EFFECTS FROM EFFLUENTS OF AN INCINERATOR FOR WASTE OF LOW LEVEL ACTIVITY IN THE ENVIRONMENT

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1. In the incinerator for radioactive waste of the Federal Institute for Reactor Research the contents of 2230 barrels of 200 l have been burned from September 1975 to March 1976 within two periods of about 8 weeks each. The 44 tons of low level radioactive waste were of various origins (hospitals, industry, nuclear installations). The initial volume could be reduced to 45 barrels of 200 l. The following quantities of radioactivity have been released from the 25m high stack of the installation:

	a) Sept.1st - Oct.25th 1975	b) Febr.2nd - March 20th 1976
$\beta + \gamma$ (Ci)	$30{,}8 \cdot 10^{-3}$	$10{,}2 \cdot 10^{-3}$
α (Ci)	$4{,}2 \cdot 10^{-5}$	$8{,}2 \cdot 10^{-5}$

For each period the incinerator was started with new ceramic filters.

2. The incinerator is situated near the northern fence of the Federal Institute (EIR, Fig.1) on the bottom of a broad valley; after this limit till to the woods (250m) surrounding the site of the institute there are cultivated fields with grass, clover and cereals. The first inhabited houses of the next villages are at a distance of about 1 km. The main wind directions are N-NE, S-SW and W; but during inversion situations and in general when local low winds prevail, all directions may occur.

3. Calculations have been made years ago to estimate the dilution of the effluents at the critical points of the environment, where the plume would reach the ground, but without taking in account the roughness of the ground which is of importance at this place (forest in N and E, buildings in S). All theoretical critical points were found to be situated too far from the source (adiabatic lapse rate: 400m, inversions:1000 - 8000m). Visual (and partly olfactory) observations of the plume have shown that these points in reality must be placed nearer to the source for instance at maximal 200m from the stack during adiabatic lapse rate, i.e. within the area of the institute (S/SW) or over the cultivated fields (N/NE).

   In order to investigate the real effects of the incinerator in the environment, measures have been made during and after the incineration periods using the instruments already installed in the environment of the EIR for surveillance purposes (air sampler, collectors of sedimented dust). In addition samples of grass and barley have been taken and analysed.

4. The already installed net of dust collectors (covered with vaseline) has been completed at the end of the second period by 2 units which were placed in 200m distance SSW and NNE of the stack ("critical" points 4 and 5 on the map). So it has been possible to survey the effects of the effluents in the immediate and general environment of the facility. The filter of the air sampler has been analysed weekly, the vaseline of the collectors every two (or four) weeks.

