
Determination of realistic exposure levels under consideration of farming and farm shopping at nuclear sites

A. Artmann
A. Becker
H. Biesold

Gesellschaft für Anlagen-und Reaktorsicherheit (GRS)mbH

ABSTRACT : In Germany, the radiation exposure levels for individuals are determined according to the provisions of the Radiation Protection Ordinance (StrlSchV) (1), considering reference persons at the highest exposure locations as example for several specified exposure paths, habits and behaviour. This issue was dealt with within the framework of Project StSch 4283, sponsored by the Federal Office for Radiation Protection (BfS), which included the analysis and assessment of the conservativity of the assumptions for the reference persons in § 47 StrlSchV (1) and the general administrative provisions (AVV) (2) for the exposure path “ingestion of contaminated food” in the area of selected nuclear sites.

The aim of the project, to determine the degree of conservativity of the AVV via the ingestion paths, was realised by forming ratios between the “critical group”, i. e. the group with the maximum ingestions rates, which, according to StrlSchV (1) and AVV (2), is usually referred to for the calculation of the potential radiation exposure, and the “reference group”, the “regional group within a of 5 km radius” and the group of the “farm shop customers”. The respective value indicates by which factor the radiation exposure for the “critical group”, usually calculated according to AVV, is higher than the one that can be determined under consideration of realistic data on the site-specific conditions as well as shopping and eating habits that are typical for a region.

The result shows that without consideration of the region’s typical cultivation and consumption habits, the radiation exposure via the ingestion paths “exhaust air” is overestimated by a factor of 10 on average, and “waste water” by a factor of 20.

1 INTRODUCTION

In Germany, the radiation exposure levels for individuals are determined according to the provisions of the Radiation Protection Ordinance (StrlSchV) (1), considering reference persons at the highest exposure locations as example for several specified exposure paths, habits and behaviour, stated in Annex VII of the Radiation Protection Ordinance (1). The procedures and further assumptions and data sets required for calculation are stated in the general administrative provision of §47 of the Radiation Protection Ordinance on the determination of radiation exposure resulting from release of radioactive substances from nuclear power plants or facilities (2). According to § 47 of the Radiation Protection Ordinance (StrlSchV) (1), the adherence to limit values for individual persons of the population is ensured if this is demonstrated on the basis of the provisions stated in § 47 and the general administrative provisions (AVV).

Within the framework of project StSch 4283, the conservativity of the assumptions for the reference persons in § 47 StrlSchV (1) and the general administrative provisions (AVV) (2)

for the exposure path “ingestion of contaminated food” in the area of selected nuclear sites was analysed and assessed. This included the following investigations:

- Determination of the cultivation of agricultural and horticultural products in the area of the sites,
- determination of the drinking-water supply at the sites,
- determination of the degree of self-supply of the population in the area of the sites,
- determination of the supply of regional agricultural and horticultural products.

The conservativity of the assumptions on the ingestion path according to § 47 StrlSchV is determined by the comparison of the calculated dose rates with those based on the actual use for the sites of the nuclear power plants Biblis, Brokdorf, Brunsbüttel, Emsland, Grafenrheinfeld, Grohnde, Gundremmingen, Isar, Krümmel, Neckarwestheim, Philippsburg and Unterweser.

2 CALCULATION BASES

The radionuclide activities in food in the near field of a nuclear facility depends on

- the amount of releases of radionuclides with exhaust air and waste water from the plant,
- the nuclide spectrum of the releases,
- the dispersion of radionuclides through air and water, and
- different nuclide-specific, ecological and agricultural characteristics and parameters as well as dose factors.

The nuclide spectrum, the nuclide-specific ecological and agricultural characteristics and parameters as well as the dose factors are stated in AVV (2). The releases (source strengths) and dispersion factors, however, differ from plant to plant.

2.1 Nuclide composition and source strengths

The model mixtures for releases via exhaust air and waste water according to AVV (2) were chosen for all plants.

Table 2.1-2: Model mixtures for radioactive releases via waste water and exhaust air according to AVV (2)

Waste Water		Exhaust Air	
Nuclide	Percentage	Nuclide	Percentage
Co-58	19	Co-58	10
Co-60	20	Co-60	40
I-131	10	Cs-134	15
Cs-134	20	Cs-137	34
Cs-137	30	Sr-90	1
Sr-90	1		

The releases via exhaust air only consider stack emissions. For all sites, the releases of radioactive substances via exhaust air and waste water are based on the emission rates approved by the authorities. For the radionuclides H-3 and C-14, the emission rates were determined on the basis of measured values from specified normal operation.

