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MONITORING OF RADIONUCLIDES IN THE VICINITIES OF FINNISH NUCLEAR POWER PLANTS IN 1997 AND 1998

S. Klemola, E. Ilus, TK. Ikäheimonen

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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STUK – Radiation and Nuclear Safety Authority
P.O. Box 14, FIN-00881 Helsinki
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Keywords: environmental radioactivity, nuclear power plants, terrestrial environment, aquatic environment

Abstract

The monitoring of radioactive substances around Finnish nuclear power plants continued in 1997-1998 in accordance with the regular programmes. Altogether, about 1000 samples from the terrestrial and aquatic environs of the two power plant sites are analysed annually.

Trace amounts of activation products originating from airborne releases from the local power plants were detected in several air and deposition samples. Discharged nuclides were more abundant in the aquatic environment, especially in samples of indicator organisms, sinking matter and sediments. However, the concentrations were so low that they did not significantly increase the radiation burden in the environment.

The dominant artificial radionuclides in the vicinity of the power plants were still the cesium isotopes, especially ^{137}Cs but also ^{134}Cs which originated from the Chernobyl accident. In seawater, elevated ^{3}H concentrations were more frequent in Loviisa, but no traces of other discharge nuclides were detected. At Olkiluoto, small amounts of ^{60}Co were detected in seawater samples taken during the maintenance outages of the power plant. The concentrations of local discharge nuclides in indicator organisms and sinking matter were somewhat higher and their distribution range was wider in the sea area off Olkiluoto.

KLEMOLA, Seppo, ILUS, Erkki, IKÄHEIMONEN, Tarja K. Suomen ydinvoimalaitosten ympäristövalvonnan tulokset vuosilta 1997 ja 1998. STUK-A205. Helsinki 2004, 104 s.

Avainsanat: ympäristön radioaktiivisuus, ydinvoimalaitokset, maaympäristö, vesiympäristö

Tiivistelmä

Suomen ydinvoimalaitosten ympäristön säteilyvalvonta jatkui vuosina 1997-1998 säännöllisten tarkkailuohjelmien mukaisesti. Kahden voimalaitospaikan maa- ja vesiympäristöstä otetaan ja analysoidaan yhteensä lähes tuhat näytettä vuodessa.

Pieniä määriä paikallisten voimalaitosten ilmapäästöistä peräisin olevia aktivoitumistuotteita havaittiin muutamissa lähialueelta otetuissa ilma- ja laskeumanäytteissä. Radioaktiivisten aineiden pitoisuudet olivat erittäin pieniä. Elintarvikkeissa ei esiintynyt paikallisista päästöistä lähtöisin olevia radioaktiivisia aineita. Olkiluodon voimalaitoksen ympäristöstä kerätyissä sienissä ja luonnonmarjoissa esiintyi vain Tshernobylin onnettomuudesta peräisin olevia cesium-isotooppeja ja luonnon kalium-40:tä.

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, mutta myös cesium-134. Kohonneita tritium-pitoisuuksia oli useammin Loviisan ympäristöstä otetuissa merivesinäytteissä, joissa toisaalta ei havaittu muita paikallisia päästönuklideja. Olkiluodossa jäähdytysveden purkupaikan edustalta otetuissa merivesinäytteissä esiintyi voimalaitoksen vuosihuoltojen yhteydessä pieniä määriä koboltti-60:tä. Myös indikaattoriorganismeissa ja pohjalle laskeutuvassa aineksessa havaittujen paikallisten päästönuklidien pitoisuudet olivat Olkiluodossa jonkin verran suuremmat ja niitä havaittiin laajemmalla alueella kuin Loviisassa. Pitoisuudet olivat kuitenkin niin pieniä, etteivät ne lisää luonnon säteilyrasitusta.

Contents

1 Introduction

There are four nuclear power plant (NPP) units in Finland: two pressurised water reactors at Loviisa (rated net electric power 445 MW, since 1 May 1998 488 MW) on the south coast and two boiling water reactors at Olkiluoto (net power 710 MW, since 20 August 1998 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. Radiological background studies were started in Loviisa in 1966 and in 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 1997 and 1998 monitoring programmes. Apart from annual refuelling and maintenance outages, the power plants were in continuous commercial operation throughout most of this period.

The annual maintenance outages of the Loviisa power plant in 1997 were from 16 August to 21 September and in 1998 from 8 August to 4 October. The outages at the Olkiluoto plant were in 1997 from 4 May to 14 June and in 1998 from 3 May to 9 June. There were also a number of shorter outages and breaks in power generation due to repair or low demands for electricity.

The annual load factors for the Loviisa reactors 1 and 2 were 93.6% and 93.6% in 1997 and 90.9% and 87.1% in 1998, respectively. The load factors for the Olkiluoto reactors, TVO I and TVO II, were 93.9% and 93.6% in 1997 and 95.1% and 93.2% in 1998, respectively [1,2]. This Report gives also the annual discharge data from both power stations into the air and sea during the report period.

The authors of the present report are each responsible for different parts of it. Seppo Klemola undertook the editing, was responsible for gammaspectrometric analyses and wrote the sections on air, measurements of

environmental gamma radiation and dose estimates. Erkki Ilus was responsible for planning the monitoring programmes and sampling and prepared the sections on programmes and the aquatic environment. Tarja K. Ikäheimonen was responsible for the pretreatment of samples and radiochemical analyses and for writing the sections on deposition, terrestrial environment and foodstuffs.

2 Discharge data

The annual airborne and aquatic discharges (Bq) from Loviisa and Olkiluoto nuclear power stations in 1997 and 1998 are given below. Only radionuclides with half-lives longer than one week are reported.

Loviisa

Annual airborne and aquatic discharges (Bq) from Loviisa nuclear power plant in 1997 and 1998.

	Airborne discharges		Aquatic discharges	
	1997	1998	1997	1998
H-3	2.5E+11	2.0E+11	1.2E+13	9.3E+12
C-14	2.3E+11	3.4E+11		
Cr-51	4.2E+06	3.3E+06		
Mn-54	2.9E+06	9.4E+06	7.9E+05	3.0E+07
Fe-59	8.1E+05	1.5E+06		
Co-57				
Co-58	3.8E+06	2.5E+07	2.9E+05	4.5E+07
Co-60	4.5E+06	1.5E+07	1.3E+06	8.9E+08
Sr-90				
Zr-95	6.8E+05	8.1E+05		7.5E+03
Nb-95	1.5E+06	3.0E+06		
Ru-103	5.4E+04			
Ag-110m	1.9E+06	2.0E+06	2.6E+05	8.2E+07
Sb-124	2.8E+06	9.6E+06	3.4E+05	3.2E+07
Sb-125				
Te-123m	7.8E+04	9.4E+04		1.3E+05
I-131	7.2E+04	3.3E+06		
Cs-134			2.5E+06	3.9E+07
Cs-137		1.4E+05	6.7E+06	1.2E+08

Olkiluoto

Annual airborne and aquatic discharges (Bq) from Olkiluoto nuclear power plant in 1997 and 1998.

	Airborne discharges		Aquatic discharges	
	1997	1998	1997	1998
H-3	3.0E+11	4.4E+11	1.3E+12	1.2E+12
C-14	6.7E+11	7.2E+11		
Cr-51	2.4E+06	9.9E+06	1.8E+08	1.1E+08
Mn-54	2.7E+06	1.4E+06	9.1E+08	1.1E+08
Fe-59				4.0E+06
Co-58	1.4E+06	3.8E+06	6.8E+08	1.2E+08
Co-60	1.3E+07	1.5E+07	3.6E+09	9.0E+08
Sr-89	1.0E+06	1.0E+06	1.2E+07	2.6E+06
Sr-90			8.9E+06	
Zr-95				2.3E+07
Nb-95				3.4E+07
Sb-124		2.3E+05		1.9E+07
Sb-125		5.1E+05	1.1E+07	3.2E+06
I-131	1.7E+07	2.7E+06	5.2E+06	1.1E+07
Cs-134			1.3E+09	2.8E+08
Cs-137			2.8E+09	8.8E+08

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 programme followed in 1997 is presented in our previous Annual Report [3]. The attached programme was taken into use from the beginning of 1998.

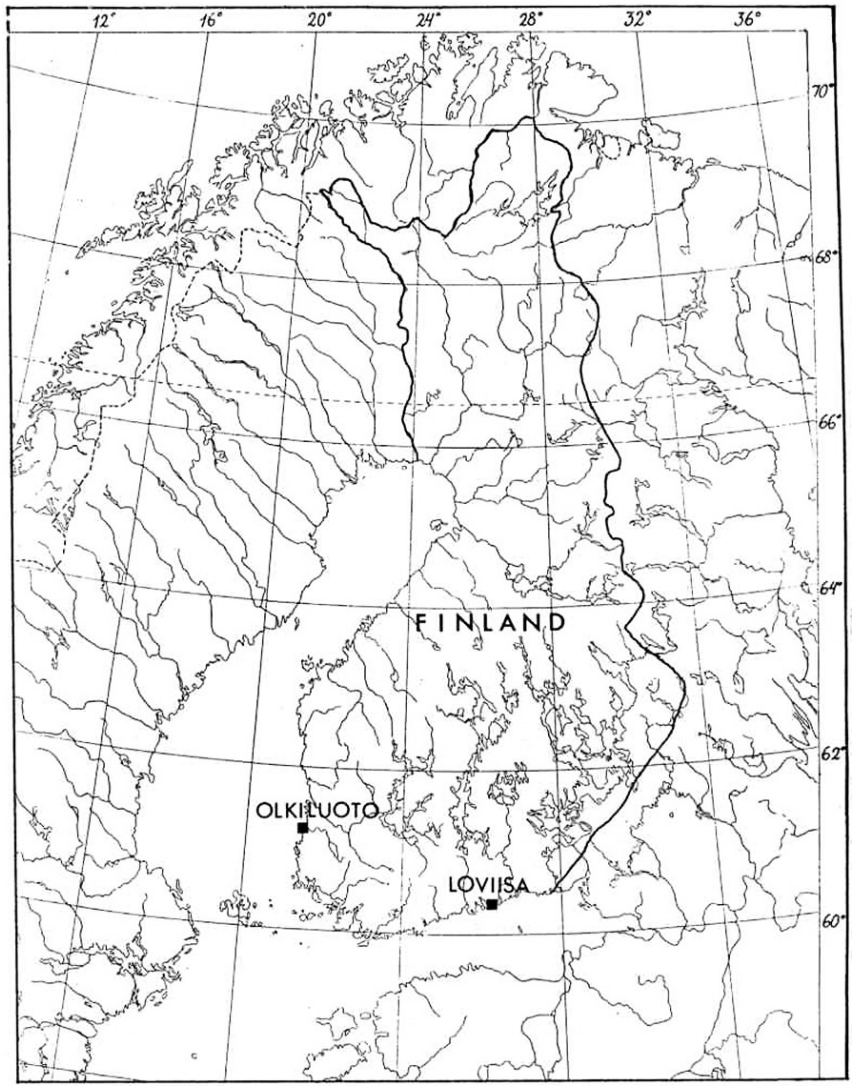

Figure 1. Location of Loviisa and Olkiluoto nuclear power stations.

Programmes for monitoring radionuclides in the environs of Finnish nuclear power plants since 1998

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 Olki–luoto (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 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 4 years. In 1997, the soil survey (combined with that of mushrooms and wild berries) was arranged in Olkiluoto and a sediment survey was conducted in Loviisa in 1998. The sampling points and areas used in these surveys are presented in Figs. 6 and 7.

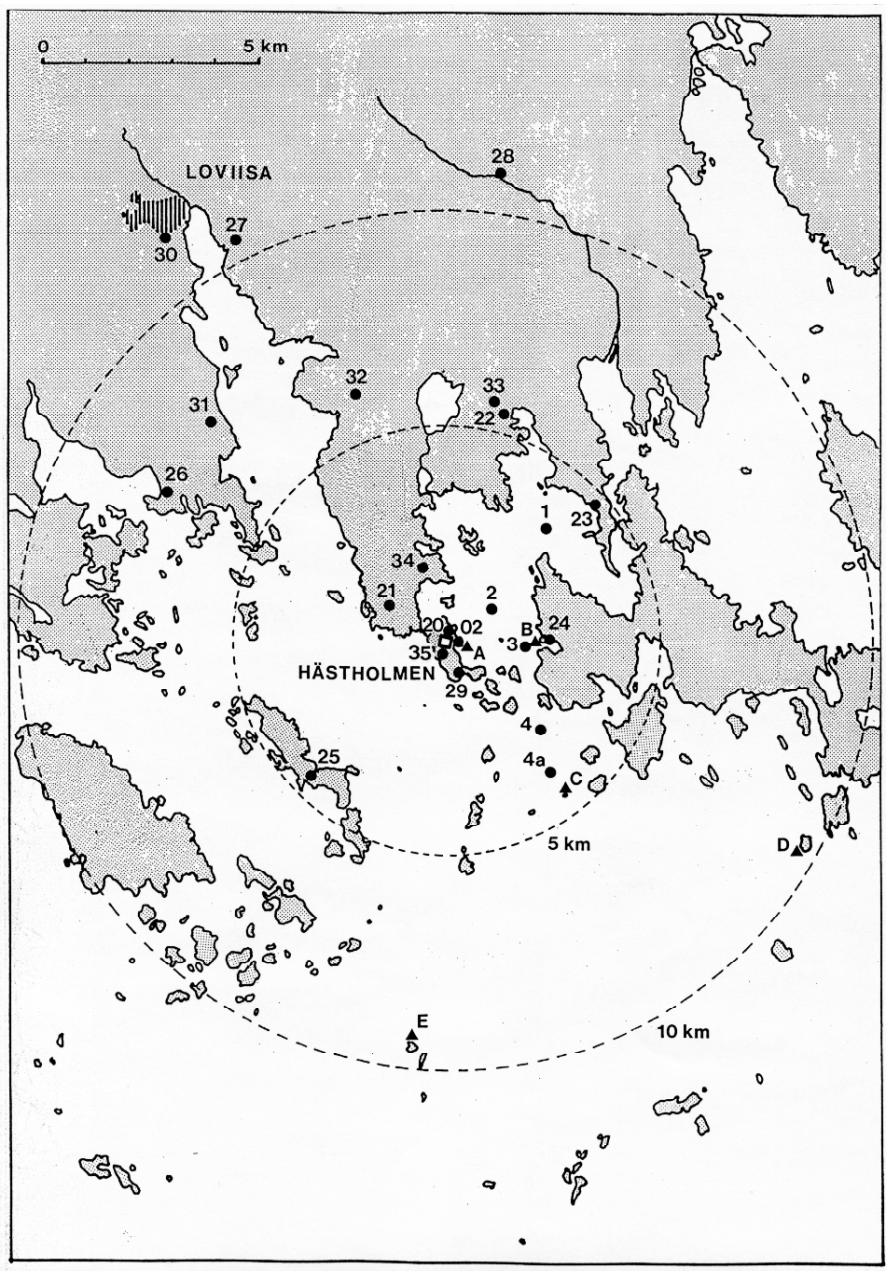

Figure 2. Sampling and measurement stations or sites in Loviisa: 20-29 TLD dosimeters; 34 direct gammaspectrometric measurements; 21,24, 27, 33 air sample collectors, 33 supplementary air sampling; 20, 24, 27, 33 rain water collectors; 20, 30 drinking water; 22 lettuce and grazing grass; 31 apple; 32 hair moss; 35 reindeer lichen and pine needles; 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.

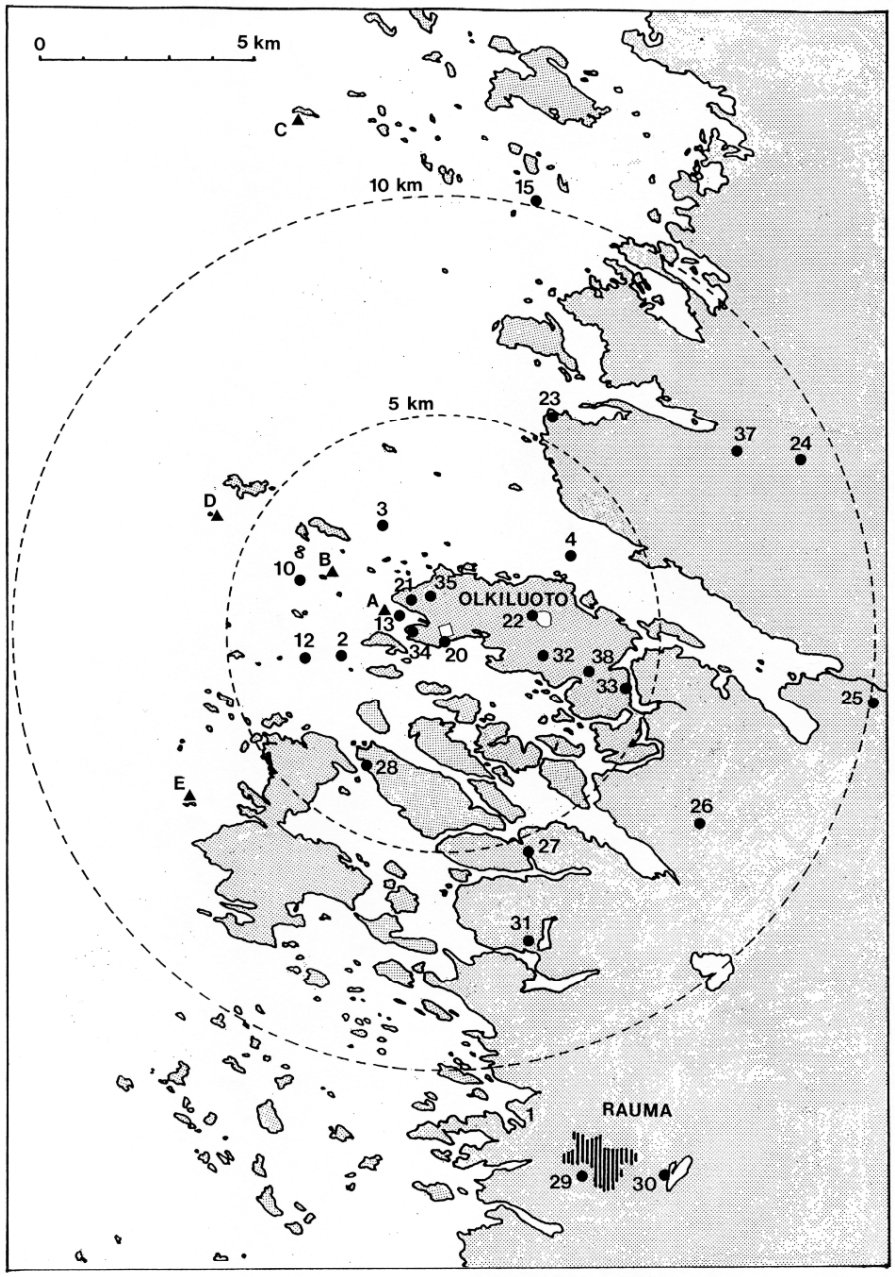

Figure 3. Sampling and measurement stations or sites in Olkiluoto: 20-29, 34 TLD dosimeters; 38 direct gammaspectrometric measurements; 22, 26, 31, 37 air sample collectors; 33 supplementary air sampling; 21, 26, 31, 37 rainwater collectors; 22, 30 drinking water; 26 lettuce and black currant; 32 hair 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.

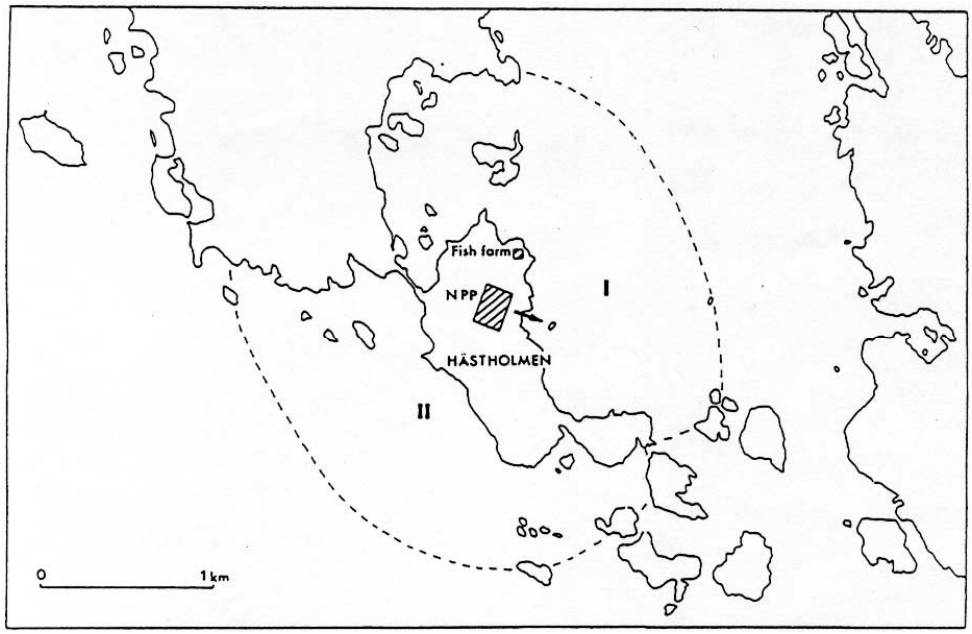

Figure 4. Fishing areas in Loviisa.

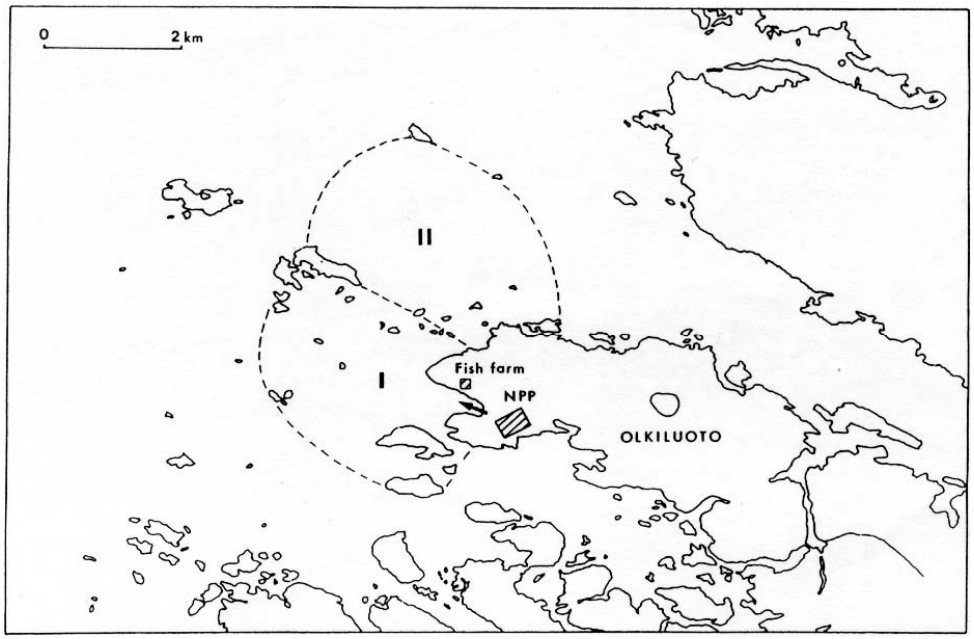

Figure 5. Fishing areas in Olkiluoto.

