | | | | | | | | | | | |
| Loviisa A | 16.8.[d] | 490 3 | 3.0 7 | 6.5 5 | 6.1 3 | - | 16.8 3 | 2.4 15 | 0.35 24 | 24.2 3 | - | - |
| *Potamogeton pectinatus* | | | | | | | | | | | | |
| Loviisa A | 16.8. | 730 3 | 3.7 6 | 14.8 4 | 3.6 4 | - | 23.4 3 | 2.28 6 | 0 | 8.9 4 | - | - |

0 = below the detection limit
- = not analysed
[a] in addition $^{51}Cr$: 161 (9)
[b] in addition $^{95}Zr$: 5.0 (19), $^{95}Nb$: 9.6 (10), $^{123m}Te$: 1.10 (22)
[c] in addition: $^{95}Nb$: 3.4 (14)
[d] in addition: $^{123m}Te$: 0.53 (15)

**Table XXc**. $^{90}Sr$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Loviisa in 2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Date | $^{40}K$ | $^{54}Mn$ | $^{58}Co$ | $^{60}Co$ | $^{90}Sr$ | $^{110m}Ag$ | $^{134}Cs$ | $^{137}Cs$ | $^{238}Pu$ | $^{239,240}Pu$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | |
| Loviisa A | 3.5. - 4.7. | 420 6 | 0 | 0 | 3.2 12 | - | 0 | 0 | 252 3 | - | - |
| | 4.7. - 2.8. | 1020 4 | 0.99 23 | 0 | 1.23 13 | - | 0 | 0.82 22 | 106 4 | - | - |
| | 2.8. - 29.8. | 400 7 | 0 | 0 | 0 | - | 8.4 12 | 0 | 69 4 | - | - |
| | 29.8. - 4.10. | 750 8 | 1.15 17 | 0.56 27 | 2.35 8 | - | 2.10 8 | 1.10 14 | 199 3 | - | - |
| *Cladophora glomerata* | | | | | | | | | | | |
| Loviisa A | 5.7. | 980 3 | 0 | 0 | 0 | - | 0 | 0 | 12.9 4 | - | - |
| | 9.8. | 2490 8 | 0 | 0 | 0.94 29 | - | 0 | 0 | 17.0 4 | - | - |
| *Fucus vesiculosus* | | | | | | | | | | | |
| Loviisa A | 17.5. | 960 4 | 1.01 9 | 0 | 1.57 4 | - | 0.61 13 | 0.45 10 | 74 3 | - | - |
| | 9.8. | 870 4 | 0.68 26 | 0 | 0.92 13 | 8.5 | 0 | 0 | 43 5 | 0 | 0.081 13 |
| Loviisa B | 17.5. | 950 4 | 0.66 16 | 0 | 1.22 7 | - | 0.70 10 | 0.38 16 | 66 4 | - | - |
| | 9.8. | 820 8 | 0 | 0 | 1.00 15 | - | 0 | 0 | 42 4 | - | - |
| Loviisa C | 16.5. | 710 4 | 0 | 0 | 0 | - | 0 | 0 | 43 4 | - | - |
| | 9.8. | 740 4 | 0 | 0 | 0 | - | 0 | 0.18 25 | 35 3 | - | - |
| Loviisa D | 15.5. | 910 3 | 0 | 0 | 0 | - | 0 | 0.26 23 | 46 3 | - | - |
| | 10.8. | 830 3 | 0 | 0 | 0 | - | 0 | 0.24 15 | 37 3 | - | - |
| Loviisa E | 15.5. | 720 3 | 0 | 0 | 0 | - | 0 | 0.26 20 | 38 3 | - | - |
| | 10.8. | 770 4 | 0 | 0 | 0 | 7.7 | 0 | 0 | 33 5 | 0 | 0.055 15 |
| *Myriophyllum spicatum* | | | | | | | | | | | |
| Loviisa A | 9.8. | 700 3 | 0.74 20 | 0 | 0.74 14 | - | 0 | 0 | 12.5 4 | - | - |
| *Potamogeton pectinatus* | | | | | | | | | | | |
| Loviisa A | 9.8. | 750 3 | 0.57 24 | 0 | 1.09 10 | - | 0 | 0 | 8.7 3 | - | - |

0 = below the detection limit
- = not analysed

**Table XXIa.** $^{90}$Sr, $^{239,240}$Pu and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Olkiluoto in 1999. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Date | $^{40}$K | | $^{54}$Mn | | $^{58}$Co | | $^{60}$Co | | $^{90}$Sr | | $^{134}$Cs | | $^{137}$Cs | | $^{238}$Pu | $^{239,240}$Pu | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | | | | | | | | |
| Olkiluoto A[a] | 27.4. - 1.7. | 650 | 5 | 3.1 | 11 | 0 | | 36 | 3 | - | | 5.5 | 7 | 540 | 3 | - | - | |
| | 1.7. - 28.7. | 590 | 4 | 1.93 | 20 | 0 | | 54 | 3 | - | | 4.4 | 11 | 410 | 4 | - | - | |
| | 27.7. - 29.9. | 580 | 5 | 1.60 | 21 | 0 | | 32 | 3 | - | | 3.4 | 9 | 350 | 3 | - | - | |
| | 27.7. - 1.9. | 800 | 8 | 0 | | 0 | | 14.0 | 5 | - | | 1.86 | 15 | 217 | 3 | - | - | |
| *Cladophora glomerata* | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 29.6. | 1210 | 4 | 0 | | 0 | | 2.20 | 6 | - | | 0.62 | 18 | 49 | 4 | - | - | |
| *Fucus vesiculosus* | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 11.5. | 710 | 3 | 0.80 | 14 | 1.16 | 11 | 5.6 | 3 | - | | 0.77 | 11 | 62 | 3 | - | - | |
| | 31.8. | 700 | 3 | 0.43 | 24 | 0 | | 5.2 | 3 | 10.7 | 10 | 0.48 | 17 | 54 | 3 | 0 | 0.074 | 15 |
| Olkiluoto B | 11.5. | 610 | 4 | 0.56 | 11 | 0.35 | 11 | 3.4 | 3 | - | | 0.52 | 7 | 60 | 3 | - | - | |
| | 31.8. | 630 | 4 | 0.27 | 29 | 0 | | 1.75 | 4 | - | | 0.53 | 11 | 46 | 4 | - | - | |
| Olkiluoto C | 11.5. | 670 | 3 | 0 | | 0 | | 0.72 | 6 | - | | 0.42 | 9 | 42 | 3 | - | - | |
| | 31.8. | 700 | 3 | 0 | | 0 | | 0.79 | 9 | 11.9 | 10 | 0.32 | 21 | 40 | 3 | 0 | 0.079 | 15 |
| Olkiluoto D | 11.5. | 580 | 3 | 0 | | 0 | | 0.76 | 8 | - | | 0.45 | 11 | 35 | 3 | - | - | |
| | 1.9. | 730 | 4 | 0 | | 0 | | 0.65 | 8 | - | | 0.46 | 14 | 38 | 3 | - | - | |
| Olkiluoto E | 11.5. | 630 | 4 | 0 | | 0 | | 1.79 | 7 | - | | 0.35 | 24 | 41 | 4 | - | - | |
| | 1.9. | 710 | 4 | 0 | | 0 | | 1.62 | 6 | - | | 0.39 | 23 | 40 | 4 | - | - | |
| *Myriophyllum spicatum* | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 1.9. | 680 | 4 | 2.25 | 7 | 1.01 | 13 | 17.5 | 3 | - | | 0.57 | 17 | 62 | 3 | - | - | |
| *Potamogeton pectinatus* | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 1.9. | 620 | 3 | 0.54 | 19 | 0 | | 3.9 | 4 | - | | 0 | | 17.2 | 3 | - | - | |

[a] = just in front of the cooling water outlet
0 = below the detection limit
- = not analysed

