THE RADIOLOGICAL IMPACT ON THE RHINE-MEUSE REGION FROM NORMAL OPERATION OF NUCLEAR FACILITIES

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The aim of this study /1/ was to assess the future radiological impact on the population in the Rhine-Meuse Region (RMR) attributable to radioactive discharges from nuclear facilities under normal operating conditions. This has been done by calculating dose rates to the period around the year 2000 on the basis of currently available plans for facilities and sites and the forecast development of nuclear technology in the coming decades.

Around the year 2000, on the basis of the currently available plans for facilities and sites, nuclear electricity generating capacity in the RMR will amount to about 55 GWe. The locations of the various sites can be seen from Fig. 1

The calculations were based on the release rates of 17 fission and activation products regarded responsible for the greater part of the total radiological exposure. For operation facilities the measured discharge rates have been adopted, while for facilities yet to be commissioned, and this is the majority of the 55 GWe, realistic anticipated values were used.

The dose rates are calculated with regard to the most important exposure pathways; namely,

for gaseous discharge
- external exposure from activity in the stack plume and from activity deposited on the ground
- internal exposure from activity inhaled and from activity ingested with food

for liquid discharge
- external exposure from activity in the water body and from activity deposited on the ground of inundation areas
- internal exposure from activity ingested with drinking water and food.

These calculations were backed by data on the environmental conditions of the

region (meteorology and hydrology) and on the civilizing structure of the region (population, agriculture, drinking water supplies, and fresh water fisheries).

The investigations show that the maximum individual dose rates for the period around the year 2000, calculated on the basis of the assumptions made, are of the order of magnitude of 1 mrem/a for most organs. For the thyroid, dose rates of up to about 27 mrem/a may occur via the gaseous effluent pathway. The average individual dose rates to the individual organs are in the region of 0.01 to 0.1 mrem/a. The average whole body dose rate - derived from the dose rates for the individual organs weighted on the base of relative organ weight - works out at 0.035 mrem/a. The average effective dose rate - derived from the dose rates for the individual organs weighted on the basis of the respective organ-dependent risk-coefficients - using the ICRP-recommended weighting factors - works out at 0.034 mrem/a (Table I).

Analysis of the contributions of the various nuclides and exposure pathways to the doses thus calculated shows in the case of the gaseous effluent exposure pathways that the ingestion pathway is the main contributor to the overall dose to every organ apart from the skin. For the whole body, the contribution is some 88%, with the C-14 isotope accounting for 66%, H-3 for 14% and Sr-90 for 6%. In the case of the skin, the Kr-85 isotope makes a particularly significant contribution to the overall dose, as do I-129 and I-131 in the case of the thyroid and the isotope Sr-90 in the case of bone.

As far as impact via the liquid effluent exposure pathways is concerned, the caesium isotopes Cs-134 and Cs-137, I-131 and Sr-90 are the main contributors. In the case of external exposure due to activity deposited on the ground, the contributions of Co-58 and Co-60 also assume relatively great significance.

A comparison of dose rates attributable to other sources in terms of whole-body exposure shows that the radiation exposure due to nuclear installations in the Rhine-Meuse Region in 2000 contributes approx. 0.02% to the total whole-body dose. In the case of persons exposed mathematically to maximum dose, the portion is approx. 0.5% (Table II)

/1/ A. Bayer
The Radiological Exposure of the Population in the Rhine-Meuse Region
Report of the Comm. of the European Communities V/2475/81EN (1982)

Table I: Maximum and Average Individual Dose Rates Within the Rhine-Meuse Region

	Dose Rates (mrem/a)	
	Maximum	Average
Gaseous Releases:		
Whole Body	1.2	0.031
Bones	0.94 (Child)	0.026
Skin	1.6 (Child)	0.082
Thyroid	27 (Infant)	0.13
Liquid Releases:		
(Drinking Water Only)	0.03	
Whole Body	0.03 (Child)	0.001
Bones	0.13 (Child)	0.004
Thyroid	0.06 (Infant)	0.001

Table II: Comparison of Whole-Body Exposures

Type of Exposure	Dose Rate (mrem/a)	(%)
Exposure to natural radiation in the Rhine-Meuse Region	75 - 260	approx. 63
Exposure to radiation (average value) attributable to medical diagnosis and treatment (1975)	50 - 80	approx. 34
Exposure to radiation attributable to nuclear weapons test (1975)	1 - 8	approx. 3
Exposure to radiation (whole body) attributable to nuclear installations in the Rhine-Meuse Region (2000)	0.035 (average) 1.2 (maximum)	0.02 0.1
Exposure to radiation (whole body) attributable to global nuclear technology (2000)	0.01	0.01
Total	approx. 175	100