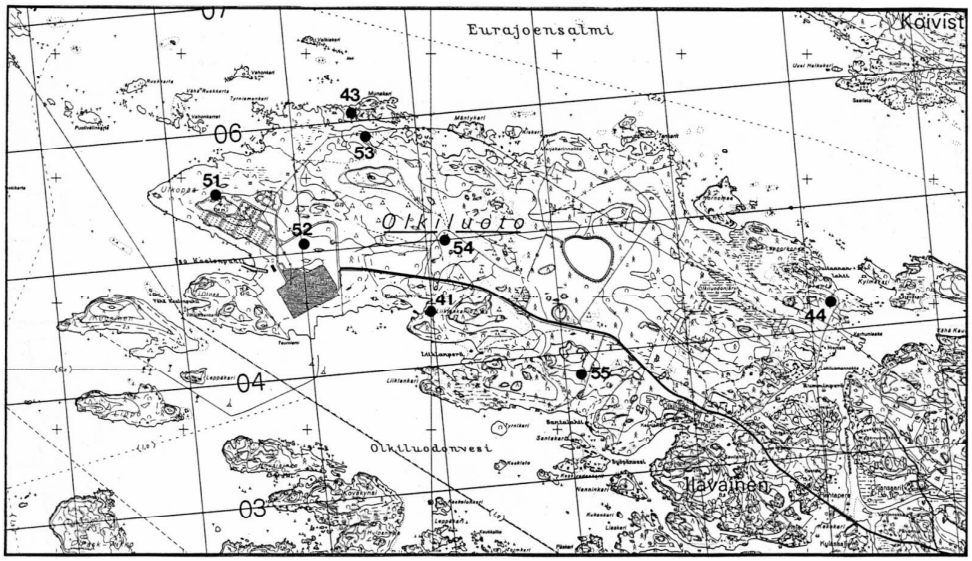

Figure 6. Sampling points and areas in the 1997 survey of soil, mushrooms and wild berries in Olkiluoto.

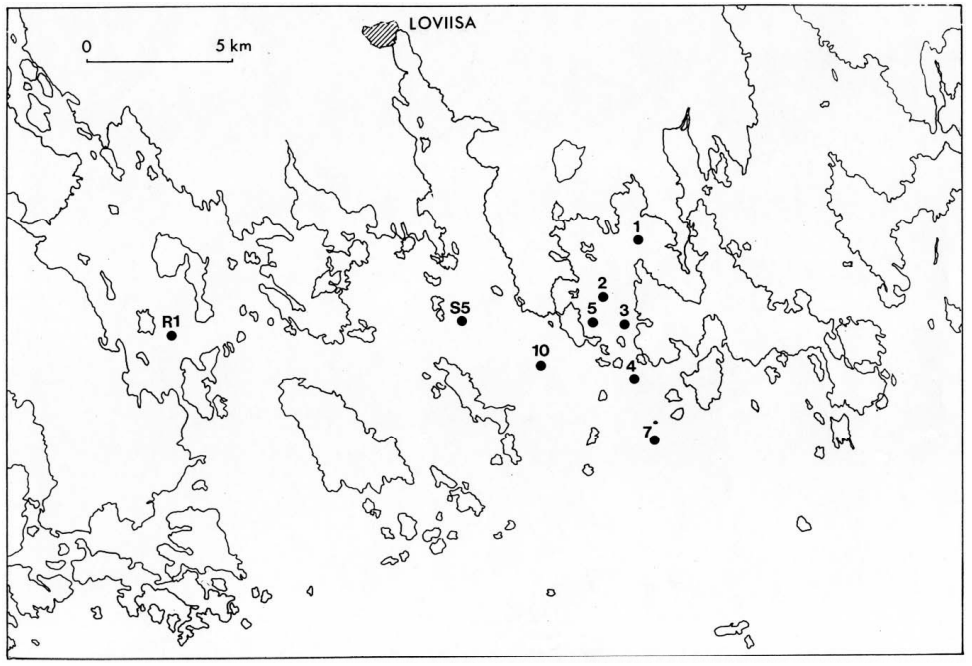

Figure 7. Sampling stations in the 1998 sediment survey in Loviisa.

4 Material and methods

The sampling and analysis methods used in environmental monitoring at Loviisa and Olkiluoto are described in our previous Annual Reports [3, 4, 5, 6, 7, 8, 9]. Only changes or additions to the earlier descriptions or deviations from the normal practise are given in this section.

In order to determine the quality of the sampling and analysis methods, our laboratory has in recent years participated in several intercomparisons and proficiency tests conducted by different organizations such as the International Atomic Energy Agency and its Marine Environment Laboratory, Nordic Nuclear Safety Research, 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, which is expressed as a relative uncertainty (%) at a 68% confidence level.

Two radiochemical methods were used for strontium separation during the period. Until 1998, the old fuming nitric acid precipitation method was used for the separation of Sr [4]. A new method was brought into use gradually during 1998. The method was based on the specific separation of Sr with a chromatographic extraction using a special reagent *Sr Resin*® (Eichrom). Preconcentrations of environmental samples were performed as in the older method, but time-consuming precipitations were replaced with the extraction. This method is described in detail elsewhere [10].

4.1 Air

The positions of two air sample collectors were changed at Loviisa. One collector was moved from site 22 to site 33 (cf. Fig. 2). The other one was moved about 200 m to the east at the site 24. The new sampling positions were taken into use in 1998-1999. The collectors themselves were the same as earlier.

4.2 Deposition and terrestrial environment

The positions of two deposition collectors were changed in Loviisa. One collector was moved from site 22 to site 33 (cf. Fig. 2). The other one was moved

about 200 m to the east at the site 24. The new sampling positions were taken into use in 1998-1999. At the same time, the old stainless steel collectors [8] at Loviisa 24 and (22)33 were replaced by all-year-round-warmed 0.07 m^2 collectors (Ritva collectors, see Fig. 8) and an additional new Ritva collector was taken to use at the site Loviisa 27. Correspondingly, the old stainless steel collectors at Olkiluoto 26 and 31 were replaced by new Ritva collectors at the beginning of July 1998, and an additional new Ritva collector was taken to use at the site Olkiluoto 37. The large-area (1 m^2) collectors at Loviisa 20 and Olkiluoto 21 were kept in use, as were the brass collectors for tritium samples (0.05 m^2) at Loviisa 20 and 33, and at Olkiluoto 21 and 26.

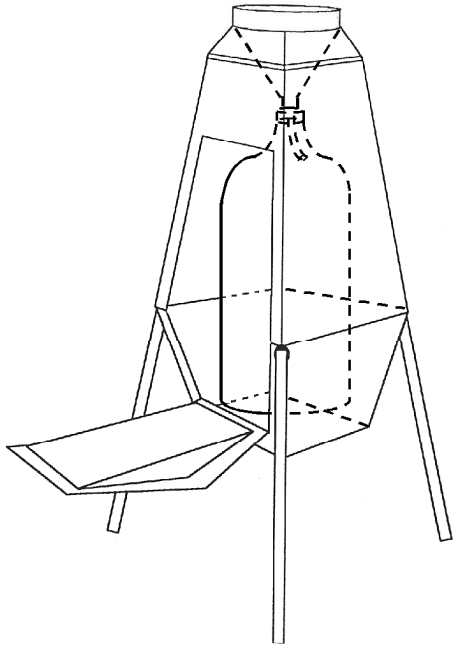

Figure 8. Design of the Ritva deposition collector.

Reindeer lichen and pine needles were taken as new indicator organisms into the monitoring programmes at Loviisa and Olkiluoto from the beginning of 1998.

The sampling points in the 1997 soil survey at Olkiluoto were same as in 1993 (Fig. 6). Sampling point 41 is a small open ground in a spruce forest with small spruces. Below a thin (3-4 cm) surface horizon of litter and peat, the soil turns to silt and fine sand. Sampling point 43 is an old vegetable garden with old

apple trees, but it has not been cultivated for dozens of years. The soil below the root horizon is mould or clay but deeper layers are sandy. Sampling point 44 is a former small field or meadow in the woods having been in a natural state for dozens of years. Below a thin (3 cm) litter horizon, the soil turns to clay. The methods used in soil sampling are described in [8]. Ten parallel cores were taken at each site and sliced into 0-2 cm, 2-4 cm, 4-6 cm and 6-22(33) cm slices. The parallel slices at each site were combined and homogenised for analysis. The samples were analysed for gamma-emitting nuclides and ^{90}Sr. Strontium was leached out using hydrochloric acid extraction.

4.3 Aquatic environment

Periphyton and the submerged seed plants *Myriophyllum spicatum* and *Potamogeton pectinatus* were taken as new indicator organisms into the monitoring programmes at Loviisa and Olkiluoto from the beginning of 1998. Periphyton is collected with large collection plates made of plywood (Fig. 9). The total collection area is 1 m^2 (both sides of the plate together). A large collection area is necessary to obtain a sufficient amount of periphyton for analysis. The plates are installed with buoys and anchors at a depth of 0.5-1 m close to the cooling water outlets of the power plants. Periphyton is scraped out from the plate into a large collection vessel 4 times during the growing season (May-September) and then transferred to a plastic box. The collection plates are used only for one growing season and then replaced by new ones. *Myriophyllum spicatum* and *Potamogeton pectinatus* are collected by SCUBA diving, as are *Fucus* samples.

The number of strontium analyses was reduced in the new monitoring programme taken into use at the beginning of 1998. The monitoring of the Olkiluoto Fish Farm was ended in 1997 because the hatchery closed.

Some sediment traps disappeared at Olkiluoto during the winter periods. The underwater winter-buoys carrying the traps were not found in the spring of 1997 at Stations Olkiluoto 3 and Olkiluoto 12 and in the spring of 1998 at Stations Olkiluoto 3 and Olkiluoto 15 (Table XXXVII). The reason was probably dislocation of the buoys by drifting ice. The winter-buoys at Loviisa were not found at Stations Loviisa 1 and Loviisa R1 in early May 1998 due to the high turbidity of the water. The buoys were found later in May, but new traps had already been installed at all the Stations on the 6 May. Consequently, the sampling periods at these two stations partly overlapped in May 1998 (Table XXXVI).

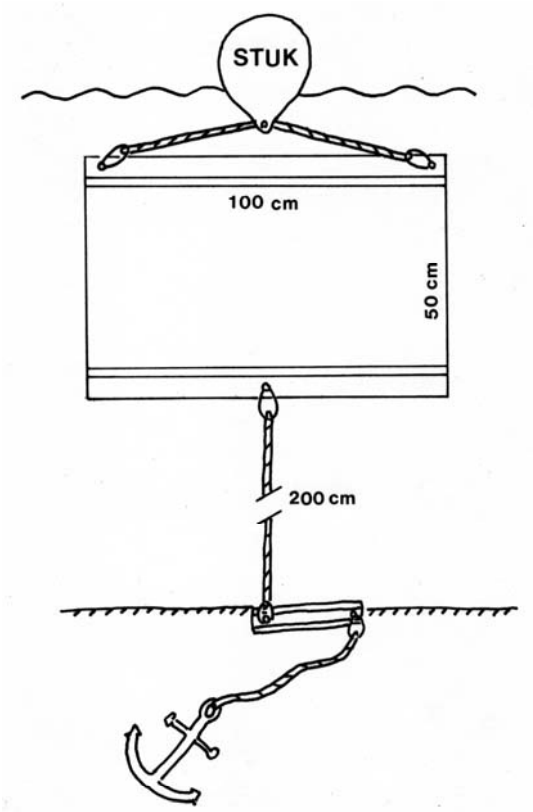

Figure 9. A periphyton collection plate.

The basic sampling stations (1, 2, 3, 4, 5, 7 10 and R1) in the 1998 sediment survey at Loviisa were same as in the earlier surveys in 1986, 1990 and 1994 but samples were also taken at one new station (S5). The locations of the sampling stations are shown in Fig. 7. The ordinary samples were taken using a Gemini Twin Corer [11] consisting of 2 parallel coring tubes with an inner diameter of 80 mm. One haul (2 parallel cores) was regularly taken using the Gemini at each station. The cores were sectioned into 5 cm thick subsamples, and the parallel subsamples were combined for analysis.

Sediment samples were taken at Station Loviisa 3 not only with the Gemini Twin Corer but also with a Niemistö corer, Limnos sampler, Aquarius box corer and STUK corer. The corers are described in [11]. These samples were taken for intercomparison purposes. The cores taken with the Aquarius box corer and STUK corer were sectioned into 5 cm thick slices and those taken with the Gemini, Niemistö and Limnos corers into 1 cm slices (Tables XXXIX and XLa-c).

The type of sediment at most of the stations was black and soft sulphidic mud. The muddy surface layer was softest and most watery at Stations 10, 7, 3 and S5 and the sulphidic mud or clay bottom was densest at Station 1. The sediment at Station R1 consisted of soft grey-brown clay with a relatively thin mud layer on the surface. The surface of the sediment was oxic at all the other stations except at Stations 10 and 7. The oxidized layer was strongest at Stations 1, R1 and 2.

4.4 Measurements of environmental gamma radiation

The frequency of environmental (*in situ*) gammaspectromeric measurements was reduced in the new programme. They have been performed every second year since 1998.

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 I-IV and those at Olkiluoto in Tables VI-IX. The radionuclide concentrations in the supplementary air samples at Loviisa and Olkiluoto are shown in Tables V and X, respectively.

Chernobyl-derived ^{137}Cs was the dominant artificial radionuclide in surface air in 1997 and 1998. It was detected in all samples, except one. The observed concentrations ranged from 0.6 to 17 µBq m^{-3} at Loviisa (Fig. 10) and from 1.3 to 57 µBq m^{-3} at Olkiluoto (Fig. 11).

Two filters from Olkiluoto contained about ten times more ^{137}Cs than the annual average, while the other filters from the same periods showed no similar increase. It is assumed that the increases were caused by 'hot' aerosol particles. Presuming that the whole cesium activity comes from one particle then the activities of the particles were about 1 Bq.

An increase of ^{137}Cs concentration in June 1997 and in September 1998 is common to both power plant sites. At the same time, the concentration of ^{7}Be also increased at all sampling sites, suggesting that the event was related to air transfer from stratosphere to ground level. There were no elevated beryllium concentrations during the smaller simultaneous increase in cesium concentration in May 1998. These events were also detected by most monitoring stations in the nation-wide network [12, 13, 14].

Concentrations of ^{134}Cs were well below the detection limit, and the only observation, in 1997 at Olkiluoto, coincided with the highest ^{137}Cs concentration. The ratio of the concentrations was typical for Chernobyl fallout in 1997, i.e. 1.9%. In 1997, the concentrations of ^{90}Sr were below the detection limit in both areas.

Nuclides originating from the local power plant were detected in five aerosol samples at Loviisa. The most frequent of these observations were those of ^{60}Co, which was detected four times during the years 1997 and 1998. Other radionuclides of local origin were ^{54}Mn and ^{58}Co, which were both detected once. Half of these observations were made during the maintenance periods at the Loviisa plant. The number of observations of local releases was less than one-third of the previous reporting period [3] and the concentrations remained very low, from a few tenths of microbecquerels to a few microbecquerels.

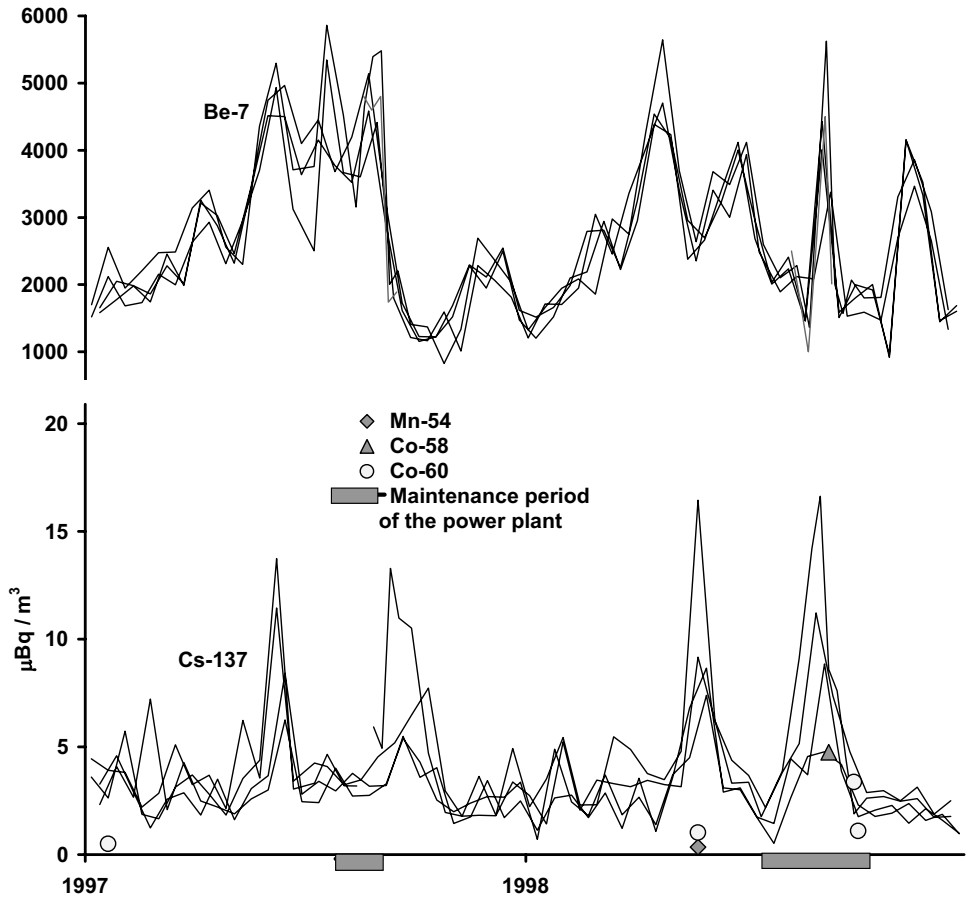

Figure 10. Concentrations of ^{7}Be and artificial nuclides detected in ground-level air (μBq m^{-3}) at four sampling stations in the vicinity of Loviisa NPP in 1997-1998.

At Olkiluoto, nuclides of local origin were detected in eight filters. The most frequent of these observations were those of ^{60}Co, which was detected in all eight samples. Another radionuclide of local origin was ^{54}Mn, which was detected twice in the reporting period. Most of these observations were made during the maintenance periods at the Olkiluoto plant.

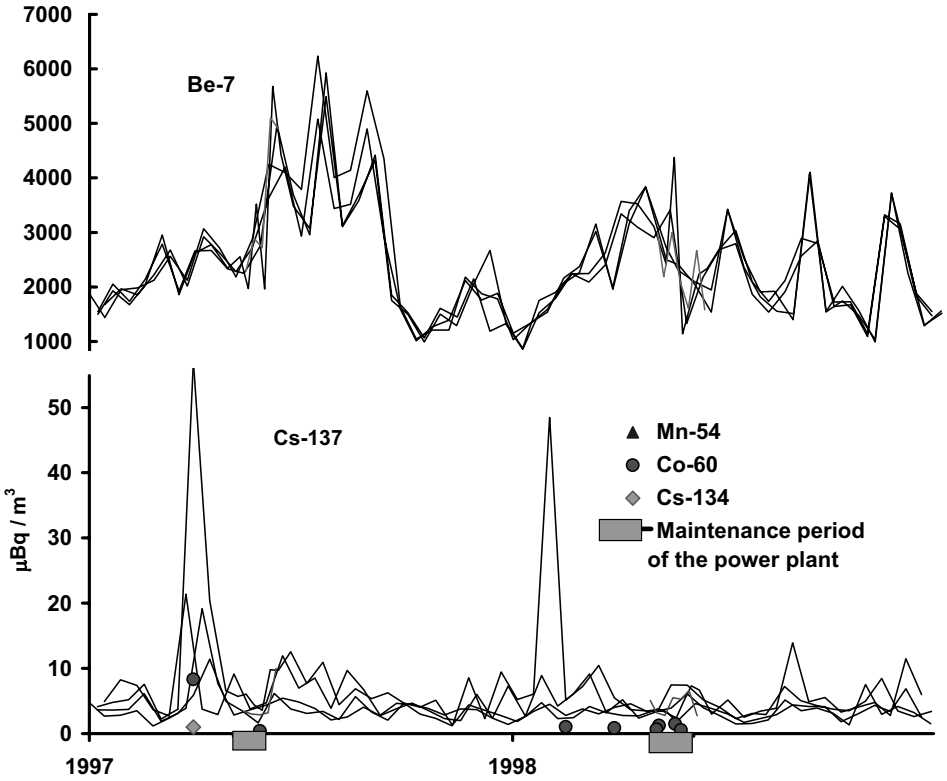

Figure 11. Concentrations of ^{7}Be and artificial nuclides detected in ground-level air at four sampling stations in the vicinity of Olkiluoto NPP in 1997-1998.

5.2 Deposition and terrestrial environment

Trace amounts of ^{60}Co were detected several times and those of ^{54}Mn and ^{58}Co fewer times during 1997 and 1998 in deposition samples from the large area collector in Loviisa (Table XI). These nuclides originated from the local NPP. In analogous samples from Olkiluoto, ^{60}Co was found more rarely in both years; ^{54}Mn and ^{58}Co were detected once in 1998 (Table XII). The observations of ^{60}Co in the large-area collectors at Loviisa and Olkiluoto after 1977 and 1981 respectively are shown in Figs. 12 and 13. Besides the observations of global fallout and the Chernobyl fallout (1980, 1981 and 1986), ^{60}Co of local origin has been detected more often at Loviisa than at Olkiluoto during the entire period. No traces of local discharge nuclides could be found in the samples collected at Stations Loviisa 22 and Olkiluoto 26 partly because the amounts of deposited material collected with small-area collectors are smaller.

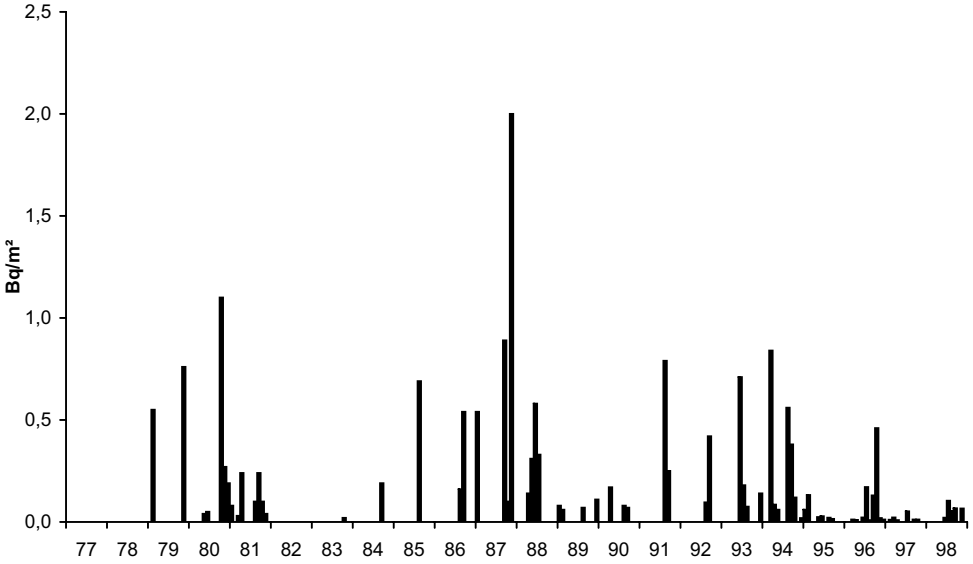

Figure 12. Observations of ^{60}Co in deposition samples at Station 20, Loviisa during 1977-1998.

