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Abstract

This report documents conditions, data and results of dose calculations for accidental and normal operation releases of tritium and activation products, performed within the NET subtask SEP2.2 (in the following named 'NET-Benchmark') of the European Fusion Technology Programme.

For accidental releases, the computer codes UFOTRI and COSYMA for assessing the radiological consequences of tritium and activation / fission products, respectively, have been applied for both deterministic and probabilistic calculations. The influence on dose estimates of different release times (2 minutes / 1 hour), two release heights (10 m / 150 m), two chemical forms of tritium (HT / HTO), and two different model approaches for the deposition velocity of HTO on soil was investigated.

The dose calculations for normal operation effluents were performed using the tritium model of the German regulatory guidelines, parts of the advanced dose assessment model NORMTRI still under development, and the statistical atmospheric dispersion model ISOLA. Accidental and normal operation source terms were defined as follows: 10g (3.7 10^{15} Bq) for accidental tritium releases, 10 Ci/day (3.7 10^{11} Bq/day) for tritium releases during normal operation and unit releases of 10^{9} Bq for accidental releases of activation products and fission products.

Ergebnisse von Dosisabschätzungen für Normalbetriebs- und unfallbedingte Freisetzungen von Tritium und Aktivierungsprodukten im Rahmen einer NET-Studie

Zusammenfassung

Dieser Bericht enthält die Definition, die Eingabedaten und die Ergebnisse von Rechnungen, die im Rahmen des europäischen Fusions-Technologieprogramms unter der Bezeichnung 'NET subtask SEP 2.2', im folgenden als "NET-Benchmark" bezeichnet, durchgeführt wurden. Hierbei wurden Dosen sowohl für unfallbedingte Freisetzungen als auch für Routinefreisetzungen von Tritium und Aktivierungsprodukten abgeschätzt. Für die unfallbedingten Freisetzungen wurden die Rechenprogramme UFOTRI (Tritium) und COSYMA (Aktivierungsprodukte / Spaltprodukte) sowohl für deterministische als auch für probabilistische Dosisabschätzungen eingesetzt. Es wurde der Einfluß unterschiedlicher Freisetzungszeiträume (2 Minuten / 1 Stunde), zweier Freisetzungshöhen (10 m / 150 m), zweier unterschiedlicher chemischer Formen von Tritium (HT / HTO) und zweier unterschiedlicher Modellansätze für die Depositionsgeschwindigkeit von HTO auf den Erdboden auf die Ergebnisse untersucht.

Für die Dosisabschätzungen im Rahmen des Routinebetriebs wurden das Tritiummodell des deutschen Genehmigungsverfahrens, Teile des Rechenprogramms NORMTRI, das sich noch in der Entwicklung befindet, sowie das statistische Ausbreitungsmodell ISOLA benutzt. Die Quellterme wurden für die unfallbedingten Freisetzungen f&ur. Tritium mit 3.7 10^{15} Bq und für Freisetzungen während des Normalbetriebs mit 10 Ci pro Tag (3.7 10^{11} Bq pro Tag) angenommen. Für die Aktivierungsprodukt- bzw. Spaltproduktfreisetzungen wurden Einheitsquellterme von 10^9 Bq je Isotop unterstellt.

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1. Dose calculations for accidental tritium releases (NET-Benchmark tasks)

1.1 Introduction

This section documents the results of calculations performed with the computer program UFOTRI [3] for assessing the radiological impact of accidental tritium releases. The source term, the calculation conditions and the model parameter values were prescribed by the NET-Benchmark tasks defined inside subtask SEP2.2 of the European Fusion Technology Programme for NET [1]. Table 9 in Appendix A shows a condensed Benchmark description. The values of the main input parameters used in the model are listed in Table 6 to Table 8 and Table 10 in Appendix A. A detailed description of the model is given in [3]. Some further improvements are described in [5].

Some restrictions of the model do not allow to consider all requested foodstuffs as well as some consumption habits. Since the standard version of UFOTRI considers only the two different plant species grass and green vegetables, all the consumed vegetable diet was assumed to be green vegetables. Furtheron only cows are modelled. Therefore the meat diet was assumed to consist only of cow's meat. In the ingestion model continuous harvesting is assumed. The food is not processed before consumption, and consumption occurs in the first year after the release. All considered foodstuffs stem from the most exposed grid point of each distance band. Concerning the inhalation pathway, it is assumed that the most exposed individual stays permanently outdoors throughout the whole first year. In case of deterministic calculations, the complex environmental tritium model in UFOTRI with hourly transfer rates dependent on the hourly changing environmental conditions runs for the first period of 170 hours after the release. Afterwards - when the atmospheric dispersion of HTO re-emitted from soil and plants is no longer important - the compartment submodel calculates the longer term behaviour of tritium in the foodchains (with mean transfer rates) resulting in the committed effective dose equivalent due to the ingestion pathways. In case of probabilistic calculations the criterion for moving from the complex tritium model to the compartment model was changed in order to reduce computing times: in a first step, the complex model runs for at least 70 hours. Then it is checked whether more than two third of the **tritium deposited** during plume passage had already been transported out of the area under consideration. If this is true, the calculations are continued with the compartment model; if not, the complex model is again used until the two third criteria mentioned above is met.