2.2 Dispersion

The area within a radius of 5 km around each facility is 78.5 km². For this area, a representative fallout and washout factor was determined. The actual height of the stack was assumed as effective stack height. A potential impact on dispersion by cooling towers or orography of the site has not been taken into consideration. The dispersion factor was assessed according to the normalised dispersion diagrams, the washout factor according to the simplified method of the AVV (2).

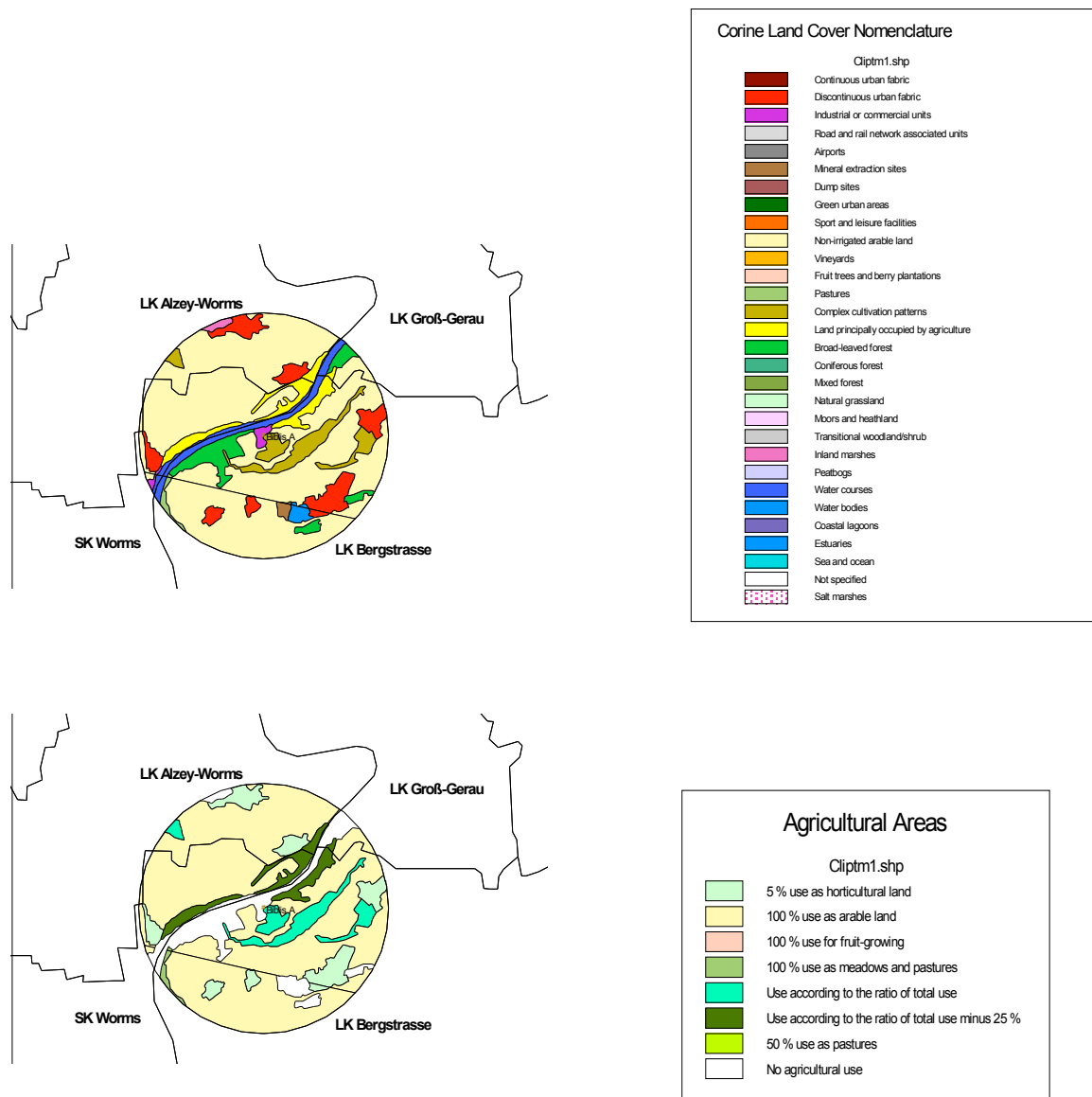
3 FARMING AND DRINKING-WATER SUPPLY AT NUCLEAR SITES

3.1 Agricultural and horticultural use in the area of nuclear sites

The agricultural areas were estimated on the basis of the types of land cover of the geographical data base CORINE (COoRdination of INformation on the Environment) Land Cover (3) of the European environment information and observation network (4). The standard nomenclature of land cover in CORINE Land Cover (3) includes 44 different types of land cover, being 36 of it relevant to the Federal Republic of Germany.