**Table XXIb.** $^{90}Sr$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Olkiluoto in 2000. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Date | $^{40}K$ | | $^{54}Mn$ | | $^{58}Co$ | | $^{60}Co$ | | $^{90}Sr$ | | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | | $^{239,240}Pu$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | | | | | | | | | |
| Olkiluoto A[a] | 26.4. - 5.7. | 700 | 3 | 2.91 | 12 | 0 | | 39 | 3 | - | | 4.0 | 8 | 540 | 3 | - | | - | |
| | 5.7. - 3.8. | 370 | 6 | 1.70 | 28 | 0 | | 10.9 | 6 | - | | 0 | | 216 | 3 | - | | - | |
| | 3.8. - 6.9. | 590 | 6 | 0 | | 0 | | 14.9 | 6 | - | | 0 | | 350 | 3 | - | | - | |
| | 6.9. - 5.10. | 650 | 5 | 2.37 | 16 | 0 | | 12.1 | 4 | - | | 2.22 | 16 | 320 | 3 | - | | - | |
| *Cladophora glomerata* | | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 7.7. | 1580 | 4 | 0 | | 0 | | 0 | | - | | 0 | | 39 | 5 | - | | - | |
| *Fucus vesiculosus* | | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 11.5. | 780 | 4 | 1.22 | 12 | 0 | | 3.5 | 4 | - | | 0.52 | 24 | 69 | 4 | - | | - | |
| | 4.9. | 700 | 4 | 0.47 | 30 | 0.36 | 27 | 6.6 | 3 | 12.4 | 7 | 0.43 | 20 | 66 | 4 | 0 | | 0.140 | 12 |
| Olkiluoto B | 11.5. | 700 | 3 | 0.262 | 19 | 0 | | 2.50 | 3 | - | | 0.44 | 9 | 63 | 3 | - | | - | |
| | 4.9. | 560 | 4 | 0.252 | 27 | 0 | | 2.04 | 4 | - | | 0.16 | 26 | 39 | 3 | - | | - | |
| Olkiluoto C | 9.5. | 740 | 4 | 0 | | 0 | | 0.44 | 11 | - | | 0.45 | 12 | 47 | 4 | - | | - | |
| | 5.9. | 710 | 4 | 0 | | 0 | | 0.38 | 11 | 6.4 | 7 | 0.29 | 17 | 40 | 3 | 0 | | 0.053 | 22 |
| Olkiluoto D | 10.5. | 640 | 3 | 0 | | 0 | | 0.69 | 6 | - | | 0.35 | 10 | 39 | 3 | - | | - | |
| | 6.9. | 660 | 3 | 0 | | 0 | | 0.71 | 9 | - | | 0 | | 32 | 4 | - | | - | |
| Olkiluoto E | 10.5. | 550 | 2 | 0 | | 0 | | 1.01 | 4 | - | | 0.24 | 14 | 38 | 3 | - | | - | |
| | 6.9. | 700 | 3 | 0 | | 0 | | 0.75 | 8 | - | | 0.23 | 24 | 36 | 4 | - | | - | |
| *Myriophyllum spicatum* | | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 4.9. | 530 | 4 | 1.93 | 14 | 0.88 | 25 | 8.7 | 4 | - | | 0 | | 31 | 5 | - | | - | |
| *Potamogeton pectinatus* | | | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 4.9. | 560 | 4 | 0.38 | 19 | 0.36 | 17 | 4.5 | 3 | - | | 0.17 | 27 | 35 | 3 | - | | - | |

[a] = just in front of the cooling water outlet
0 = below the detection limit
- = not analysed

**Table XXIc.** $^{90}Sr$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq $kg^{-1}$ dry weight) in aquatic plants in the sampling areas A-E at Olkiluoto in 2001. Relative uncertainties ($1\sigma$) include both statistical and calibration uncertainty.

| | Date | $^{40}K$ | | $^{54}Mn$ | | $^{60}Co$ | | $^{90}Sr$ | | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | | $^{239,240}Pu$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Periphyton* | | | | | | | | | | | | | | | | | |
| Olkiluoto A[a] | 26.4. - 26.6. | 600 | 5 | 0 | | 19.2 | 6 | - | | 0 | | 420 | 5 | - | | - | |
| | 26.6. - 25.7. | 380 | 8 | 0 | | 10.9 | 7 | - | | 0 | | 276 | 3 | - | | - | |
| | 25.7. - 22.8. | 960 | 4 | 0 | | 3.5 | 5 | - | | 0 | | 69 | 4 | - | | - | |
| | 22.8. - 25.9. | 650 | 4 | 0.58 | 23 | 6.1 | 3 | - | | 0.93 | 15 | 168 | 4 | - | | - | |
| *Cladophora glomerata* | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 26.7. | 1770 | 4 | 0 | | 3.5 | 8 | - | | 0 | | 59 | 5 | - | | - | |
| *Fucus vesiculosus* | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 9.5. | 810 | 3 | 0.47 | 24 | 5.8 | 3 | - | | 0.47 | 16 | 53 | 3 | - | | - | |
| | 5.9. | 820 | 5 | 0 | | 4.8 | 5 | 9.1 | 5 | 0.16 | 25 | 56 | 5 | 0 | | 0.063 | 17 |
| Olkiluoto B | 9.5. | 700 | 4 | 0.22 | 24 | 2.15 | 3 | - | | 0.38 | 10 | 51 | 3 | - | | - | |
| | 5.9. | 700 | 4 | 0 | | 1.65 | 8 | - | | 0 | | 40 | 5 | - | | - | |
| Olkiluoto C | 8.5. | 730 | 3 | 0 | | 0.34 | 17 | - | | 0.33 | 16 | 39 | 4 | - | | - | |
| | 6.9. | 880 | 3 | 0 | | 0.36 | 21 | 8.6 | 5 | 0.22 | 21 | 40 | 3 | 0 | | 0.052 | 25 |
| Olkiluoto D | 8.5. | 710 | 4 | 0 | | 0.42 | 11 | - | | 0.31 | 16 | 34 | 3 | - | | - | |
| | 6.9. | 940 | 4 | 0 | | 0 | | - | | 0 | | 43 | 5 | - | | - | |
| Olkiluoto E | 8.5. | 720 | 4 | 0 | | 0.60 | 12 | - | | 0.33 | 24 | 39 | 4 | - | | - | |
| | 6.9. | 820 | 4 | 0 | | 0.63 | 11 | - | | 0.21 | 23 | 38 | 3 | - | | - | |
| *Myriophyllum spicatum* | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 5.9. | 600 | 8 | 0 | | 8.5 | 6 | - | | 0 | | 24.3 | 4 | - | | - | |
| *Potamogeton pectinatus* | | | | | | | | | | | | | | | | | |
| Olkiluoto A | 5.9. | 630 | 3 | 0 | | 1.83 | 5 | - | | 0 | | 24.7 | 4 | - | | - | |

[a] = just in front of the cooling water outlet
0 = below the detection limit
- = not analysed

**Table XXII.** The concentrations of $^{90}Sr$ and gamma-emitting nuclides (Bq $kg^{-1}$ dry weight) in a benthic crustacean at Loviisa and two benthic bivalves at Olkiluoto in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Date | $^{40}K$ | | $^{54}Mn$ | | $^{60}Co$ | | $^{89}Sr$* | | $^{90}Sr$* | | $^{110m}Ag$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Saduria entomon* | | | | | | | | | | | | | | |
| Loviisa 3 | | | | | | | | | | | | | | |
| 5.5.-27.5.1999 | 253 | 4 | 0 | | 1.22 | 15 | 0 | | 15.3 | 5 | 1.31 | 20 | 26.0 | 4 |
| 5.5.-31.5.2000 | 226 | 5 | 0 | | 0.70 | 14 | 3.0 | 8 | 15.4 | 5 | 0.46 | 21 | 24.8 | 3 |
| 4.5.-29.5.2001 | 234 | 5 | 0 | | 0 | | 0 | | 19.2 | 20 | 1.76 | 12 | 21.8 | 4 |
| *Macoma baltica* | | | | | | | | | | | | | | |
| Olkiluoto 9 | | | | | | | | | | | | | | |
| 30.6.1999 | 70 | 8 | 0 | | 1.32 | 13 | - | | - | | 0 | | 12.0 | 6 |
| 30.6.1999 | 76 | 6 | 0 | | 1.18 | 12 | 0 | | 19.2 | 7 | 0 | | 11.1 | 4 |
| 4.7.2000 | 57 | 7 | 0 | | 1.21 | 11 | 0 | | 18.2 | 6 | 0 | | 12.0 | 4 |
| 24.7.2001 | 65 | 8 | 0 | | 0.50 | 24 | - | | 17.4 | 10 | 0 | | 10.5 | 4 |
| *Mytilus edulis* | | | | | | | | | | | | | | |
| Olkiluoto A | | | | | | | | | | | | | | |
| 29.6.1999 | 59 | 6 | 1.21 | 16 | 7.9 | 3 | - | | - | | 0 | | 3.8 | 7 |
| 2.7.1999 | 54 | 5 | 1.31 | 9 | 7.6 | 9 | - | | - | | 0 | | 3.6 | 5 |
| 7.7.2000 | 57 | 10 | 0 | | 4.9 | 7 | - | | - | | 0 | | 3.4 | 10 |
| 26.7.2001 | 54 | 9 | 0 | | 1.69 | 11 | - | | - | | 0 | | 4.5 | 7 |