Since two different release durations (1 hour, 2 minutes) are prescribed in the Benchmark task, two different sets of dispersion parameters were used in the Gaussian plume transport model of UFOTRI. The dispersion parameter set from 'Klug' [6] (see Table 5 in Appendix A), based on tracer experiments performed in prairies with short grass and sampling times of about 10 minutes, was applied for the puff release. The dispersion parameter set from 'S.C.K./C.E.N. Mol' [7] (see Table 4 in Appendix A), based on measurements in more structured terrain with bushes and trees and a sampling time of 1 hour was chosen for the 1 hour release.

Two different exposure pathways are considered:

- Internal exposure after inhalation of tritium (HTO / HT) by breathing in contaminated air and absorption of HTO by the skin (in the following summarized by 'inhalation + skin absorption')
- Internal exposure after consumption of contaminated foodstuffs (ingestion pathway)

Three different dose calculations were performed:

early individual dose	committed effective dose equivalent from 7 days exposure (inhalation and skin absorption) of an individual (adult)
chronic individual dose	committed effective dose equivalent from long term exposure of an individual (adult)
collective dose	committed effective dose equivalent from long term exposure of the population within 100 km distance (exclusion radius 1 km) and a population density of 250 persons/km^2

Besides a fixed deposition velocity as defined in the Benchmark task, a submodel for calculating the deposition rate to the soil was applied in UFOTRI. The improved resistance model calculates the deposition velocity to the soil according to an atmospheric resistance, a boundary layer resistance near the soil surface and a soil resistance. The atmospheric and boundary layer resistances are variable whereas the soil resistance was set to 150 s/m. In case of rain and dew formation the soil resistance goes towards very small values. A more detailed description is given in [5].

At KfK plant experiments are under way to improve the knowledge about the transfer of tritium to the tubes of potato plants and to the corn of grain plants. If these experiments have been carried out successfully, the code UFOTRI will be extended by additional potato and grain compartments to consider these two foodstuffs in further calculations. The calculated dose from the ingestion pathway may then increase because the OBT-concentration in the harvested fruits will then dominate the result.

1.2 Deterministic calculations

Following calculations for the ITER-benchmark from 1989/90 (results documented in [5]. deterministic calculations for three different weather sequences with changing weather conditions were performed for the new NET-benchmark [1]. The three weather sequences (with hourly recorded meteorological data) were selected as representative to describe realistic worst case scenarios. The weather sequences should include stable atmospheric stratifications (narrow plume with high peak concentrations), heavy rain (high deposition rate) and conditons which force high reemission rates (dose due to the reemission process). The three weather sequences which are described in detail in Appendix D can be characterized as follows:

1. Release early in the **morning** at a summer day with stable atmospheric stratification (Pasquill E) and very low wind speed (0.5 m/s in 10 m height) during the release, followed by days with high solar insolation.

2. Release during **night** with very stable atmospheric stratification (Pasquill F) and very low wind speed (0.5 m/s)

3. Release during heavy **rain** (5 mm/h) with neutral stable atmospheric stratification (Pasquill D) and moderate wind speed (2.0 m/s)

Three different sets of calculations were performed with the computer code UFOTRI. For the release height of 10 m the effect of the building wake was taken into account.

1. Fixed HTO deposition rate on soil; 1 hour release of HT and HTO separately; 10 m / 150 m release height; 3 weather sequences.
   The results are shown in Table 13 to Table 26 in Appendix B.
   Some important input parameters are presented in Table 6 in Appendix A.

2. Fixed HTO deposition rate on soil; 2 minutes release of HT and HTO separately; 10 m / 150 m release height; 3 weather sequences.
   The results are shown in Table 27 to Table 40 in Appendix B.
   Some important input parameters are presented in Table 7 in Appendix A.

3. The HTO deposition velocity on soil was calculated according to the atmospheric and soil resistances; 2 minutes / 1 hour release of HTO; 10 m release height; 2 weather sequences (morning and night).
   The results are shown in Table 41 to Table 47 in Appendix B.
   Some important input parameters are presented in Table 8 in Appendix A.

