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**User report**

Catharina Söderström, Rune Arntsing, Karin Lindh, Ingemar Vintersved

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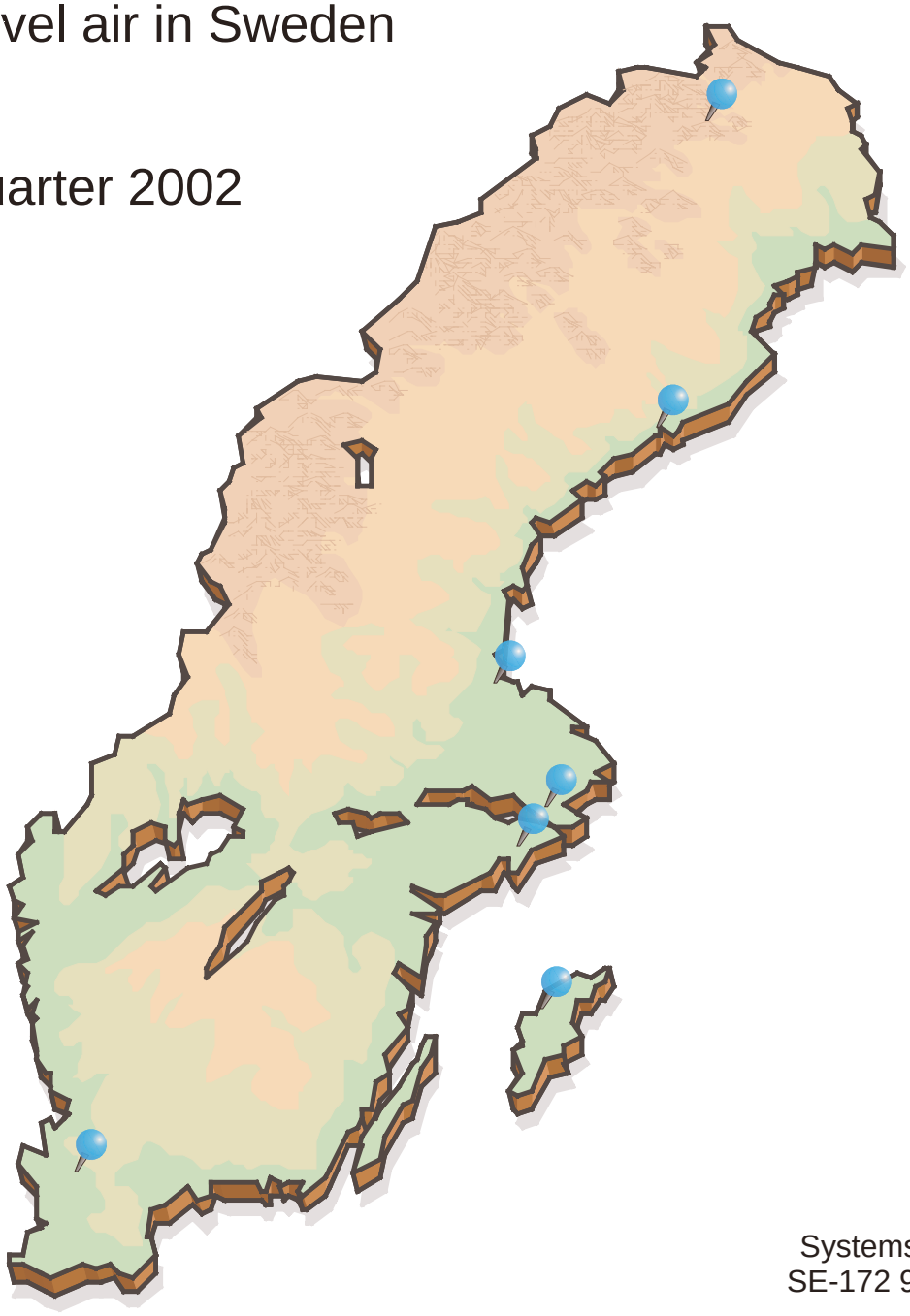
## Fourth quarter 2002



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**Report title**

Quarterly report on measurements of radionuclides in ground level air in Sweden. Fourth quarter 2002.