* = analytical error included
0 = below the detection limit
\- = not analysed

**Table XXIII.** Gamma-emitting radionuclides and $^{90}$Sr in edible parts of fish caught in the vicinity of the Loviisa power plant in 1999–2001 (Bq kg$^{-1}$ fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Species | Date | $^{40}$K | | $^{90}$Sr* | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|
| **Perch**[a] | | | | | | | | | |
| *Perca fluviatilis* | | | | | | | | | |
| Area I | | | | | | | | | |
| 1999 | 1.5. - 31.5. | 95 | 5 | - | | 0.34 | 8 | 30.0 | 5 |
| | 1.9. - 30.9. | 107 | 3 | 0.164 | 10 | 0.166 | 9 | 20.2 | 3 |
| 2000 | 1.5. - 31.5. | 108 | 3 | - | | 0.177 | 10 | 25.0 | 3 |
| | 1.9. - 30.9. | 97 | 6 | 0.150 | 8 | 0.124 | 15 | 20.3 | 5 |
| 2001 | 27.5. - 31.5. | 103 | 3 | - | | 0 | | 25.3 | 4 |
| | 25.9. - 7.10. | 109 | 4 | 0.170 | 7 | 0.093 | 13 | 21.8 | 3 |
| Area II | | | | | | | | | |
| 1999 | 1.5. - 31.5. | 95 | 3 | - | | 0.263 | 10 | 32 | 4 |
| | 1.9. - 30.9. | 92 | 4 | - | | 0.081 | 16 | 8.7 | 3 |
| 2000 | 1.5. - 31.5. | 103 | 3 | - | | 0.182 | 10 | 28.3 | 3 |
| | 1.9. - 30.9. | 109 | 3 | - | | 0.148 | 14 | 23.3 | 4 |
| 2001 | 27.5. - 31.5. | 92 | 4 | - | | 0.149 | 10 | 23.8 | 3 |
| | 25.9. - 7.10. | 99 | 3 | 0.41 | 6 | 0.119 | 21 | 21.9 | 4 |
| **Pike**[b] | | | | | | | | | |
| *Esox lucius* | | | | | | | | | |
| Area I | | | | | | | | | |
| 1999 | 1.5. - 31.5. | 120 | 4 | - | | 0.133 | 8 | 17.4 | 4 |
| | 1.9. - 30.9. | 121 | 3 | - | | 0.185 | 8 | 20.7 | 3 |
| 2000 | 1.5. - 31.5. | 110 | 3 | - | | 0.161 | 11 | 18.7 | 4 |
| | 1.9. - 30.9. | 119 | 5 | - | | 0.122 | 17 | 16.4 | 5 |
| 2001 | 27.5. - 31.5. | 111 | 4 | - | | 0.199 | 6 | 32 | 3 |
| | 25.9. - 7.10. | 123 | 3 | - | | 0.066 | 15 | 16.7 | 4 |
| Area II | | | | | | | | | |
| 1999 | 1.5. - 31.5. | 120 | 4 | - | | 0.202 | 7 | 20.1 | 3 |
| | 1.9. - 30.9. | 115 | 4 | - | | 0.196 | 5 | 20.3 | 3 |
| 2000 | 1.5. - 31.5. | 119 | 3 | - | | 0.120 | 9 | 22.2 | 3 |
| | 1.9. - 30.9. | 125 | 3 | - | | 0.109 | 12 | 19.6 | 5 |
| 2001 | 27.5. - 31.5. | 122 | 6 | - | | 0 | | 17.3 | 5 |
| | 25.9. - 7.10. | 122 | 5 | - | | 0 | | 14.3 | 5 |

[a] flesh and bones analysed
[b] only flesh analysed
* = analytical error included
0 = below the detection limit
- = not analysed

**Table XXIII.** Continued.

| Species | Date | | | $^{40}$K | | $^{90}$Sr* | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Baltic herring**[a] | | | | | | | | | | | |
| *Clupea harengus membras* | | | | | | | | | | | |
| Area I | | | | | | | | | | | |
| 1999 | 1.5. | - | 31.5. | 108 | 3 | - | | 0.095 | 15 | 7.5 | 4 |
| | 1.9. | - | 30.9. | 124 | 3 | 0.039 | 15 | 0.068 | 9 | 7.8 | 3 |
| 2000 | 1.5. | - | 31.5. | 111 | 4 | - | | 0.063 | 15 | 7.0 | 5 |
| | 1.9. | - | 30.9. | 112 | 3 | 0.054 | 8 | 0.056 | 18 | 7.8 | 4 |
| 2001 | 27.5. | - | 31.5. | 110 | 3 | - | | 0 | | 6.9 | 4 |
| | 25.9. | - | 7.10. | 103 | 4 | 0.041 | 9 | 0 | | 6.3 | 5 |
| Area II | | | | | | | | | | | |
| 1999 | 1.5. | - | 31.5. | 98 | 3 | - | | 0.065 | 16 | 6.9 | 3 |
| | 1.9. | - | 30.9. | 126 | 6 | - | | 0.045 | 17 | 7.5 | 5 |
| 2000 | 1,5, | - | 31.5. | 106 | 5 | - | | 0.051 | 27 | 7.0 | 5 |
| | 1.9. | - | 30.9. | 117 | 3 | - | | 0.033 | 22 | 7.8 | 5 |
| 2001 | 27.5. | - | 31.7. | 105 | 5 | - | | 0 | | 6.4 | 5 |
| | 25.9. | - | 7.10. | 117 | 4 | 0.036 | 9 | 0.036 | 9 | 6.4 | 5 |
| **Roach**[a] | | | | | | | | | | | |
| *Rutilus rutilus* | | | | | | | | | | | |
| Area I | | | | | | | | | | | |
| 1999 | 1.5. | - | 31.5. | 101 | 3 | - | | 0.090 | 14 | 7.2 | 3 |
| | 1.9. | - | 30.9. | 105 | 3 | - | | 0.055 | 19 | 5.7 | 3 |
| 2000 | 1.5. | - | 31.5. | 106 | 3 | - | | 0.029 | 24 | 6.9 | 4 |
| | 1.9. | - | 30.9. | 105 | 4 | - | | 0 | | 4.9 | 5 |
| 2001 | 27.5. | - | 31.5. | 101 | 4 | - | | 0.028 | 22 | 4.6 | 3 |
| | 25.9. | - | 7.10. | 94 | 3 | - | | 0 | | 4.9 | 5 |
| Area II | | | | | | | | | | | |
| 1999 | 1.5. | - | 31.5. | 96 | 4 | - | | 0.094 | 18 | 7.8 | 5 |
| | 1.9. | - | 30.9. | 104 | 4 | - | | 0.069 | 13 | 6.3 | 3 |
| 2000 | 1.5. | - | 31.5. | 108 | 3 | - | | 0 | | 6.9 | 3 |
| | 1.9. | - | 30.9. | 107 | 3 | - | | 0.067 | 28 | 6.1 | 4 |

[a] flesh and bones analysed
[b] only flesh analysed
* = analytical error included
0 = below the detection limit
\- = not analysed

**Table XXIII.** Continued.

| Species Date | $^{40}K$ | | $^{90}Sr$* | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|
| **Bream** | | | | | | | |
| *Abramis brama* | | | | | | | |
| Area II | | | | | | | |
| 2001 27.5. - 31.5. | 103 | 4 | - | 0.029 | 30 | 6.0 | 3 |
| 25.9. - 7.10. | 101 | 4 | - | 0 | | 4.7 | 5 |
| | | | | | | | |
| **Ide** | | | | | | | |
| *Leuciscus idus* | | | | | | | |
| Area II | | | | | | | |
| 2001 27.5. - 31.5. | 94 | 4 | - | 0 | | 8.3 | 5 |

[a] flesh and bones analysed
[b] only flesh analysed
* = analytical error included
0 = below the detection limit
- = not analysed

**Table XXIV.** Gamma-emitting radionuclides and $^{90}Sr$ in edible parts of fish caught in the vicinity of the Olkiluoto power plant in 1999–2001 (Bq $kg^{-1}$ fresh weight). Relative uncertainties ($1\sigma$) include both statistical and calibration uncertainty.

| Species | Date | $^{40}K$ | | $^{60}Co$ | | $^{90}Sr$* | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Perch**[a] | | | | | | | | | | | |
| *Perca fluviatilis* | | | | | | | | | | | |
| Area I | | | | | | | | | | | |
| 1999 | 28.4. - 5.5. | 91 | 4 | 0 | | - | | 0.41 | 7 | 43 | 3 |
| | 10.9. - 21.10. | 99 | 4 | 0 | | 0.51 | 10 | 0.34 | 7 | 37 | 3 |
| 2000 | 9.5. - 20.5. | 100 | 6 | 0 | | - | | 0.33 | 14 | 47 | 5 |
| | 5.9. - 22.9. | 80 | 4 | 0 | | 0.37 | 8 | 0.236 | 9 | 33 | 5 |
| 2001 | 9.5. - 30.5. | 102 | 3 | 0 | | - | | 0.234 | 12 | 41 | 5 |
| | 18.9. - 30.10. | 98 | 4 | 0 | | 0.39 | 7 | 0.153 | 13 | 34 | 3 |
| Area II | | | | | | | | | | | |
| 1999 | 6.5. - 12.5. | 93 | 5 | 0 | | - | | 0.37 | 8 | 40 | 5 |
| | 12.9. - 21.10. | 111 | 3 | 0.122 | 13 | - | | 0.33 | 7 | 44 | 3 |
| 2000 | 13.5. - 17.5. | 100 | 3 | 0 | | - | | 0.258 | 13 | 41 | 4 |
| | 7.9. - 28.9. | 81 | 4 | 0 | | - | | 0.179 | 9 | 30 | 5 |
| 2001 | 9.5. - 30.5. | 104 | 3 | 0 | | - | | 0.242 | 13 | 44 | 4 |
| | 24.9. - 26.10. | 107 | 3 | 0 | | 0.20 | 6 | 0.140 | 13 | 34 | 5 |
| **Pike**[b] | | | | | | | | | | | |
| *Esox lucius* | | | | | | | | | | | |
| Area I | | | | | | | | | | | |
| 1999 | 28.4. - 5.5. | 112 | 3 | 0 | | - | | 0.243 | 7 | 22.8 | 4 |
| | 10.9. - 21.10. | 123 | 6 | 0 | | - | | 0.247 | 7 | 26.5 | 5 |
| 2000 | 9.5. - 20.5. | 113 | 2 | 0 | | - | | 0.149 | 6 | 25.2 | 2 |
| | 5.9. - 22.9. | 111 | 5 | 0 | | - | | 0.141 | 11 | 21.2 | 5 |
| 2001 | 9.5. - 30.5. | 118 | 3 | 0 | | - | | 0.152 | 12 | 29.0 | 4 |
| | 18.9. - 30.10. | 107 | 4 | 0 | | - | | 0.110 | 11 | 31 | 4 |
| Area II | | | | | | | | | | | |
| 1999 | 6.5. - 12.5. | 112 | 5 | 0 | | - | | 0.223 | 13 | 26.8 | 5 |
| | 12.9. - 21.10. | 119 | 3 | 0 | | - | | 0.219 | 6 | 31 | 3 |
| 2000 | 13.5. - 17.5. | 112 | 5 | 0 | | - | | 0.250 | 8 | 33 | 5 |
| | 7.9. - 28.9. | 115 | 3 | 0 | | - | | 0.166 | 7 | 25.7 | 4 |
| 2001 | 9.5. - 30.5. | 117 | 4 | 0 | | - | | 0.182 | 6 | 41 | 3 |
| | 24.9. - 26.10. | 113 | 5 | 0 | | - | | 0.107 | 16 | 21.4 | 5 |