Fig. 3.1-2 shows the relation between agricultural areas and land cover, taking the Biblis site as example.

Fig. 3.1-2: Relation between agricultural area and land cover according to CORINE Land Cover



3.2 Determination of the agricultural production in the area of the sites

In Germany, the cultivation and production of crops, the type and size of agricultural farms, breeding, husbandry and feeding of pigs, beef cows, dairy cows, chickens etc. is systematically recorded on behalf of the ministers of agriculture and published by the statistical offices of the *Länder* and the Federal Statistical Office at regular intervals. With the agricultural land uses derived from the land cover and the average yields at the administrative district level, the agricultural production was determined for the 5 km radius around the respective sites. The results of this evaluation is presented in Table 3.1.

Table 3.1: Potential agricultural products for human consumption within a radius of 5 km around the sites

Site	Leafy vegetables	Vegetables	Fruit	Wheat	Potatoes
Biblis	1,116.7	10,848.7	517.8	6,068.6	9,672.2
Brokdorf	8.4	308.6	164.6	339.0	607.6
Brunsbüttel	16.1	1,679.8	184.5	684.0	1,275.3
Emsland	507.0	3,451.8	745.7	280.6	22,673.0
Grafenrheinfeld	325.4	7,990.2	180.5	5,112.0	472.6
Grohnde	781.4	4,323.6	594.3	8,802.9	0.0
Gundremmingen	75.7	1,628.0	254.1	5,889.1	2,700.9
Isar	114.3	2,173.1	102.6	4,338.0	2,191.0
Krümmel	271.6	2,907.0	1,076.9	1,941.8	3,381.2
Neckarwestheim	509.0	3,016.4	981.7	4,076.4	3,267.5
Philippsburg	415.1	2,407.6	852.1	2,518.7	8,289.6
Unterweser	0.0	0.0	437.5	0.0	0.0

The results of the annual livestock census are also registered at the statistical offices of the Federal Government and the Länder. Here, distinction is drawn between dairy cows and beef cows, breeding sows, sheep and poultry. However, in the nutrition package according to the AVV (revised) it is postulated that the meat consumption of the reference person only consists of beef.

For the determination of the number of cattle in a radius of 5 km around the site, the ratio between the number of cattle and the available pastures of the administrative district was referred to. This resulted in an average of 3 beef cows and 1 dairy cow per 1 ha pasture. The area-related animal stocking rates were multiplied by the pastures within the respective 5 km radius derived on the basis of the land cover types and added up for each site.

Table 3.2: Production of food of animal origin in a radius of 5 km

	Beef cows	Dairy cows	Meat	Milk	Fish
Site	[N]		[kg]	[l]	[kg]
Biblis	95	38	7866	219559	38174
Brokdorf	9296	4575	2490931	26378152	13102
Brunsbüttel	7204	3369	1930261	19388525	27614
Emsland	1366	398	366144	2506363	600
Grafenrheinfeld	970	245	259882	1205711	19574
Grohnde	95	47	25433	293577	38500
Gundremmingen	834	357	223402	1760633	12919
Isar	5916	1951	1585302	9615357	13014
Krümmel	1896	793	508152	4881210	46430
Neckarwestheim	200	90	53645	443572	9894
Philippsburg	278	81	74383	404071	59657
Unterweser	10528	5052	2821187	31783996	110638

The calculation of the meat produced is based on the medium slaughter weight of a cow (319 kg) and the consumable meat portion (0.84) according to (5). On an average, 84 % of the halves are fit for human consumption. In Germany, the average slaughter age for cows is 3.3 years according to calculations based on data of the Federal Statistical Office.

The milk produced was calculated on the basis of the average milk yield, per dairy cow. The respective data on the average milk yield was available for all administrative districts under consideration. The milk yield averaged over all administrative districts for a dairy cow is about 5,600 l/a (5).

3.3 Fish

In the waters located in the near field of the nuclear sites, fishing is nearly exclusively practiced as a hobby. There is only commercial fishery in some Rhine sections and in the lower reaches of the rivers Elbe and Weser. Reliable data on the catch of fishes and their utilisation is not available. For all sites, a catch of 200 kg/ha is assumed (6). According to (7), the consumable portion of freshwater fish is 50 %.

3.4 Drinking water

In the general calculation basis of the AVV (2) it is assumed that water is directly consumed from the receiving water or as bank filtrate, respectively, without further decontamination.