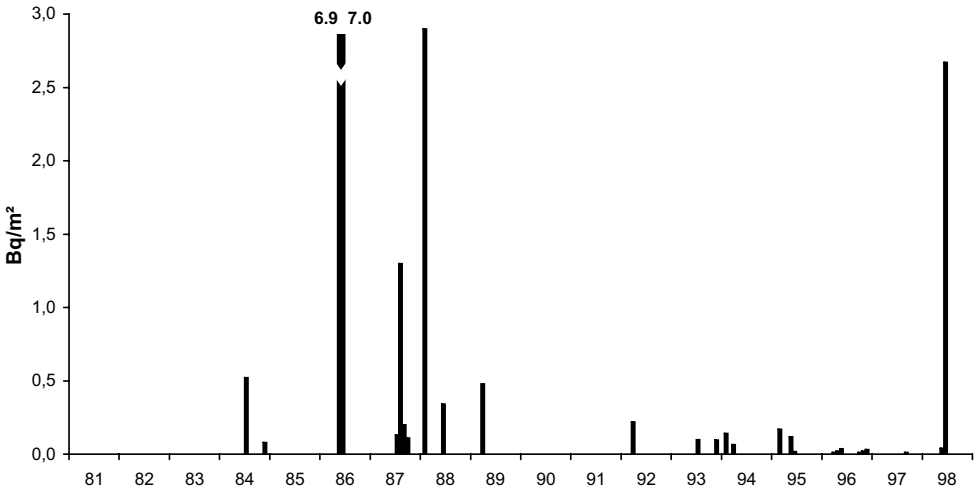

Figure 13. Observations of ^{60}Co in deposition samples at Station 21, Olkiluoto during 1981-1998.

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

The annual total depositions of ^{137}Cs, calculated from the quarterly results of the quantitative 0.05 m^2 collectors varied at Loviisa and Olkiluoto from 6 to 12 Bq m^{-2} (Table XIV). The total amounts were slightly smaller than in the previous two-year period [3].

The highest concentrations of Chernobyl-derived ^{90}Sr, ^{134}Cs and ^{137}Cs in the soil samples taken from Olkiluoto in 1997 (Table XV) were located in the two uppermost layers (0 - 4 cm). A trace amount of ^{125}Sb could also be found in one surface sample. No other nuclides originating from the local power plant were detected in the soil samples. The total amounts of ^{137}Cs varied between 10 000 and 21 000 Bq m^{-2}.

Generally, the amounts of ^{90}Sr were low in the hair moss samples (Table XVI). In Loviisa, the concentrations of ^{134}Cs and ^{137}Cs continued to decrease and in Olkiluoto they were at the same level as in previous years, but the levels of ^{137}Cs were still noticeably higher compared with those of the years before the Chernobyl accident [16]. Despite generally higher Chernobyl fallout in the Olkiluoto area, the ^{137}Cs concentrations in the hair moss samples were clearly higher in the Loviisa area due to the local habitat.

^{134}Cs and ^{137}Cs were the only artificial gamma-emitting radionuclides in grazing grass (Table XVII).

The higher Chernobyl fallout of ^{137}Cs in the Olkiluoto area, when compared with the Loviisa area, can be clearly seen in concentrations of pine needles and reindeer lichen samples (Table XVIII). In lichen, which accumulates cesium very well from deposition, the concentration of ^{137}Cs was as high as 8900 Bq kg^{-1} d.w. at Olkiluoto. NPP originating ^{54}Mn and ^{60}Co could be found in the lichen sample from Olkiluoto in 1998.

The ditchwater samples taken from the exempted-waste dump at Olkiluoto contained ^{134}Cs (in 1997) and ^{137}Cs from the Chernobyl fallout, but the higher values for ^{137}Cs in 1998 were probably due to local waste (Table XIX).

5.3 Foodstuffs

In 1997, the annual mean concentrations of ^{90}Sr in milk samples representing a 0 - 40 km zone around Loviisa and the entire output of the local dairy in Olkiluoto were 0.051 Bq l^{-1} and 0.065 Bq l^{-1}, and the respective concentrations in 1998 were 0.030 Bq l^{-1} and 0.041 Bq l^{-1} (Tables XXIIa and XXIIb). The amounts of ^{90}Sr were approximately at pre-Chernobyl levels. The ^{137}Cs contents in milk continued to decrease slowly (Tables XX and XXI). ^{134}Cs could still be seen occasionally in milk from the both of areas. ^{131}I was not detected in the milk samples taken at either Loviisa or Olkiluoto during 1997 - 1998.

Trace amounts of ^{60}Co and ^{110m}Ag were detected in one drinking water sample taken from Loviisa NPP (Table XXIIIa). The sample was taken by employees of the power plant. It might be possible that the sample was contaminated from the hands or clothes of the person who took the sample. No other traces of fresh releases from the NPPs were detected in the foodstuff samples. The other artificial radionuclides detected were ^{90}Sr, ^{134}Cs and ^{137}Cs, which originated from the Chernobyl accident and older global fallout.

The contents of ^{90}Sr in drinking water (Tables XXIIIa and b) were at the same level as in the early 1980s. The ^{137}Cs contents generally continued to decrease slowly or were at the same level as in previous years [3]. A clear difference between the ^{137}Cs concentrations in the drinking water taken from the Loviisa NPP compared with that of the Olkiluoto NPP and the town of Rauma has been found since the Chernobyl accident [4]. This is due to the type of soil, which is very clay-rich on the west coast of Finland (Olkiluoto and Rauma), effectively retaining cesium in the soil. This phenomenon reduces concentrations in surface waters. The water supply in the town of Loviisa is from groundwater, which explains the very low concentration of artificial radionuclides in these samples.

The concentrations of tritium in all tap 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 (Table XXIV). The ^{137}Cs and ^{134}Cs contents in garden produce and beef (Tables XXV and XXVI) generally showed a slightly decreasing trend compared with those of the previous years.

Only Chernobyl-derived gammanuclides, ^{134}Cs and ^{137}Cs, were found in mushrooms and wild berries picked from the Olkiluoto area (Table XXVII). The concentrations fell within the ranges reported for the same species in the same fallout area after the Chernobyl accident [16]. As in general, the concentrations were highest in mushrooms of the genus *Russula*.

Fish samples are discussed in Section 5.4.3.

5.4 Aquatic environment

5.4.1 Seawater

Tritium in seawater generally originates from the 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 ^{3}H is still the most abundant radionuclide in seawater. Nevertheless, ^{3}H is also produced in nuclear reactors, and consequently it is the predominant radionuclide both in airborne and liquid discharges from nuclear power plants.

The concentrations of ^{3}H in Finnish coastal waters decreased from about 10-15 kBq m^{-3} to less than 5 kBq m^{-3} between the late 1970s and late 1990s. It is therefore obvious that local discharges have contributed to the values higher than 5 kBq m^{-3} in the Loviisa and Olkiluoto sea areas. In 1997-1998, the maximum concentration of ^{3}H was about 27 kBq m^{-3} in the discharge area of Loviisa and 6.6 kBq m^{-3} in Olkiluoto (Tables XXVIII-XXIX). Elevated ^{3}H concentrations were more frequent in Loviisa (Fig. 14), which is due to larger discharges, and to the slower exchange of water in the discharge area at Loviisa. Besides ^{3}H, ^{60}Co was the only local discharge nuclide detected in seawater samples. Small amounts of ^{60}Co were observed in three seawater samples taken close by the Olkiluoto power plant in May 1997 and August 1998 (Tables XXIXa-b).

The ^{137}Cs and ^{134}Cs found in seawater in both areas mainly originated from the Chernobyl fallout and ^{90}Sr from the global fallout caused by the atmospheric nuclear weapons tests. Due to its short half-life (2.06 years), the concentrations of ^{134}Cs began to fall below the detection limit in 1997-1998.

In 1998, the mean ^{137}Cs concentration of seawater was 53 (44-61 Bq m^{-3}) in Loviisa and 87 (75-103 Bq m^{-3}) in Olkiluoto. Since the Chernobyl accident in 1986, the cesium concentrations have decreased more rapidly in Loviisa and in the whole of the Gulf of Finland than they have in Olkiluoto and the Bothnian Sea. In Figure 15, Station LL3a represents the open sea in front of Loviisa and Station EB1 that in front of Olkiluoto. During 1986-1998, the decrease in ^{137}Cs values was about 88% in Loviisa, but only 74% in Olkiluoto. The main reason for the different decreasing rates of cesium levels 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 than it does in Olkiluoto and consequently the exit rate of cesium from seawater in the discharge area. The ^{90}Sr concentrations in seawater ranged from 12 to 14 Bq m^{-3} in Loviisa and from 10 to 16 Bq m^{-3} in Olkiluoto.

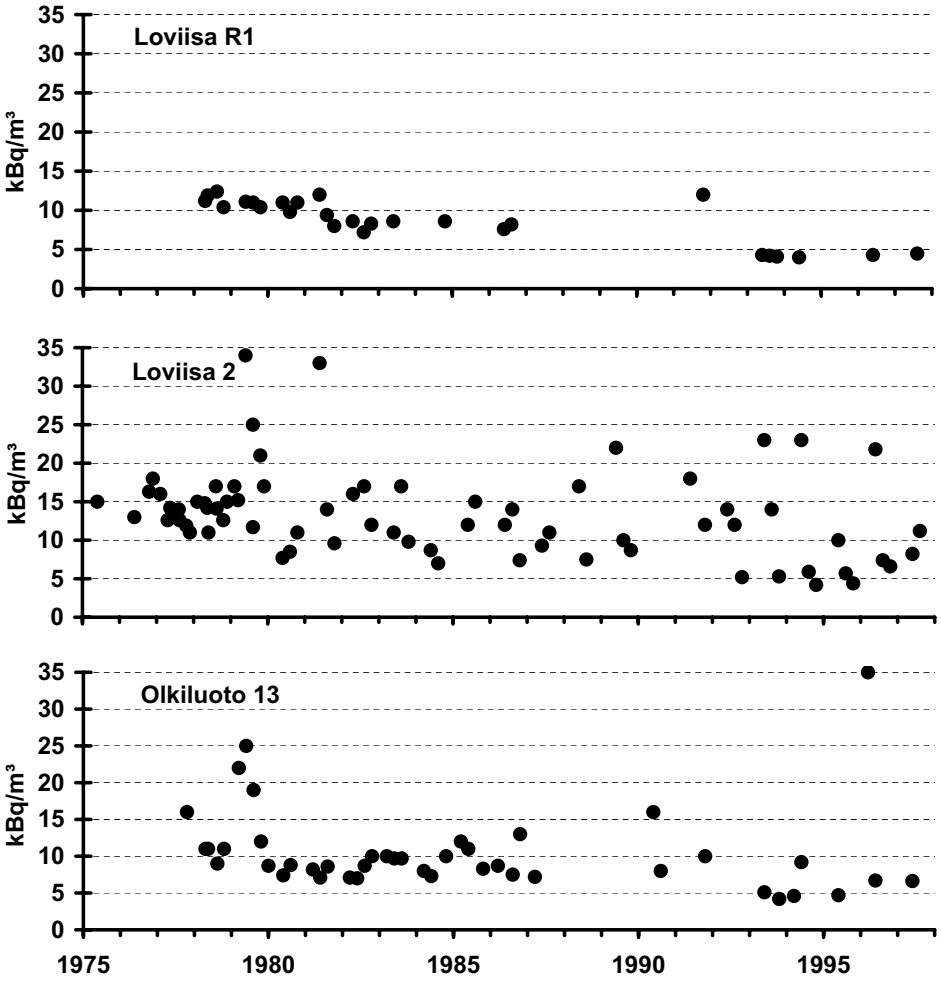

Figure 14. Tritium concentrations in seawater at Stations Loviisa R1, Loviisa 2 and Olkiluoto 13 in 1976-1998 (detection limit 4 kBq m^{-3}).

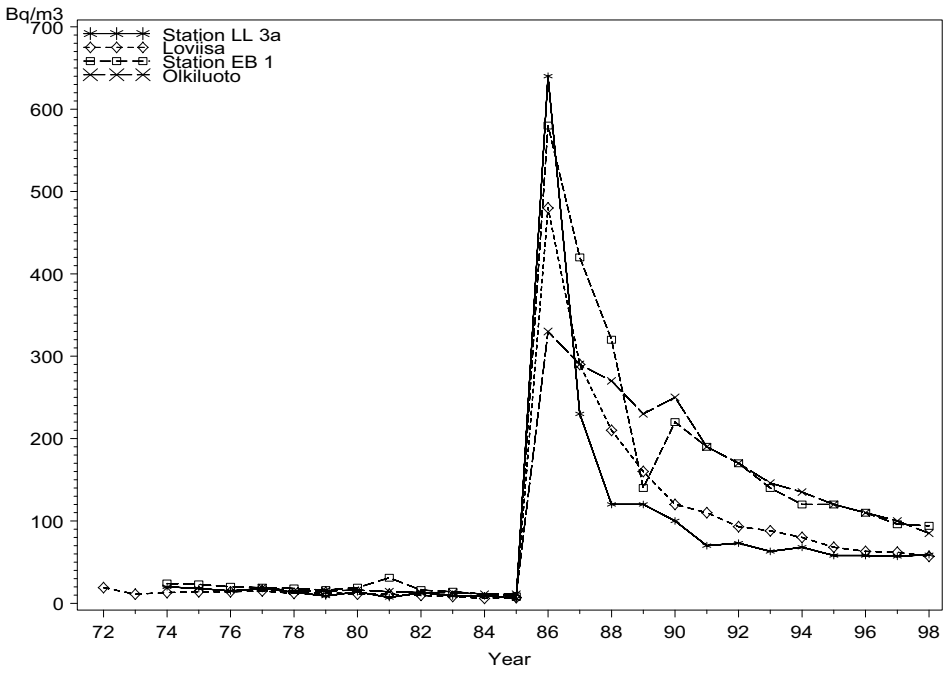

Figure 15. Late-summer mean concentrations of ^{137}Cs in surface seawater at Loviisa and Olkiluoto, and the nearest offshore Stations LL3a (Gulf of Finland) and EB 1 (Bothnian Sea) in 1972-1998.

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, as have the relict crustacean *Saduria entomon* in Loviisa and the bivalve mussels *Mytilus edulis* and *Macoma baltica* in Olkiluoto. Since 1998, periphyton and the submerged seed plants *Myriophyllum spicatum* and *Potamogeton pectinatus* were taken as new indicator organisms into the monitoring programmes at both power plants. Indicator organisms effectively accumulate radionuclides from water and sediments, thus promoting the detection of small traces of radionuclides in the environment.

Activity concentrations of Chernobyl-derived cesium in indicator organisms continued to decrease in both areas. In Loviisa however, the cesium concentrations in *Fucus vesiculosus* have decreased slower than in seawater. Thus, the concentrations in *Fucus* are still at the same level at Loviisa and Olkiluoto, although the concentrations in seawater are clearly lower at Loviisa.

In 1998, the mean ^{137}Cs concentration of all *Fucus* samples collected from Loviisa was 50 (29-87) Bq kg^{-1} dry wt. and 50 (38-73) Bq kg^{-1} dry wt. at Olkiluoto (Tables XXXb and XXXIb). As before, a clear difference occurred between the cesium values at the outermost and innermost sampling sites in both areas, the values being higher at the innermost sites. The potential contribution of the thermal effect caused by cooling water from the power plants to the areal differences has been discussed in our previous reports, as well as that of low water-salinity, high turbidity and other hydrographic characteristics typical for the discharge areas [7, 8]. Nevertheless, the ^{137}Cs discharges from the power plants may also give some rise to the concentrations in the vicinity of the discharge points.

Periphyton seems to accumulate cesium much more effectively than the old indicator organisms *Fucus, Cladophora* and the benthic animals. *Myriophyllum* seems to be a little bit better indicator than *Fucus* and *Potamogeton.* In 1998, the activity concentration of ^{137}Cs in *Cladophora* was 23 Bq kg^{-1} dry wt. at Loviisa and 38 Bq kg^{-1} dry wt. at Olkiluoto (Tables XXXb and XXXIb). In periphyton, the values were 230-420 Bq kg^{-1} dry wt. at Loviisa and 400-520 Bq kg^{-1} dry wt. at Olkiluoto. In *Saduria* from Loviisa, the concentration was 29 Bq kg^{-1} dry wt. and in *Macoma* from Olkiluoto, it was 17 Bq kg^{-1} dry wt. In *Mytilus* from Olkiluoto, the ^{137}Cs concentration was about 4 Bq kg^{-1} dry wt. (Table XXXII).

Differently from the cesium isotopes, ^{90}Sr and ^{239,240}Pu originate mainly from the nuclear weapons tests. The activity concentrations of ^{90}Sr in *Fucus* ranged from 10 to 16 Bq kg^{-1} dry wt. in Loviisa and from 9 to 11 Bq kg^{-1} dry wt. in Olkiluoto. In benthic animals, the ^{90}Sr concentrations were a little higher (15-16 Bq kg^{-1} dry wt. in *Saduria* and 17-21 Bq kg^{-1} dry wt. in *Macoma*). The activity concentrations of ^{239,240}Pu were 0.04-0.11 Bq kg^{-1} dry wt. in the *Fucus* samples collected from both areas. 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 [17, 18].

The other radionuclides detected in the indicator organisms originated from local discharges; i.e. ^{54}Mn, ^{58}Co, ^{59}Fe, ^{60}Co, ^{95}Nb, ^{95}Zr, ^{110m}Ag and ^{124}Sb in Loviisa, and ^{54}Mn, ^{58}Co and ^{60}Co in Olkiluoto. ^{59}Fe, ^{95}Nb and ^{95}Zr were observed only in periphyton samples collected near to the cooling water outlet at Loviisa.

In general, the activity concentrations of the above-mentioned local discharge nuclides were somewhat higher in the Olkiluoto area than in Loviisa (Fig. 16). In 1998, the highest ^{60}Co concentration found in indicator organisms was 83 Bq kg^{-1} dry wt. in the periphyton sampled near the cooling water outlet

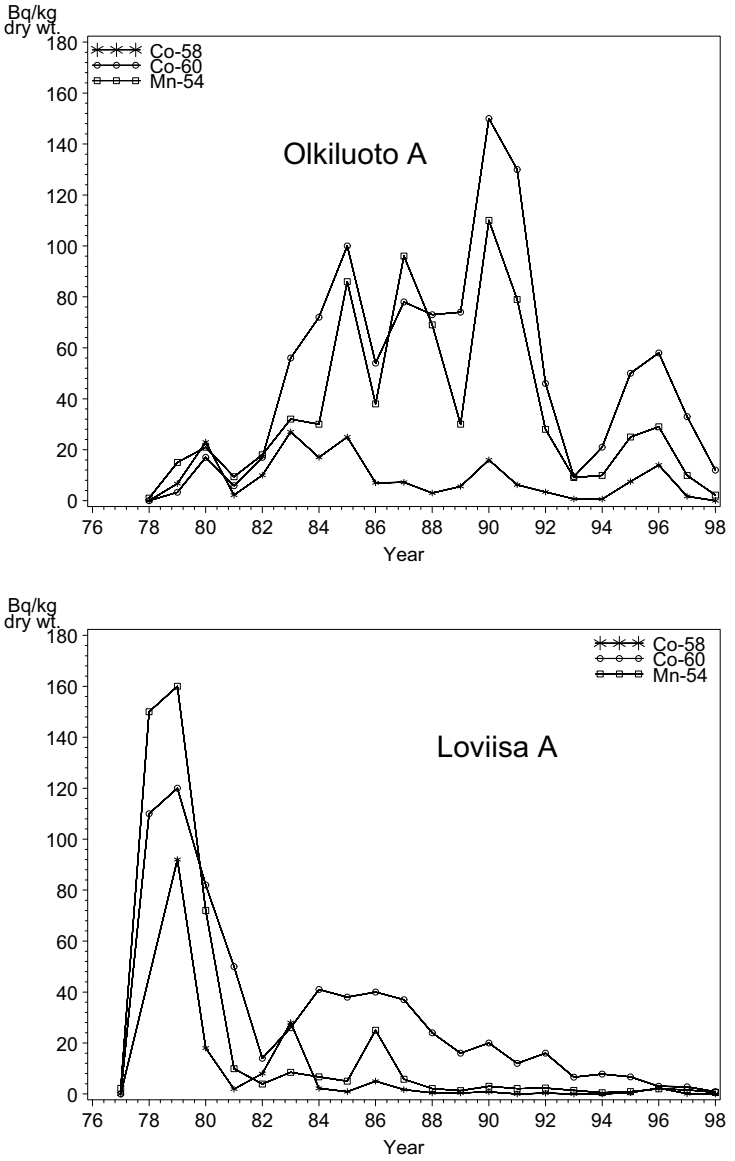

Figure 16. Annual mean concentrations of ^{54}Mn, ^{58}Co and ^{60}Co in *Fucus vesiculosus* at sampling Stations Olkiluoto A and Loviisa A in 1977-1998.

at Loviisa but in *Fucus,* the concentrations were very low (less than 2 Bq kg^{-1} dry wt.). At Olkiluoto, the mean concentration of ^{60}Co in *Fucus* was 12 Bq kg^{-1} dry wt. at the innermost sampling site (A) and 1 Bq kg^{-1} dry wt. at the outermost sampling site (C).

The new sampling objects in the monitoring programmes (and first of all periphyton) seem to be excellent indicator organisms for most of the local discharge nuclides detected in environmental samples monitored at Loviisa and Olkiluoto. Besides periphyton, *Myriophyllum* also seems to be a good indicator and *Potamogeton* is at least equal to *Fucus.* Nevertheless, *Fucus* seems to be a better indicator than seed plants e.g. for cesium. *Saduria* is a good indicator for ^{110m}Ag and ^{60}Co. *Myriophyllum* seems to accumulate effectively ^{58}Co, *Mytilus* ^{60}Co and *Cladophora* ^{54}Mn.

5.4.3 Fish

The cesium concentrations in fish samples caught at Loviisa and Olkiluoto were consistent with those of seawater, the concentrations being in all fish species somewhat higher at Olkiluoto than at Loviisa (Tables XXXIII-XXXIV). In general, the differences between the fish species were the same as previously: the concentrations were highest in perch and lowest in roach.

In 1998, the highest ^{137}Cs concentration in perch was 53 Bq kg^{-1} fresh wt. at Olkiluoto and 29 Bq kg^{-1} fresh wt. at Loviisa. The activity concentrations of ^{90}Sr, ^{134}Cs and ^{137}Cs in pike and Baltic herring were in both areas at the same level as on the Finnish coast in general (perch and roach are not monitored regularly). Local discharge nuclides were not detected in fish samples caught at Loviisa and Olkiluoto in 1997-1998.

The activity concentrations of ^{137}Cs in fish samples taken from the fish farms operating in association with the Loviisa and Olkiluoto NPPs were clearly lower than in the free-living fish and ^{134}Cs was no longer detectable (Tables XXXV). The highest ^{137}Cs concentration in farmed fish was 2.4 Bq kg^{-1} fresh wt. It was stated earlier that the low concentrations are due to the low cesium contents of the feed used by the farms. Only once were traces of local discharge nuclides found in a fish sample taken from the fish farms. In May 1994, the concentrations of ^{60}Co and ^{54}Mn were very low; i.e. 0.13 and 0.05 Bq kg^{-1} fresh wt. in young salmon taken from the Olkiluoto fish farm [9]. The Olkiluoto Fish Farm was closed in 1997.