**Abstract (not more than 200 words)**

Filtering of ground level air is performed weekly at seven different locations in Sweden: Kiruna, Umeå, Gävle, Ursvik, Grindsjön, Visby and Ljungbyhed. The filters are compressed and the contents of different radionuclides are measured by gamma spectroscopy. Precipitation is also collected at four of the stations: Kiruna, Gävle, Ursvik and Ljungbyhed, the samples are ashed and the contents of radionuclides measured.

The levels of $^{7}$Be and $^{137}$Cs in air and deposition are presented for the different stations.

Other anthropogenic radionuclides detected, if any, are also presented.



**Keywords**

Airborne radionuclides, deposition, $^{7}$Be, $^{137}$Cs

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**Rapportens titel (i översättning)**

Radionuklider i markluft i Sverige. Kvartalsrapport, fjärde kvartalet 2002.


**Sammanfattning (högst 200 ord)**

Stationer för filtrering av markluft finns på sju olika ställen i Sverige: Kiruna, Umeå, Gävle, Ursvik, Grindsjön, Visby och Ljungbyhed. Filtren analyseras veckovis genom gammaspektroskopi med germaniumdetektor. Nederbörd samlas in på fyra av dessa stationer: Kiruna, Gävle, Ursvik och Ljungbyhed. Nederbördsproven askas in och mäts på samma sätt.
Halterna i luft och deposition av $^{7}$Be och $^{137}$Cs presenteras för de olika stationerna. I de fall andra antropogena radionuklider detekterats presenteras även dessa.



**Nyckelord**

Luftburen radioaktivitet, deposition, $^{7}$Be, $^{137}$Cs

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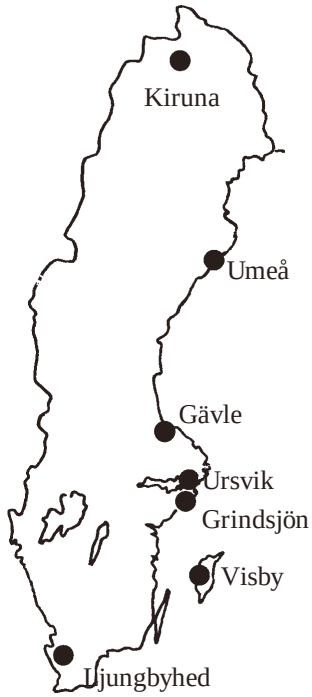
# Sampling and analysis procedures

Sampling of ground level air is performed at seven different locations in Sweden, as follows:




| | | |
|---|---|---|
| Kiruna: | 67,84° N | 20,42° O |
| Umeå: | 63,85° N | 20,34° O |
| Gävle: | 60,40° N | 17,14° O |
| Ursvik: | 59,39° N | 17,96° O |
| Grindsjön: | 59,07° N | 17,82° O |
| Visby: | 57,63° N | 18,32° O |
| Ljungbyhed: | 56,08° N | 13,23° O |

At all stations except at Grindsjön, 1000 $m^3$/h of air is filtered through a glass fibre filter (Camfil type CS 5.0). At Grindsjön 5500 $m^3$/h of air is filtered through 5 filters. At each station the filters are changed twice a week (Monday and Thursday or Friday) and sent by mail to our laboratory for measurement and analysis.

Weekly samples are made from each station by taking 3/4 of each filter (1/4 of the filter is left for the archive) and compress them together into a small disc (diameter 60 mm, thickness 13 mm). These samples are measured, 3-4 days after the collection, on well shielded High Purity Germanium (HPGe) detectors. From the Grindsjön station, the 10 filters produced per week are assembled in a Marinelli like geometry by pressing them into one circular disc, placed on top of the detector, and into five rectangular bricks (77 mm by 48 mm by 13 mm) placed around the detector.

At four of the stations (Kiruna, Umeå, Ursvik and Ljungbyhed) a small part of the air flow (12$m^3$/h) that has passed the filter is taken through a charcoal cartridge in order to collect gaseous iodine. The cartridges are changed weekly but only analysed if particulate iodine in greater amount has been detected in the filter.

The stations in Kiruna, Gävle, Ursvik and Ljungbyhed are each equipped with a big stainless steel funnel (1m radius) to collect the precipitation that is passed through a cartridge consisting of a filter part, an anion part and a cation part. The cartridges are changed weekly and sent by mail to our laboratory. Four samples are combined to a monthly sample by ashing. The samples are measured on our HPGe detectors. From these measurements the total deposition is calculated.