The evaluation on water supply of the population at the administrative district level shows that the supply of the administrative districts under consideration is completely realised with ground water, reservoir water, spring water and others, except for the sites Biblis, Grafenrheinfeld, Grohnde and Philippsburg. Here, however, the supply is not exclusively realised with bank filtrate but also with ground and spring water.

4 FOOD SUPPLY OF THE POPULATION LIVING NEAR NUCLEAR FACILITIES

4.1 Age structure

On the basis of the average population density of each administrative district and its area belonging to the 5 km radius, the number of inhabitants was determined at each site. Here, it was assumed that the population is evenly distributed over the administrative district. The data on the age composition of the population at the administrative district level was adopted from (8) and adapted to the age groups according to AVV (2).

Table 4.1: Population structure in the 5 km radius

Site	Population (N)	Age group (as of 1998)					
		<1	1-2	2-7	7-12	12-17	>17
Biblis	31785	313	313	1653	1771	1730	26005
Brokdorf	6693	73	73	390	405	375	5377
Brunsbüttel	6401	70	70	370	385	361	5145
Emsland	7979	99	99	518	560	551	6153
Grafenrheinfeld	16820	160	160	890	1008	990	13611
Grohnde	16019	157	157	813	857	808	13228
Gundremmingen	9656	109	109	597	642	612	7586
Isar	14969	149	149	775	808	772	12316
Krümmel	11766	127	127	662	677	621	9552
Neckarwestheim	40440	451	451	2347	2397	2256	32539
Philippsburg	30367	313	313	1664	1765	1695	24617
Unterweser	8200	89	89	466	492	460	6604

4.2 Degree of self-supply

On the basis of the number of persons and the age structure of the population living within the 5 km radius as well as on the basis of the AVV nutrition package for the reference persons it was possible to calculate those quantities of food that are theoretically required for the supply of the population in the 5 km radius. The so-called “self-supply degree” is determined by comparison with the agricultural products actually produced at the sites. This self-supply degree is the quotient of the quantities of agricultural products theoretically needed for the supply of the population and the actually agricultural production in the 5 km radius.

Table 4.2 presents the results of the degree of self-supply regarding agricultural products in the site regions for the inhabitants. It shows that there is no site having a degree of self-supply >1 for all ingestion paths; this means that there is no site where the population living within the 5 km radius can be subsist absolutely autonomously according to the nutrition conditions of the reference persons in AVV (2).

Table 4.2: Degree of self-supply of the population in the 5 km radius

Site	Milk, dairy products	Meat, sausage, eggs	Cereals, cereal products	Fresh fruit, fruit products, juices	Potatoes, root vegetables, juices	Leafy vegetables	Vegetables, vegetable products, juices
Biblis	0.05	0.00	1.77	0.40	5.49	2.79	8.60
Brokdorf	29.60	1.57	0.52	0.67	1.81	0.11	1.23
Brunsbüttel	22.75	1.27	1.10	0.79	3.97	0.21	6.98
Emsland	2.34	0.16	0.35	2.15	47.48	4.77	10.26
Grafenrheinfeld	0.54	0.06	2.67	0.25	0.41	1.61	12.52
Grohnde	0.14	0.01	5.34	0.89	0.00	3.59	6.32
Gundremmingen	1.36	0.08	5.40	0.60	4.05	0.66	4.47
Isar	4.84	0.38	2.55	0.16	2.11	0.63	3.82
Krümmel	3.12	0.17	1.67	2.38	5.37	1.85	6.28
Neckarwestheim	0.08	0.00	0.88	0.63	1.06	1.15	2.17
Philippsburg	0.10	0.01	0.75	0.74	4.61	1.23	2.27
Unterweser	28.99	1.19	0.00	1.25	0.00	0.00	0.00

4.3 Supply of the population with regional agricultural and horticultural products - farm shopping

To determine the critical group of persons which can be realistically found in the site region, that group of persons was selected which regularly covers its domestic needs for food by farm shopping (see below). Farm shopping is part of the sale strategy of agricultural farm in order to find new income sources in view of increasing competition pressure and decreasing sales revenue.

According to (9), many farmers have been using this option in the past years to improve their income situation by direct sale of the products to the consumers. Meanwhile, according to (9), there are about 60,000 farms that offer their products via direct sale, i. e. at farm shops. This corresponds to about one fifth of all agricultural farms in Germany. In the past, data on the group of persons using this way of shopping as customer sporadically, often or regularly were only available to a very limited extent. Recently, new data and analyses for the year 2001 on shopping patterns, consumer profile and product ranger in connection with direct sale - farm shopping - was published in (9) The results of the studies on the coverage of needs for the relevant food products food needs via farm shopping according to (9) are summarised in Table 4.3.