5.4.4 Sinking matter

Suspended particulate matter can be considered as a non-living indicator of radionuclides in the aquatic environment as many radionuclides tend to adsorb to sinking particles. The affinity of cesium to clay particles is well known, but many other nuclides seem to have a similar tendency. Since many problems are involved in sampling 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 substituted by continuous round-the-year collection of sinking matter.

The activity concentrations of ^{137}Cs and ^{134}Cs in sinking matter were clearly higher than in indicator organisms. In 1998, the mean concentration of ^{137}Cs was 715 (600-850) Bq kg^{-1} dry wt. at Hästholmsfjärden (Station 3) in Loviisa, 750 (630-850) Bq kg^{-1} dry wt. at Reference Station Loviisa R1 and 708 (660-750) Bq kg^{-1} dry wt. at Station Olkiluoto 12. (Tables XXXVI-XXXVII). The slightly higher values in the Loviisa area are explained by the higher particle content in water [7].

The ^{54}Mn, ^{58}Co, ^{60}Co and ^{95}Zr found in sinking matter at Loviisa, as well as the ^{54}Mn, ^{60}Co and ^{125}Sb at Olkiluoto, originated from local discharges. The maximum concentration of these nuclides was 63 Bq kg^{-1} dry wt. of ^{60}Co in a sample collected during late autumn in 1998 at Station Olkiluoto 12. No traces of local discharges were detected at Reference Station Loviisa R1 located about 14 km to the west of the Loviisa NPP. However, ^{60}Co was regularly detected at Station Olkiluoto 15 located 10 km to the north of the Olkiluoto NPP. The long-term fluctuations of ^{54}Mn, ^{58}Co and ^{60}Co in sinking matter collected during the open-water periods at Stations Loviisa 3 and Olkiluoto 2 (12 since 1993) are illustrated in Fig. 17.

The activity concentrations of ^{238}Pu and ^{239,240}Pu in sinking mater were 0.026-0.032 Bq kg^{-1} dry wt. and 0.66-1.1 Bq kg^{-1} dry wt. at Loviisa, and 0.065-0.13 and 1.3-2.1 Bq kg^{-1} dry wt. at Olkiluoto, respectively (Table XXXVIII).

5.4.5 Bottom sediments

Besides the fallout nuclides principally originating from the nuclear weapons tests (^{90}Sr, ^{238}Pu and ^{239,240}Pu) and from the Chernobyl accident (^{134}Cs and ^{137}Cs), the sediment samples taken during the 1998 sediment survey at Loviisa also contained smaller amounts of ^{60}Co, ^{124}Sb and ^{125}Sb (Tables XXXIX-XL). The observations of ^{124}Sb and ^{125}Sb were quite random but ^{60}Co was detected at all other sampling stations except Stations S5 and R1.

The peak values of cesium caused by the Chernobyl fallout occurred in the 10-15 cm sediment layer at most stations. Fig. 18 illustrates the vertical

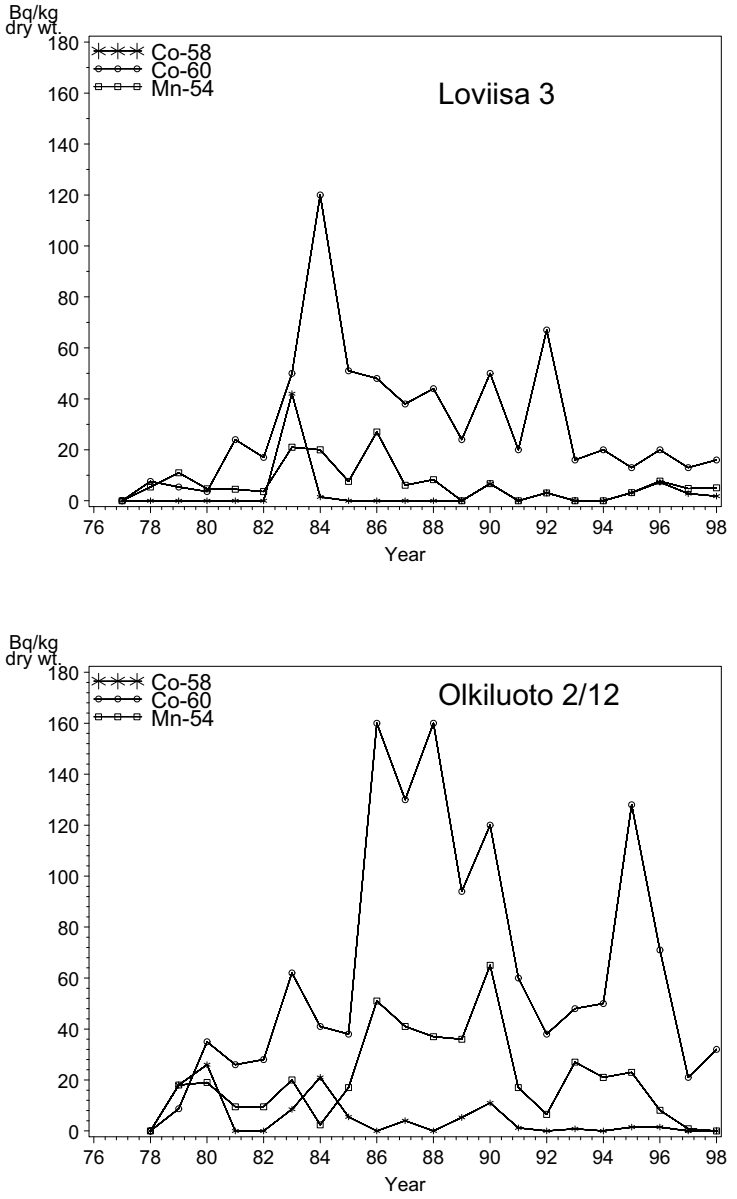

Figure 17. Mean concentrations of ^{54}Mn, ^{58}Co and ^{60}Co in sinking matter at Stations Loviisa 3 and Olkiluoto 2/12 during the open-water period in 1977-1998.

distribution of ^{137}Cs in 1 cm slices at Station 3 in 1986-1998. In 1998, the highest activity concentration of ^{137}Cs (5200 Bq kg^{-1} dry wt.) was found in the 12-13 cm layer (Table XLa) and the highest ^{60}Co concentration (36 Bq kg^{-1} dry wt.) in the

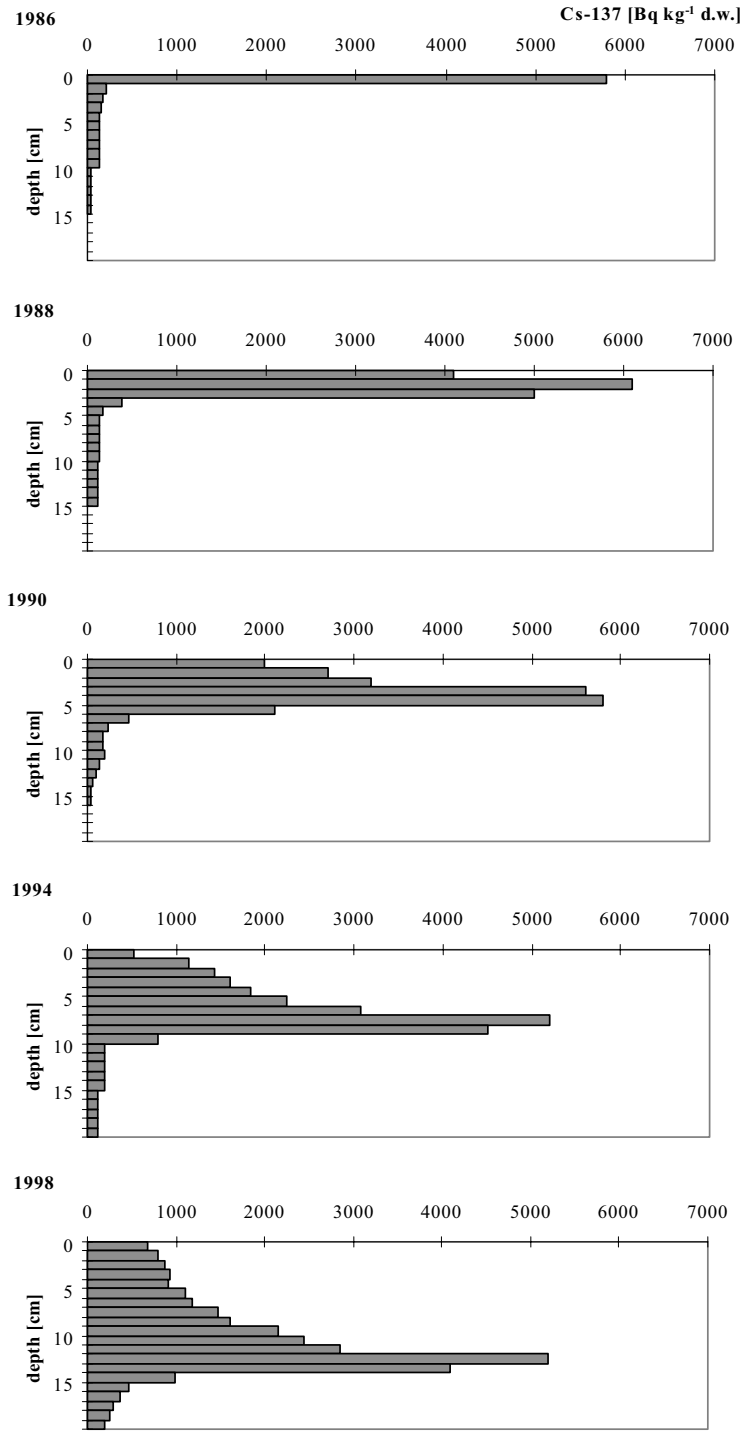

Figure 18. Vertical distribution of ^{137}Cs concentrations at Station Loviisa 3 in 1986–1998.

8-9 cm layer (Table XLc). The deepest observations of ^{60}Co were generally in the layers less than 15 or 20 cm. The sedimentation rate at this station is estimated at about 7-8 mm y^{-1} (0.08-0.10 g cm^{-2} y^{-1}) [19]. Thus, the occurrence of locally discharged ^{60}Co in the 15-20 cm layer is in agreement with the sedimentation rate, given that the power plant was commissioned in 1977. The cesium peak in the 12-13 cm layer results in a slightly higher sedimentation rate.

The highest total amount of ^{137}Cs was 49 200 Bq m^{-2} in the sample taken by the STUK Corer at Station 3 and the lowest was 23 300 Bq m^{-2} taken at Station 7. In general, the total amounts were equal or somewhat higher than in the preceding 1994 sediment survey.

The results obtained with different corers from Station 3 were statistically tested using the same method as in [11]. The differences between the corers were tested by calculating relative differences from the reference corer. The selection criteria for the reference corer were as follows: 1) lowest dry weight in surface layer, 2) the highest ^{137}Cs peak in the sediment profile, 3) the highest total amount of ^{137}Cs in the core, and 4) the total amount of ^{137}Cs in the profile nearest to the median of the results. In this comparison, the smallest average differences were obtained for the Limnos sampler and for the Gemini Twin Corer when the core was sliced into 1 cm slices:

Limnos	0.05
Gemini (1 cm slices)	0.09
Aquarius	0.21
STUK Corer	0.23
Gemini (5 cm slices)	0.27
Niemistö Corer	0.34

The activity concentrations of ^{90}Sr, ^{238}Pu and ^{239,240}Pu in the sediment samples taken from the Loviisa area were 3-11 Bq kg^{-1}, 0.04-0.08 Bq kg^{-1} and 0.8-2.2 Bq kg^{-1} dry wt., respectively. These values do not diverge from those typical for the Gulf of Finland.

5.5 Measurements of environmental gamma radiation

The results of the measurements made at the dosimeter stations in 1997 and 1998 are given in Tables XLI and XLII. The values ranged from 0.12 to 0.22 µSv h^{-1} in the Loviisa area and from 0.10 to 0.15 µSv h^{-1} in the Olkiluoto area. Table XLIII shows the fallout nuclides 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 using 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 1997 and 1998 are summarised in the following table:

		From airborne releases	From aquatic releases
Individual dose (μSv)			
Loviisa	1997	0.026	0.009
	1998	0.004	0.047
Olkiluoto	1997	0.002	0.049
	1998	0.002	0.013
Collective dose (manSv)			
Loviisa	1997	1.3×10^{-3}	4.2×10^{-6}
	1998	1.5×10^{-3}	3.1×10^{-4}
Olkiluoto	1997	1.6×10^{-4}	5.4×10^{-4}
	1998	2.3×10^{-4}	1.4×10^{-4}

The collective doses were calculated for the population residing within 80 km of the power plant. 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. 19. In 1998, the dose for the critical group at Loviisa increased more than tenfold compared with the previous years. This is mainly due to the aquatic releases of ^{60}Co, which increased by two orders of magnitude compared with the year 1997 (cf. Section 2).

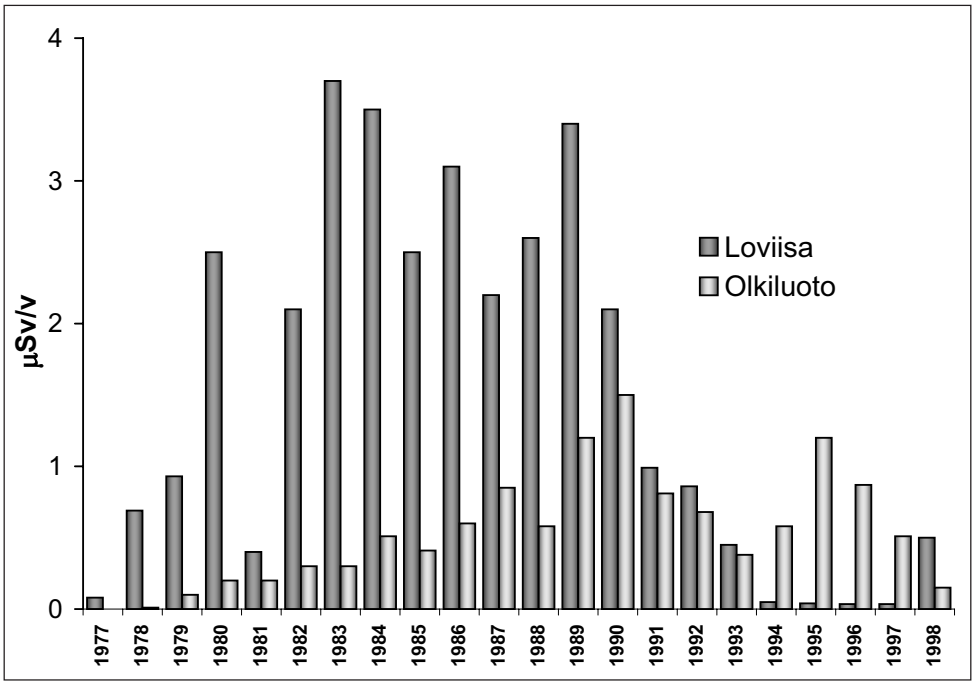

Figure 19. Average doses to critical groups in the vicinities of Finnish NPPs since beginning of power production.

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Table Ia. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 21 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{60}Co		^{137}Cs	
31.12.1996	-	14.1.1997	1700	3	0		3.7	7
14.1.1997	-	28.1.1997	2550	3	0.6	15	2.7	7
28.1.1997	-	11.2.1997	1950	3	0		5.8	7
11.2.1997	-	25.2.1997	2210	3	0		2.0	8
25.2.1997	-	11.3.1997	2480	3	0		1.8	15
11.3.1997	-	25.3.1997	2480	3	0		3.2	10
25.3.1997	-	8.4.1997	3100	3	0		3.8	10
8.4.1997	-	22.4.1997	3400	3	0		2.9	10
22.4.1997	-	6.5.1997	2560	3	0		1.9	8
6.5.1997	-	20.5.1997	2300	3	0		3.6	9
20.5.1997	-	3.6.1997	4400	3	0		4.5	8
3.6.1997	-	17.6.1997	5300	3	0		13.8	5
17.6.1997	-	1.7.1997	3700	3	0		3.1	11
8.7.1997	-	15.7.1997	3800	3	0		3.4	19
15.7.1997	-	29.7.1997	5900	5	0		4.8	13
29.7.1997	-	12.8.1997	4500	5	0		3.3	10
12.8.1997	-	19.8.1997	3200	5	0		3.3	18
19.8.1997	-	26.8.1997	4700	5	0		0	
26.8.1997	-	2.9.1997	5400	3	0		6.0	19
2.9.1997	-	9.9.1997	5500	3	0		5.0	14
9.9.1997	-	16.9.1997	2000	3	0		13.4	7
16.9.1997	-	23.9.1997	2200	3	0		11.1	8
23.9.1997	-	7.10.1997	1410	3	0		10.6	4
7.10.1997	-	21.10.1997	1370	3	0		4.8	6
21.10.1997	-	4.11.1997	830	4	0		2.1	9
4.11.1997	-	18.11.1997	1340	3	0		1.9	10
18.11.1997	-	2.12.1997	2690	3	0		1.9	15
2.12.1997	-	16.12.1997	2360	3	0		1.9	15
16.12.1997	-	30.12.1997	2030	3	0		3.5	9

0 = below the detection limit

Table Ib. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 21 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period	^{7}Be	^{54}Mn	^{58}Co	^{60}Co	^{137}Cs
30.12.1997 - 13.1.1998	1330 3	0	0	0	2.8 9
13.1.1998 - 27.1.1998	1660 3	0	0	0	1.5 21
27.1.1998 - 10.2.1998	1950 3	0	0	0	5.3 8
10.2.1998 - 24.2.1998	2090 3	0	0	0	2.2 12
24.2.1998 - 10.3.1998	1860 3	0	0	0	3.6 10
10.3.1998 - 24.3.1998	2980 3	0	0	0	3.4 10
24.3.1998 - 7.4.1998	2750 3	0	0	0	3.2 11
7.4.1998 - 21.4.1998	4300 3	0	0	0	3.5 9
21.4.1998 - 5.5.1998	5600 3	0	0	0	3.3 13
5.5.1998 - 19.5.1998	3700 3	0	0	0	3.2 11
19.5.1998 - 2.6.1998	2640 3	0.4 26	0	1.1 12	9.3 4
2.6.1998 - 16.6.1998	3700 3	0	0	0	6.3 8
16.6.1998 - 30.6.1998	3500 3	0	0	0	4.5 10
30.6.1998 - 14.7.1998	4100 3	0	0	0	3.8 6
14.7.1998 - 28.7.1998	2600 3	0	0	0	2.3 8
28.7.1998 - 11.8.1998	2100 3	0	0	0	4.0 6
11.8.1998 - 25.8.1998	2280 5	0	0	0	9.2 9
25.8.1998 - 1.9.1998	1360 3	0	0	0	14 7
1.9.1998 - 8.9.1998	3500 3	0	0	0	17 6
8.9.1998 - 15.9.1998	5600 3	0	4.9 14	0	8.7 9
15.9.1998 - 22.9.1998	2010 3	0	0	0	7.7 10
22.9.1998 - 29.9.1998	1570 3	0	0	0	4.7 12
29.9.1998 - 6.10.1998	2070 3	0	0	3.5 15	2.0 22
6.10.1998 - 20.10.1998	1800 3	0	0	0	2.7 12
20.10.1998 - 3.11.1998	1810 3	0	0	0	2.8 13
3.11.1998 - 17.11.1998	3300 3	0	0	0	2.6 12
17.11.1998 - 1.12.1998	3900 3	0	0	0	2.7 12
1.12.1998 - 15.12.1998	3100 3	0	0	0	1.8 16
15.12.1998 - 29.12.1998	1630 3	0	0	0	1.9 11

0 = below the detection limit

Table IIa. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 33 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
7.1.1997	-	21.1.1997	1580	3	2.4	12
21.1.1997	-	4.2.1997	1780	3	4.2	8
4.2.1997	-	18.2.1997	1980	3	2.8	11
18.2.1997	-	4.3.1997	1740	3	7.3	6
4.3.1997	-	18.3.1997	2450	3	2.2	15
18.3.1997	-	1.4.1997	1990	3	4.4	9
1.4.1997	-	15.4.1997	3300	3	2.6	7
15.4.1997	-	29.4.1997	2880	3	2.3	7
29.4.1997	-	13.5.1997	2320	3	2.0	14
13.5.1997	-	27.5.1997	3400	3	2.7	16
27.5.1997	-	10.6.1997	4500	3	3.1	24
10.6.1997	-	24.6.1997	4500	5	6.3	12
24.6.1997	-	8.7.1997	3600	3	2.6	25
8.7.1997	-	22.7.1997	4200	3	2.5	20
22.7.1997	-	5.8.1997	3800	3	4.1	20
5.8.1997	-	19.8.1997	3500	3	2.8	19
19.8.1997	-	2.9.1997	4600	3	2.8	20
2.9.1997	-	16.9.1997	2950	3	3.4	20
16.9.1997	-	30.9.1997	1610	3	5.5	8
30.9.1997	-	14.10.1997	1150	3	4.4	9
14.10.1997	-	28.10.1997	1220	5	2.6	16
28.10.1997	-	11.11.1997	1520	3	2.1	14
11.11.1997	-	25.11.1997	2280	3	2.5	13
25.11.1997	-	9.12.1997	1950	3	2.8	12
9.12.1997	-	23.12.1997	2500	3	2.8	8
23.12.1997	-	5.1.1998	1470	5	3.5	14

Table IIb. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 33 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{60}Co		^{137}Cs	
5.1.1998	-	20.1.1998	1200	4	0		0.8	28
20.1.1998	-	3.2.1998	1520	5	0		5.0	15
3.2.1998	-	17.2.1998	2100	3	0		2.5	12
17.2.1998	-	3.3.1998	2190	4	0		1.9	9
3.3.1998	-	17.3.1998	2940	3	0		3.8	9
17.3.1998	-	31.3.1998	2220	3	0		1.9	9
31.3.1998	-	14.4.1998	2950	3	0		2.8	23
14.4.1998	-	28.4.1998	4400	3	0		1.5	22
28.4.1998	-	12.5.1998	4200	3	0		3.8	9
12.5.1998	-	26.5.1998	2380	3	0		4.6	9
26.5.1998	-	9.6.1998	2660	3	0		7.5	7
9.6.1998	-	23.6.1998	3400	3	0		3.2	6
23.6.1998	-	7.7.1998	4100	3	0		3.1	9
7.7.1998	-	21.7.1998	2680	3	0		1.8	19
21.7.1998	-	4.8.1998	2010	3	0		0.6	36
4.8.1998	-	18.8.1998	2230	3	0		2.7	14
18.8.1998	-	1.9.1998	1460	3	0		4.7	9
1.9.1998	-	15.9.1998	4000	3	0		4.9	15
15.9.1998	-	29.9.1998	1590	3	0		4.3	8
29.9.1998	-	13.10.1998	1800	5	1.2	19	2.4	6
13.10.1998	-	27.10.1998	2000	3	0		1.9	15
27.10.1998	-	10.11.1998	920	3	0		2.0	13
10.11.1998	-	24.11.1998	4200	3	0		2.5	17
24.11.1998	-	8.12.1998	3300	5	0		1.7	18
8.12.1998	-	22.12.1998	1460	5	0		2.0	14
22.12.1998	-	5.1.1999	1610	5	0		1.1	24

