POST-CHERNOBYL WHOLE-BODY COUNTING MEASUREMENTS IN THE FEDERAL REPUBLIC OF GERMANY

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Introduction: The Federal Republic of Germany (F.R.G.) is situated about 1500 km west of Chernobyl, has a borderline approximately parallel with that of the Soviet Union, is densely populated, and was the first contaminated Central European country outside the Eastern Block. Furthermore, a network of whole-body counting laboratories extends over the entire F.R.G.'s territory for radiation protection purposes. These institutions started measurements immediately after the radioactive cloud reached Germany (April 30, 1986). The paper summarizes the measurements of Cs-134 and Cs-137 body burdens of reference groups under both the regional aspect and the aspect of body burden development from May 1986 till October 1987.

Materials and Methods: For the feeding areas of the institutions with their respective reference groups, see fig. 1 which also shows the average Cs-137 surface contamination as of May, 1986. Note that two installations are located in Munich (München) and that the reference group of South-East Bavaria has been monitored by the BGA Munich counter.
In table 1, the main technical data of the 9 monitors are summarized. They all use

	Detector d/h	No.	Meas. Time (min)	Efficiency* Cs-134 (/min/Bq)	Cs-137 (/min/Bq)	Background Cs-134 (/min)	Cs-137 (/min)	Detector Geometry
Saarland	8"Ø 4"	2	10	0.3	0.5	100	150	scanning, variable speed
Karlsruhe	8"Ø 4"	4	5	0.63	0.72	244	412	fixed, stretcher
Frankfurt	8"Ø 4"	1	20	0.294	0.334	53	124	fixed, tilted chair
Mainz	5"Ø 4"	12	5	1.07	1.01	270	680	fixed, stretcher
Berlin	5"Ø 4"	4	20	0.43	0.67	90	140	fixed, stretcher
Duesseldorf	11.5" 4"	1	10	0.92	0.80	315		fixed, tilted chair
Juelich	4"Ø 2"	4	10	0.12	0.14	100	200	fixed, stretcher
Munich BGA	5"Ø 4"	4	20	0.30	0.34	70	100	fixed, stretcher
Munich GSF	5"Ø 4"	4	25	0.190	0.202	123	210	fixed, stretcher

Table 1; see text.

* 70kg standard man

sodium iodide detector(s), at least for the results reported in this study.
The number of persons measured differs from installation to installation as well as from month to month but is normally between 10 and 20 for each reference group and month.
Thanks to a program being started about 4 years ago and still in progress, all monitors have been subjected to calibration intercomparison runs and, if necessary, recalibrated. Thus, we may assume that the average deviations of mean specific radiocesium acivities due to differences in monitor calibration do not exceed 20%.

Results: The results of the counter measurements of the reference groups in the different areas and for the first 18 months after the Chernobyl accident are shown in figs. 2 (males) and 3 (females), respectively.

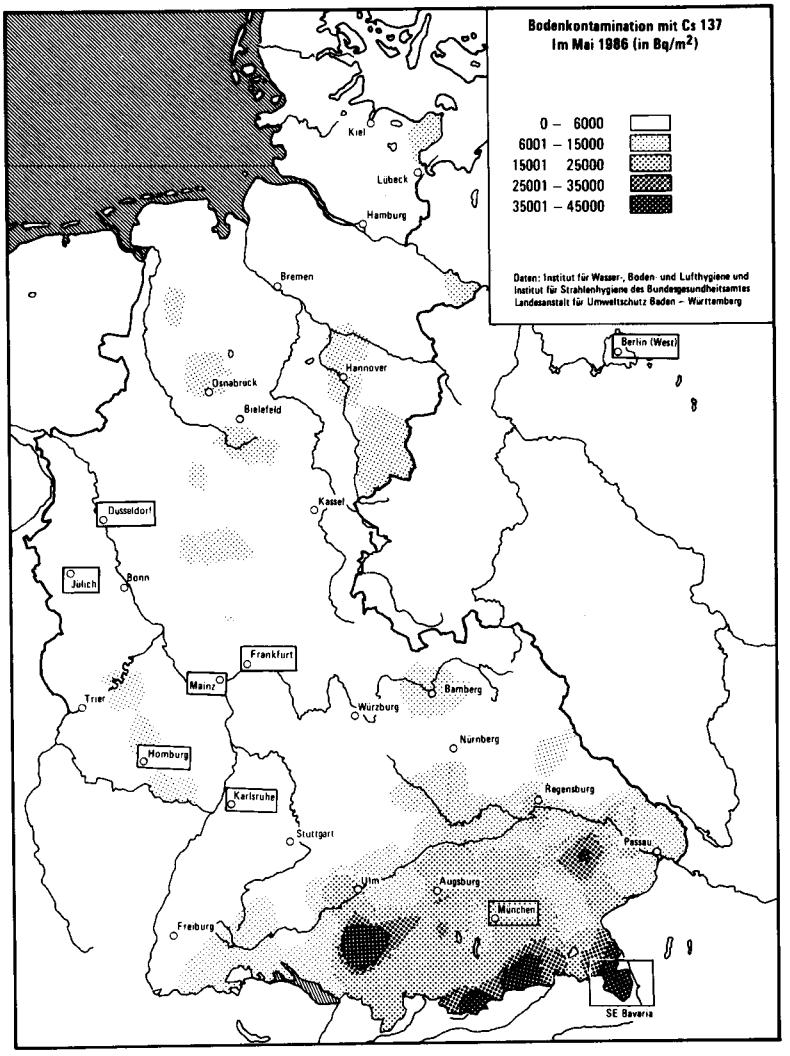

Fig. 1: Map of the Federal Republic of Germany including the locations of the reference groups. The Cs-137 surface contamination as of May, 1986, is also shown.