Table 4.3: Supply of food by farm shopping

Food	Supply in %
Milk/dairy products	(18) ¹⁾
Meat	57
Cereals	16
Fresh fruit	11
Potatoes	50
Leafy vegetables	15
Vegetables	15

¹⁾The value refers to the purchase of dairy products (cheese) and not to milk bought on weekly markets

The results exclusively consider those households which use the option of farm shopping at all. For the nutrition package "milk and dairy products" no values have been determined with regard to farm shopping. This is due to the fact that the direct sale of milk and dairy products at farm shops is not of significance regarding the customers considered here.

4.4 Regional consumption habits

In (9), the products bought in the year 2000 were identified for representatively selected households. On this basis, the consumption of the most important agricultural products can be derived for the 33.1 Mio households in Germany representatively. In addition to the absolute quantities, the regional deviations between the *Länder* were of special interest for the intended purpose. The results of these studies for the different food groups, which largely correspond to the groups in AVV /BFS 02/ or which easily can be classified, clearly show regional differences. These regional differences were proportionally applied to the consumption habits of the population living in the site regions. The results achieved are presented in the Table 4.4.

Table 4.4: Regional consumption habits at nuclear sites in relation to the national average (=1)

Site	Meat	Milk	Fruit	Vegetables	Potatoes	Bread
Biblis	1.10	0.99	0.97	0.97	0.98	0.98
Brokdorf	1.14	1.02	1.09	1.02	1.07	1.09
Brunsbüttel	1.14	1.02	1.09	1.02	1.08	1.09
Emsland	0.94	1.02	0.94	0.90	0.90	1.03
Grafenrheinfeld	0.98	1.02	0.92	1.01	0.78	0.93
Grohnde	0.94	1.02	0.94	0.90	0.90	1.03
Gundremmingen	0.98	1.02	0.92	1.01	0.78	0.93
Isar	0.98	1.02	0.92	1.01	0.78	0.93
Krümmel	1.06	1.02	1.03	0.97	1.01	1.07
Neckarwestheim	0.81	1.05	1.04	1.11	0.71	0.92
Philippsburg	0.93	1.03	1.05	1.09	0.91	0.96
Unterweser	0.94	1.02	0.94	0.90	0.90	1.03

5 RADIATION EXPOSURE OF THE POPULATION LIVING WITHIN THE 5 KM RADIUS OF THE NUCLEAR SITES

5.1 Groups of persons

The radiation exposure of the population living within the 5 km radius of a nuclear site is determined on the basis of the data and studies on site- and plant-specific conditions and parameters, as stated in the previous chapters. The most significant ecological and agricultural data and parameters correspond to those of the AVV (2).

The following groups of persons, with their different nutrition habits, were considered in the calculations. The average annual consumption quantities for the reference group, including the multiplier for the critical group, is presented in Table 5.1, adapted to the specifications in (2).

- **Reference group:** Group of persons with nutrition habits according to AVV, without multiplier
- **Critical group:** Group of persons with nutrition habits according to AVV, with multiplier
- **Regional reference group within a 5 km radius:** Group of persons with the nutrition habits of the reference group under consideration of the regional-specific nutrition habits. Only those exposure paths are considered whose supply degree for the population in the site region is > 1 % (see Table 4.2).
- **Farm shop customers:** Group of persons with nutrition habits according to AVV, without multiplier, which buys agricultural products directly at the farms. Only those products are bought that are actually available at the site. Studies showed that the sale of milk at farm shops is not (or no longer) of significance for economic reasons and due to hygiene law provisions. Thus, the exposure path of consuming milk from farm shops has not been considered for the group of persons for all sites.
- **Anglers:** It is assumed that the group of farm shop customers also eats regionally caught freshwater fish.

Table 5.1: Annual consumption quantities for the reference group modified according to (2) and supplemented according to (10)

Age group/ Food	Age [a]							Multiplier for critical group
	≤1 (breast- fed)	≤1 (bottle- fed)	≥1 - ≤2	≥2 - ≤7	≥7 - ≤12	≥12 - ≤17	≥17	
Drinking water	55	160	100	100	150	200	350	2
Breast milk,	145							3
milk, dairy products	45	45	160	160	170	170	130	3
Fish-total 1)	0.5	0.5	3	3	4.5	5	7.5	5
Fish-angler's family 2)	0.455	0.455	2.73	2.73	4.55	4.55	6.825	
Meat, sausage, eggs	5	5	13	50	65	80	90	2
Cereals, cereal products	12	12	30	80	95	110	110	2
Fresh fruit (lo- cal) fruit prod- ucts, juices	25	25	45	65	65	60	35	3
Potatoes, po- tato products, juices	30	30	40	45	55	55	55	3
Leafy vegeta- bles	3	3	6	7	9	11	13	3
Vegetables, vegetable prod- ucts, juices	5	5	17	30	35	35	40	3