[a] flesh and bones analysed
[b] only flesh analysed
* = analytical error included
0 = below the detection limit
- = not analysed

**Table XXIV.** Continued.

| Species | Date | $^{40}$K | | $^{60}$Co | $^{90}$Sr* | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Baltic herring** | | | | | | | | | | |
| *Clupea harengus membras* | | | | | | | | | | |
| Area I | | | | | | | | | | |
| 1999 | 28.4. - 5.5. | 104 | 5 | 0 | - | | 0.108 | 15 | 10.5 | 5 |
| | 10.9. - 21.10. | 123 | 6 | 0 | 0.040 | 15 | 0.122 | 7 | 14.9 | 5 |
| 2000 | 27.5. - 28.5. | 128 | 2 | 0 | - | | 0.089 | 13 | 11.6 | 3 |
| | 1.10. - 2.10. | 127 | 3 | 0 | 0.045 | 8 | 0.075 | 12 | 13.8 | 5 |
| 2001 | 9.5. - 30.5. | 123 | 4 | 0 | - | | 0.046 | 15 | 10.4 | 3 |
| | 18.9. - 30.10. | 119 | 4 | 0 | 0.043 | 9 | 0.047 | 20 | 12.0 | 5 |
| Area II | | | | | | | | | | |
| 1999 | 6.5. - 12.5. | 114 | 4 | 0 | - | | 0.116 | 9 | 12.3 | 3 |
| | 12.9. - 21.10. | 118 | 3 | 0 | - | | 0.106 | 8 | 14.0 | 3 |
| 2000 | 13.5. - 17.5. | 120 | 3 | 0 | - | | 0.060 | 18 | 11.2 | 3 |
| | 7.9. - 28.9. | 126 | 3 | 0 | - | | 0.076 | 9 | 12.7 | 5 |
| 2001 | 9.5. - 30.5. | 100 | 4 | 0 | - | | 0.057 | 23 | 8.0 | 5 |
| | 24.9. - 26.10. | 128 | 3 | 0 | 0.031 | 9 | 0.060 | 20 | 12.3 | 4 |
| **Roach** | | | | | | | | | | |
| *Rutilus rutilus* | | | | | | | | | | |
| Area I | | | | | | | | | | |
| 1999 | 28.4. - 5.5. | 95 | 3 | 0 | - | | 0.084 | 16 | 10.5 | 3 |
| | 10.9. - 21.10. | 105 | 3 | 0 | - | | 0.082 | 18 | 9.9 | 3 |
| 2000 | 9.5. - 20.5. | 111 | 3 | 0 | - | | 0.060 | 17 | 11.1 | 4 |
| | 5.9. - 22.9. | 100 | 4 | 0 | - | | 0.062 | 26 | 7.3 | 5 |
| 2001 | 9.5. - 30.5. | 97 | 3 | 0 | - | | 0.055 | 27 | 7.6 | 4 |
| | 18.9. - 30.10. | 103 | 6 | 0 | - | | 0 | | 8.0 | 5 |
| Area II | | | | | | | | | | |
| 1999 | 6.5. - 12.5. | 97 | 4 | 0 | - | | 0.102 | 14 | 12.5 | 5 |
| | 12.9. - 21.10. | 123 | 3 | 0 | - | | 0.231 | 9 | 27.7 | 3 |
| 2000 | 13.5. - 17.5. | 103 | 5 | 0 | - | | 0 | | 9.2 | 5 |
| | 5.11. - 6.11. | 86 | 6 | 0 | - | | 0 | | 7.0 | 5 |
| 2001 | 9.5. - 30.5. | 98 | 6 | 0 | - | | 0 | | 7.0 | 5 |
| **Bream** | | | | | | | | | | |
| *Abramis brama* | | | | | | | | | | |
| Area II | | | | | | | | | | |
| 2001 | 24.9. - 26.10 | 96 | 6 | 0 | - | | 0 | | 5.7 | |

[a] flesh and bones analysed
[b] only flesh analysed
* = analytical error included
0 = below the detection limit
- = not analysed

**Table XXV.** Gamma-emitting radionuclides in young salmon (*Oncorhynchus mykiss*) from the Loviisa Fish Farm in 1999–2001 (Bq $kg^{-1}$ fresh weight). Relative uncertainties include (1σ) both statistical and calibration uncertainty.

| Date | $^{40}K$ | | $^{137}Cs$ | |
|---|---|---|---|---|
| 4.1.1999 | 98 | 4 | 0.41 | 8 |
| 1.2.1999 | 104 | 4 | 0.49 | 8 |
| 1.3.1999 | 99 | 3 | 0.85 | 6 |
| 6.4.1999 | 106 | 4 | 1.14 | 5 |
| 4.5.1999 | 109 | 4 | 1.18 | 5 |
| 1.6.1999 | 96 | 4 | 0.40 | 8 |
| 29.11.1999 | 96 | 3 | 0.249 | 21 |
| 3.1.2000 | 103 | 5 | 0.34 | 18 |
| 1.2.2000 | 110 | 4 | 0.31 | 11 |
| 6.3.2000 | 114 | 4 | 0.233 | 14 |
| 3.4.2000 | 117 | 4 | 0.40 | 9 |
| 18.4.2000 | 110 | 3 | 1.01 | 5 |
| 20.4.2000 | 108 | 2 | 0.34 | 11 |
| 7.5.2000 | 114 | 4 | 0.41 | 9 |
| 5.6.2000 | 113 | 4 | 0.48 | 14 |
| 4.12.2000 | 115 | 4 | 0.206 | 23 |
| 2.1.2001 | 104 | 3 | 0.245 | 18 |
| 5.2.2001 | 107 | 4 | 0.194 | 20 |
| 5.3.2001 | 103 | 3 | 0.230 | 15 |
| 28.3.2001 | 115 | 4 | 0.32 | 11 |
| 3.4.2001 | 124 | 4 | 0.44 | 13 |
| 2.5.2001 | 115 | 4 | 0.48 | 12 |
| 4.6.2001 | 123 | 4 | 0.32 | 17 |
| 3.12.2001 | 89 | 3 | 0.25 | 14 |

**Table XXVIa.** Gamma-emitting radionuclides in sinking matter (Bq kg$^{-1}$ dry weight) in the vicinity of Loviisa nuclear power plant in 1999–2001. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| | Sampling depth m | Dry weight g | $^{40}$K | $^{54}$Mn | $^{58}$Co | $^{60}$Co | $^{110m}$Ag | $^{134}$Cs | $^{137}$Cs |
|---|---|---|---|---|---|---|---|---|---|
| **Loviisa 1** | 8 | | | | | | | | |
| 4.11.1998 - 20.5.1999 | | 27.0 | 860 4 | 0 | 0 | 8.4 4 | 0 | 10.6 5 | 950 3 |
| 4.5.1999 - 30.6.1999 | | 90.7 | 760 7 | 0 | 0 | 0 | 0 | 10.2 15 | 800 5 |
| 30.6.1999 - 24.8.1999 | | 26.9 | 820 3 | 0 | 0 | 4.0 12 | 0 | 7.9 9 | 850 3 |
| 24.8.1999 - 10.11.1999 | | 61.6 | 740 5 | 0 | 0 | 4.5 11 | 0 | 5.8 12 | 890 3 |
| 10.11.1999 - 4.5.2000 | | 38.6 | 810 5 | 0 | 0 | 4.7 9 | 0 | 7.6 10 | 900 3 |
| 4.5.2000 - 29.6.2000 | | 13.2 | 770 3 | 0 | 0 | 2.15 20 | 0 | 7.6 10 | 850 3 |
| 29.6.2000 - 30.8.2000 | | 28.1 | 790 4 | 0 | 0 | 3.7 9 | 4.0 9 | 5.0 9 | 790 4 |
| 30.8.2000 - 22.11.2000 | | 66.8 | 830 4 | 0 | 0 | 4.3 8 | 0 | 5.1 10 | 830 4 |
| 22.11.2000 - 3.5.2001 | | 30.7 | 790 5 | 0 | 0 | 2.11 15 | 0 | 4.9 12 | 820 3 |
| 3.5.2001 - 4.7.2001 | | 11.6 | 720 5 | 0 | 0 | 2.45 15 | 0 | 3.6 14 | 730 3 |
| 4.7.2001 - 29.8.2001 | | 23.7 | 840 5 | 0 | 0 | 2.62 14 | 0 | 4.2 15 | 760 3 |
| 29.8.2001 - 31.10.2001 | | 46.2 | 810 3 | 0 | 0 | 3.0 11 | 0 | 2.21 16 | 760 4 |