0 = below the detection limit

Table IIIa. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 24 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
7.1.1997	-	21.1.1997	1660	3	3.4	12
21.1.1997	-	4.2.1997	2050	3	4.7	10
4.2.1997	-	18.2.1997	1990	3	3.0	13
18.2.1997	-	4.3.1997	1860	3	1.3	18
4.3.1997	-	18.3.1997	2280	3	2.7	15
18.3.1997	-	1.4.1997	2010	4	3.0	23
1.4.1997	-	15.4.1997	3200	3	1.9	8
15.4.1997	-	29.4.1997	3000	3	3.6	16
29.4.1997	-	13.5.1997	2460	3	1.7	17
13.5.1997	-	27.5.1997	3500	3	3.2	17
27.5.1997	-	10.6.1997	4700	3	3.8	9
10.6.1997	-	24.6.1997	5000	3	8.5	6
24.6.1997	-	8.7.1997	4100	3	2.9	11
8.7.1997	-	22.7.1997	4500	5	3.5	19
22.7.1997	-	5.8.1997	3700	5	3.1	20
5.8.1997	-	19.8.1997	4200	3	3.9	9
19.8.1997	-	2.9.1997	5100	5	3.3	18
2.9.1997	-	16.9.1997	3300	3	3.3	16
16.9.1997	-	30.9.1997	1730	3	5.6	8
30.9.1997	-	14.10.1997	1230	3	3.7	10
14.10.1997	-	28.10.1997	1220	3	4.1	11
28.10.1997	-	11.11.1997	1690	3	1.5	18
11.11.1997	-	25.11.1997	2290	5	1.8	25
25.11.1997	-	9.12.1997	2110	3	3.5	23
9.12.1997	-	23.12.1997	2540	3	1.8	12
23.12.1997	-	5.1.1998	1620	5	2.6	17

Table IIIb. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 24 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
5.1.1998	-	20.1.1998	1520	3	1.2	20
20.1.1998	-	3.2.1998	1660	3	2.7	12
3.2.1998	-	17.2.1998	1990	3	2.9	11
17.2.1998	-	3.3.1998	2790	4	1.8	18
3.3.1998	-	17.3.1998	2810	3	3.0	11
17.3.1998	-	31.3.1998	2250	3	1.3	14
31.3.1998	-	14.4.1998	3300	3	3.6	10
14.4.1998	-	28.4.1998	4500	3	1.2	26
28.4.1998	-	12.5.1998	4200	3	3.7	10
12.5.1998	-	26.5.1998	2960	3	6.9	7
26.5.1998	-	9.6.1998	2700	3	8.7	6
9.6.1998	-	23.6.1998	3200	3	3.0	7
23.6.1998	-	7.7.1998	4000	3	3.2	7
7.7.1998	-	21.7.1998	2960	3	1.8	18
21.7.1998	-	4.8.1998	2040	3	1.5	12
4.8.1998	-	18.8.1998	2410	3	4.5	7
18.8.1998	-	1.9.1998	1490	3	3.8	13
1.9.1998	-	15.9.1998	4400	3	9.0	6
15.9.1998	-	29.9.1998	1510	3	4.0	12
29.9.1998	-	13.10.1998	2000	3	1.9	15
13.10.1998	-	27.10.1998	1920	3	2.2	16
27.10.1998	-	10.11.1998	950	3	2.4	16
10.11.1998	-	24.11.1998	4200	3	1.6	19
24.11.1998	-	8.12.1998	3500	3	2.2	13
8.12.1998	-	22.12.1998	1450	3	1.7	18
22.12.1998	-	5.1.1999	1690	3	1.1	19

Table IVa. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 27 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
31.12.1996	-	14.1.1997	1520	4	4.5	19
14.1.1997	-	28.1.1997	2120	3	4.0	8
28.1.1997	-	11.2.1997	1680	3	3.9	10
11.2.1997	-	25.2.1997	1730	4	2.3	14
25.2.1997	-	11.3.1997	2160	3	3.0	13
11.3.1997	-	25.3.1997	2000	3	5.2	10
25.3.1997	-	8.4.1997	2630	3	3.4	12
8.4.1997	-	22.4.1997	2930	3	3.8	11
22.4.1997	-	6.5.1997	2310	3	2.2	8
6.5.1997	-	20.5.1997	2950	3	6.3	13
20.5.1997	-	3.6.1997	3700	5	3.7	16
3.6.1997	-	17.6.1997	4900	3	11.5	5
17.6.1997	-	1.7.1997	3100	3	3.5	12
8.7.1997	-	15.7.1997	2500	4	4.3	30
15.7.1997	-	29.7.1997	5300	3	4.2	10
29.7.1997	-	12.8.1997	3700	3	3.3	9
12.8.1997	-	26.8.1997	3600	3	3.6	13
26.8.1997	-	9.9.1997	4400	3	4.6	15
9.9.1997	-	23.9.1997	1800	4	5.3	15
23.9.1997	-	7.10.1997	1210	3	6.6	5
7.10.1997	-	21.10.1997	1160	3	7.8	13
21.10.1997	-	4.11.1997	1590	3	3.1	12
4.11.1997	-	18.11.1997	1010	4	1.9	19
18.11.1997	-	2.12.1997	2280	4	3.7	20
2.12.1997	-	16.12.1997	2060	3	1.9	16
16.12.1997	-	30.12.1997	1810	3	5.0	14

Table IVb. The concentration of gamma-emitting nuclides in ground-level air at the Loviisa 27 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
30.12.1997	-	13.1.1998	1210	5	2.3	14
13.1.1998	-	27.1.1998	1710	3	3.6	28
27.1.1998	-	10.2.1998	1700	3	5.5	8
10.2.1998	-	24.2.1998	1950	4	2.4	17
24.2.1998	-	10.3.1998	3000	3	2.4	16
10.3.1998	-	24.3.1998	2450	4	5.6	15
24.3.1998	-	7.4.1998	3400	3	5.0	11
7.4.1998	-	21.4.1998	4000	3	3.9	5
21.4.1998	-	5.5.1998	4700	3	3.6	12
5.5.1998	-	19.5.1998	3400	3	4.9	8
19.5.1998	-	2.6.1998	2350	3	17	5
2.6.1998	-	16.6.1998	3400	3	6.3	8
16.6.1998	-	30.6.1998	3000	3	3.4	12
30.6.1998	-	14.7.1998	3900	3	3.5	11
14.7.1998	-	21.7.1998	2490	3	1.9	15
28.7.1998	-	11.8.1998	1890	3	3.9	10
11.8.1998	-	25.8.1998	2120	3	5.3	6
25.8.1998	-	8.9.1998	2080	3	11	6
8.9.1998	-	22.9.1998	3400	3	7.5	7
22.9.1998	-	6.10.1998	1530	3	4.9	10
6.10.1998	-	20.10.1998	1590	3	3.0	7
20.10.1998	-	3.11.1998	1470	3	3.1	14
3.11.1998	-	17.11.1998	2690	3	2.6	17
17.11.1998	-	1.12.1998	3500	3	3.2	12
1.12.1998	-	15.12.1998	2650	3	2.0	23
15.12.1998	-	29.12.1998	1330	6	2.6	20

Table V. The concentration of gamma-emitting radionuclides in supplementary samples of ground-level air at the Loviisa 33 sampling station in 1997-98 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
19.8.1997	-	25.8.1997	4800	3	2.0	9
25.8.1997	-	1.9.1997	4600	3	3.5	7
1.9.1997	-	9.9.1997	4800	3	2.7	8
8.9.1997	-	15.9.1997	1740	3	3.4	6
15.9.1997	-	22.9.1997	1890	3	4.0	5
10.8.1998	-	17.8.1998	2500	3	2.7	6
17.8.1998	-	24.8.1998	1780	3	4.8	5
24.8.1998	-	31.8.1998	1000	3	6.5	4
31.8.1998	-	7.9.1998	2710	3	6.2	6
7.9.1998	-	14.9.1998	4500	3	6.6	4
10.9.1998	-	22.9.1998	2010	3	5.0	4

Table VIa. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 22 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period	^{7}Be	^{60}Co	^{134}Cs	^{137}Cs
3.1.1997 - 15.1.1997	1500 5	0	0	4.2 8
15.1.1997 - 29.1.1997	1930 3	0	0	4.9 5
29.1.1997 - 12.2.1997	1670 3	0	0	5.3 13
12.2.1997 - 25.2.1997	2040 3	0	0	7.7 11
25.2.1997 - 13.3.1997	2950 3	0	0	2.3 16
13.3.1997 - 26.3.1997	1860 3	0	0	3.9 9
26.3.1997 - 9.4.1997	2620 3	8.4 4	1.1 13	57 4
9.4.1997 - 23.4.1997	2780 3	0	0	20.4 4
23.4.1997 - 7.5.1997	2340 3	0	0	6.7 6
7.5.1997 - 14.5.1997	2550 3	0	0	5.8 10
14.5.1997 - 21.5.1997	1970 3	0	0	6.1 10
21.5.1997 - 28.5.1997	3500 3	0	0	4.5 10
28.5.1997 - 4.6.1997	1960 5	0	0	3.7 23
4.6.1997 - 11.6.1997	5700 5	0	0	9.9 11
11.6.1997 - 18.6.1997	4400 3	0	0	9.8 8
18.6.1997 - 2.7.1997	3500 3	0	0	12.6 5
2.7.1997 - 16.7.1997	3100 3	0	0	7.8 6
16.7.1997 - 30.7.1997	5500 3	0	0	11.0 8
30.7.1997 - 13.8.1997	3100 5	0	0	4.5 12
13.8.1997 - 27.8.1997	3600 3	0	0	7.0 6
27.8.1997 - 10.9.1997	4400 5	0	0	5.5 16
10.9.1997 - 24.9.1997	1850 3	0	0	6.4 7
24.9.1997 - 8.10.1997	1530 3	0	0	4.8 8
8.10.1997 - 22.10.1997	1070 3	0	0	4.2 6
22.10.1997 - 4.11.1997	1610 3	0	0	5.2 5
5.11.1997 - 19.11.1997	1450 3	0	0	1.4 17
19.11.1997 - 3.12.1997	2150 3	0	0	8.7 11
3.12.1997 - 17.12.1997	1190 4	0	0	2.4 15
17.12.1997 - 31.12.1997	1330 3	0	0	9.5 9

0 = below the detection limit

Table VIb. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 22 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{60}Co		^{137}Cs	
31.12.1997	-	14.1.1998	870	3	0		5.3	4
14.1.1998	-	28.1.1998	1750	3	0		6.2	7
28.1.1998	-	11.2.1998	1900	4	0		49	6
11.2.1998	-	25.2.1998	2240	4	1.1	17	5.2	7
25.2.1998	-	12.3.1998	2250	3	0		7.3	4
12.3.1998	-	25.3.1998	2620	3	0		11	5
25.3.1998	-	8.4.1998	3600	3	0.9	22	5.6	15
8.4.1998	-	22.4.1998	3500	3	0		3.8	5
22.4.1998	-	6.5.1998	3100	3	0		3.6	9
6.5.1998	-	13.5.1998	2420	3	1.3	14	3.8	8
13.5.1998	-	20.5.1998	4400	3	0		3.4	14
20.5.1998	-	27.5.1998	1140	3	1.6	20	2.1	20
27.5.1998	-	3.6.1998	1680	3	0		4.9	11
3.6.1998	-	10.6.1998	2230	3	0		7.4	8
10.6.1998	-	17.6.1998	2340	3	0		6.8	9
17.6.1998	-	1.7.1998	2700	3	0		3.1	6
1.7.1998	-	15.7.1998	3000	3	0		5.2	9
15.7.1998	-	29.7.1998	2090	3	0		2.6	10
29.7.1998	-	12.8.1998	1730	3	0		3.5	7
12.8.1998	-	26.8.1998	2120	3	0		4.0	8
26.8.1998	-	9.9.1998	2890	3	0		14	5
9.9.1998	-	23.9.1998	2800	3	0		5.0	8
23.9.1998	-	7.10.1998	1720	3	0		5.6	8
7.10.1998	-	21.10.1998	1730	3	0		3.4	10
21.10.1998	-	5.11.1998	1140	3	0		4.2	5
5.11.1998	-	19.11.1998	3300	3	0		4.9	7
19.11.1998	-	2.12.1998	3200	3	0		2.9	6
2.12.1998	-	16.12.1998	1880	4	0		12	5
16.12.1998	-	29.12.1998	1550	4	0		6.1	5

0 = below the detection limit

Table VIIa. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 26 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
27.12.1996	-	8.1.1997	1700	5	2.9	23
8.1.1997	-	22.1.1997	1680	3	5.0	8
22.1.1997	-	5.2.1997	1970	5	8.4	6
5.2.1997	-	19.2.1997	1850	3	7.5	6
19.2.1997	-	5.3.1997	2220	3	3.8	16
5.3.1997	-	19.3.1997	2680	3	2.8	7
19.3.1997	-	3.4.1997	2010	3	21.5	6
3.4.1997	-	16.4.1997	2920	3	3.8	9
16.4.1997	-	30.4.1997	2620	3	3.0	9
30.4.1997	-	14.5.1997	2280	3	9.2	5
14.5.1997	-	28.5.1997	2720	3	3.9	11
28.5.1997	-	11.6.1997	3600	3	4.8	9
11.6.1997	-	25.6.1997	4200	3	12.0	8
25.6.1997	-	9.7.1997	2930	3	7.1	7
9.7.1997	-	23.7.1997	5100	3	8.6	6
23.7.1997	-	6.8.1997	3400	3	4.0	10
6.8.1997	-	20.8.1997	3500	3	9.8	6
20.8.1997	-	3.9.1997	4900	5	6.9	10
3.9.1997	-	18.9.1997	2930	3	2.9	17
18.9.1997	-	1.10.1997	1600	3	4.7	8
1.10.1997	-	15.10.1997	1010	5	4.6	14
15.10.1997	-	29.10.1997	1270	3	4.0	5
29.10.1997	-	12.11.1997	1390	3	2.9	9
12.11.1997	-	26.11.1997	2120	5	3.9	8
26.11.1997	-	10.12.1997	1760	5	3.8	9
10.12.1997	-	23.12.1997	1890	5	2.5	14
22.12.1997	-	7.1.1998	1150	4	7.4	6

Table VIIb. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 26 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
7.1.1998	-	21.1.1998	1340	3	2.8	11
21.1.1998	-	4.2.1998	1590	3	9.0	5
4.2.1998	-	18.2.1998	2060	3	4.3	8
18.2.1998	-	3.3.1998	2260	3	6.2	5
3.3.1998	-	18.3.1998	3200	3	9.3	5
18.3.1998	-	1.4.1998	1960	3	3.3	11
1.4.1998	-	15.4.1998	3200	3	2.9	20
15.4.1998	-	29.4.1998	3800	3	2.8	10
6.5.1998	-	13.5.1998	2720	3	4.0	8
13.5.1998	-	27.5.1998	2300	3	7.6	10
27.5.1998	-	10.6.1998	2090	3	7.5	10
10.6.1998	-	24.6.1998	1950	3	5.3	7
24.6.1998	-	8.7.1998	3400	3	4.1	6
8.7.1998	-	22.7.1998	2520	3	2.4	14
22.7.1998	-	5.8.1998	1910	3	3.2	13
5.8.1998	-	15.8.1998	1920	5	3.0	15
19.8.1998	-	2.9.1998	1400	5	7.3	9
2.9.1998	-	16.9.1998	4100	3	5.2	7
16.9.1998	-	30.9.1998	1550	3	4.4	8
30.9.1998	-	14.10.1998	2010	3	3.8	11
14.10.1998	-	28.10.1998	1570	3	3.6	9
28.10.1998	-	11.11.1998	990	3	5.1	7
11.11.1998	-	25.11.1998	3700	4	8.5	17
25.11.1998	-	9.12.1998	2510	3	3.6	9
9.12.1998	-	23.12.1998	1300	5	2.7	16
23.12.1998	-	8.1.1999	1520	3	3.5	10

Table VIIIa. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 31 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
3.1.1997	-	15.1.1997	1550	3	3.8	12
15.1.1997	-	29.1.1997	2050	3	3.7	9
29.1.1997	-	12.2.1997	1740	3	3.8	10
12.2.1997	-	25.2.1997	2140	3	6.2	7
25.2.1997	-	13.3.1997	2780	3	2.0	14
13.3.1997	-	26.3.1997	1920	5	3.2	16
26.3.1997	-	9.4.1997	2660	3	6.0	7
9.4.1997	-	23.4.1997	2670	3	11.5	5
23.4.1997	-	7.5.1997	2330	3	5.1	7
7.5.1997	-	21.5.1997	2250	3	3.6	10
21.5.1997	-	4.6.1997	2750	3	1.8	25
4.6.1997	-	18.6.1997	5000	5	6.3	10
18.6.1997	-	2.7.1997	3700	5	3.9	14
2.7.1997	-	16.7.1997	2960	5	3.2	17
16.7.1997	-	30.7.1997	5900	3	3.5	10
30.7.1997	-	13.8.1997	3100	3	2.3	19
13.8.1997	-	27.8.1997	3700	3	5.8	13
27.8.1997	-	10.9.1997	4300	3	3.4	10
10.9.1997	-	24.9.1997	1750	3	2.2	12
24.9.1997	-	8.10.1997	1500	3	4.8	8
8.10.1997	-	22.10.1997	990	5	3.1	14
22.10.1997	-	4.11.1997	1500	3	2.4	10
4.11.1997	-	19.11.1997	1290	6	1.3	25
19.11.1997	-	3.12.1997	2050	3	4.5	20
3.12.1997	-	17.12.1997	2670	4	3.7	20
17.12.1997	-	31.12.1997	1310	4	2.8	11

Table VIIIb. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 31 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
31.12.1997	-	14.1.1998	860	4	1.9	14
14.1.1998	-	28.1.1998	1520	5	3.5	20
28.1.1998	-	11.2.1998	1790	5	4.6	15
11.2.1998	-	25.2.1998	2240	4	2.9	10
25.2.1998	-	12.3.1998	2090	3	3.9	11
12.3.1998	-	25.3.1998	2400	3	3.1	19
25.3.1998	-	8.4.1998	3300	3	4.1	8
8.4.1998	-	22.4.1998	3100	3	4.7	13
22.4.1998	-	6.5.1998	2900	3	3.5	8
6.5.1998	-	20.5.1998	3400	3	3.5	12
20.5.1998	-	3.6.1998	1330	4	2.3	21
3.6.1998	-	17.6.1998	2170	3	4.7	14
17.6.1998	-	1.7.1998	2680	3	3.9	6
1.7.1998	-	15.7.1998	2790	3	3.1	22
15.7.1998	-	29.7.1998	1860	3	1.8	13
29.7.1998	-	12.8.1998	1540	3	2.4	12
12.8.1998	-	26.8.1998	1910	3	3.0	10
26.8.1998	-	9.9.1998	2570	3	4.5	10
9.9.1998	-	23.9.1998	2850	3	4.3	8
23.9.1998	-	7.10.1998	1640	3	4.2	9
7.10.1998	-	21.10.1998	1670	3	1.9	7
21.10.1998	-	5.11.1998	1090	4	3.1	6
5.11.1998	-	19.11.1998	3300	3	4.4	7
19.11.1998	-	2.12.1998	3100	3	3.5	9
2.12.1998	-	16.12.1998	1830	5	7.0	19
16.12.1998	-	29.12.1998	1470	6	2.7	14

Table IXa. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 37 sampling station in 1997 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period			^{7}Be		^{137}Cs	
27.12.1996	-	8.1.1997	1870	3	4.8	9
8.1.1997	-	22.1.1997	1440	3	2.8	13
22.1.1997	-	5.2.1997	1950	3	2.9	12
5.2.1997	-	19.2.1997	1980	3	3.6	10
19.2.1997	-	5.3.1997	2120	3	1.3	24
5.3.1997	-	19.3.1997	2560	3	2.5	12
19.3.1997	-	3.4.1997	2120	3	4.0	14
3.4.1997	-	16.4.1997	3100	3	19.2	4
16.4.1997	-	30.4.1997	2720	3	7.8	5
30.4.1997	-	14.5.1997	2180	3	3.0	13
14.5.1997	-	28.5.1997	2880	3	3.7	10
28.5.1997	-	11.6.1997	4200	3	4.5	7
11.6.1997	-	25.6.1997	4100	3	5.5	6
25.6.1997	-	9.7.1997	3800	3	4.9	7
9.7.1997	-	23.7.1997	6200	3	4.0	11
23.7.1997	-	6.8.1997	4000	5	2.2	23
6.8.1997	-	20.8.1997	4100	5	2.7	18
20.8.1997	-	3.9.1997	5600	5	4.1	17
3.9.1997	-	18.9.1997	4400	3	2.9	12
18.9.1997	-	1.10.1997	1640	5	3.9	14
1.10.1997	-	15.10.1997	1050	3	4.8	8
15.10.1997	-	29.10.1997	1210	5	3.7	9
29.10.1997	-	12.11.1997	1210	3	2.4	12
12.11.1997	-	26.11.1997	2180	3	2.1	14
26.11.1997	-	10.12.1997	1870	4	6.1	15
10.12.1997	-	23.12.1997	1780	5	2.5	14
22.12.1997	-	7.1.1998	1030	4	1.5	15

Table IXb. The concentration of gamma-emitting nuclides in ground-level air at the Olkiluoto 37 sampling station in 1998 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period		^{7}Be		^{137}Cs	
7.1.1998	- 21.1.1998	1340	3	2.8	10
21.1.1998	- 4.2.1998	1540	3	4.9	8
4.2.1998	- 18.2.1998	2160	3	2.4	12
18.2.1998	- 3.3.1998	2370	3	2.5	13
3.3.1998	- 18.3.1998	3000	3	4.2	8
18.3.1998	- 1.4.1998	1990	3	3.3	24
1.4.1998	- 15.4.1998	3400	3	5.3	7
15.4.1998	- 29.4.1998	3800	3	2.5	11
6.5.1998	- 13.5.1998	2500	3	3.6	10
13.5.1998	- 27.5.1998	2400	3	4.0	14
27.5.1998	- 10.6.1998	2050	4	6.2	14
10.6.1998	- 24.6.1998	1540	3	4.1	9
24.6.1998	- 8.7.1998	3400	3	2.8	6
8.7.1998	- 22.7.1998	2360	3	1.6	17
22.7.1998	- 5.8.1998	1820	3	1.6	15
5.8.1998	- 19.8.1998	1560	5	2.2	21
19.8.1998	- 3.9.1998	1510	5	5.3	13
3.9.1998	- 16.9.1998	4100	3	3.6	9
16.9.1998	- 30.9.1998	1540	3	4.0	8
30.9.1998	- 14.10.1998	1740	4	3.2	19
14.10.1998	- 28.10.1998	1470	3	1.4	21
28.10.1998	- 11.11.1998	1040	3	7.6	7
11.11.1998	- 25.11.1998	3700	5	3.0	14
25.11.1998	- 9.12.1998	2250	5	4.3	16
9.12.1998	- 23.12.1998	1290	3	3.3	11
23.12.1998	- 7.1.1999	1560	4	1.6	15