   Fig. 2 shows that in October 1975 the collected activity has also increa-

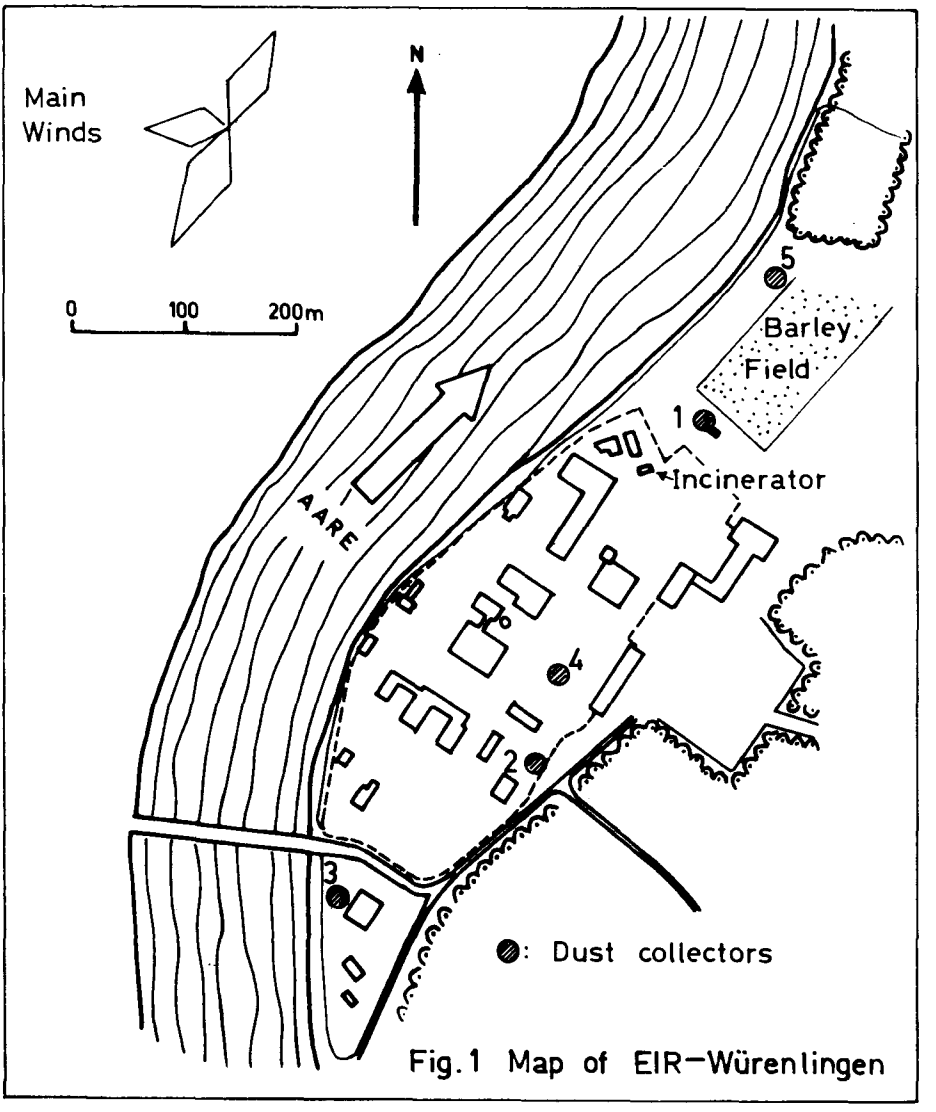


Fig.1 Map of EIR–Würenlingen

sed significantly in a location situated at 1,8 km distance from the stack. This village where the measure was made, is situated on the critical path of the winds from N/NE, which are frequent in the colder seasons and during inversions. The second location 2 km in the North has never been touched though it is also situated on a critical path, because in this country precipitations occur practically always with winds from S-SW and W.

On the filters of the air sampler an α-activity of about 0,001±50%pCi/m^3 air was detected after each incineration period . After the first period it was not possible to detect a sgnificant α-activity on the dust collectors, but a few pCi/m^2 Pu-239 and Po-210 could be identified on a gras sample collected in November 1975 at the location 1 (cf.map).During the second period an experiment was started at the beginning of February to investigate the retention capacity of the installation with respect to Pu-239. The analysis of the vaseline of the dust collectors at P 1, P 3 and of snow samples did not give significant results (about 2 pCi non-identifiable α-activity on each sample).

After the incineration periods of the winter 75/76 it was interesting to know whether grass and barley growing in the neighbourhood of the installation had been influenced with regard to their activity content by the deposited radionuclides It is to be remembered that the main growth period of vegetation takes place from April to June and that these crops are havested in May (grass) and in June (barley).

The first grass samples were collected on April 30th at P 1, P 4 and P 5. The β-activity of all 3 samples is similar, i.e.

300 ± 20 pCi/g ash;

these values are practically the same as those found in summer 1975 at the same location (280±15 pCi/g ash). The samples contained all three of the radionuclides already identified in the air dust, i.e. Cs-137,Cs-134 and Co-60.

Four weeks later, grass samples collected at P 1 did not contain more than 130±30 (β) pCi/g ash which corresponds to a normal K-40-content, and none of the radioisotopes found in the earlier samples could be identified.