- 1) Share regarding regional consumption: 0.17
2) according to values stated in (10)

5.2 Results

Regarding the radiation exposure of the population living in the different site regions by releases via exhaust air (waste water) and ingestions, the following general statements can be made:

- The radiation exposure to be expected for all age groups and groups of persons with different eating and shopping habits and shopping, averaged over all sites, is between 0.11 (waste water: 0.01) and 4 (waste water: 10) μSv .
- The highest level of radiation exposure has been determined for members of the "critical group". This level decreases for the other groups in the following order: reference group, regional group within a 5 km radius and farm shop customers.
- The levels of radiation exposure differ from site to site which is due to the various dispersion factors (dispersion conditions in the receiving water) and source strengths.
- In comparison with the limit value of 0.3 mSv/a, the ingestion dose calculated under consideration of the AVV for exposure paths "exhaust air" is smaller by a factor of 30 and for the exposure paths "waste water" smaller by a factor of 60.

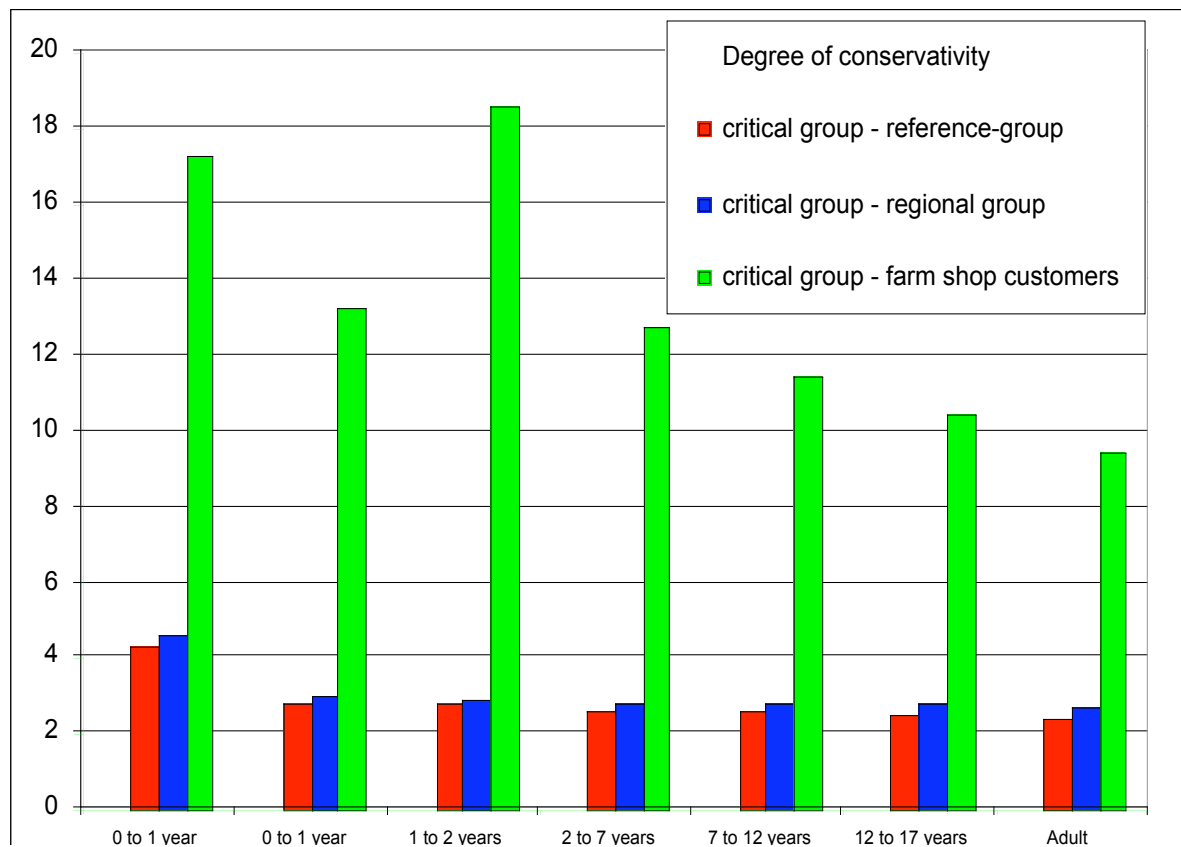
6 RESULT: DEGREE OF CONSERVATIVITY