Table X. The concentration of gamma-emitting radionuclides in supplementary samples of ground-level air at the Olkiluoto 33 sampling station in 1997-98 (μBq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling period	^{7}Be	^{54}Mn	^{60}Co	^{137}Cs
12.5.1997 - 19.5.1997	2290 3	0	0	3.5 9
19.5.1997 - 26.5.1997	2890 3	0	0	3.1 8
26.5.1997 - 2.6.1997	2720 3	0	0.52 14	3.0 5
2.6.1997 - 9.6.1997	5100 3	0	0	3.3 5
9.6.1997 - 16.6.1997	4900 5	0	0	10.1 5
30.4.1998 - 4.5.1998	3000 3	0	0	5.2 6
4.5.1998 - 11.5.1998	2190 3	0.33 24	0.74 12	3.3 5
11.5.1998 - 18.5.1998	3000 3	0	0	2.9 6
18.5.1998 - 25.5.1998	2100 3	0	0	5.6 5
25.5.1998 - 1.6.1998	1610 3	0.30 23	0.65 12	5.4 5
1.6.1998 - 8.6.1998	2670 3	0	0	6.7 4
8.6.1998 - 15.6.1998	1580 3	0	0	2.9 10

0 = below the detection limit

Table XI. Monthly deposits of gamma-emitting nuclides at the Loviisa 20 sampling station (Bq m^{-2}) in 1997-98. Area of the collector is 1 m^2. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Month	^{7}Be		^{54}Mn		^{58}Co		^{60}Co		^{110m}Ag		^{134}Cs		^{137}Cs	
1997														
Jan	83	3	0.014	30	0.032	27	0.019	18	0.033	13	0.030	19	0.44	4
Feb	59	3	0.037	7	0.007	27	0.011	15	0.039	8	0		0.27	4
Mar	41	3	0		0		0.022	18	0		0		0.49	4
Apr	39	3	0		0		0.009	20	0		0		0.29	4
May	42	5	0		0		0		0		0		0.32	5
Jun	108	5	0		0		0		0		0		0.96	5
Jul	73	3	0		0		0.052	11	0.025	18	0		0.96	3
Aug	59	3	0		0		0		0		0		0.69	3
Sep	105	3	0		0		0.012	15	0		0.012	19	0.71	3
Oct	30	3	0		0		0.012	15	0.015	19	0		0.35	3
Nov	85	3	0		0		0		0		0		0.19	7
Dec	42	3	0		0		0		0		0		0.14	6
Annual total													5.83	
1998														
Jan	76	3	0		0		0		0		0		0.30	5
Feb	67	3	0		0		0		0		0		0.35	4
Mar	61	3	0		0		0		0		0		0.13	11
Apr	38	3	0		0		0		0		0		0.13	6
May	60	3	0		0		0		0		0		1.21	4
Jun	262	3	0		0		0.021	18	0		0		1.11	3
Jul	127	3	0		0		0.104	6	0		0		0.24	5
Aug	141	3	0		0		0.054	17	0		0		0.39	6
Sep[a]	53	3	0.030	19	0.072	13	0.067	9	0.018	25	0		0.23	5
Oct	93	3	0		0		0		0		0		0.14	6
Nov	49	3	0		0		0.066	8	0		0		0.16	6
Dec	79	5	0		0		0		0		0		0.22	9
Annual total													4.63	

0 = below the detection limit
[a] in addition: ^{124}Sb: 0.027 (26)

Table XII. Monthly deposits of gamma-emitting nuclides at the Olkiluoto 21 sampling station (Bq m^{-2}) in 1997-98. Area of the collector is 1 m^2. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Month	^{7}Be		^{54}Mn		^{58}Co		^{60}Co		^{134}Cs		^{137}Cs	
1997												
Jan	52	5	0		0		0		0		0.14	9
Feb	81	3	0		0		0		0		0.33	3
Mar	60	3	0		0		0		0		0.36	4
Apr	45	3	0		0		0		0		0.22	4
May	31	5	0		0		0		0		0.21	5
Jun	45	5	0		0		0		0		0.53	5
Jul	107	3	0		0		0		0		0.25	5
Aug	71	5	0		0		0		0.043	19	1.80	5
Sep	185	3	0		0		0.010	14	0.015	13	0.95	4
Oct	70	3	0		0		0		0		0.48	4
Nov	62	3	0		0		0		0		0.11	6
Dec	49	3	0		0		0		0		0.16	5
Annual total											5.52	
1998												
Jan	29	3	0		0		0		0		0.12	7
Feb	59	3	0		0		0		0		0.32	4
Mar	86	3	0		0		0		0.052	13	2.18	4
Apr	38	3	0		0		0		0		0.33	4
May	55	3	0		0		0.039	12	0		0.32	4
Jun	258	3	0.24	6	0.36	6	2.67	3	0.032	17	0.90	3
Jul	105	5	0		0		0		0		0.31	5
Aug	114	5	0		0		0		0		0.31	7
Sep	52	3	0		0		0		0		0.16	6
Oct	90	3	0		0		0		0		0.33	4
Nov	32	3	0		0		0		0		0.18	6
Dec	42	3	0		0		0		0		0.11	6
Annual total											5.56	

0 = below the detection limit

Table XIII. Quarterly deposits of ^{90}Sr at the Loviisa 20 and Olkiluoto 21 sampling stations (Bq m^{-2}) in 1997-98. Area of the collector is 1 m^2. The uncertainties (1σ) include statistical, calibration and analytical uncertainty.

	Loviisa		Olkiluoto	
1997				
Jan - Apr	< 0.03		< 0.03	
Apr - Jun	0.031	20	< 0.03	
Jun - Sep	0.110	15	0.074	15
Sep - Dec	< 0.03		0.100	20
1998				
Jan - Apr	< 0.03		0.040	20
Apr - Jun	0.046	20	< 0.03	
Jul - Sep	0.069	10	0.055	10
Oct - Dec	0.040	20	0.060	20

Table XIV. Quarterly deposits of ^{90}Sr and gamma-emitting nuclides at the Loviisa 22 and Olkiluoto 26 sampling stations (Bq m^{-2}) in 1997-98. Area of the collector is 0.05/0.07 m^2. The uncertainties (1σ) include both statistical and calibration uncertainty.

	^{7}Be		^{90}Sr	^{137}Cs	
Loviisa 22/33					
1997					
Jan - Mar	250	6	< 0.3	2.25	10
Apr - Jun	234	3	< 0.3	2.31	8
Jul - Sep	370	5	< 0.3	1.50	8
Oct - Dec	248	5	< 0.3	0.80	23
Annual total				6.86	
1998					
Jan - Mar	184	3	< 0.3	1.40	9
Apr - Jun	540	4	< 0.3	3.74	9
Jul - Sep	430	3	< 0.3	1.55	8
Oct - Dec	220	3	< 0.3	5.69	4
Annual total				12.38	
Olkiluoto 26					
1997					
Jan - Apr	203	5	< 0.3	3.43	8
Apr - Jun	251	4	< 0.3	1.79	7
Jul - Oct	590	5	< 0.3	4.14	5
Oct - Dec	135	4	< 0.3	0.79	14
Annual total				10.16	
1998					
Jan - Mar	175	4	< 0.3	1.06	9
Apr - Jul	540	3	< 0.3	3.39	6
Jul - Sep	320	3	-	0.88	10
Sep - Dec	194	3	-	0.46	9
Annual total				5.79	

- = not analysed

Table XV. The amounts of ^{90}Sr and gamma-emitting nuclides in soil samples taken from the vicinity of the Olkiluoto nuclear power station in 1997 (Bq kg^{-1} dry weight). The relative uncertainties (1σ) include both statistical and calibration uncertainty.

Sampling depth cm	^{40}K		^{90}Sr*		^{125}Sb		^{134}Cs		^{137}Cs	
Olkiluoto 41										
0-2	310	3	15.9	10	5.0	12	14.5	3	830	3
2-4	610	4	4.0	10	0		7.0	3	460	4
4-6	630	4	1.2	10	0		1.0	6	74	3
6-24	730	3	-		0		0		5.5	3
Olkiluoto 43										
0-2	840	3	6.9	10	0		2.9	3	180	3
2-4	790	3	6.2	10	0		1.7	5	116	3
4-6	810	3	4.4	10	0		1.4	6	88	3
6-33	930	4	-		0		0		14.2	4
Olkiluoto 44										
0-2	141	6	9.7	10	0		17.9	3	1060	4
2-4	270	4	5.1	10	0		16.4	3	930	3
4-6	480	2	2.5	10	0		3.5	5	223	3
6-22	710	3	-		0		0.3	28	14.8	3

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

Table XVI. ^{90}Sr and gamma-emitting nuclides in hair moss at Loviisa and Olkiluoto in 1997-1998 (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										
1997										
30.5.	195	5	239	3	-		28.4	3	1650	3
25.9.	450	4	276	3	3.1	10	26.3	3	1660	3
1998										
28.5.	217	5	231	4	-		16.3	3	1220	3
22.9.	580	3	360	3	2.4	10	17.4	3	1550	3
Olkiluoto 32										
1997										
7.7.	251	4	310	4	-		14.1	3	890	4
8.10.	440	4	225	3	4.5	15	7.8	3	490	3
1998										
22.6.	420	4	277	4	-		8.3	5	740	4
4.10.	430	5	282	4	5.5	15	6.1	4	550	3

* = analytical error included
- = not analysed

Table XVII. Gamma-emitting nuclides in grazing grass in a zone extending 10 km from the Loviisa and Olkiluoto power plants in 1997-1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	^{7}Be	^{40}K	^{134}Cs	^{137}Cs
Loviisa				
1997				
9.7.	41 4	730 3	0	1.51 9
19.8.	132 4	590 4	0	3.4 8
1998				
16.7.	137 5	600 4	0	8.0 4
24.8.	310 4	370 4	0	1.89 7
Olkiluoto				
1997				
11.6.	10 12	830 3	0	4.1 5
20.8.	47 4	980 3	0	5.3 4
1998				
17.6.	36 6	640 3	0	4.8 6
19.8.	121 3	700 3	0.38 17	24.4 3

0 = below the detection limit

Table XVIII. Gamma-emitting nuclides in pine needle and lichen samples at Loviisa and Olkiluoto in 1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Date	Dry matter %	^{7}Be	^{40}K	^{54}Mn	^{60}Co	^{134}Cs	^{137}Cs
Pine needles								
Loviisa 35	24.9.1998	43.8	64 5	154 4	0	0	0.37 12	25.1 3
Olkiluoto 21	2.7.1998	69.9	49 3	70 3	0	0	0.86 5	72 3
Reindeer lichen								
Loviisa 35	24.9.1998	35.3	228 4	67 6	0	0	6.2 5	510 4
Olkiluoto 21	2.7.1998	29.6	261 4	38 4	0.077 28	0.53 8	109 3	8900 3

0 = below the detection limit

Table XIX. Gamma-emitting radionuclides in the water of the ditch around dumping ground of Olkiluoto in 1997-1998 (Bq m^{-3}). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Date	^{40}K		^{134}Cs		^{137}Cs	
1997						
16.5.	457	5	1.78	16	44	4
13.10.	310	3	0.30	28	20.3	3
1998						
14.5.	860	3	0		2.82	10
29.9.	0		0		2.27	21

0 = below the detection limit

Table XX. ^{134}Cs and ^{137}Cs in monthly milk samples (Bq l^{-1}) from Loviisa area in 1997-1998. 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	
1997								
Jan	0		0.222	4	0		0.35	4
Feb	0		0.32	3	0		0.278	4
Mar	0		0.289	6	0		0.31	4
Apr	0		0.50	4	0		0.33	3
May	0		0.49	4	0		0.287	4
Jun	0		0.40	5	0		0.257	5
Jul	0.008	19	0.51	3	0		0.254	4
Aug	0		0.50	4	0.012	21	0.38	3
Sep	0		0.32	5	0		0.236	4
Oct	0		0.258	5	0		0.183	3
Nov	0.007	20	0.33	4	0		0.227	6
Dec	0.008	21	0.34	4	0		0.244	4
Mean			0.37				0.255	
1998								
Jan	0		0.30	6	0		0.59	3
Feb	0		0.258	5	0		0.240	4
Mar	0		0.210	4	0.011	24	0.261	4
Apr	0		0.187	6	0		0.296	4
May	0		0.204	4	0		0.252	4
Jun	0		0.31	5	0		0.142	8
Jul	0		0.210	4	0		0.234	4
Aug	0		0.45	4	0.011	20	0.33	4
Sep	0		0.35	3	0		0.209	6
Oct	0		0.198	7	0		0.172	4
Nov	0		0.251	5	0		0.38	3
Dec	0		0.177	7	0		0.164	4
Mean			0.258				0.273	

0 = below the detection limit

Table XXI. ^{134}Cs and ^{137}Cs in monthly milk samples (Bq l^{-1}) from Olkiluoto area in 1997-1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Within a 10 km radius of the power nuclear plant				**Whole production of the local dairy**			
	^{134}Cs		**^{137}Cs**		**^{134}Cs**		**^{137}Cs**	
1997								
Jan	0.021	13	1.01	3	0.032	16	1.68	4
Feb	0.012	16	0.64	3	0.032	11	1.45	5
Mar	0		0.297	4	0.027	7	1.34	3
Apr	0		0.30	4	0.029	12	1.34	4
May	0		0.47	7	0.020	13	1.25	4
Jun	0.014	20	0.76	4	0.017	10	1.06	3
Jul	0		0.65	5	0.019	17	1.12	4
Aug	0.022	14	1.07	4	0.016	20	1.05	4
Sep	0.011	25	0.50	5	0.027	5	1.48	3
Oct	0.009	18	0.52	4	0.035	8	1.84	3
Nov	0.009	25	0.40	3	0.020	6	1.51	3
Dec	0		0.65	4	0.036	14	1.81	4
Mean			0.61				1.41	
1998								
Jan	0.014	26	0.75	4	0.025	15	1.12	5
Feb	0		0.59	4	0.021	10	1.36	3
Mar	0		0.63	4	0.019	21	1.33	3
Apr	0		0.43	3	0.030	18	1.34	4
May	0		1.50	4	0.015	25	0.32	3
Jun	0		0.66	4	0.015	17	1.19	3
Jul	0		0.42	3	0.011	18	0.93	3
Aug	0		0.41	3	0.013	16	1.08	3
Sep	0		0.54	3	0		0.85	4
Oct	0		0.52	3	0		0.87	3
Nov	0		0.49	6	0		0.86	4
Dec	0		0.297	3	0		0.79	3
Mean			0.61				1.03	

0 = below the detection limit

Table XXIIa. ^{90}Sr in monthly milk samples (Bq l^{-1}) from Loviisa and Olkiluoto areas in 1997. Relative uncertainties (1σ) include both statistical, calibration and analytical uncertainty.

	Loviisa		Olkiluoto	
Jan	0.071	15	0.069	15
Feb	0.051	10	0.064	15
Mar	0.054	15	0.058	15
Apr	0.046	15	0.061	15
May	0.046	15	0.053	15
Jun	0.053	15	0.073	15
Jul	0.055	15	0.067	15
Aug	0.052	15	0.084	15
Sep	0.047	15	0.066	15
Oct	0.049	15	0.068	15
Nov	0.047	15	0.062	15
Dec	0.046	15	0.055	15
Mean	0.051		0.065	

Table XXIIb. ^{90}Sr in bi-monthly milk samples (Bq l^{-1}) from Loviisa and Olkiluoto areas in 1998. Relative uncertainties (1σ) include both statistical, calibration and analytical uncertainty.

	Loviisa		Olkiluoto	
Jan-Feb	0.048	15	0.048	15
Mar-Apr	0.046	15	0.061	15
May-Jun	0.051	15	0.072	15
Jul-Aug	0.064	10	0.083	10
Sep-Oct	0.079	15	0.092	15
Nov-Dec	0.076	15	0.130	20
Mean	0.030		0.041	

Table XXIIIa. ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in drinking water sampled in the waterworks serving the Loviisa and Olkiluoto power plants and nearest towns in 1997. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Date	^{40}K		^{90}Sr*		^{134}Cs		^{137}Cs	
Town of Loviisa[a]								
28.2.	188	7	0		0		0	
30.5.	156	6	-		0		0	
29.8.	150	6	2.32	10	0		1.23	28
28.11.	149	5	-		0		0	
Loviisa power plant[a]								
28.2.	72	7	9.4	10	1.88	9	90	3
30.5.	50	12	-		1.55	15	49	5
29.8.	72	8	8.1	10	1.06	19	83	3
28.11.	68	8	-		1.10	15	58	4
Town of Rauma[b]								
8.1.	113	6	9.2	10	0		10.5	5
9.4.	116	5	13.1	10	0		5.5	7
9.7.	84	6	9.4	10	0		7.7	5
8.10.	110	4	10.9	10	0		7.2	5
Olkiluoto power plant[b]								
8.1.	102	5	10.6	10	0		7.7	5
9.4.	94	7	11.2	10	0		8.1	7
9.7.	79	7	10.6	10	0		8.6	5
8.10.	83	7	9.4	10	0		8.7	5

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

Table XXIIIb. ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in drinking water sampled in the waterworks serving the Loviisa and Olkiluoto power plants and nearest towns in 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Date	^{40}K	^{60}Co	^{110m}Ag	^{90}Sr*	^{134}Cs	^{137}Cs
Town of Loviisa[a]						
2.3.	153 8	0	0	-	0	0
1.6.	156 4	0	0	0	0	0.46 30
28.8.	169 4	0	0	-	0	0
27.11.	138 5	0	0	0	0	0
Loviisa power plant[a]						
2.3.	79 6	0	0	-	1.62 11	84 4
1.6.	59 7	0	0	7.7 10	0.64 3	54 4
28.8.	54 8	0	0	-	0.68 22	71 3
27.11.	61 10	2.1 14	34 3	7.8 10	0.96 21	59 4
Town of Rauma[b]						
14.1.	89 6	0	0	11.4 10	0	4.6 7
8.4.	119 6	0	0	-	0	6.7 6
8.7.	76 9	0	0	9.5 10	0	6.1 9
7.10.	94 7	0	0	-	0	8.0 5
Olkiluoto power plant[b]						
14.1.	95 11	0	0	13.6 10	0	9.9 8
8.4.	82 11	0	0	-	0	5.8 11
8.7.	86 8	0	0	11.3 10	0	8.2 7
7.10.	82 7	0	0	-	0	8.0 5

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

Table XXIV. ^{90}Sr and gamma-emitting radionuclides in cereals in the vicinity of Loviisa and Olkiluoto in 1997-1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Dry matter %	^{40}K		^{90}Sr*		^{137}Cs	
Loviisa							
1997							
Rye	91.4	165	4	0.14	20	0.41	6
Wheat	91.8	142	4	0.21	20	0.42	4
1998							
Rye	92.7	145	4	-		0.23	7
Wheat	92.5	167	4	0.25	20	0.29	5
Olkiluoto							
1997							
Rye	90.8	179	3	0.12	20	0.17	6
Wheat	90.2	144	4	0.19	20	0.15	11
1998							
Rye	86.8	174	3	-		3.0	3
Wheat	88.1	142	4	0.21	15	0.38	5

* = analytical error included

- = not analysed

Table XXV. Gamma-emitting radionuclides in lettuce, apple and black currant samples in 1997-1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Date	Dry matter %	^{7}Be		^{40}K		^{137}Cs	
Lettuce								
Loviisa 22/33								
	29.7.1997	5.8	84	5	2030	4	2.44	7
	19.8.1997	8.0	66	3	2200	4	2.01	6
	16.7.1998	7.0	167	3	2230	3	4.9	4
	24.8.1998	7.6	360	3	2440	3	2.78	6
Olkiluoto 26								
	30.7.1997	5.9	113	5	1500	4	3.7	10
	3.9.1997	5.6	47	4	2240	3	4.0	4
	29.7.1998	4.7	79	4	1940	3	2.18	8
	19.8.1998	5.2	111	5	2280	4	1.44	13
Apple								
Loviisa 31								
	18.9.1997	5.5	3.1	14	272	3	0.51	12
	20.9.1998	12.4	8.0	6	330	4	0.86	6
Black currant								
Olkiluoto 26								
	30.7.1997	15.3	10.3	7	620	4	0.97	9
	19.8.1998	13.9	11.7	8	650	4	0.98	8

Table XXVI. Gamma-emitting radionuclides in beef in the Loviisa and Olkiluoto areas in 1997-1998 (Bq kg^{-1} fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	K-40		Cs-134		Cs-137	
Loviisa						
1997						
Spring	101	4	0		1.21	7
Autumn	81	4	0		0.36	4
1998						
Spring	52	3	0.014	17	0.50	3
Autumn	83	4	0.012	26	1.12	3
Olkiluoto						
1997						
Spring	87	4	0.036	18	1.11	3
Autumn	88	3	0.039	12	2.11	4
1998						
Spring	53	4	0		0.61	4
Autumn	83	4	0		0.57	3

0 = below the detection limit

Table XXVII. The amounts of gamma-emitting radionuclides in musrooms and wild berries taken from the vicinity of the Olkiluoto nuclear power plant in 1997 (Bq kg^{-1} fresh weight). For sampling sites see Fig. 6. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Specie	Sampling area	^{40}K		^{134}Cs		^{137}Cs	
Cep *Boletus edulis*	55	45	8	0.45	4	34	3
Orange-cap boletus *Leccinum sp.*	55	77	8	0.95	3	64	3
Rufous milk-cap *Lactarius rufus*	51, 54	75	4	3.7	3	242	3
Russula *Russula vinosa*	51	141	4	9.0	4	540	4
Funnel cap *Clitocybe gibba*	54	70	3	0.249	13	16.3	3
Lingonberry *Vaccinium vitis-idaea*	51	33	8	0.41	7	25.8	3
Blueberry *Vaccinium myrtillus*	51	45	4	0.76	4	46	4
Raspberry *Rubus idaeus*	51	57	4	0		0.73	5
Rosehip *Rosa sp.*	52	127	3	0		0.184	11
Rowanberry *Sorbus aucuparia*	53	93	4	0		1.58	5
Buckthornberry *Hippophae rhamnoides*	52	53	4	0		0.066	8

0 = below the detection limit

Table XXVIIIa. ^{3}H, ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in sea water samples at Loviisa in 1997. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

Sampling station	Date	Salinity ‰	^{3}H	^{40}K	^{90}Sr*	^{134}Cs	^{137}Cs
02	13.3.	4.89	0[a]	1970 3	13.8 10	0	57 4
	21.5.	4.56	6100 11	1640 4	12.3 10	1.0 23	53 4
	31.7.	3.92	11900 7	1640 4	13.5 10	0	69 4
	1.10.	5.44	4100 16	1980 3	13.0 10	0	58 4
1	21.5.	4.25	10000 8	1600 4	-	0	56 4
	31.7.	3.89	10800 7	1560 4	-	0	65 5
	1.10.	5.34	0[a]	2040 4	-	0	63 4
2	21.5.	4.47	8200 9	1840 4	-	0	59 5
	31.7.	3.89	11200 7	1370 3	-	0	55 3
	1.10.	5.24	0[a]	1810 3	-	0	54 3
4	21.5.	4.64	4600 14	1690 3	-	0	60 4
	31.7.	3.94	9400 8	1540 3	-	0	62 4
	1.10.	5.20	0[a]	1770 3	-	0	55 3
R1	22.5.	4.68	0[a]	1490 3	13.9 10	0	48 3
	31.7.	4.10	4500 14	1580 3	13.0 10	0	59 3
	2.10.	5.47	0[a]	1880 3	13.6 10	0	52 4

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

Table XXVIIIb. ^{3}H, ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in sea water samples at Loviisa in 1998. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

Sampling station	Date	Salinity ‰	^{3}H		^{40}K		^{90}Sr*		^{137}Cs	
02	23.3.	4.55	11800	6	1600	4	12.2	10	53	4
	19.5.	4.38	0[a]		1810	4	12.5	10	55	4
	4.8.	5.14	4200	16	2000	4	11.8	10	58	4
	13.10.	4.41	0[a]		1760	5	14.2	10	55	5
1	19.5.	3.92	19300	5	1550	4	-		52	4
	5.8.	4.67	5900	12	1620	3	-		55	4
	13.10.	4.30	5000	20	1480	3	-		49	4
2	19.5.	4.22	26600	4	1690	4	-		53	4
	5.8.	4.99	4400	16	1830	4	-		58	4
	14.10.	4.36	0[a]		1620	4	-		51	4
4	19.5.	-	5600	12	1610	5	-		52	6
	5.8.	5.12	0[a]		1750	3	-		52	4
	14.10.	4.43	0[a]		1810	5	-		57	5
R1	19.5.	3.75	0[a]		1590	5	13.8	10	44	6
	4.8.	5.08	0[a]		2140	4	11.7	10	61	5
	13.10.	4.44	0[a]		1590	3	14.0	10	50	4

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

Table XXIXa. ^{3}H, ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in sea water samples at Olkiluoto in 1997. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

Sampling station	Date	Salinity ‰	^{3}H	^{40}K	^{60}Co	^{90}Sr*	^{134}Cs	^{137}Cs
13	10.3.	0.81	0[a]	480 5	0	10.3 10	0	27.3 5
	28.5.	5.18	6600 10	2020 3	4.4 14	14.1 10	0	95 3
	6.8.	5.64	0[a]	2240 3	0	14.8 10	1.70 30	110 3
	17.10.	5.40	0[a]	1860 3	0	13.1 10	1.63 16	86 3
10	28.5.	5.26	0[a]	2080 4	0	-	2.90 16	100 4
	6.8.	5.53	0[a]	2250 3	0	-	0	101 3
	17.10.	5.48	0[a]	2120 3	0	-	0	93 3
2	28.5.	5.17	0[a]	1770 3	2.45 10	-	2.70 17	87 3
	6.8.	5.60	0[a]	4200 3	0	-	0	97 10
	17.10.	5.49	0[a]	1900 3	0	-	0	86 3
3	28.5.	5.18	0[a]	2050 4	0	-	0	105 4
	6.8.	5.51	0[a]	2030 4	0	-	1.55 18	101 4
	17.10.	5.42	0[a]	1970 4	0	-	1.88 19	88 4
15	15.5.	4.91	0[a]	1710 3	0	14.2 10	1.71 13	81 3
	6.8.	5.44	0[a]	2260 4	0	15.6 10	2.71 15	115 4
	17.10.	5.42	0[a]	2010 3	0	13.0 10	3.1 17	93 3

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

Table XXIXb. ^{3}H, ^{90}Sr and gamma-emitting radionuclides (Bq m^{-3}) in sea water samples at Olkiluoto in 1998. Relative uncertaintainties (1σ) include both statistical and calibration uncertainty.