Owing to lack of space, only the sum of Cs-137 and Cs-134 is given. To make the diagrams readable and since the relation is nearly constant (2 : 1 to 3 : 1), we did not diffentiate graphically between the values for both nuclides.
From the activities measured, we calculated the dose equivalents (a) for the first year after the accident (i.e. from May, 1986, until April, 1987), (b) for the year 1986, and (c) for the year 1987 (November and December estimated); see table 2.

1987 (November and December estimated); see table 2.
The calculations were performed under the assumption that the monthly values for the Cs-137 and Cs-134 content measured in each reference group can be considered as being maintained, to a good approximation, at almost a constant level for such a relatively short period of time.

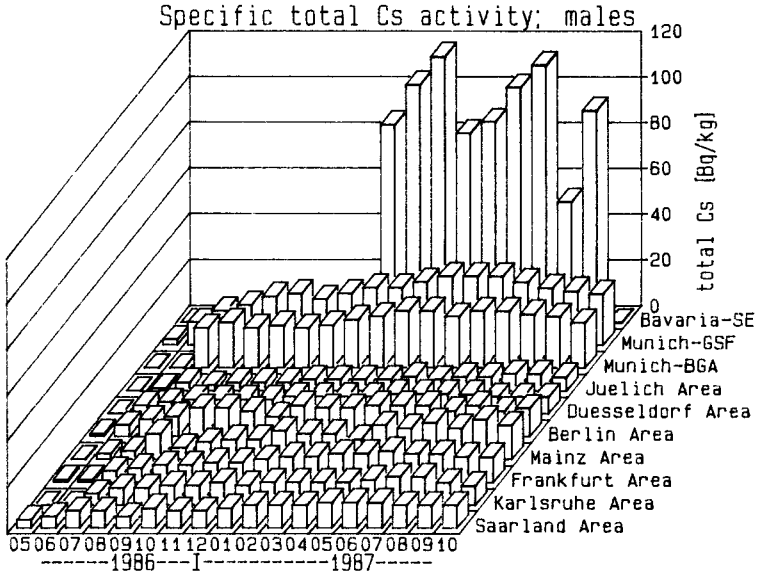

Fig. 2: Total cesium body burden; **males**

We used the dose value per decay and took into account the age dependence as recommended by ICRP.

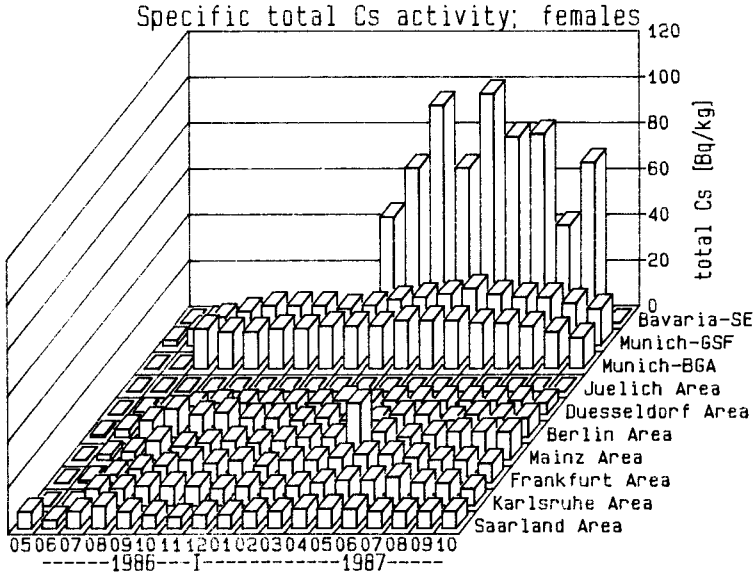

Fig. 3: Total cesium body burden; **females**

Discussion: Corresponding to the surface contamination (fig. 1), the incorporated activities are higher in the southern part of Germany, with a pronounced maximum in South-East Bavaria.
As an important result, it should be noted that their is at least no further increase in radiocesium body burden since the mid-1987; some institutions already report a decrease.
Nevertheless, the retrograde "12 months' doses" are still on the increase for most of the year 1987. Starting September, a light decrease is observed.
In general, the dose equivalents for 1987 are about twice those in 1986. However, the absolute dose equivalents for the majority of the population of the Federal Republic of Germany is well below 100 (50) microSv/year for males (females) and therefore negligible in comparison with the value due to natural sources (about 2000 microSv/year). This is valid even for South-East Bavaria.

Dose Equivalent (microSv/year)

Area	(a) First year		(b) 1986		(c) 1987	
	male	female	male	female	male	female
Saar-land	27	19	15	12	34	21
Karls-ruhe	28	21	18	13	32	25
Frank-furt	25	20	13	11	37	27
Mainz	24	21	13	10	44	31
Berlin	33	22	19	15	40	22
Duessel-dorf	20	11	11	6	24	15
Juelich	12	n.a.	6	n.a.	19	n.a.
Munich BGA	62	44	35	26	75	48
Munich GSF	65	41	35	24	85	48
Bavaria-SE (BGA)	230	150	130	90	260	160

Table 2; see text n.a.: not available

Acknowledgments: In particular during the first months following the Chernobyl accident, the counter installations were inundated with requests for measurement from the local population as well as with calls from both the government and the press. The authors would like to thank their respective staff members for their indefatigable cooperation. Special thanks are due to Dr. I. Gans for the pattern used for fig. 1.

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