Radionuclides seen in the filters are normally only the naturally occurring radon daughters and $^{7}$Be. Most of our stations also detect $^{137}$Cs, which is due to the resuspension of the Chernobyl fallout. In tables I and II the concentrations of $^{7}$Be and $^{137}$Cs are presented. The depositions at the stations where we collect precipitation are presented in table III. Sometimes we also detect other anthropogenic radionuclides and in that case these are presented in Table IV.

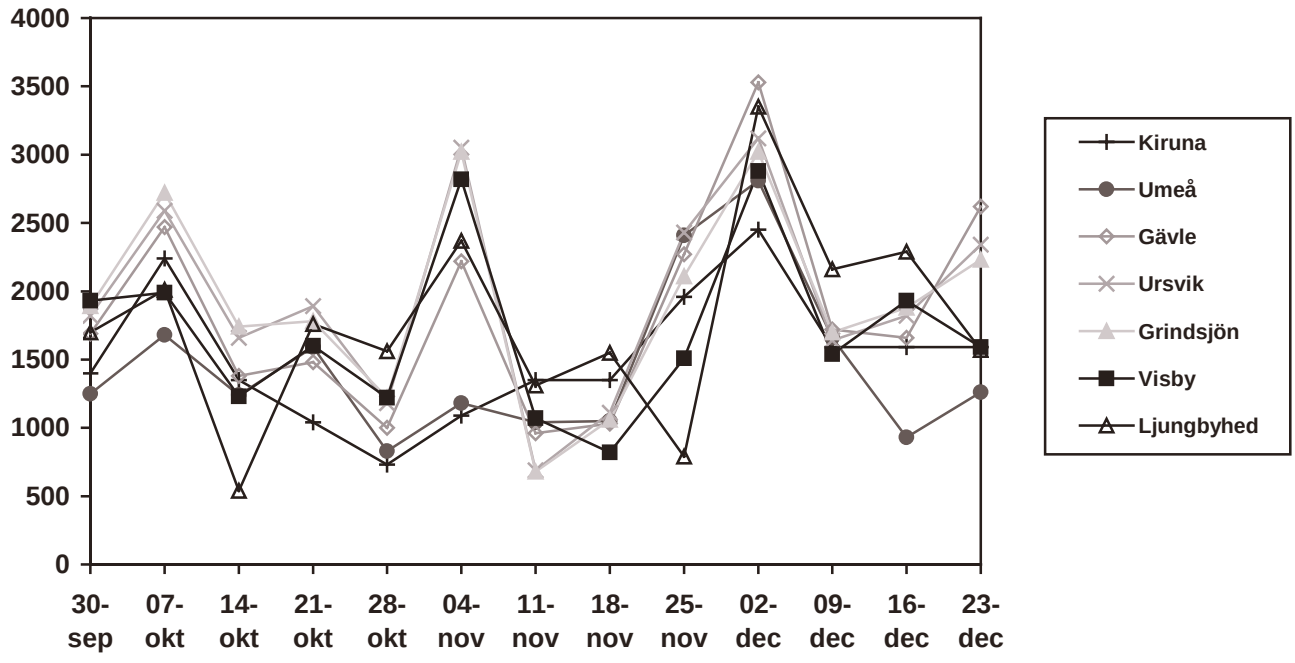
## *Table I*

# *$^{7}$Be concentrations in Sweden, fourth quarter 2002*

| *Week starting* | *Kiruna* | | *Umeå* | | *Gävle* | | *Ursvik* | | *Grindsjön* | | *Visby* | | *Ljungbyhed* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30-sep | 1400 | (0.2) | 1250 | (0.2) | 1690 | (0.3) | 1820 | (0.3) | 1890 | (0.1) | 1930 | (0.2) | 1700 | (0.2) |
| 7-oct | 2240 | (0.1) | 1680 | (0.2) | 2470[(5)] | (0.2) | 2590 | (0.2) | 2720 | (0.1) | 1990 | (0.2) | 2010 | (0.2) |
| 14-oct | 1350 | (0.2) | 1240 | (0.2) | 1380[(6)] | (0.3) | 1660 | (0.3) | 1740 | (0.1) | 1230 | (0.3) | 540 | (0.3) |
| 21-oct | 1040 | (0.2) | 1590 | (0.2) | 1480 | (0.3) | 1890 | (0.2) | 1770 | (0.1) | 1600 | (0.2) | 1760 | (0.2) |
| 28-oct | 730 | (0.3) | 830 | (0.3) | 1000 | (0.4) | 1180 | (0.4) | 1220 | (0.1) | 1220 | (0.3) | 1560 | (0.2) |
