DETECTION OF LOW-LEVEL ENVIRONMENTAL EXPOSURE RATES DUE TO NOBLE GAS RELEASES FROM THE MUEHLEBERG NUCLEAR POWER PLANT.

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To verify the adherence to the regulations on limits for the
release of radioactive waste gases from nuclear power plants (NPP's),
monitoring networks with solid state dosimeters, usually TLD, are
prescribed in practically every country. Because of variations in
the natural background radiation and the low value of emissions
from modern NPP's, the determination of the net dose above back-
ground in most cases is very difficult. At best, only the upper
limits for the additional doses can be indicated. For that reason,
for several years now, high pressure ionization chambers (Reuter
& Stokes RS-III), which are capable of detecting dose rate increases
in the range of natural background radiation as small as a few
tenths of a $\mu R/h$, have been used for monitoring NPP emissions in
Switzerland. The dose rate is continuously recorded on magnetic
tape (digital record every 32 sec.) and on strip charts, and is
continuously integrated by a counter. The correlation of these meas-
urements with the emission and wind measurements makes it possible
to calculate the dose amounts attributable to the exhaust plume.

This paper covers such measurements made at the Mühleberg NPP
near Bern Switzerland (BWR, 320 MWe). For several years, the contin-
uous releases of radioactive noble gases from the stack have been
for the most part less than 100 $\mu Ci/s$ ^{133}Xe-equivalent. In addition,
several times per year as a result of transient operations, short-
time higher releases (spikes) occur that are 30 to 50 times higher than
the continuous releases. The Mühleberg NPP is located in the gently
curved Aare Valley with 2 distinct prevailing wind directions. The
nearest house, where the calculational model indicates the maximum
doses would be expected, lies about 500 m west of the plant on the
hill "Ufem Horn". This place was selected as the site for instal-
lation of an Ionization Chamber.
Because of the hilly terrain such as that at Mühleberg, the disper-
sion models have only limited validity. Consequently, by evaluation
of the dose rate peaks, and correlating them with the stack release
measurements, a determination was made of the short-time dispersion
factors for Gamma-Submersion. Figure 1 (16 Jan.1978) and Figure 2
(22 April 1976) show the stack and dose rate records for such higher
emissions. For 24 such spikes that occurred during the last two
years, the integrals of the dose rate increases at the measuring
point and the emission spikes from the stack (^{133}Xe-equivalent)
were calculated, and hence, by using the dose factor for ^{133}Xe

(0.0$\overline{1}$1 mrem/Ci per s/m^2), the short-time dispersion factor was cal-
culated. The correlation line so obtained (correlation coefficient
0.76) is shown in Figure 3. The mean value of the short-time disper-
sion factor was found to be $(5\overset{+}{-}3)\cdot10^{-3}$s/m^2. From weather statistics,
one can determine a relationship of long-time to short-time disper-
sion factors to be approximately 0.1. The calculated value of the
dispersion factor is thus in agreement with that of G. Schriber (1)
for the long-time dispersion factor determined for the same place by
other methods.
The determination of the net dose contribution from the continuous
stack releases is very difficult because of the meteorologically
dependent variations of the natural background radiation at a given
place, and because of the very small releases. Thus, only the higher
limits of this dose contribution can be determined. The dose rate
records from magnetic tape are evaluated using a desk calculator to
determine hourly average values. In addition, consideration is given
to whether the wind at the stack is blowing in the direction toward
the measuring point, or in another direction. In this way, one ob-
tains the average hourly values of the dose rate when the wind is
toward the measuring point and when the wind is in other directions.
The difference between these two curves corresponds then to the net
contribution from the plume. Figure 4a shows an example of such an
evaluation for the period from 16 March 1977 to 26 April 1977. The
averaged value of the dose rate is given for the wind in the direc-
tion toward the measuring point (dotted line) and for other wind
directions (solid line). Figure 4b shows the difference between the
two curves. For this example, the calculated average net dose rate
is 0.05$\overset{+}{-}$0.07 μR/h or $\leq$ 0.12 μR/h, which corresponds to the higher
limit of the additional yearly dose contribution from the NPP, and
amounts to less than 1.1 mR/y above background radiation.