0 = below the detection limit
- = not analysed

**Table XXVIa**. Continued.

| | Sampling depth m | Dry weight g | $^{40}K$ | $^{54}Mn$ | $^{58}Co$ | $^{60}Co$ | $^{110m}Ag$ | $^{134}Cs$ | $^{137}Cs$ |
|---|---|---|---|---|---|---|---|---|---|
| **Loviisa 3** | 17 | | | | | | | | |
| - 4.5.1999 | | | - | - | - | - | - | - | - |
| 4.5.1999 - 30.6.1999 | | 13.0 | 640 7 | 0 | 0 | 0 | 0 | 7.4 19 | 520 5 |
| 30.6.1999 - 24.8.1999 | | 9.6 | 670 8 | 0 | 0 | 6.1 17 | 0 | 8.3 19 | 620 5 |
| 24.8.1999 - 10.11.1999 | | 23.2 | 730 4 | 0 | 0 | 9.6 7 | 0 | 5.0 13 | 670 3 |
| 10.11.1999 - 4.5.2000 | | 38.4 | 820 5 | 0 | 0 | 7.6 6 | 0 | 7.6 10 | 870 3 |
| 4.5.2000 - 29.6.2000 | | 28.6 | 750 5 | 0 | 0 | 5.2 7 | 0 | 4.0 12 | 670 3 |
| 29.6.2000 - 30.8.2000 | | 11.8 | 720 5 | 1.3 29 | 1.5 28 | 7.1 6 | 7.2 5 | 3.3 13 | 550 3 |
| 30.8.2000 - 22.11.2000 | | 29.3 | 750 6 | 0 | 0 | 5.1 9 | 2.89 14 | 3.8 13 | 650 5 |
| 22.11.2000 - 3.5.2001 | | 26.3 | 820 5 | 0 | 0 | 5.9 7 | 4.6 19 | 5.6 9 | 820 3 |
| 3.5.2001 - 4.7.2001 | | 14.4 | 520 5 | 0 | 0 | 1.33 13 | 0 | 1.42 15 | 310 3 |
| 4.7.2001 - 29.8.2001 | | 7.3 | 660 6 | 0 | 0 | 5.0 15 | 0 | 0 | 530 3 |
| 29.8.2001 - 30.10.2001 | | 18.5 | 740 4 | 0 | 0 | 4.2 6 | 2.07 22 | 2.87 10 | 620 3 |

0 = below the detection limit
- = not analysed

**Table XXVIa**. Continued.

| | Sampling depth m | Dry weight g | $^{40}K$ | $^{54}Mn$ | $^{58}Co$ | $^{60}Co$ | $^{110m}Ag$ | $^{134}Cs$ | $^{137}Cs$ |
|---|---|---|---|---|---|---|---|---|---|
| **Loviisa 4A** | 27 | | | | | | | | |
| 4.11.1998 - 4.5.1999 | | 8.8 | 720 4 | 0 | 0 | 2.96 16 | 0 | 8.4 11 | 810 4 |
| 4.5.1999 - 30.6.1999 | | 6.8 | 500 6 | 0 | 0 | 2.26 22 | 0 | 5.3 17 | 400 3 |
| 30.6.1999 - 24.8.1999 | | 7.0 | 680 5 | 0 | 0 | 0 | 0 | 7.3 13 | 660 3 |
| 24.8.1999 - 10.11.1999 | | 22.3 | 710 4 | 0 | 0 | 0 | 0 | 5.0 16 | 700 3 |
| 10.11.1999 - 4.5.2000 | | 50.3 | 690 7 | 0 | 0 | 0 | 0 | 3.6 23 | 750 5 |
| 4.5.2000 - 29.6.2000 | | 9.1 | 560 5 | 4.0 19 | 0 | 3.5 16 | 0 | 4.3 15 | 530 3 |
| 29.6.2000 - 30.8.2000 | | 11.7 | 670 4 | 0 | 0 | 0 | 0 | 3.6 15 | 650 4 |
| 30.8.2000 - 4.12.2000 | | 36.8 | 690 5 | 0 | 0 | 0 | 0 | 3.7 16 | 740 5 |
| 4.12.2000 - 4.5.2001 | | 6.7 | 620 9 | 0 | 0 | 0 | 0 | 0 | 680 5 |
| 4.5.2001 - 4.7.2001 | | 9.2 | 490 6 | 0 | 0 | 0 | 0 | 0 | 330 3 |
| 4.7.2001 - 29.8.2001 | | 6.4 | 630 6 | 0 | 0 | 0 | 0 | 0 | 530 5 |
| 29.8.2001 - 29.10.2001 | | 20.4 | 750 5 | 0 | 0 | 1.12 20 | 0 | 3.1 12 | 710 3 |

0 = below the detection limit
- = not analysed

**Table XXVIa**. Continued.

| | Sampling depth m | Dry weight g | $^{40}$K | | $^{54}$Mn | $^{58}$Co | $^{60}$Co | $^{110m}$Ag | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Loviisa R1** | 13 | | | | | | | | | | | |
| 4.11.1998 - 4.5.1999 | | 11.2 | 820 | 4 | 0 | 0 | 0 | 0 | 8.2 | 7 | 810 | 3 |
| 4.5.1999 - 30.6.1999 | | 30.1 | 910 | 5 | 0 | 0 | 0 | 0 | 6.3 | 10 | 650 | 3 |
| 30.6.1999 - 24.8.1999 | | 31.8 | 890 | 5 | 0 | 0 | 0 | 0 | 6.8 | 9 | 690 | 3 |
| 24.8.1999 - 10.11.1999 | | 52.4 | 960 | 3 | 0 | 0 | 0 | 0 | 7.0 | 10 | 710 | 3 |
| 10.11.1999 - 4.5.2000 | | 26.0 | 870 | 5 | 0 | 0 | 0 | 0 | 5.3 | 12 | 740 | 3 |
| 4.5.2000 - 27.6.2000 | | 44.4 | 920 | 3 | 0 | 0 | 0 | 0 | 4.8 | 9 | 650 | 4 |
| 27.6.2000 - 28.8.2000 | | 35.7 | 920 | 4 | 0 | 0 | 0 | 0 | 4.6 | 12 | 650 | 5 |
| 28.8.2000 - 22.11.2000 | | 53.6 | 900 | 4 | 0 | 0 | 0 | 0 | 4.2 | 8 | 660 | 3 |
| 22.11.2000 - 4.5.2001 | | 16.9 | 870 | 5 | 0 | 0 | 0 | 0 | 4.6 | 17 | 720 | 5 |
| 4.5.2001 - 5.7.2001 | | 30.9 | 790 | 3 | 0 | 0 | 0 | 0 | 0 | | 430 | 5 |
| 5.7.2001 - 29.8.2001 | | 24.6 | 940 | 5 | 0 | 0 | 0 | 0 | 2.89 | 13 | 620 | 3 |
| 29.8.2001 - 31.10.2001 | | 51.9 | 950 | 6 | 0 | 0 | 0 | 0 | 3.1 | 13 | 630 | 5 |

0 = below the detection limit
\- = not analysed

**Table XXVIb.** Gamma-emitting radionuclides in sinking matter (Bq kg$^{-1}$ dry weight) in the vicinity of Olkiluoto nuclear power plant in 1999–2001. Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| | | | Sampling depth m | Dry weight g | $^{40}K$ | | $^{60}Co$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 12** | | | 15 | | | | | | | | | |
| 12.11.1998 | - | 11.5.1999 | | 35.6 | 680 | 5 | 10.2 | 6 | 7.0 | 10 | 650 | 3 |
| 27.4.1999 | - | 29.6.1999 | | 21.4 | 880 | 4 | 19.2 | 6 | 5.4 | 17 | 710 | 4 |
| 29.6.1999 | - | 1.9.1999 | | 19.9 | 700 | 4 | 22.4 | 5 | 4.8 | 10 | 630 | 4 |
| 1.9.1999 | - | 16.11.1999 | | 60.2 | 670 | 5 | 13.1 | 5 | 4.4 | 12 | 630 | 3 |
| 16.11.1999 | - | 9.5.2000 | | 117 | 770 | 5 | 8.0 | 6 | 5.1 | 12 | 600 | 3 |
| 9.5.2000 | - | 4.7.2000 | | 34.0 | 690 | 3 | 7.6 | 6 | 3.8 | 11 | 540 | 3 |
| 4.7.2000 | - | 5.9.2000 | | 20.3 | 740 | 4 | 11.3 | 6 | 2.99 | 17 | 620 | 5 |
| 5.9.2000 | - | 14.11.2000 | | 22.1 | 690 | 6 | 9.2 | 8 | 3.7 | 19 | 550 | 5 |
| 14.11.2000 | - | 26.4.2001 | | 31.0 | 710 | 6 | 8.9 | 7 | 3.3 | 15 | 540 | 5 |
| 26.4.2001 | - | 26.6.2001 | | 19.8 | 640 | 4 | 7.5 | 6 | 2.73 | 14 | 470 | 4 |
| 26.6.2001 | - | 4.9.2001 | | 27.1 | 670 | 5 | 7.5 | 8 | 2.61 | 15 | 590 | 3 |
| 4.9.2001 | - | 6.11.2001 | | 59.4 | 710 | 4 | 8.6 | 6 | 2.31 | 19 | 510 | 5 |