| 4-nov | 1090 | (0.2) | 1180 | (0.2) | 2220 | (0.2) | 3050 | (0.2) | 3020 | (0.1) | 2820 | (0.2) | 2370 | (0.2) |
| 11-nov | 1350 | (0.2) | 1040 | (0.3) | 960 | (0.4) | 690 | (0.3) | 680 | (0.2) | 1070 | (0.4) | 1310 | (0.2) |
| 18-nov | 1350 | (0.2) | 1050 | (0.2) | 1030 | (0.4) | 1110 | (0.3) | 1060 | (0.1) | 820 | (0.3) | 1550 | (0.2) |
| 25-nov | 1960 | (0.1) | 2410 | (0.1) | 2270 | (0.2) | 2430 | (0.2) | 2110 | (0.1) | 1510 | (0.2) | 790 | (0.3) |
| 2-dec | 2450 | (0.1) | 2810 | (0.2) | 3530 | (0.2) | 3120 | (0.2) | 3020 | (0.1) | 2880 | (0.1) | 3350 | (0.1) |
| 9-dec | 1590[(1)] | (0.1) | 1660[(2)] | (0.2) | 1720 | (0.4) | 1640 | (0.2) | 1700 | (0.1) | 1540 | (0.3) | 2160 | (0.2) |
| 16-dec | 1590[(1)] | (0.1) | 930[(3)] | (0.4) | 1660 | (0.3) | 1820 | (0.2) | 1880 | (0.1) | 1930[(8)] | (0.2) | 2290 | (0.2) |
| 23-dec | 1590[(1)] | (0.1) | 1260[(4)] | (0.2) | 2620[(7)] | (0.2) | 2340 | (0.2) | 2230 | (0.1) | 1590[(9)] | (0.2) | 1570 | (0.2) |

Values are given in μBq/m$^3$.
Error estimates (1σ %) are given in brackets.

[1)] 30 days filter, 9/12 - 8/1
[2)] Eight days filter, 9 - 17/12
[3)] Three days filter 17 - 20/12
[4)] 18 days filter, 20/12 - 7/1
[5)] Eight days filter, 7 - 15/10
[6)] Six days filter, 15 - 21/10
[7)] Ten days filter, 23/12 – 2/1
[8)] Three days filter, 16 – 19/12
[9)] 11 days filter, 19 - 30/12