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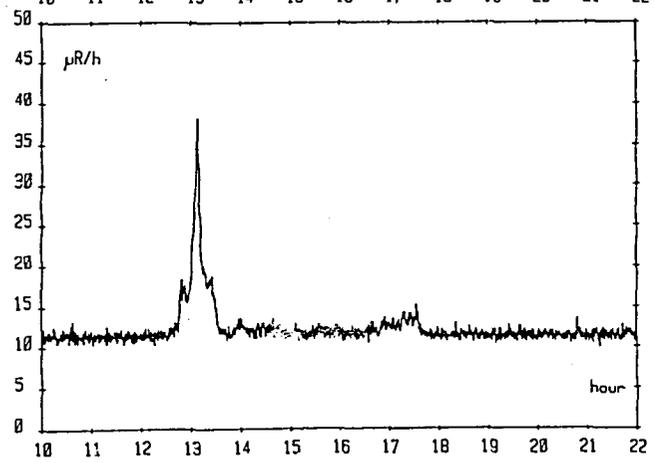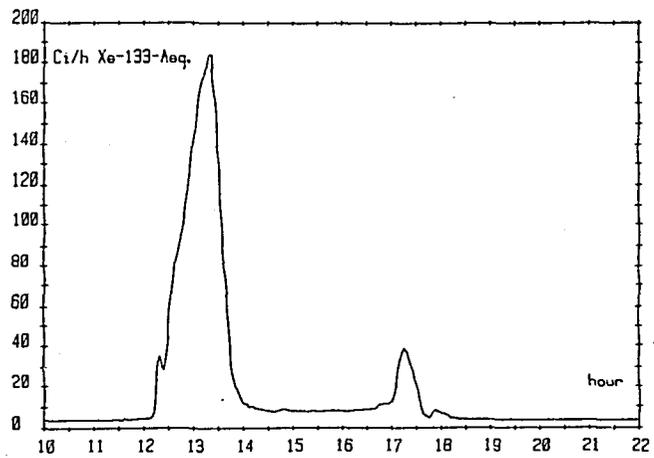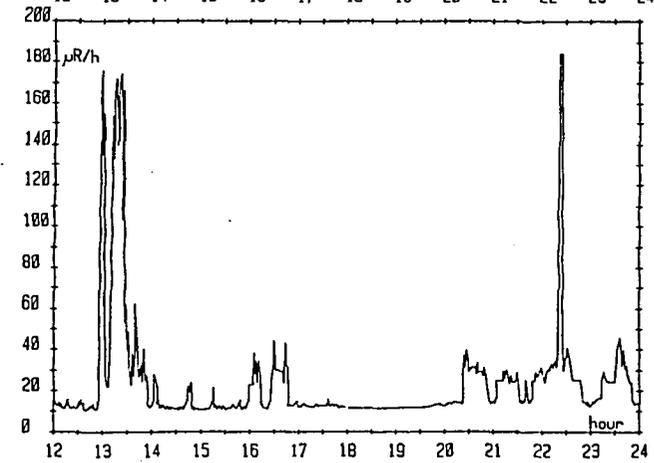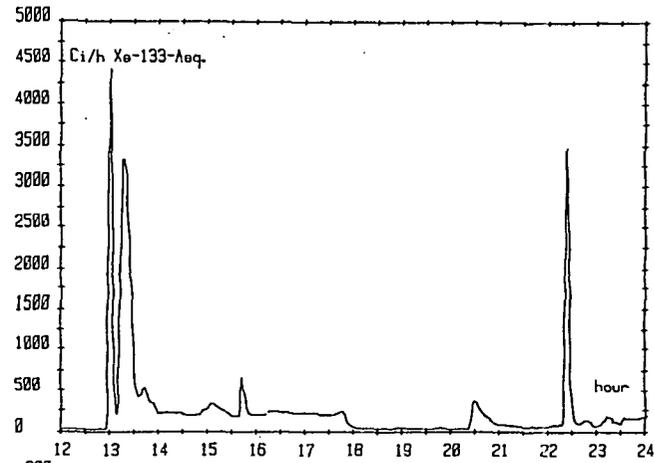   monitoring ionization chambers, Health Physics 27, 132