Sampling station	Date	Salinity ‰	^{3}H	^{40}K		^{60}Co		^{90}Sr*		^{134}Cs		^{137}Cs	
13	18.3.	5.63	0[a]	2260	4	0		13.6	10	0		87	5
	13.5.	5.50	0[a]	2290	4	0		16.1	10	0		103	5
	12.8.	5.72	0[a]	2050	4	0		12.1	10	0		88	4
	5.10.	5.72	0[a]	2150	4	0		14.0	10	0		83	4
10	13.5.	5.47	0[a]	2350	4	0		-		0		98	5
	12.8.	5.68	0[a]	1990	3	0		-		0		85	4
	5.10.	5.72	0[a]	1930	3	0		-		0		77	3
2	13.5.	5.49	0[a]	2240	4	0		-		0		95	5
	12.8.	5.74	0[a]	2320	4	3.5	23	-		0		93	5
	5.10.	5.75	0[a]	2330	4	0		-		0		89	5
3	13.5.	5.30	0[a]	1980	4	0		-		1.0	26	84	4
	12.8.	5.54	0[a]	1820	3	0		-		0		75	3
	5.10.	5.68	0[a]	1940	3	0		-		0		81	3
15	13.5.	5.31	0[a]	1900	4	0		13.7	10	0		84	4
	12.8.	5.53	0[a]	2180	3	0		12.7	10	0		84	4
	5.10.	5.53	0[a]	2020	4	0		14.4	10	0		79	4

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

Table XXXa. ^{90}Sr, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg^{-1} dry weight) in littoral algae in the sampling areas A-E at Loviisa in 1997. 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	$^{239,240}Pu$	
Cladophora glomerata																				
Loviisa A	8.7.	540	3	0		0		0		-		0		0.58	11	23.2	3	-	-	
Fucus vesiculosus																				
Loviisa A	23.5.	900	3	2.25	4	0.11	27	3.6	3	-		0.91	3	1.37	4	82	3	-	-	
	22.8.	780	5	0.98	10	0		1.98	4	15.5	10	0.67	9	1.39	6	73	3	0	0.108	11
Loviisa B	23.5.	830	3	1.06	10	0		2.29	4	-		0.54	12	1.09	6	64	3	-	-	
	22.8.	750	3	0.49	23	0		1.32	7	-		0.69	10	1.16	9	59	3	-	-	
Loviisa C	22.5.	880	4	0		0		0.32	17	-		0		1.18	6	63	3	-	-	
	22.8.	760	3	0		0		0		-		0		1.01	7	59	3	-	-	
Loviisa D	21.5.	750	3	0		0		0		-		0		0.95	6	46	3	-	-	
	21.8.	870	4	0		0		0		-		0		1.30	9	66	4	-	-	
Loviisa E	21.5.	820	4	0		0		0		-		0		0.88	6	51	3	-	-	
	21.8.	820	3	0		0		0		10.5	10	0		0.94	7	57	3	0	0.055	15

0 = below the detection limit
- = not analysed

Table XXXb. ^{90}Sr, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg^{-1} dry weight) in periphyton, littoral algae and submerged seed plants in the sampling areas A-E at Loviisa in 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty

	Date	^{40}K	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{90}Sr	^{95}Nb	^{95}Zr	^{110m}Ag	^{124}Sb	^{134}Cs	^{137}Cs	^{239}Pu	$^{239,240}Pu$
Periphyton															
Loviisa A	6.5.-8.7.	520 4	1.89 25	0	0	7.9 10	-	0	0	0	0	4.0 13	293 4	-	-
	8.7.-4.8.	450 6	0	0	0	5.8 14	-	0	0	0	0	0	229 4	-	-
	4.8.-24.8.	510 5	4.4 14	0	7.3 10	8.6 7	-	0	0	6.6 8	8.7 7	4.4 9	410 3	-	-
	24.8.-22.9.	500 3	35 4	5.5 9	43 3	83 3	-	7.3 7	3.4 11	4.3 11	8.9 9	5.0 5	420 3	-	-
Cladophora glomerata															
Loviisa A	8.7.	120 8	0	0	0	0	-	0	0	0	0	0	22.5 4	-	-
Fucus vesiculosus															
Loviisa A	19.5.	850 3	1.26 10	0	0	1.89 5	-	0	0	0	0	1.16 7	87 3	-	-
	24.8.	880 4	0	0	0	0	13.4 10	0	0	0	0	1.62 21	60 5	0	0.108 13
Loviisa B	19.5.	790 4	1.05 11	0	0	1.84 5	-	0	0	0	0	1.02 9	72 3	-	-
	24.8.	770 3	0.59 16	0	0.65 15	1.39 6	-	0	0	0.65 10	0.41 13	0.48 12	45 3	-	-
Loviisa C	19.5.	650 4	0	0	0	0.22 23	-	0	0	0	0	0.69 10	49 3	-	-
	24.8.	900 4	0	0	0	0	-	0	0	0	0	0.50 17	49 4	-	-
Loviisa D	18.5.	530 4	0	0	0	0	-	0	0	0	0	0.46 12	29.2 3	-	-
	24.8.	940 4	0	0	0	0	-	0	0	0	0	0.56 12	42 3	-	-
Loviisa E	18.5.	550 4	0	0	0	0	-	0	0	0	0	0.43 12	34 4	-	-
	24.8.	810 3	0	0	0	0	10.0 10	0	0	0	0	0.37 9	37 3	0	0.087 14
Myriophyllum spic.															
Loviisa A	25.8.	440 3	2.13 6	0	2.73 5	2.71 4	-	0	0	2.43 3	2.83 4	0.62 9	58 3	-	-
	28.8.	520 4	3.1 6	0	7.4 4	7.1 3	-	0	0	3.3 3	3.8 4	1.17 6	92 4	-	-
Potamogeton pect.															
Loviisa A	25.8.	540 3	0.79 10	0	0.90 8	1.50 4	-	0	0	0.94 5	1.07 7	0.39 10	27.1 3	-	-

0 = below the detection limit
- = not analysed

Table XXXIa. ^{90}Sr, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg^{-1} dry weight) in littoral algae in the sampling areas A-E at Olkiluoto in 1997. 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	$^{239,240}Pu$	
Cladophora glomerata																		
Olkiluoto A	4.7.	490	3	8.3	3	0.49	20	4.6	3	-		1.05	7	24	3	-	-	
Fucus vesiculosus																		
Olkiluoto A	13.5.	710	4	11.7	4	1.86	5	42	3	-		1.72	4	65	3	-	-	
	25.8.	860	3	8.1	3	1.60	5	24.9	3	10.3	10	1.36	5	73	3	0	0.061	16
Olkiluoto B	13.5.	520	3	2.65	5	0.62	20	10.3	3	-		1.20	7	51	3	-	-	
	25.8.	510	2	2.86	3	0.82	6	10.2	3	-		0.75	6	40	3	-	-	
Olkiluoto C	14.5.	740	4	0		0		1.97	6	-		0.93	9	51	4	-	-	
	25.8.	520	3	0		0		1.16	6	8.8	10	0.50	12	38	3	0	0.036	21
Olkiluoto D	12.5.	860	3	0.60	16	0		2.39	4	0		0.91	8	55	3	-	-	
	28.8.	630	4	0.299	22	0		1.57	4	-		0.62	8	42	4	-	-	
Olkiluoto E	15.5.	670	3	0.65	15	0		4.0	3	-		1.00	8	50	3	-	-	
	28.8.	590	4	0.88	13	0.24	32	3.8	4	-		0.69	10	44	4	-	-	

0 = below the detection limit
- = not analysed

Table XXXIb. ^{90}Sr, $^{239,240}Pu$ and gamma-emitting radionuclides (Bq kg^{-1} dry weight) in periphyton, littoral algae and submerged seed plants in the sampling areas A-E at Olkiluoto in 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Date	^{40}K		^{54}Mn		^{58}Co		^{60}Co		^{90}Sr		^{134}Cs		^{137}Cs		^{239}Pu	$^{239,240}Pu$	
Periphyton																		
Olkiluoto A	28.4.-30.6.	510	3	6.1	9	0		52	3	-		10.5	4	400	3	-	-	
	30.6.-12.8.	630	4	4.5	11	0		38	3	-		7.7	6	520	3	-	-	
	12.8.-2.9.	580	4	3.5	13	0		40	3	-		5.7	8	500	3	-	-	
	2.9.-29.9.	620	8	3.6	13	0		49	5	-		7.3	8	520	3	-	-	
Cladophora glomerata																		
Olkiluoto A	30.6.	1530	4	0		0		3.2	6	-		0.57	16	38	5	-	-	
Fucus vesiculosus																		
Olkiluoto A	14.5.	680	4	2.72	6	0		11.7	3	-		1.13	8	73	3	-	-	
	2.9.	760	4	1.64	11	0		11.5	3	11.3	10	1.18	9	71	4	0	0.110	15
Olkiluoto B	14.5.	570	3	1.21	9	0		7.1	3	-		1.01	8	64	3	-	-	
	4.9.	620	2	0.90	8	0		4.5	3	-		0.55	8	46	3	-	-	
Olkiluoto C	14.5.	680	4	0		0		0.88	8	-		0.62	11	49	3	-	-	
	2.9.	660	4	0		0		1.00	6	8.7	10	0.54	10	38	3	0	0.065	17
Olkiluoto D	14.5.	570	3	0.30	28	0		1.37	5	-		0.54	13	40	3	-	-	
	3.9.	730	4	0		0		1.45	5	-		0.40	13	38	3	-	-	
Olkiluoto E	14.5.	570	3	0		0		2.96	4	-		0.46	14	41	3	-	-	
	3.9.	880	3	0		0		1.05	7	-		0.54	13	43	3	-	-	
Myriophyllum spicatum																		
Olkiluoto A	2.9.	440	4	3.8	4	0.17	20	15.8	3	-		1.01	6	67	3	-	-	
Potamogeton pectinatus																		
Olkiluoto A	2.9.	570	4	2.27	5	0		9.8	3	-		0.88	5	62	3	-	-	

0 = below the detection limit
- not analysed

Table XXXII. The concentration 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 1997 and 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Date	^{40}K	^{54}Mn	^{60}Co	^{90}Sr	^{110m}Ag	^{134}Cs	^{137}Cs
Saduria entomon							
Loviisa B							
22.5.-5.6.1997	161 5	0	0.81 19	15.9 10	2.72 9	0	22.9 4
6.5.-4.6.1998	227 5	0	1.37 17	12.4 10	0	0.92 23	28.6 3
Macoma baltica							
Olkiluoto A							
3.7.1997	70 8	0	3.2 8	21.2 10	0	0	21.7 5
30.6.1998	58 7	0	2.56 6	17.4 10	0	0	16.6 4
Mytilus edulis							
Olkiluoto A							
4.7.1997	47 11	9.0 7	23.0 3	-	0	0	4.4 10
30.6.1998	55 13	3.8 13	12.5 5	-	0	0	3.6 12

0 = below the detection limit
- = not analysed

Table XXXIIIa. Gamma-emitting radionuclides and ^{90}Sr in edible parts of fish caught in the vicinity of the Loviisa power plant in 1997 (Bq kg^{-1} fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Species	Date	^{40}K		^{90}Sr		^{134}Cs		^{137}Cs	
Baltic herring[a]									
Clupea harengus membras									
Area I	1.5. - 31.5.	110	4	-		0.168	12	9.0	4
	1.9. - 30.9.	115	3	0.054	20	0.115	7	8.3	3
Area II	1.5. - 31.5.	100	4	-		0.174	5	9.8	4
	1.9. - 30.9.	117	4	-		0.128	13	7.8	4
Perch[a]									
Perca fluviatilis									
Area I	1.5. - 31.5.	105	3	-		0.63	3	37	3
	1.9. - 30.9.	102	4	0.31	20	0.38	6	24.9	5
Area II	1.5. - 31.5.	101	3	-		0.69	5	38	4
	1.9. - 30.9.	103	3	-		0.42	6	23.9	4
Pike[b]									
Esox lucius									
Area I	1.5. - 31.5.	127	4	-		0.43	6	25.9	4
	1.9. - 30.9.	112	3	-		0.36	3	21.9	4
Area II	1.5. - 31.5.	133	3	-		0.41	3	24.2	3
	1.9. - 30.9.	127	3	-		0.34	4	21.6	3
Roach[a]									
Rutilus rutilus									
Area I	1.5. - 31.5.	96	4	-		0.108	9	6.3	3
	1.9. - 30.9.	106	4	-		0.069	14	5.5	5
Area II	1.5. - 31.5.	91	3	-		0.140	6	7.6	4
	1.9. - 30.9.	103	4	-		0.139	15	6.0	4

[a] flesh and bones analysed
[b] only flesh analysed
- = not analysed

Table XXXIIIb. Gamma-emitting radionuclides and ^{90}Sr in edible parts of fish caught in the vicinity of the Loviisa power plant in 1998 (Bq kg^{-1} fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Species	Date	^{40}K		^{90}Sr		^{134}Cs		^{137}Cs	
Baltic herring[a]									
Clupea harengus membras									
Area I	1.5. - 31.5.	112	3	-		0.105	14	8.3	4
	1.9. - 30.9.	109	4	0.062	15	0.086	11	8.5	3
Area II	1.5. - 31.5.	118	3	-		0.113	9	8.7	3
	1.9. - 30.9.	113	5	-		0.139	14	8.6	5
Perch[a]									
Perca fluviatilis									
Area I	1.5. - 31.5.	95	3	-		0.35	7	28.4	4
	1.9. - 30.9.	103	3	0.270	15	0.33	8	26.8	3
Area II	1.5. - 31.5.	95	3	-		0.31	7	29.3	3
	1.9. - 30.9.	104	6	-		0.30	12	28.1	5
Pike[b]									
Esox lucius									
Area I	1.5. - 31.5.	106	3	-		0.34	4	27.9	3
	1.9. - 30.9.	129	5	-		0.36	7	28.6	5
Area II	1.5. - 31.5.	108	4	-		0.34	4	28.0	3
	1.9. - 30.9.	128	5	-		0.31	7	25.0	5
Roach[a]									
Rutilus rutilus									
Area I	1.5. - 31.5.	99	4	-		0		5.9	4
	1.9. - 30.9.	97	4	-		0.056	16	6.2	3
Area II	1.5. - 31.5.	94	3	-		0.088	18	5.6	3
	1.9. - 30.9.	105	3	-		0.104	12	6.8	3

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

Table XXXIVa. Gamma-emitting radionuclides and ^{90}Sr in edible parts of fish caught in the vicinity of the Olkiluoto power plant in 1997 (Bq kg^{-1} fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Species	Date	^{40}K	^{90}Sr	^{134}Cs	^{137}Cs
Baltic herring[a]					
Clupea harengus membras					
Area I	21.4. - 9.5.	107 3	-	0.297 4	16.8 3
	24.9. - 5.10.	120 3	0.044 20	0.267 4	17.2 3
Area II	9.5. - 9.6.	100 4	-	0.252 7	14.4 3
	27.9. - 7.10.	110 4	-	0.30 4	17.6 3
Perch[a]					
Perca fluviatilis					
Area I	21.4. - 9.5.	99 4	-	1.17 4	61 4
	24.9. - 5.10.	94 4	0.55 20	0.70 3	44 3
Area II	9.5. - 9.6.	86 3	-	0.85 3	48 3
	27.9. - 7.10.	92 2	-	0.72 4	46 3
Pike[b]					
Esox lucius					
Area I	21.4. - 9.5.	92 4	-	0.64 3	29.1 3
	24.9. - 5.10.	117 4	-	0.77 4	43 4
Area II	9.5. - 9.6.	116 3	-	0.66 3	37 3
	27.9. - 7.10.	120 3	-	0.34 4	21.4 3
Roach[a]					
Rutilus rutilus					
Area I	21.4. - 9.5.	91 4	-	0.281 11	12.0 4
	24.9. - 5.10.	101 4	-	0.174 12	9.5 4
Area II	9.5. - 9.6.	83 4	-	0.220 10	10.8 3
	27.9. - 7.10.	104 3	-	0.174 8	12.4 3

[a] flesh and bones analysed
[b] only flesh analysed
- = not analysed

Table XXXIVb. Gamma-emitting radionuclides and ^{90}Sr in edible parts of fish caught in the vicinity of the Olkiluoto power plant in 1998 (Bq kg^{-1} fresh weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

Species	Date	^{40}K		^{90}Sr		^{134}Cs		^{137}Cs	
Baltic herring[a]									
Clupea harengus membras									
Area I	3.6.	116	4	-		0.151	11	14.1	4
	26.9. - 12.10.	130	4	0.050	15	0.179	7	15.9	3
Area II	13.5. - 24.5.	128	3	-		0.190	6	15.3	3
	3.9. - 3.10.	121	3	-		0.160	7	15.1	4
Perch[a]									
Perca fluviatilis									
Area I	27.4. - 25.5.	95	3	-		0.69	4	53	3
	26.9. - 12.10.	96	6	0.64	15	0.55	8	48	5
Area II	13.5. - 24.5.	95	3	-		0.64	5	46	3
	3.9. - 3.10.	89	4	-		0.48	7	40	3
Pike[b]									
Esox lucius									
Area I	27.4. - 25.5.	115	3	-		0.39	4	28.2	3
	26.9. - 12.10.	115	3	-		0.38	4	33	3
Area II	2.10. - 3.10.	120	4	-		0.36	5	29.0	4
	18.5. - 19.5.	104	4	-		0.36	4	28.0	3
Roach[a]									
Rutilus rutilus									
Area I	27.4. - 25.5.	95	4	-		0.145	12	10.8	5
	26.9. - 12.10.	105	3	-		0.095	17	8.6	4
Area II	13.5. - 24.5.	93	4	-		0.124	11	10.6	3
	3.9. - 3.10.	99	4	-		0.117	19	10.3	4

[a] flesh and bones analysed
[b] only flesh analysed
- = not analysed

Table XXXV. Gamma-emitting radionuclides in young salmon from the Loviisa and Olkiluoto Fish Farms in 1997 and 1998 (Bq kg^{-1} fresh weight). Relative uncertainties include (1σ) both statistical and calibration uncertainty.