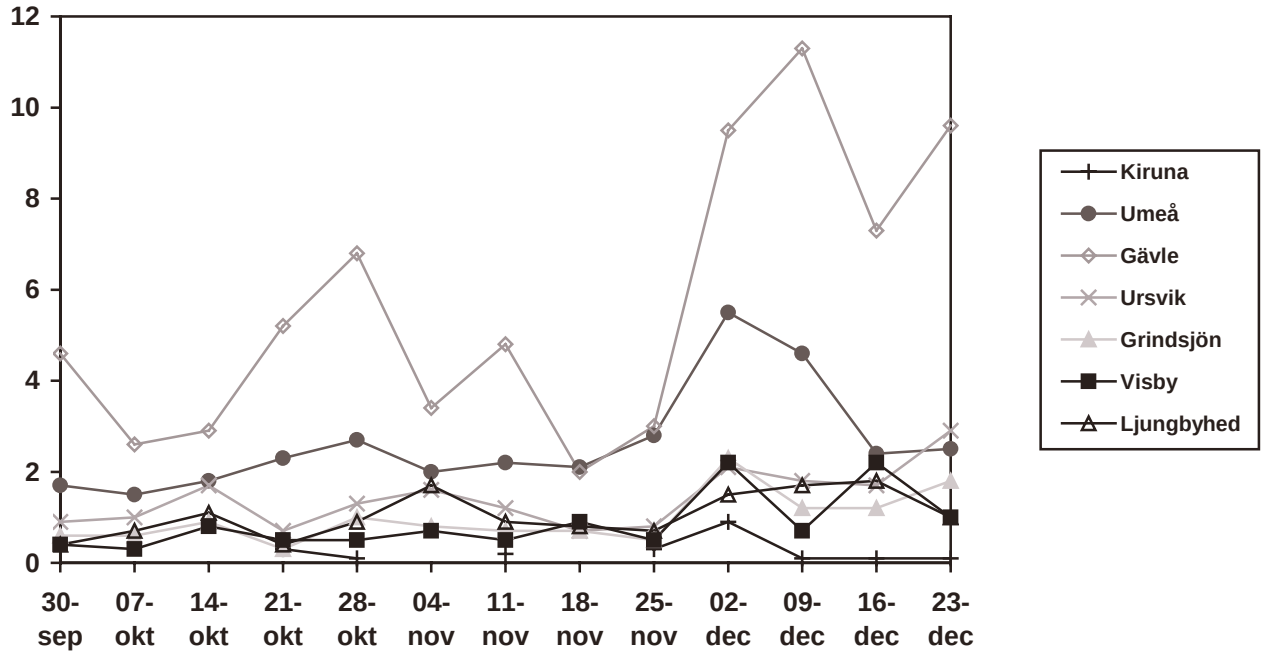
## *Table II*

# *$^{137}$Cs concentrations in Sweden, fourth quarter 2002*

| *Week starting* | *Kiruna* | *Umeå* | *Gävle* | *Ursvik* | *Grindsjön* | *Visby* | *Ljungbyhed* |
|---|---|---|---|---|---|---|---|
| 30-sep | <0.1 | 1.7 (3) | 4.6 (4) | 0.9 (12) | 0.6 (5) | 0.4 (19) | 0.4 (12) |
| 7-oct | <0.1 | 1.5 (4) | 2.6[5] (6) | 1.0 (11) | 0.6 (4) | 0.3 (25) | 0.7 (9) |
| 14-oct | <0.1 | 1.8 (3) | 2.9[6] (7) | 1.7 (6) | 0.9 (3) | 0.8 (16) | 1.1 (6) |
| 21-oct | 0.3 (13) | 2.3 (2) | 5.2 (4) | 0.7 (14) | 0.3 (7) | 0.5 (9) | 0.4 (10) |
| 28-oct | 0.1 (63) | 2.7 (3) | 6.8 (2) | 1.3 (12) | 1.0 (3) | 0.5 (20) | 0.9 (6) |
| 4-nov | <0.1 | 2.0 (3) | 3.4 (5) | 1.6 (11) | 0.8 (4) | 0.7 (15) | 1.7 (5) |
| 11-nov | 0.2 (21) | 2.2 (7) | 4.8 (4) | 1.2 (5) | 0.7 (4) | 0.5 (24) | 0.9 (8) |
| 18-nov | <0.1 | 2.1 (3) | 2.0 (12) | 0.7 (10) | 0.7 (4) | 0.9 (7) | 0.8 (6) |
| 25-nov | 0.3 (12) | 2.8 (2) | 3.0 (6) | 0.8 (12) | 0.5 (6) | 0.5 (9) | 0.7 (8) |
| 2-dec | 0.9 (4) | 5.5 (3) | 9.5 (1) | 2.1 (4) | 2.3 (2) | 2.2 (3) | 1.5 (5) |
| 9-dec | 0.1[1] (12) | 4.6[2] (2) | 11.3 (3) | 1.8 (5) | 1.2 (3) | 0.7 (15) | 1.7 (5) |
| 16-dec | 0.1[1] (12) | 2.4[3] (7) | 7.3 (2) | 1.7 (4) | 1.2 (3) | 2.2[8] (6) | 1.8 (4) |
| 23-dec | 0.1[1] (12) | 2.5[4] (2) | 9.6[7] (2) | 2.9 (4) | 1.8 (2) | 1.0[9] (7) | 1.0 (7) |

Values are given in µBq/m$^3$.
Error estimates (1σ %) are given in brackets.