- = not analysed

**Table XXVIb.** Continued.

| | | | Sampling depth m | Dry weight g | $^{40}$K | | $^{60}$Co | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 3** | | | 13 | | | | | | | | | |
| 12.11.1998 | - | 27.4.1999 | | 44.3 | 630 | 6 | 13.4 | 6 | 6.6 | 12 | 520 | 5 |
| 27.4.1999 | - | 29.6.1999 | | 22.2 | 630 | 3 | 10.3 | 4 | 4.1 | 9 | 440 | 3 |
| 29.6.1999 | - | 1.9.1999 | | 25.7 | 730 | 6 | 13.4 | 8 | 5.1 | 13 | 500 | 5 |
| 1.9.1999 | - | 16.11.1999 | | 107 | 680 | 3 | 11.2 | 5 | 3.5 | 12 | 510 | 3 |
| 16.11.1999 | - | 9.5.2000 | | 164 | 640 | 5 | 6.7 | 8 | 4.3 | 12 | 470 | 3 |
| 9.5.2000 | - | 4.7.2000 | | 40.9 | 720 | 3 | 5.4 | 5 | 3.7 | 9 | 450 | 3 |
| 4.7.2000 | - | 5.9.2000 | | 19.4 | 750 | 5 | 9.7 | 5 | 2.87 | 14 | 480 | 3 |
| 5.9.2000 | - | 14.11.2000 | | 22.2 | 740 | 5 | 9.0 | 4 | 3.2 | 14 | 490 | 3 |
| 14.11.2000 | - | 26.4.2001 | | 46.7 | 730 | 4 | 5.6 | 4 | 2.70 | 9 | 510 | 3 |
| 26.4.2001 | - | 26.6.2001 | | 43.0 | 620 | 4 | 4.2 | 9 | 2.31 | 16 | 400 | 4 |
| 26.6.2001 | - | 4.9.2001 | | 22.6 | 760 | 5 | 5.7 | 12 | 2.49 | 20 | 410 | 5 |
| 4.9.2001 | - | 6.11.2001 | | 74.8 | 720 | 4 | 12.9 | 3 | 2.34 | 9 | 440 | 3 |

- = not analysed

**Table XXVIb.** Continued.

| | | | Sampling depth m | Dry weight g | $^{40}K$ | | $^{60}Co$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 4** | | | 8 | | | | | | | | | |
| | - | 27.4.1999 | | | - | | - | | - | | - | |
| 27.4.1999 | - | 29.6.1999 | | 21.4 | 680 | 5 | 9.5 | 9 | 6.0 | 13 | 480 | 5 |
| 29.6.1999 | - | 31.8.1999 | | 21.1 | 620 | 7 | 14.2 | 8 | 6.7 | 15 | 520 | 5 |
| 31.8.1999 | - | 17.11.1999 | | 71.3 | 690 | 5 | 12.9 | 7 | 4.8 | 15 | 550 | 5 |
| 17.11.1999 | - | 09.5.2000 | | 79.6 | 750 | 5 | 7.2 | 6 | 4.5 | 14 | 560 | 3 |
| 9.5.2000 | - | 4.7.2000 | | 33.2 | 720 | 3 | 11.5 | 4 | 2.88 | 13 | 510 | 4 |
| 4.7.2000 | - | 5.9.2000 | | 13.0 | 730 | 5 | 64 | 3 | 4.5 | 14 | 530 | 3 |
| 5.9.2000 | - | 15.11.2000 | | 12.0 | 680 | 4 | 11.2 | 6 | 4.3 | 15 | 470 | 4 |
| 15.11.2000 | - | 26.4.2001 | | 15.4 | 690 | 5 | 8.6 | 6 | 2.68 | 20 | 490 | 3 |
| 26.4.2001 | - | 26.6.2001 | | 30.6 | 670 | 6 | 6.7 | 8 | 0 | | 390 | 5 |
| 26.6.2001 | - | 4.9.2001 | | 25.8 | 670 | 5 | 10.0 | 7 | 2.96 | 20 | 460 | 5 |
| 4.9.2001 | - | 6.11.2001 | | 25.1 | 730 | 4 | 8.6 | 5 | 2.01 | 19 | 440 | 5 |

- = not analysed

**Table XXVIb.** Continued.

| | | | Sampling depth m | Dry weight g | $^{40}K$ | | $^{60}Co$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 15** | | | 11 | | | | | | | | | |
| | - | 27.4.1999 | | | - | | - | | - | | - | |
| 27.4.1999 | - | 29.6.1999 | | 18.6 | 650 | 3 | 2.33 | 16 | 5.8 | 10 | 480 | 3 |
| 29.6.1999 | - | 1.9.1999 | | 25.1 | 740 | 5 | 3.6 | 9 | 3.9 | 11 | 560 | 3 |
| 1.9.1999 | - | 16.11.1999 | | 58.2 | 770 | 4 | 3.9 | 13 | 6.2 | 14 | 560 | 4 |
| 16.11.1999 | - | 9.5.2000 | | - | - | | - | | - | | - | |
| 9.5.2000 | - | 4.7.2000 | | 30.4 | 750 | 4 | 3.4 | 8 | 3.3 | 12 | 510 | 4 |
| 4.7.2000 | - | 5.9.2000 | | 26.5 | 770 | 4 | 4.5 | 12 | 4.0 | 16 | 540 | 4 |
| 5.9.2000 | - | 14.11.2000 | | 16.0 | 730 | 5 | 2.53 | 14 | 2.42 | 22 | 490 | 3 |
| 14.11.2000 | - | 25.4.2001 | | 16.1 | 690 | 5 | 3.4 | 13 | 2.79 | 19 | 500 | 3 |
| 25.4.2001 | - | 26.6.2001 | | 22.1 | 640 | 4 | 1.32 | 12 | 2.55 | 10 | 430 | 3 |
| 26.6.2001 | - | 4.9.2001 | | 29.4 | 780 | 4 | 3.8 | 16 | 1.88 | 21 | 470 | 4 |
| 4.9.2001 | - | 6.11.2001 | | 60.7 | 710 | 4 | 1.98 | 11 | 1.98 | 12 | 460 | 3 |

- = not analysed

**Table XXVII.** The concentrations of $^{238}$Pu and $^{239,240}$Pu (Bq kg$^{-1}$ dry weight) in combined sinking matter samples in the vicinities of Loviisa and Olkiluoto nuclear power plants in 1999–2001. Relative uncertainties (1σ) include statistical and calibration uncertainty.

| | $^{238}$Pu | | $^{239,240}$Pu | |
|---|---|---|---|---|
| **Loviisa 3** | | | | |
| 4.5.1999-10.11.1999 | 0 | | 1.00 | 5 |
| 10.11.1999-22.11.2000 | 0.030 | 38 | 1.32 | 7 |
| 22.11.2000-30.10.2001 | 0.040 | 28 | 0.90 | 8 |
| **Loviisa R1** | | | | |
| 4.11.1998-10.11.1999 | 0 | | 0.58 | 9 |
| 10.11.1999-22.11.2000 | 0.040 | 29 | 0.69 | 8 |
| 22.11.2000-31.10.2001 | 0.030 | 33 | 0.62 | 8 |
| **Olkiluoto 12** | | | | |
| 12.11.1998-16.11.1999 | 0 | | 1.48 | 5 |
| 16.11.1999-14.11.2000 | 0.050 | 16 | 1.15 | 5 |
| 14.11.2000-6.11.2001 | 0.060 | 18 | 1.43 | 5 |
| **Olkiluoto 15** | | | | |
| 27.4.1999-16.11.1999 | 0.260 | 23 | 1.81 | 10 |
| 10.5.2000-14.11.2000 | 0.050 | 28 | 1.39 | 7 |
| 14.11.2000-6.11.2001 | 0.080 | 20 | 1.61 | 6 |

**Table XXVIII.** Vertical distribution of $^{90}Sr$, $^{238}Pu$, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg$^{-1}$ dry weight) and total amounts of $^{137}Cs$ (Bq m$^{-2}$) in bottom sediments at Olkiluoto in 1999. Relative uncertainties (1σ) include both statistical and calibration uncertainty. The samples were taken by Gemini Twin Corer.