1.2.1 Results for HTO-releases (fixed deposition velocity)

1.2.1.1 Individual doses: release duration 1 hour

The highest doses in the vicinity of the source for both exposure pathways (inhalation + skin absorption; ingestion) were calculated for the night case and a release height of 10 m including building wake effects. This was expected since the very stable atmospheric stratification during the release results in a narrow plume geometry. Additionally, the wind speed of 0.5 m/s during the release phase was the lowest one considered in this benchmark. All releases from a stack of 150 m height without any influence of a building result in low doses in the vicinity of the plant. This is because the primary plume touches the surface some 100 meters far from the release point. Only the weather sequence with rain in the first two hours shows relatively high doses from the ingestion pathways (due to washout) but significantly lower than those from the low release heights.

Far away from the plant (100 km) the doses are always low, since the plume is widely spread, highly diluted and most of the initial tritium is deposited. For the inhalation pathway, the morning case and 10 m release height gives the highest dose. For the ingestion pathways the highest dose was calculated for the release from the 150 m stack and the weather sequence 'rain'.

One remark according to the results obtained for 100 km distance: because of using hourly records of real weather data, the meteorological conditions at this distance are in general different from the first hour weather condition (hour of release). Only the history of the plume (a.o. plume depletion) is influenced by the meteorological conditions prevailing the hours before.

1.2.1.2 Individual doses: release duration 2 minutes

In general the doses from the puff release are 2 to 3 times higher than from the 1 hour release. This can be explained by the small plume geometry when assuming a short term release. As long as the puff length is small compared with most of the turbulence elements in the atmosphere, it will be only slightly diluted but mainly moved by turbulent motions. As for the release duration of 1 hour, the highest doses in the vicinity of the plant and for all exposure pathways were calculated for the night case and a release height of 10 m. As explained above, all stack releases result in low doses in the vicinity of the plant. Only the weather sequence with rain gives doses from the ingestion of contaminated foodstuffs which are similar to those obtained for the low release heights. The doses far away from the plant (100 km) are low for all exposure pathways; compared to the 1 hour release, the doses are in the same order of magnitude (morning and rain) or up to 3 times higher (night). For both exposure pathways, the weather sequence 'night' with 10 m release height gives the highest dose.

1.2.1.3 Collective dose

The weather sequence 'night' with the 10 m release height and the puff release gives the highest collective doses from both exposure pathways. From nearly all other weather sequences, independent of the release height or the release duration, about the same collective dose values have been obtained. The only exception is the release early in the morning (150 m height), which gives for both release durations the lowest collective dose for the ingestion pathways.

1.2.2 Results for HT-releases (fixed deposition velocity)

1.2.2.1 Individual doses: release duration 1 hour

The doses from an HT-release are in general dominated by the re-emitted HTO. As for an HTO-release, the weather sequence 'night' (10 m release height) gives the highest doses in the vicinity of the plant for the ingestion pathways. This is reasonable, because the amount of deposited tritium is highest for this weather sequence. In contrast to an HTO-release, the weather sequence 'morning' (10 m release height) results in the highest dose for the inhalation pathway. An explanation is rather difficult as the whole re-emission phase has to be analysed. The impact by the re-emitted HTO strongly depends on changing wind directions coupled with the re-emission rate and the actual turbulent mixing. In the first hours of the re-emission phase of the weather sequence 'night' the wind direction remains constant but the re-emission rate is very low (about 1% or less). Afterwards, when the re-emission rate increases, the wind direction fluctuates often by more than 90^0. The re-emission rate following the release in the morning was high during the first day (up to 7%). The fluctuation of the wind direction was obviously lower than for the night case. This combination of a high re-emission rate and a moderate wind fluctuation might be one reason of the relatively high dose contribution from the re-emission phase for the 'morning' weather sequence.

Up to a few kilometers the doses from the elevated release point (150 m) are at least one (inhalation) to two (ingestion) orders of magnitude lower. In the farther range the weather sequence 'rain' with 10 m release height gives the highest dose via the ingestion pathways. The night case with 10 m release height gives the highest dose from inhalation. In comparison to the near range, the difference between the dose values from the two release heights is only a factor of about 3 to 4 for the inhalation and 1 to 4 for the ingestion pathway. This is due to the fact that the activity is uniformly distributed throughout the whole mixing layer and the activity concentration in air is at far distances nearly independent of the initial release height.