The aim of the project, to determine the degree of conservativity of the AVV via the ingestion paths, is realised by forming ratios between the “critical group”, which, according to AVV (2), is usually referred to for the calculation of the potential radiation exposure, and the “reference group”, the “regional group within a radius of 5 km” and the group of the “farm shop customers”. The respective value indicates by which factor the radiation exposure for the “critical group, usually calculated according to AVV, is higher than the one that can be determined under consideration of realistic data on the site-specific conditions as well as shopping and eating habits that are typical for a region. Thus, it represents a reference value for the degree of conservativity of the AVV (2).

The results regarding the degree of conservativity in the calculation of the radiation exposure via ingestion paths “exhaust air” at all sites show that in the order “reference group”, “regional group within 5 km radius” and “farm shop customers” the values for the degree of conservativity increases from Factor 2 via Factor 3 up to Factor 9. The values practically apply to all age groups, although even higher values up to a maximum factor of 29 are achieved in individual cases in the group of farm shop customers.

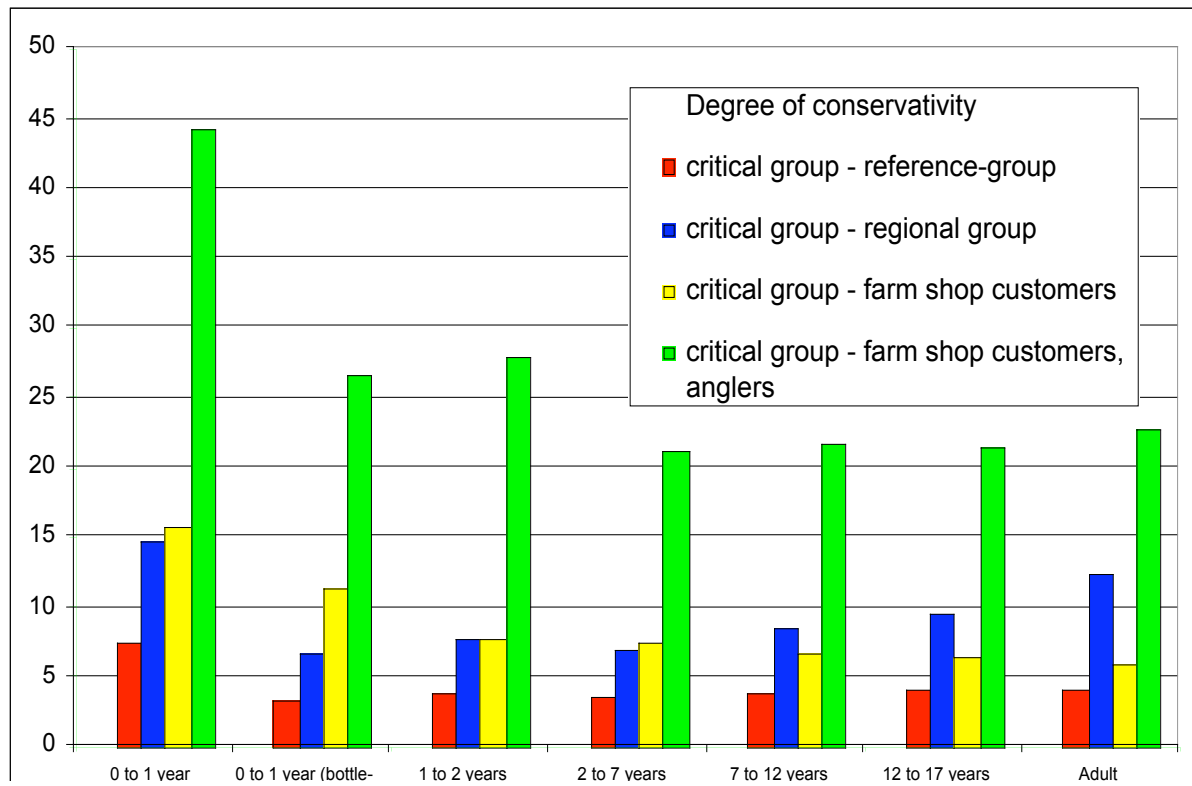
For the Unterweser site, the values calculated for the group of farm shop customers are considerably higher due to the relatively high tritium emissions and a self-supply degree of only 0.5. Here, the degree of conservativity is in the range of 21 (adults) up to 71 (age group 1 to 2 years).