| Sampling station (depth) slice (cm) | Dry matter % | $^{40}K$ | | $^{60}Co$ | | $^{90}Sr$* | $^{125}Sb$ | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | $^{239,240}Pu$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 1** (6.2 m) | | | | | | | | | | | | | |
| 0-5 | 19 | 670 | 5 | 17.8 | 5 | - | 0 | 5.9 | 11 | 560 | 3 | - | - |
| 5-10 | 33 | 750 | 6 | 6.1 | 5 | - | 0 | 2.42 | 9 | 273 | 5 | - | - |
| 10-15 | 30 | 780 | 6 | 0 | | - | 0 | 0 | | 62 | 6 | - | - |
| 15-20 | 32 | 710 | 4 | 0 | | - | 0 | 0 | | 14.8 | 3 | - | - |
| 20-25 | 28 | 760 | 5 | 0 | | - | 0 | 0 | | 5.1 | 7 | - | - |
| 25-30 | | 830 | 6 | 0 | | - | 0 | 0 | | 1.6 | 30 | - | - |
| total amount | | | | | | | | | | 14300 | Bq m$^{-2}$ | | |
| **Olkiluoto 4** (8.6 m) | | | | | | | | | | | | | |
| 0-5 | 18 | 740 | 6 | 23.0 | 4 | - | 0 | 6.1 | 7 | 690 | 5 | - | - |
| 5-10 | 23 | 700 | 5 | 15.3 | 5 | - | 0 | 8.9 | 8 | 850 | 3 | - | - |
| 10-15 | 26 | 740 | 6 | 3.6 | 10 | - | 0 | 4.3 | 11 | 480 | 5 | - | - |
| 15-20 | 25 | 730 | 6 | 0 | | - | 0 | 0 | | 100 | 5 | - | - |
| 20-25 | 27 | 810 | 5 | 0 | | - | 0 | 0 | | 68 | 5 | - | - |
| 25-30 | 28 | 730 | 3 | 0 | | - | 0 | 0 | | 37 | 4 | - | - |
| total amount | | | | | | | | | | 30500 | Bq m$^{-2}$ | | |

0 = below the detection limit
- = not analysed
* = analytical error included

**Table XXVIII.** Continued.

| Sampling station (depth) slice (cm) | Dry matter % | $^{40}K$ | | $^{60}Co$ | | $^{90}Sr$* | | $^{125}Sb$ | | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | | $^{239,240}Pu$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 5** (5.0 m) | | | | | | | | | | | | | | | | | |
| 0-5 | 23 | 750 | 6 | 7.4 | 9 | - | | 0 | | 3.7 | 20 | 390 | 5 | - | | - | |
| 5-10 | 31 | 710 | 5 | 1.24 | 21 | - | | 0 | | 1.28 | 25 | 198 | 3 | - | | - | |
| 10-15 | 26 | 740 | 6 | 0 | | - | | 0 | | 0 | | 41 | 6 | - | | - | |
| 15-20 | 26 | 780 | 5 | 0 | | - | | 0 | | 0 | | 14.5 | 5 | - | | - | |
| 20-25 | 25 | 790 | 5 | 0 | | - | | 0 | | 0 | | 6.8 | 6 | - | | - | |
| 25-30 | 25 | 800 | 6 | 0 | | - | | 0 | | 0 | | 2.87 | 22 | - | | - | |
| total amount | | | | | | | | | | | | 10500 | Bq m$^{-2}$ | | | | |
| **Olkiluoto 9** (9.5 m) | | | | | | | | | | | | | | | | | |
| 0-5 | 12 | 450 | 4 | 36 | 3 | 4.1 | 6 | 0 | | 4.8 | 10 | 440 | 3 | 0 | | 1.97 | 5 |
| 5-10 | 18 | 720 | 6 | 68 | 4 | 6.8 | 6 | 0 | | 7.4 | 10 | 890 | 5 | 0.074 | 14 | 1.59 | 4 |
| 10-15 | 22 | 790 | 6 | 46 | 4 | - | | 0 | | 10.3 | 7 | 1050 | 5 | - | | - | |
| 15-20 | 25 | 670 | 7 | 246 | 4 | - | | 25.8 | 16 | 9.6 | 16 | 980 | 5 | - | | - | |
| 20-25 | 25 | 730 | 6 | 6.3 | 8 | - | | 0 | | 0 | | 239 | 5 | - | | - | |
| 25-30 | 27 | 780 | 4 | 0.97 | 14 | - | | 0 | | 0 | | 90 | 3 | - | | - | |
| total amount | | | | | | | | | | | | 30300 | Bq m$^{-2}$ | | | | |

0 = below the detection limit
- = not analysed
* = analytical error included

**Table XXVIII.** Continued.

| Sampling station (depth) slice (cm) | Dry matter % | $^{40}$K | | $^{60}$Co | | $^{90}$Sr* | | $^{134}$Cs | | $^{137}$Cs | | $^{238}$Pu | | $^{239,240}$Pu | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto 12** (15.5 m) | | | | | | | | | | | | | | | |
| 0-5 | 17 | 730 | 3 | 19.5 | 4 | 10.5 | 6 | 7.5 | 8 | 790 | 3 | 0.094 | 16 | 1.51 | 5 |
| 5-10 | 22 | 730 | 6 | 16.2 | 5 | 6.2 | 6 | 8.8 | 9 | 990 | 5 | 0.086 | 17 | 2.03 | 4 |
| 10-15 | 23 | 440 | 5 | 3.5 | 6 | - | | 4.8 | 6 | 520 | 3 | - | | - | |
| 15-20 | 23 | 760 | 6 | 0 | | - | | 0.79 | 28 | 152 | 6 | - | | - | |
| 20-25 | 25 | 730 | 4 | 0 | | - | | 0 | | 78 | 3 | - | | - | |
| 25-30 | 28 | 680 | 5 | 0 | | - | | 0 | | 25.0 | 4 | - | | - | |
| total amount | | | | | | | | | | 31100 | Bq m$^{-2}$ | | | | |
| **Olkiluoto S5** (7.5 m) | | | | | | | | | | | | | | | |
| 0-5 | 19 | 720 | 5 | 2.90 | 11 | 2.90 | 6 | 5.3 | 9 | 610 | 3 | 0.150 | 10 | 2.27 | 4 |
| 5-10 | 28 | 750 | 6 | 2.76 | 11 | 2.10 | 6 | 6.4 | 8 | 650 | 5 | 0.130 | 14 | 2.43 | 4 |
| 10-15 | 36 | 740 | 3 | 0 | | - | | | | 252 | 3 | - | | - | |
| 15-20 | 46 | 760 | 6 | 0 | | - | | | | 23.3 | 5 | - | | - | |
| 20-25 | 39 | 800 | 5 | 0 | | - | | | | 5.5 | 8 | - | | - | |
| 25-30 | 38 | 760 | 5 | 0 | | - | | | | 2.23 | 16 | - | | - | |
| total amount | | | | | | | | | | 24700 | Bq m$^{-2}$ | | | | |

0 = below the detection limit
- = not analysed
* = analytical error included

**Table XXVIII.** Continued.

| Sampling station (depth) slice (cm) | Dry matter % | $^{40}K$ | | $^{60}Co$ | | $^{90}Sr$* | | $^{134}Cs$ | | $^{137}Cs$ | | $^{238}Pu$ | | $^{239,240}Pu$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Olkiluoto S6** (6.4 m) | | | | | | | | | | | | | | | |
| 0-5 | 15 | 780 | 3 | 7.4 | 6 | - | | 4.9 | 11 | 470 | 3 | - | | - | |
| 5-10 | 20 | 780 | 4 | 4.3 | 7 | - | | 4.3 | 9 | 510 | 4 | - | | - | |
| 10-15 | 23 | 800 | 6 | 3.2 | 11 | - | | 3.2 | 13 | 480 | 5 | - | | - | |
| 15-20 | 26 | 780 | 5 | 0 | | - | | 0 | | 126 | 3 | - | | - | |
| 20-25 | 26 | 870 | 5 | 0 | | - | | 0 | | 31 | 4 | - | | - | |
| 25-30 | 27 | 790 | 5 | 0 | | - | | 0 | | 7.2 | 9 | - | | - | |
| total amount | | | | | | | | | | 19000 | Bq m$^{-2}$ | | | | |
| **Olkiluoto S8** (12.7 m) | | | | | | | | | | | | | | | |
| 0-5 | 15 | 750 | 5 | 2.04 | 15 | 3.4 | 7 | 6.1 | 10 | 720 | 3 | 0.093 | 12 | 2.26 | 4 |
| 5-10 | 21 | 720 | 6 | 0 | | 8.2 | 6 | 7.1 | 13 | 780 | 5 | 0 | | 2.50 | 4 |
| 10-15 | 24 | 750 | 7 | 0 | | - | | 0 | | 450 | 5 | - | | - | |
| 15-20 | 26 | 780 | 6 | 0 | | - | | 0 | | 112 | 6 | - | | - | |
| 20-25 | 28 | 740 | 5 | 0 | | - | | 0 | | 27.5 | 6 | - | | - | |
| 25-30 | 30 | 840 | 5 | 0 | | - | | 0 | | 10.7 | 10 | - | | - | |
| total amount | | | | | | | | | | 24900 | Bq m$^{-2}$ | | | | |

0 = below the detection limit
- = not analysed
* = analytical error included

**Table XXIXa.** Vertical distribution of gamma-emitting radionuclides in 1 cm slices of surficial bottom sediments taken by GeminiTwin Corer at the station Olkiluoto 2 in 1999 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1$\sigma$) include both statistical and calibration uncertainty.