[1] 30 days filter, 9/12 - 8/1
[2] Eight days filter, 9 - 17/12
[3] Three days filter 17 - 20/12
[4] 18 days filter, 20/12 - 7/1
[5] Eight days filter, 7 - 15/10
[6] Six days filter, 15 - 21/10
[7] Ten days filter, 23/12 – 2/1
[8] Three days filter, 16 – 19/12
[9] 11 days filter, 19 - 30/12



## *Table III*

# *Deposition measurements, fourth quarter 2002*

## *Kiruna*

| *Weeks* | *Period* | *$^{7}$Be* | *$^{137}$Cs* | *Precipitation (mm)* |
|---|---|---|---|---|
| 40 - 43 | 30/9 – 28/10 | 5100 (1.2) | 9 (40) | 15.3 |
| 44 - 47 | 28/10 – 25/11 | 1400 (2.3) | <5 | 4.1 |

## *Gävle*

| *Weeks* | *Period* | *$^{7}$Be* | *$^{137}$Cs* | *Precipitation (mm)* |
|---|---|---|---|---|
| 39 - 42 | 23/9 – 21/10 | 62000 (0.3) | 68 (5) | 40.7 |
| 43 - 46 | 21/10 – 18/11 | 71400 (0.2) | 92 (4) | 67.9 |
| 47 – 50* | 18/11 – 16/12 | 62200 (0.2) | 125 (3) | 65.3 |

*Also detected $^{131}$I, concentration: 65 (19) mBq/m$^2$

## *Ursvik*

| *Weeks* | *Period* | *$^{7}$Be* | *$^{137}$Cs* | *Precipitation (mm)* |
|---|---|---|---|---|
| 38 - 41 | 16/9 – 14/10 | 16000 (0.4) | 6 (33) | 24.5 |
| 42 - 45 | 14/10 – 11/11 | 24800 (0.4) | 6 (40) | 40.2 |
| 46 - 49 | 11/11 – 9/12 | 41200 (0.3) | 16 (17) | 39.9 |

## *Ljungbyhed*

| *Weeks* | *Period* | *$^{7}$Be* | *$^{137}$Cs* | *Precipitation (mm)* |
|---|---|---|---|---|
| 37 - 40 | 9/9 – 7/10 | 20300 (0.5) | 8 (30) | 15.3 |
| 41 - 44 | 7/10 – 4/11 | 45600 (0.3) | 8 (33) | 79.1 |
| 45 – 48 | 4/11 – 2/12 | 80300 (0.2) | 17 (12) | 66.5 |
| 49 – 52 | 2/12 - 30/12 | 34800 (0.3) | 9 (22) | 30.9 |

Values are given in mBq/m$^2$.

Error estimates (1σ %) are given in brackets.

## *Table IV*

# *Other anthropogenic radionuclides detected, fourth quarter 2002*

| *Week starting* | *Station* | *Isotope* | *Concentration* | *Note* |
|---|---|---|---|---|
| 11-nov | Umeå | $^{131}$I | 3.9 (8) | 1 |
| 11-nov | Gävle | $^{131}$I | 0.7 (30) | 2 |
| 25-nov | Gävle | $^{131}$I | 1.0 (22) | 2 |
| 9-dec | Gävle | $^{131}$I | 9.4 (5) | 2 |
| 9-dec | Ursvik | $^{82}$Br | 22.1 (4) | 3 |

Values are given in µBq/m$^3$.
Error estimates (1σ %) are given in brackets.

(1) Due to an incident with a leaking $^{131}$I bottle at Norrland's University Hospital in Umeå. The activity in the bottle was 3 000 MBq, and was left in the fume hood to decay.
(2) The activity of $^{131}$I found in Gävle, and earlier findings in Gävle, has been shown to correspond to administration of cancer treatment doses for thyroid cancer at the Gävle-Sandviken County Hospital (see Erlandsson et al, "I-131 in air filters at Gävle", presented at the 13th NSRP meeting in Åbo, August 25-29, 2002).
(3) The isotope $^{82}$Br ($T_{1/2}$=35h) is used for calibration of gas flow meters. On December 13, a total of 180 MBq of $^{82}$Br in the form of ethyl bromide was injected into the gasflow at the Stockholm Gasworks. The gas is distributed to about 106 000 customers in the Stockholm area. Roughly 3 Bq of the distributed 180 MBq were collected in the filter.