Fig. 6.1: Degree of conservativity for ingestion paths (exhaust air) averaged over the sites



The results for the degree of conservativity regarding the calculation of the radiation exposure via ingestion paths (waste water) at all sites also show that that in the order “reference group”, “regional group within a 5 km radius” and “farm shop customers” the values for the degree of conservativity (adult) increase from Factor 4 via Factor 12 up to Factor 23. These values are applicable to all age groups - except for age group 0 to 1 year (breast- or bottle-fed) and 1 to 3 years- for which values have been determined in the range of 30 to 60.

Fig. 6.2: Degree of conservativity averaged over the sites for ingestions paths (waste water)



The result shows that, under application of the AVV without consideration of the region's typical cultivation and consumption habits, the radiation exposure via the ingestion paths "exhaust air" is overestimated by a factor of 10 on average, and the radiation exposure via the ingestion paths "waste water" by a factor of 20

7 REFERENCES

- [1] Strahlenschutzverordnung (StrlSchV)
Verordnung über den Schutz vor Schäden durch ionisierende Strahlen
Bundesanzeiger Verlag 2001
Radiation Protection Ordinance
Ordinance on the Protection against Damage by Ionizing Radiation
Bundesanzeiger Verlag 2001
- [2] Bundesamt für Strahlenschutz
Entwurf der Allgemeinen Verwaltungsvorschrift zu § 47 StrlSchV
Stand 11. 11. 2002
Federal Office for Radiation Protection
Draft of the General Administrative Provision of § 47 StrlSchV
as of 11th November 2002
- [3] Statistisches Bundesamt
CORINE Land Cover
Datenerhebungsanleitung, Stand: 01.09.1996
Wiesbaden, 1996
Federal Statistical Office
CORINE Land Cover
Data Collection Method as of 1st Sept. 1996
Wiesbaden, 1996
- [4] Verordnung (EWG) Nr. 1210/90 des Rates vom 7. Mai 1990 zur Errichtung einer Europäischen Umweltagentur und eines Europäischen Umweltinformations- und Umweltbeobachtungsnetzes
(Amtsblatt L 120 vom 11.5.1990)
Council Regulation (EEC) No. 1210/90 of 7th May 1990 on the establishment of the European Environment Agency and the European environment information and observation network [Official Journal L 120, 11.05.1990]
- [5] Zentrale Markt- und Preisberichtsstelle GmbH
Einkaufsmenge je Haushalt beim Erzeuger- Sonderauswertung mittels ZMP-Rohdatenanalyse auf Basis des GfK-Haushaltspanels
Bonn, 2003
Central Market and Price Reporting Agency (ZMP)
Quantities purchased from each Household at the Producers'- Special Evaluation by Means of ZMP Raw Data Analysis on the Basis of the GfK Household Panel
Bonn, 2003
- [6] Kraftwerk Union Aktiengesellschaft
Sicherheitsbericht Kernkraftwerk Emsland mit Druckwasserreaktor elektrische Leistung 1300 MW, 1978
Kraftwerk Union Aktiengesellschaft
Safety Report for Emsland NPP with 1,300 MWe PWR, 1978
- [7] Souci, Fachmann, Kraut
Die Zusammensetzung der Lebensmittel
Nährwerttabellen 1981/82
Stuttgart, 1981
Souci, Fachmann, Kraut
Food Composition and Nutrition Tables 1981/82
Stuttgart, 1981

- [8] (8) "Statistik regional - Daten und Informationen der Statistischen Ämter des Bundes und der Länder"
Herausgegeben von den Statistischen Ämtern des Bundes und der Länder
Ausgabe 2001- ISBN 3-935372-06-X
Regional Statistics - Data and Information from the Federal Statistical Office and Statistical Offices of the Länder
Published by the Federal Statistical Office and Statistical Offices of the Länder
2001 Edition - ISBN 3-935372-06-X
- [9] Zentrale Markt- und Preisberichtsstelle GmbH
Direktvermarktung - Fakten zum Verbraucherverhalten
Materialien zur Marktberichterstattung, Band 42
Bonn, 7/2002
Central Market and Price Reporting Agency (ZMP)
Direct Marketing - Facts on Consumer Behaviour
Materials on Market Information, Vol. 42
Bonn, 7/2002
- [10] Gesellschaft für Konsum- Markt- und Absatzforschung e.V.
Analyse der Angelgewohnheiten und des Fischkonsums
Nürnberg, 1980
Society for Consumer, Market and Sales Research
Analysis of Fishing Habits and Fish Consumption
Nürnberg, 1980