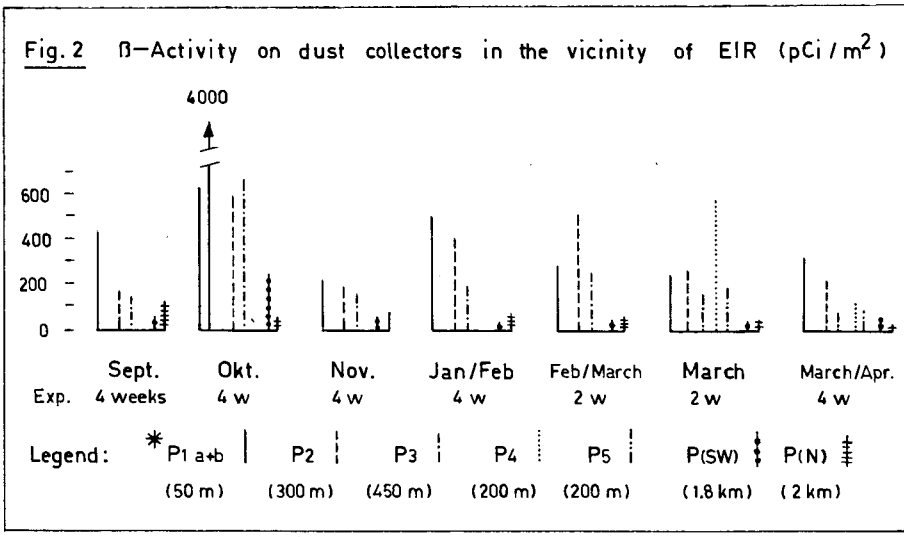
Ripe barley collected near P 1 and P 5 at the end of June showed the following activity content:

		P 1	P 2
straw	β (tot)	320±30 pCi/g ash	340±30 pCi/g ash
	K-40	280±90 pCi/g ash	280±90 pCi/g ash
	Cs-137	(≈ 4 pCi/g ash)	(≈ 4 pCi/g ash)
grain	β (tot)	190±30 pCi/g ash	180±30 pCi/g ash
	K-40	160±60 pCi/g ash	160±60 pCi/g ash
	Cs-137	(≈ 4 pCi/g ash)	(≈ 4 pCi/g ash)

Most of the radioactivity originates from K-40; only traces of Cs-137 could be identified.

Neither in grass nor in barley significant quantities on Sr-90 or α-emitters could be detected. It seems that most of the radionuclides deposited on the ground from September 1975 till April 1976 have been washed or blown off and have been "diluted" by the following rapid growth of vegetation.

5. In conclusion one can say that the effects due to the releases of the incinerator in the environment were very small. A first measurable contamination of the ground did not persist so that no biological cycles were involved. This result was obtained because incineration of waste did not take place during a period of great biological activity.



*Cf. map in Fig.1; at P-1 there are 2 dust collectors (exposed during 2 resp. 4 weeks) and an air sampler.

One should remark the relatively high figure at P-1, collector b), of the same period as named before (October) which seems to have been due to "hot" particle(s)" of Ce-144, an isotope which has not been identified on the other plates.

Obviously more dust and radioactivity have been deposited during the first period than within the second during which also 3 times less activity was expelled through the stack (cf.p.1).

The geographical distribution of the deposited activity seems to show that fall-out (and rainout) scavenge the particles to the ground in the immediate neighbourhood of the stack. Only between March 5th - 19th, 1976 the main deposition occured at a "critical" point 200m from the source (P 4).

Wind measurements on stack height have not been made during these periods; but observations showed that no exceptional weather situations occured.

Significantly more activity was still deposited during 3 - 4 weeks following incineration. This release was due to dust and soot from the walls of the stack and the incinerator. Later the activity fell everywhere under 100 pCi/m^2.

The following radionuclides could be identified in the vaseline by γ-spektrometry (Ge-Li-diode):

1st period: Ce-144,Cs-137, Cs-134, Co-60, Co-57, Rh/Ru-106
2nd period: Rh/Ru-106, Co-57, Co-60, Cs-137, Ir-192, Co-58, Cs-134

During the same time the air sampler showed also an increasing activity in the air; before and 4 weeks after the periods of incineration 0,001 - 0,005 pCi/m^3 air were counted. During and shortly after the first period the figures climbed to 0,08 pCi/m^3, in the second only to 0,02 pCi/m^3.The radioisotopes on the filter were the same as those which have been identified on the dust collectors.