Species	Date	^{40}K		^{137}Cs	
Loviisa Fish Farm					
Salmo gairdneri	30.1.1997	109	4	0.67	6
Salmo gairdneri	3.2.1997	96	3	0.49	9
Salmo gairdneri	10.3.1997	106	3	0.57	8
Salmo salar	3.4.1997	99	3	0.93	6
Salmo gairdneri	8.4.1997	100	4	0.66	6
Salmo gairdneri	13.5.1997	98	3	2.40	4
Salmo gairdneri	11.6.1997	94	4	0.69	6
Salmo gairdneri	2.12.1997	88	3	0.49	9
Salmo gairdneri	7.1.1998	107	4	0.37	15
Salmo gairdneri	5.2.1998	105	4	0.255	19
Salmo gairdneri	5.3.1998	107	4	0.285	11
Coregonus lavaretus	23.3.1998	109	5	0.76	11
Coregonus lavaretus	31.3.1998	110	4	0.97	8
Salmo gairdneri	11.5.1998	110	4	0.46	14
Salmo gairdneri	3.6.1998	103	4	0.37	12
Salmo gairdneri	1.12.1998	97	3	0.73	7
Olkiluoto Fish Farm					
Salmo gairdneri	2.1.1997	101	3	0.70	8
Salmo salar	3.2.1997	106	3	0.71	7
Salmo salar	3.3.1997	104	3	0.68	7
Salmo trutta	3.4.1997	100	3	0.52	8
Salmo trutta	16.4.1997	102	3	0.58	8
Salmo trutta	2.5.1997	100	4	0.69	6
Salmo gairdneri	2.6.1997	96	3	1.55	5

Table XXXVI. Gamma-emitting radionuclides in sinking matter (Bq kg^{-1} dry weight) in the vicinity of Loviisa nuclear power plant in 1997 and 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Sampling depth m	Dry weight g	^{40}K	^{54}Mn	^{58}Co	^{60}Co	^{95}Zr	^{134}Cs	^{137}Cs
Loviisa 1	8								
18.11.1996 - 7.5.1997		25.2	800 4	0	0	5.3 18	0	18.5 8	980 4
7.5.1997 - 27.6.1997		6.2	730 5	0	0	5.0 14	0	11.8 8	850 3
27.6.1997 - 2.9.1997		23.4	780 3	0	0	4.5 6	0	15.3 3	900 3
2.9.1997 - 22.10.1997		21.3	780 3	1.99 17	0	6.4 6	0	15.8 6	950 4
22.10.1997 - 28.5.1998		21.1	830 4	0	0	7.7 7	0	13.8 7	1030 3
6.5.1998 - 9.7.1998		15.0	570 5	0	0	2.8 16	0	7.5 11	660 3
9.7.1998 - 25.8.1998		18.6	760 3	0	0	5.1 6	0	10.5 3	840 3
25.8.1998 - 4.11.1998		59.2	790 4	1.84 18	3.7 12	5.9 5	0	10.9 4	920 3
Loviisa 3	17								
18.11.1996 - 7.5.1997		16.2	710 3	3.1 25	0	12.3 6	0	14.3 5	830 3
7.5.1997 - 27.6.1997		16.6	730 3	0	0	8.6 5	0	12.5 4	760 3
27.6.1997 - 2.9.1997		7.2	620 6	9.3 18	0	11.9 10	0	10.3 12	690 4
2.9.1997 - 22.10.1997		11.8	730 3	6.9 8	11.0 6	18.7 3	0	11.6 5	730 3
22.10.1997 - 6.5.1998		21.9	710 4	3.6 21	0	18.1 5	0	11.1 6	850 3
6.5.1998 - 9.7.1998		18.8	690 4	4.3 20	0	13.1 7	0	8.4 9	630 3
9.7.1998 - 25.8.1998		6.6	660 5	0	0	8.3 8	0	7.4 11	600 5
25.8.1998 - 4.11.1998		22.3	820 5	12.4 7	7.2 13	23.7 4	8.1 22	7.4 9	780 3
Loviisa 4A	27								
18.11.1996 - 7.5.1997		5.5	700 5	0	0	0	0	15.7 10	830 3
7.5.1997 - 27.6.1997		6.2	410 5	15.3 6	3.0 27	10.3 6	0	8.5 6	480 3
27.6.1997 - 2.9.1997		-	490 8	0	0	0	0	10.9 15	490 5
2.9.1997 - 22.10.1997		16.2	680 4	0	0	2.43 10	0	13.6 4	810 3
22.10.1997 - 6.5.1998		15.2	720 4	0	0	2.04 18	0	12.8 6	930 3
6.5.1998 - 9.7.1998		8.9	500 5	0	0	3.8 26	0	6.6 13	500 4
9.7.1998 - 25.8.1998		5.6	570 4	0	0	2.50 15	0	7.1 8	580 3
25.8.1998 - 4.11.1998		28.4	740 5	0	0	2.85 13	0	8.2 7	820 3
Loviisa R1	13								
18.11.1996 - 7.5.1997		11.6	830 4	0	0	0	0	18.2 6	860 3
7.5.1997 - 26.6.1997		49.6	950 5	0	0	0	0	12.4 7	800 5
26.6.1997 - 2.9.1997		39.1	960 4	0	0	0	0	11.4 5	750 4
2.9.1997 - 22.10.1997		38.2	950 4	0	0	0	0	12.6 4	770 4
22.10.1997 - 19.5.1998		16.2	940 4	0	0	0	0	12.1 6	850 3
6.5.1998 - 9.7.1998		45.0	890 4	0	0	0	0	10.7 13	630 4
9.7.1998 - 25.8.1998		27.0	920 4	0	0	0	0	9.9 5	750 3
25.8.1998 - 4.11.1998		43.4	910 4	0	0	0	0	8.2 3	770 3

0 = below the detection limit
- = not determined

Table XXXVII. Gamma-emitting radionuclides in sinking matter (Bq kg^{-1} dry weight) in the vicinity of Olkiluoto nuclear power plant in 1997 and 1998. Relative uncertainties (1σ) include both statistical and calibration uncertainty.

	Sampling depth m	Dry weight g	^{40}K		^{54}Mn		^{60}Co		^{125}Sb		^{134}Cs		^{137}Cs	
Olkiluoto 12	15													
15.5.1997 - 2.7.1997		18.9	630	5	0		21.8	6	0		13.7	8	650	5
2.7.1997 - 26.8.1997		11.2	690	4	0		22.9	4	0		12.1	7	750	4
26.8.1997 - 19.11.1997		89.5	720	4	2.14	15	23.9	3	0		12.6	3	720	3
19.11.1997 - 28.4.1998		26.9	780	4	0		22.2	4	0		12.1	6	740	3
28.4.1998 - 30.6.1998		12.5	720	4	0		18.1	4	0		10.6	9	680	3
30.6.1998 - 2.9.1998		37.9	770	3	0		25.2	4	0		9.7	9	750	3
02.9.1998 - 12.11.1998		65.3	700	5	0		63	3	0		6.6	9	660	3
Olkiluoto 3	13													
15.5.1997 - 2.7.1997		13.9	630	4	1.98	26	13.6	5	0		9.9	6	570	3
2.7.1997 - 26.8.1997		11.0	650	6	4.5	25	26.9	6	0		13.5	8	560	4
26.8.1997 - 19.11.1997		156.9	770	3	2.51	12	19.6	3	0		11.5	3	640	3
28.4.1998 - 30.6.1998		19.9	670	6	0		11.0	11	0		8.9	15	500	4
30.6.1998 - 1.9.1998		21.8	690	3	0		16.4	3	0		7.1	6	520	3
1.9.1998 - 12.11.1998		86.7	720	3	0		15.4	5	0		6.7	9	530	3
Olkiluoto 4	8													
26.11.1996 - 15.5.1997		36.0	700	5	4.7	19	27.4	5	0		15.0	6	670	5
15.5.1997 - 2.7.1997		14.8	640	5	3.4	21	19.0	5	0		10.9	7	590	3
2.7.1997 - 26.8.1997		14.4	760	4	5.4	12	25.7	3	0		13.0	5	720	3
26.8.1997 - 19.11.1997		72.6	760	3	2.74	11	16.6	3	4.0	23	10.7	3	650	3
19.11.1997 - 28.4.1998		13.6	670	4	0		17.2	4	0		9.7	7	590	3
28.4.1998 - 30.6.1998		23.7	370	7	0		16.9	5	0		8.3	10	550	3
30.6.1998 - 1.9.1998		12.5	700	3	0		19.7	3	0		7.1	7	610	3
1.9.1998 - 12.11.1998		59.0	790	5	0		16.2	4	0		8.1	8	670	3
Olkiluoto 15	11													
26.11.1996 - 14.5.1997		38.9	730	6	0		20.2	7	0		16.8	9	690	4
14.5.1997 - 2.7.1997		49.1	640	5	0		4.3	16	0		9.9	11	580	4
2.7.1997 - 25.8.1997		11.9	710	3	0		7.1	7	0		13.1	5	680	4
25.8.1997 - 19.11.1997		85.2	790	4	0		10.0	6	0		10.3	5	660	4
28.4.1998 - 30.6.1998		23.6	680	4	0		0		0		6.6	12	560	3
30.6.1998 - 1.9.1998		30.9	800	4	0		5.6	10	0		7.0	11	650	3
1.9.1998 - 12.11.1998		77.4	790	6	0		4.1	16	0		8.0	11	570	5

0 = below the detection limit

Table XXXVIII. 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 1997 and 1998. Relative uncertainties (1σ) include statistical and calibration uncertainty.

	^{238}Pu		$^{239,240}Pu$	
Loviisa 3				
18.11.1996 - 22.10.1997	0.026	34	1.08	6
22.10.1997 - 4.11.1998	0.032	40	1.08	9
Loviisa R1				
18.11.1996 - 22.10.1997	0.0297	26	0.78	6
22.10.1997 - 4.11.1998	0		0.66	10
Olkiluoto 12				
15.5.1997 - 19.11.1997	0.065	24	1.60	6
19.11.1997 - 12.11.1998	0.088	25	1.74	7
Olkiluoto 15				
26.11.1996 - 19.11.1997	0.082	20	1.28	6
28.4.1998 - 12.11.1998	0.130	30	2.12	9

0 = below the detection limit

Table XXXIX. Vertical distribution of ^{90}Sr, ^{238}Pu, $^{239,240}Pu$ and gamma-emitting radionuclides and total amounts of ^{137}Cs, in bottom sediments at Loviisa in 1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty. The samples were taken by Gemini Twin Corer except two cores by Aquarius Box Corer and STUK Corer at Loviisa 3.

Sampling station (depth) slice (cm)	Dry matter %	^{40}K	^{60}Co	^{90}Sr*	^{125}Sb	^{134}Cs	^{137}Cs	^{238}Pu	$^{239,240}Pu$
Loviisa 1 (7.9 m)									
0-5	9	820 3	4.4 5	3.2 8	0	13.0 5	1080 3	0	2.16 15
5-10	15	810 4	5.7 7	6.2 7	0	14.7 4	1120 4	0.055 30	2.20 10
10-15	17	860 5	4.4 8	-	0	18.8 3	1510 3	-	-
15-20	19	810 3	0	-	0	3.8 11	370 3	-	-
20-25	22	810 6	0	-	0	0	106 5	-	-
25-30	23	850 5	0	-	0	0	18.2 5	-	-
total amount (0-30 cm)							34900 Bqm^{-2}		
Loviisa 2 (11.7 m)									
0-5	8	770 4	15.3 5	-	0	16.1 6	1230 3	-	-
5-10	12	750 4	18.8 4	-	0	25.7 4	2000 3	-	-
10-15	15	930 5	11.5 6	-	13.2 26	29.6 3	2340 3	-	-
15-20	19	620 6	0	-	0	4.0 20	400 4	-	-
20-25	19	820 3	0	-	0	0	43 4	-	-
25-30	21	900 3	0	-	0	0	14.4 6	-	-
total amount (0-30 cm)							42400 Bqm^{-2}		

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

Table XXXIX. Continues.

Sampling station (depth) corer slice (cm)	Dry matter %	^{40}K	^{60}Co	^{90}Sr*	^{124}Sb	^{134}Cs	^{137}Cs	^{238}Pu	^{239,240}Pu
Loviisa 3 (17.1 m)									
Gemini Twin Corer									
0-5	10	840 5	9.2 6	3.9 8	0	16.0 7	1050 3	0.057 40	1.35 14
5-10	12	760 5	21.7 4	6.9 8	0	23.4 4	1930 3	0	1.92 15
10-15	15	810 4	11.2 3	-	9.2 17	33 3	2620 3	-	-
15-20	17	750 4	1.83 12	-	0	1.96 14	236 3	-	-
20-25	18	780 4	0.77 16	-	0	0	112 3	-	-
25-30	20	880 5	0	-	0	0	169 5	-	-
total amount (0-30 cm)							42700 Bqm^{-2}		
Aquarius Box Corer									
0-5	9	770 6	14.0 8	-	0	12.8 13	940 5	-	-
5-10	12	780 5	23.2 4	-	0	19.6 8	1720 3	-	-
10-15	15	800 6	15.4 9	-	0		3500 5	-	-
15-20	16	760 5	5.1 11	-	0	5.3 25	470 3	-	-
20-25	15	830 5	0	-	0	1.63 24	233 3	-	-
total amount (0-25 cm)							47300 Bqm^{-2}		
STUK Corer									
0-5	10	720 7	12.9 10	-	0	9.7 12	870 5	-	-
5-10	13	780 7	25.9 6	-	0	20.9 6	1550 5	-	-
10-15	14	810 3	16.9 4	-	0	39 4	3100 3	-	-
15-20	16	800 5	6.5 8	-	0	12.0 6	1040 3	-	-
20-25	15	820 5	0	-	0	1.23 25	218 3	-	-
25-30	19	840 5	0	-	0		62 3	-	-
total amount (0-30 cm)							49200 Bqm^{-2}		

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

Table XXXIX Continues.

Sampling station (depth) cm	Dry matter %	^{40}K		^{60}Co		^{90}Sr*		^{124}Sb		^{134}Cs		^{137}Cs		^{238}Pu		^{239,240}Pu	
Loviisa 4 (23.5 m)																	
0-5	6	670	4	0		4.9	9	0		10.5	8	920	3	0		1.43	9
5-10	11	730	4	3.4	12	10.7	7	0		21.8	4	1770	3	0.068	20	2.24	6
10-15	16	760	5	0		-		0		36	3	2730	3	-		-	
15-20	17	810	3	0		-		0		3.8	15	430	3	-		-	
20-25	12	770	4	0		-		0		0		165	4	-		-	
25-30	21	770	7	0		-		0		0		104	6	-		-	
total amount (0-30 cm)												43800 Bqm^{-2}					
Loviisa 5 (10.8 m)																	
0-5	10	720	3	16.6	5	4.9	9	0		11.5	8	920	3	0		1.32	15
5-10	13	740	4	19.1	5	6.7	8	0		17.6	6	1420	3	0		1.58	15
10-15	16	820	5	13.6	6	-		0		19.3	5	1620	3	-		-	
15-20	17	800	6	0		-		0		3.1	25	220	4	-		-	
20-25	18	840	3	0		-		0		0		101	4	-		-	
25-30	20	870	6	0		-		0		0		29.1	6	-		-	
total amount (0-30 cm)												32100 Bqm^{-2}					
Loviisa 7 (32.5 m)																	
0-5	5	660	4	0		-		0		9.6	9	840	3	0.043	28	1.22	7
5-10	8	690	4	3.4	15	-		0		17.7	5	1410	3	0.078	20	1.93	7
10-15	14	820	3	2.03	11	-		6.5	14	20.5	3	1640	3	-		-	
15-20	18	820	4	0		-		0		1.10	27	177	3	-		-	
20-25	17	770	4	0		-		0		0		113	3	-		-	
25-30	18	840	4	0		-		0		0		115	4	-		-	
total amount (0-30 cm)												23300 Bqm^{-2}					

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

Table XXXIX. Continues

Sampling station (depth) slice (cm)	Dry matter %	^{40}K	^{60}Co	^{90}Sr*	^{134}Cs	^{137}Cs	^{238}Pu	^{239,240}Pu
Loviisa 10 (24 m)								
0-5	6	660 4	0 -	-	13.7 8	930 3	0.040 27	1.14 7
5-10	11	750 5	3.2 16	-	20.8 4	1730 3	0.050 27	1.95 7
10-15	15	800 3	0 -	-	35 4	2770 3	-	-
15-20	17	850 3	0 -	-	2.87 16	267 3	-	-
20-25	16	780 4	0 -	-	0	136 3	-	-
25-30	16	760 5	0 -	-	0	116 3	-	-
total amount (0-30 cm)						40000 Bqm^{-2}		
Loviisa R1 (12.4 m)								
0-5	18	910 3	0	3.3 8	10.0 5	840 3	0.059 40	0.79 14
5-10	24	860 4	0	2.86 8	15.1 6	1130 3	0	1.33 13
10-15	27	890 3	0	-	0	930 3	-	-
15-20	28	980 5	0	-	2.75 15	241 3	-	-
20-25	27	920 5	0	-	0	69 3	-	-
25-30	29	900 3	0	-	0	9.7 6	-	-
total amount (0-30 cm)						44000 Bqm^{-2}		
Loviisa S5 (16 m)								
0-5	6	710 4	0	-	10.7 7	930 3	-	-
5-10	11	850 4	0	3.1 12	20.2 4	1660 3	-	-
10-15	16	820 4	0	-	26.1 4	2270 3	-	-
15-20	17	780 4	0	-	4.6 8	460 3	-	-
20-25	19	870 5	0	-	0	98 3	-	-
25-30	22	870 6	0	-	0	20.9 7	-	-
total amount (0-30 cm)						38000 Bqm^{-2}		

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

Table XLa. Vertical distribution of gamma-emitting radionuclides in 1 cm slices of surficial bottom sediments taken by Gemini Twin corer at the station Loviisa 3 in 1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

cm	Dry matter %	^{40}K		^{60}Co		^{124}Sb		^{134}Cs		^{137}Cs	
0-1	4	660	5	4.3	16	0		9.0	8	670	3
1-2	10	700	6	13.2	7	0		9.9	11	790	5
2-3	10	750	5	11.9	4	0		12.0	5	880	3
3-4	10	730	5	11.3	7	0		11.2	7	940	3
4-5	9	690	7	6.3	19	0		16.8	4	910	4
5-6	11	760	4	8.7	9	0		14.2	6	1110	3
6-7	11	690	5	10.7	8	0		14.7	6	1180	3
7-8	13	740	4	24.1	3	0		19.9	4	1480	3
8-9	12	810	6	15.1	10	0		22.9	10	1610	4
9-10	12	790	4	22.3	4	0		27.4	6	2160	3
10-11	14	800	5	26.2	5	0		32	4	2440	3
11-12	13	760	4	13.7	10	0		36	5	2860	3
12-13	13	820	5	11.9	6	15.2	25	70	3	5200	3
13-14	15	820	4	10.5	8	17.0	27	50	3	4100	3
14-15	15	810	4	11.7	6	0		10.3	9	990	3
15-16	16	820	3	14.0	6	0		4.1	14	460	3
16-17	15	800	3	6.9	5	0		3.2	10	360	3
17-18	16	790	4	3.3	9	0		2.49	15	300	3
18-19	16	840	5	2.91	8	0		2.11	14	247	3
19-20	16	780	5	3.2	18	0		0		193	5
20-21	15	780	6	0		0		0		171	5
21-22	16	770	3	0		0		0		150	4
22-23	16	800	7	0		0		0		138	5
23-24	16	780	3	0		0		0		130	3
24-25	17	750	5	0		0		0		134	5
25-26	17	750	6	0		0		0		127	5
26-27	17	730	4	0		0		0		96	4
27-28	17	770	5	0		0		0		66	3
28-29	19	860	4	0		0		0		46	5
29-30	20	880	3	0		0		0		33	3
										total amount 40400 Bqm^{-2}	

0 = below the detection limit

Table XLb. Vertical distribution of gamma-emitting radionuclides in 1 cm slices of surficial bottom sediments taken by Niemistö corer at the station Loviisa 3 in 1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

cm	Dry matter %	^{40}K		^{60}Co		^{124}Sb		^{134}Cs		^{137}Cs	
0-1	7	760	5	7.4	13	0		8.6	13	730	3
1-2	10	680	6	9.3	11	0		11.2	13	790	5
2-3	10	410	5	6.4	11	0		5.3	18	580	3
3-4	12	760	5	17.0	8	0		15.4	13	1420	4
4-5	12	700	8	17.8	10	0		20.3	14	1600	5
5-6	13	820	7	22.0	8	0		27.8	10	2080	5
6-7	13	790	5	15.7	5	10.8	22	37	3	2640	3
7-8	14	800	5	9.7	11	0		47	5	3700	4
8-9	14	860	3	13.8	5	0		39	5	3200	3
9-10	16	800	4	8.9	9	0		2.93	7	2220	4
10-11	16	760	3	8.0	8	0		11.1	8	960	3
11-12	17	810	3	5.3	10	0		3.4	19	370	3
12-13	16	830	5	4.1	11	0		3.4	18	270	3
13-14	17	790	3	0		0		0		200	3
14-15	16	740	5	0		0		0		169	3
15-16	17	960	5	0		0		0		165	3
16-17	17	800	3	0		0		0		132	4
17-18	14	760	4	0		0		0		102	5
18-19	18	780	4	0		0		0		66	5
19-20	19	800	4	0		0		0		42	5
20-21	20	830	6	0		0		0		31	7
21-22	20	860	3	0		0		0		21.0	3
22-23	20	870	6	0		0		0		13.1	7
23-24	21	880	4	0		0		0		9.1	10
24-25	21	900	5	0		0		0		7.4	11
25-26	21	840	3	0		0		0		5.4	11
26-27	22	1050	5	0		0		0		5.8	8
27-28	22	920	5	0		0		0		4.3	9
28-29	22	920	4	0		0		0		4.0	18
29-30	22	910	3	0		0		0		2.84	18
										total amount	29000 Bqm^{-2}

0 = below the detection limit

Table XLc. Vertical distribution of gamma-emitting radionuclides in 1 cm slices of surficial bottom sediments taken by Limnos corer at the station Loviisa 3 in 1998 (Bq kg^{-1} dry weight). Relative uncertainties (1σ) include both statistical and calibration uncertainty.

cm	Dry matter %	^{40}K		^{60}Co		^{124}Sb		^{134}Cs		^{137}Cs	
0-1	2	740	5	5.6	17	0		10.0	15	730	3
1-2	4	720	6	7.3	14	0		11.5	11	750	4
2-3	6	770	4	12.4	5	0		10.7	9	870	3
3-4	5	760	4	12.6	5	0		11.6	8	970	3
4-5	5	710	5	13.2	7	0		9.8	7	980	7
5-6	6	750	3	10.3	7	0		11.6	7	1020	3
6-7	4	800	7	11.6	13	0		14.8	19	1160	5
7-8	4	730	4	25.2	6	0		14.7	8	1260	3
8-9	7	770	5	36	6	0		19.3	7	1550	3
9-10	6	750	5	34	5	0		20.8	6	1670	3
10-11	7	790	4	21.7	6	0		26.9	7	1950	4
11-12	6	760	3	16.3	5	0		28.7	5	2150	3
12-13	6	750	5	14.2	5	0		35	5	2950	3
13-14	6	730	5	11.9	6	0		56	4	4100	3
14-15	7	770	5	9.0	7	11.2	19	59	4	4800	3
15-16	7	820	5	11.5	7	0		14.1	8	1160	3
16-17	7	790	5	8.5	5	0		5.9	11	490	3
17-18	7	790	7	4.3	19	0		0		340	5
18-19	7	800	5	2.26	13	0		3.3	15	277	3
19-20	7	820	5	0		0		2.06	20	215	3
20-21	7	770	4	0		0		0.96	28	167	3
21-22	6	840	4	0		0		0		152	12
22-23	9	820	3	0		0		0		132	3
23-24	8	770	5	0		0		0		119	3
24-25	8	830	5	0		0		0		90	3
25-26	8	800	5	0		0		0		54	3
26-27	7	840	5	0		0		0		37	4
27-28	9	850	5	0		0		0		25.3	4
28-29	8	780	4	0		0		0		16.9	4
29-30	8	830	5	0		0		0		16.6	4
										total amount 45600 Bqm^{-2}	

0 = below the detection limit

Table XLI. High pressure ionization chamber measurements of environmental dose rates in the vicinity of Loviisa nuclear power plant in 1997-1998.

Station		Dose rate μSv h^{-1}	
		1997	1998
20	Laitosalue	0.18	0.16
21	Säämasto	0.16	0.17
22	Keitala	0.16	0.16
23	Saaristotie	0.20	0.19
24	Böle	0.14	0.14
25	Hudö	0.13	0.12
26	Fantsnäs	0.14	0.13
27	Määrlahti	0.18	0.17
28	Tesjoki	0.17	0.17
29	Tallholmen	0.22	0.22

Table XLII. High pressure ionization chamber measurements of environmental dose rates in the vicinity of Olkiluoto nuclear power plant in 1997-1998.

Station		Dose rate μSv h^{-1}	
		1997	1998
20	Laituri	0.13	0.11
21	Säämasto	0.12	0.11
22	Korvensuo	0.13	0.13
23	Pujonnokka	0.13	0.13
24	Kuivalahti	0.15	0.14
25	Linnamaa	0.11	0.11
26	Hankkila	0.11	0.11
27	Taipalmaa	0.12	0.11
28	Reksaari	0.13	0.11
29	Rauma	0.14	0.14
34	Otpää	0.11	0.10

Table XLIII. Direct spectroscopic measurements of source activity on open fields near the nuclear power plants in 1997-1998 (kBq m^{-2}).

	^{137}Cs
Loviisa 34	
1997	4.3
1998	5.6
Olkiluoto 38	
1997	2.4