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Fig 1

Fig 2

Time correlated Records of Gaseous Effluents Spikes at the Stack (Ci/h, ^{133}Xe- equivalent) and Dose Rate Spikes (μR/h) 500 m West from the NPP on the 16 Jan 1979 (Fig 1) and on 22 April 1976 (Fig 2)
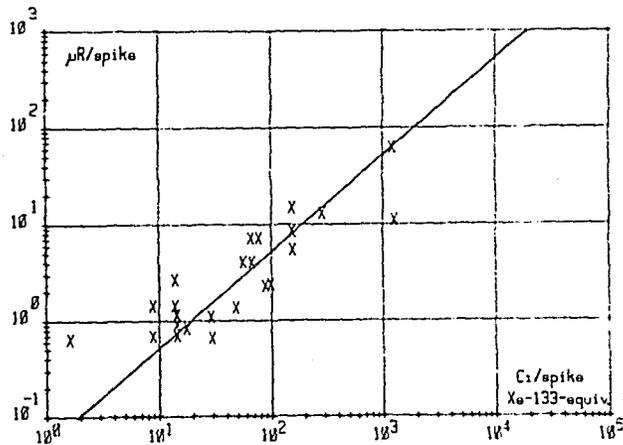
Fig 3 Correlation between Dose Spikes (μR/Spike), measured 500 m West from the NPP, and Stack Release Spikes (Ci/Spike, ^{133}Xe-equivalent)
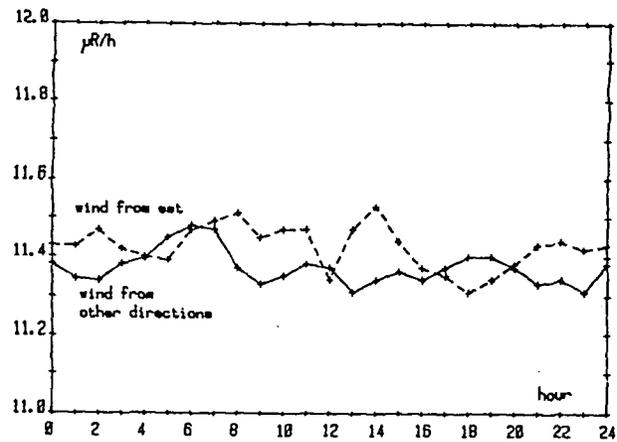
Fig 4a Mean hourly values of the Dose Rate (μR/h) at a Point 500 m West from the NPP with an East Wind (---), and with other Wind Directions (——) calculated for the Time Span: 16 March to 22 April 1977
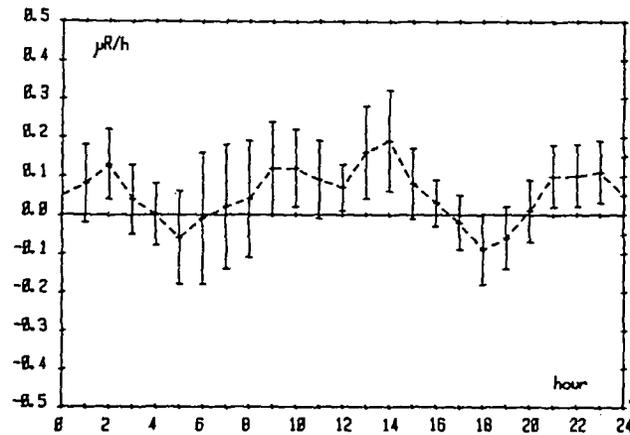
Fig 4b Calculated Net Dose Rate for the same Time Span