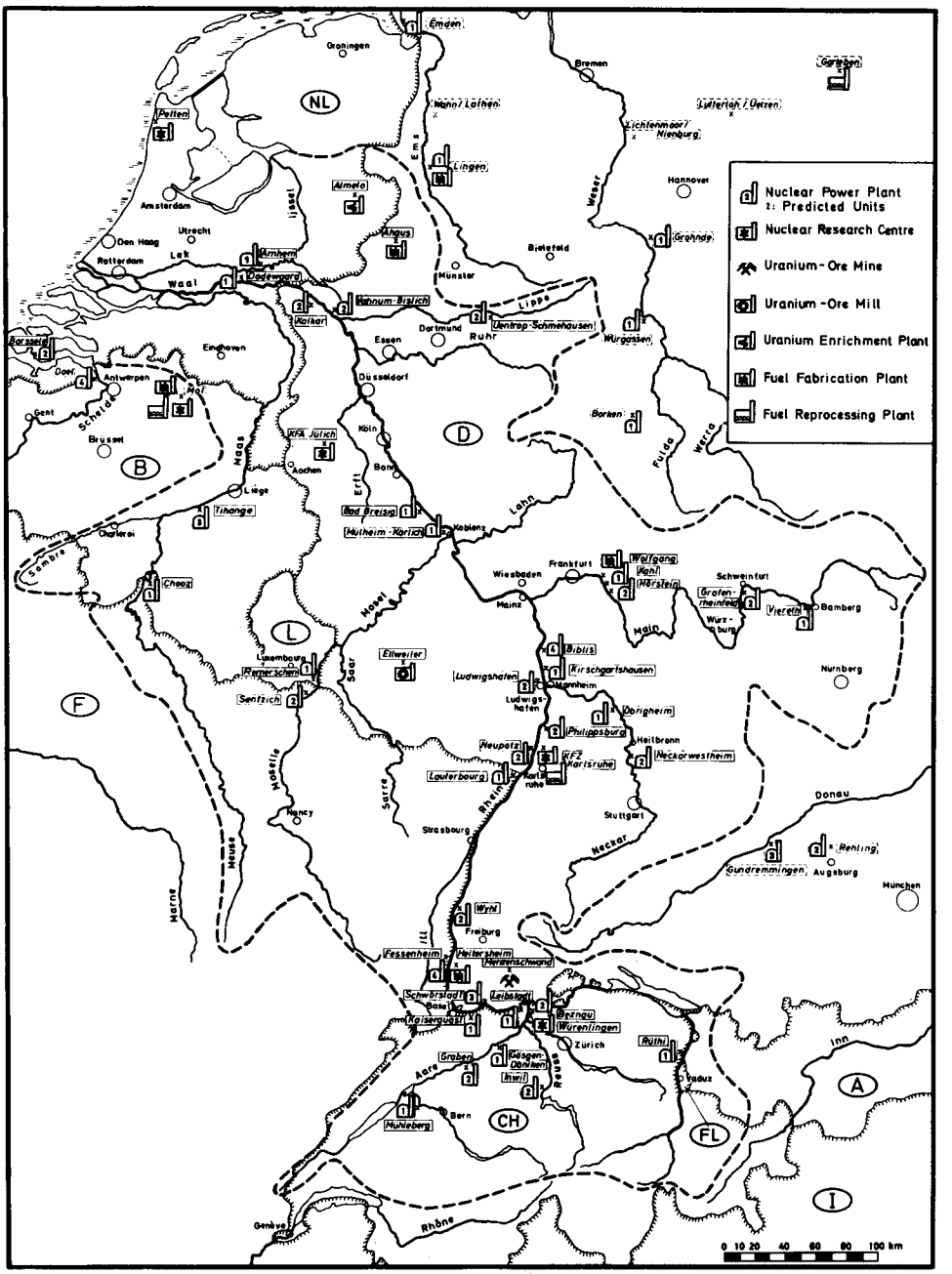

Fig. 1: Sites of Nuclear Facilities within the Rhine-Meuse Region