| Slice (cm) | Dry matter % | $^{40}K$ | | $^{60}Co$ | | $^{134}Cs$ | | $^{137}Cs$ | |
|---|---|---|---|---|---|---|---|---|---|
| 0-1 | 2 | 530 | 22 | < 20 | | < 20 | | 440 | 6 |
| 1-2 | 11 | 690 | 6 | 34 | 5 | 5.4 | 24 | 710 | 3 |
| 2-3 | 17 | 770 | 5 | 18.5 | 4 | 8.2 | 8 | 810 | 3 |
| 3-4 | 17 | 720 | 6 | 36 | 5 | 8.4 | 13 | 760 | 5 |
| 4-5 | 19 | 720 | 8 | 25.5 | 8 | 8.1 | 20 | 900 | 5 |
| 5-6 | 16 | 750 | 5 | 28.8 | 4 | 9.8 | 11 | 810 | 3 |
| 6-7 | 18 | 770 | 5 | 51 | 4 | 12.9 | 10 | 960 | 3 |
| 7-8 | 14 | 740 | 5 | 74 | 3 | 10.8 | 9 | 980 | 3 |
| 8-9 | 13 | 680 | 7 | 46 | 5 | 9.2 | 15 | 860 | 5 |
| 9-10 | 19 | 760 | 5 | 35 | 3 | 11.6 | 9 | 1020 | 3 |
| 10-11 | 21 | 780 | 5 | 35 | 4 | 10.4 | 12 | 1100 | 3 |
| 11-12 | 22 | 760 | 4 | 29.1 | 4 | 11.3 | 9 | 1030 | 4 |
| 12-13 | 22 | 720 | 4 | 27.3 | 4 | 8.5 | 12 | 1040 | 4 |
| 13-14 | 24 | 670 | 5 | 20.8 | 6 | 11.3 | 13 | 1210 | 3 |
| 14-15 | 24 | 730 | 4 | 24.5 | 4 | 16.0 | 6 | 1510 | 4 |
| 15-16 | 23 | 760 | 4 | 19.4 | 6 | 19.4 | 11 | 1980 | 3 |
| 16-17 | 22 | 750 | 5 | 16.2 | 9 | 19.8 | 14 | 1650 | 4 |
| 17-18 | 19 | 730 | 4 | 20.8 | 4 | 5.0 | 19 | 660 | 4 |
| 18-19 | 18 | 640 | 6 | 13.9 | 8 | 0 | | 330 | 5 |
| 19-20 | 22 | 650 | 8 | 0 | | 0 | | 153 | 5 |
| 20-21 | 22 | 760 | 5 | 5.3 | 12 | 0 | | 149 | 3 |
| 21-22 | 23 | 740 | 4 | 3.7 | 15 | 0 | | 135 | 3 |
| 22-23 | 22 | 680 | 8 | 0 | | 0 | | 116 | 6 |
| 23-24 | 24 | 680 | 5 | 3.7 | 20 | 0 | | 126 | 3 |
| 24-25 | 22 | 760 | 4 | 1.92 | 23 | 0 | | 112 | 5 |
| 25-26 | 22 | 720 | 5 | 0 | | 0 | | 99 | 5 |
| 26-27 | 25 | 690 | 6 | 0 | | 0 | | 95 | 5 |
| 27-28 | 23 | 730 | 5 | 0 | | 0 | | 97 | 5 |
| 28-29 | 23 | 710 | 5 | 0 | | 0 | | 90 | 5 |
| 29-30 | 25 | 640 | 8 | 0 | | 0 | | 75 | 6 |
| total amount | | | | | | | | 42600 Bq m$^{-2}$ | |

0 = below the detection limit

**Table XXIXb.** Vertical distribution of gamma-emitting radionuclides in 1 cm slices of surficial bottom sediments taken by GeminiTwin Corer at the station Olkiluoto 12 in 1999 (Bq kg$^{-1}$ dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

| Slice (cm) | Dry matter % | $^{40}$K | | $^{60}$Co | | $^{125}$Sb | | $^{134}$Cs | | $^{137}$Cs | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-1 | 8 | 650 | 5 | 11.7 | 6 | 0 | | 6.7 | 12 | 670 | 3 |
| 1-2 | 17 | 750 | 5 | 20.0 | 3 | 0 | | 9.1 | 8 | 800 | 3 |
| 2-3 | 19 | 720 | 3 | 22.2 | 3 | 0 | | 6.8 | 7 | 770 | 3 |
| 3-4 | 20 | 740 | 3 | 21.2 | 3 | 0 | | 7.6 | 9 | 830 | 4 |
| 4-5 | 22 | 780 | 5 | 17.4 | 4 | 0 | | 9.5 | 9 | 900 | 3 |
| 5-6 | 22 | 780 | 3 | 22.2 | 3 | 0 | | 9.1 | 8 | 940 | 3 |
| 6-7 | 22 | 750 | 5 | 20.6 | 5 | 0 | | 8.6 | 13 | 990 | 5 |
| 7-8 | 22 | 690 | 7 | 21.5 | 7 | 0 | | 11.1 | 13 | 1000 | 5 |
| 8-9 | 22 | 760 | 4 | 17.6 | 6 | 0 | | 11.8 | 13 | 1160 | 4 |
| 9-10 | 22 | 750 | 3 | 11.0 | 6 | 0 | | 10.7 | 11 | 1150 | 5 |
| 10-11 | 23 | 690 | 5 | 10.4 | 7 | 0 | | 10.0 | 9 | 1160 | 3 |
| 11-12 | 23 | 750 | 5 | 9.0 | 6 | 12.4 | 21 | 9.0 | 7 | 1120 | 3 |
| 12-13 | 24 | 770 | 5 | 5.9 | 7 | 0 | | 7.1 | 9 | 880 | 3 |
| 13-14 | 24 | 790 | 4 | 6.3 | 11 | 0 | | 7.0 | 15 | 620 | 4 |
| 14-15 | 24 | 710 | 5 | 4.4 | 10 | 0 | | 4.1 | 16 | 410 | 3 |
| 15-16 | 25 | 770 | 5 | 0 | | 0 | | 0 | | 280 | 5 |
| 16-17 | 24 | 710 | 6 | 0 | | 0 | | 0 | | 188 | 5 |
| 17-18 | 24 | 770 | 5 | 2.0 | 21 | 0 | | 0 | | 151 | 5 |
| 18-19 | 24 | 720 | 6 | 0 | | 0 | | 0 | | 112 | 5 |
| 19-20 | 25 | 710 | 4 | 0 | | 0 | | 0 | | 107 | 3 |
| 20-21 | 12 | 740 | 4 | 0 | | 0 | | 0 | | 99 | 4 |
| 21-22 | 26 | 730 | 5 | 0 | | 0 | | 0 | | 87 | 5 |
| 22-23 | 26 | 740 | 6 | 0 | | 0 | | 0 | | 73 | 5 |
| 23-24 | 27 | 690 | 7 | 0 | | 0 | | 0 | | 62 | 6 |
| 24-25 | 27 | 720 | 4 | 0 | | 0 | | 0 | | 51 | 5 |
| 25-26 | 26 | 780 | 7 | 0 | | 0 | | 0 | | 36 | 7 |
| 26-27 | 30 | 830 | 5 | 0 | | 0 | | 0 | | 26.9 | 4 |
| 27-28 | 31 | 750 | 4 | 0 | | 0 | | 0 | | 17.4 | 8 |
| 28-29 | 30 | 770 | 5 | 0 | | 0 | | 0 | | 12.8 | 8 |
| 29-30 | 31 | 770 | 5 | 0 | | 0 | | 0 | | 8.8 | 7 |
| total amount | | | | | | | | | | 37400 Bq m$^{-2}$ | |

0 = below the detection limit

**Table XXXa.** High pressure ionization chamber measurements of environmental dose rates in the vicinity of Loviisa nuclear power plant in 1999–2001.

| Station | Dose rate µSv $h^{-1}$ | | |
|---|---|---|---|
| | 1999 | 2000 | 2001 |
| 20 | 0.15 | 0.16 | 0.16 |
| 21 | 0.19 | 0.15 | 0.17 |
| 22 | 0.17 | 0.18 | 0.16 |
| 23 | 0.20 | 0.20 | 0.22 |
| 24 | 0.16 | 0.14 | 0.14 |
| 25 | 0.13 | 0.13 | 0.13 |
| 26 | 0.17 | 0.14 | 0.13 |
| 27 | 0.21 | 0.21 | 0.21 |
| 28 | 0.20 | 0.17 | 0.17 |
| 29 | 0.23 | 0.22 | 0.22 |

**Table XXXb.** High pressure ionization chamber measurements of environmental dose rates in the vicinity of Olkiluoto nuclear power plant in 1999–2001.

| Station | Dose rate µSv $h^{-1}$ | | |
|---|---|---|---|
| | 1999 | 2000 | 2001 |
| 20 | 0.13 | 0.11 | 0.13 |
| 21 | 0.13 | 0.10 | 0.10 |
| 22 | 0.13 | 0.11 | 0.12 |
| 23 | 0.10 | 0.12 | 0.13 |
| 24 | 0.15 | 0.14 | 0.14 |
| 25 | 0.14 | 0.09 | 0.10 |
| 26 | 0.10 | 0.10 | 0.11 |
| 27 | 0.11 | 0.10 | 0.11 |
| 28 | 0.11 | 0.11 | 0.12 |
| 29 | 0.33 | 0.11 | 0.12 |
| 34 | 0.16 | 0.09 | 0.10 |

**Table XXXI.** Direct spectroscopic measurements of source activity on open fields near the nuclear power plants in 1999–2001 (kBq $m^{-2}$).

| | $^{137}Cs$ |
|---|---|
| **Loviisa 34** | |
| 2000 | 12 |
| **Olkiluoto 38** | |
| 1999 | 5.8 |
| 2001 | 2.4 |

# STUK-A reports

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