1.2.2.2 Individual doses: release duration 2 minutes

As for the longer release time the doses in the vicinity of the plant are dominated by the night case (10 m release height). For both exposure pathways the doses are 2 to 3 times higher than for the longer release duration of 1 hour (narrow plume geometry). The doses from the elevated release point (150 m) are at least two (inhalation) to three (ingestion) orders of magnitude lower than obtained for a 10 m release height. The three weather sequences give for a 150 m release height significantly lower doses from the ingestion pathway compared with the 1 hour release. One reason is that the plume geometry is very narrow as explained in Section 1.2.1.2. Thus the plume has just reached the surface when assuming a release height of 150 m and no building wake effects. Since the washout is negligible in case of an HT plume the weather sequence with rain in the beginning results in the lowest ingestion doses.

In the farther range the doses from inhalation and ingestion calculated for the night case (10 m release height) are the highest ones. The differences between the two release heights are about a factor of 2 to 20 for the inhalation pathway and 2 to 4 for the ingestion pathway.

1.2.2.3 Collective dose

The collective doses are dominated by the weather sequence 'night' (10 m release height, puff release). The doses from all other release situations are significantly lower. Releases during heavy rain give the lowest doses for the inhalation pathway compared to calculations for the two other weather situations and under similar release situations (release height, release time).

1.2.2.4 Comparison of HT- and HTO-releases

When comparing the dose conversion factors of HT and HTO (Table 6 in Appendix A), a difference of more than four orders of magnitude for the doses from inhalation should be expected. This difference can be found for doses resulting from inhalation during the passage of the primary plume in the vicinity of the source. If the re-emission process is taken into account, the difference between a comparable HTO- and HT-release at 1000 m distance is of a factor of about 50 (rain, 10 m) to 1000 (rain, 150 m) for inhalation doses and a factor of about 10 (morning, 10 m) to 300 (rain, 150 m) for ingestion doses. At farther distances (100 km) the difference is reduced to a factor of about 2 (morning, 150 m) to 30 (night, 10 m) for the inhalation dose and a factor of about 2 (rain, 10 m) to 10 (night, 10 m) for the ingestion doses. This is due to the fact that the depletion of an HT plume is lower than for an HTO plume because the deposition velocity of HT on soil is lower than the deposition velocity of HTO on soil (factor of 10 in our example). Additionally, the washout of HT and the deposition rate of HT on plants are negligible. This leads with growing distance to a rapid reduction of HTO activity concentration in air, and therefore to relatively low values at far distances.

1.2.3 Results with the resistance model (HTO-release)

The results described in this paragraph are obtained by using the improved deposition velocity model in UFOTRI. The HTO deposition velocity on soil was calculated according to the prevailing meteorological conditions and the soil resistance. Calculations with this model are made exemplarily for only four different situations, 2 weather sequences (night and morning) and two release durations (2 minutes and 1 hour). Tritium was released as HTO and the release height was assumed to be 10 m including building wake effects.

1.2.3.1 Individual doses

In the vicinity of the plant the doses from the inhalation pathways are in general higher (10% - 20%), for the ingestion pathways in general lower (about 20%), than those obtained with the fixed deposition velocity model. This can be explained by the calculated deposition velocities of HTO on soil. Because of the low atmospheric turbulence during the considered release situations, the deposition rate is lower by a factor of more than 2 compared with the fixed deposition velocity assumed in the preceding runs. Therefore the tritium content in the plume remains relatively high (and therefore higher inhalation doses), whereas the amount of deposited tritium is relatively low (and therefore lower ingestion doses).

In the farther range the ingestion dose is nearly constant (1 hour release) or becomes even higher for the puff relases. One reason may be that the amount of tritium which remains in the plume is higher than calculated with the fixed model. This is due to the fact that the deposition velocity of HTO on ground is reduced as explained above.

1.2.3.2 Collective doses

The collective doses obtained by applying the improved resistance model differ in general not significantly from those calculated with the fixed deposition model. Only the weather sequence 'night' (puff release) results in doses from the inhalation pathway higher by a factor of about 1.8.

1.3 Probabilistic calculations

The consequences of a postulated release of radioactive material will vary considerably with the conditions pertaining at the time of the accidental release, in particular with the prevailing meteorological conditions, the season, the location and habits of population. For any given release, therefore, there will be a spectrum of possible consequences, each having different probabilities of occurrence determined by the environmental characteristics of the release location and its surroundings. To estimate the full spectrum of consequences of an accidental release a computer code should calculate all possible sequences of weather (a weather sequence is defined by its starting time in the weather record) which may occur during this period. Thus several thousands of different weather sequences had to be considered. In practice, time and computer effort prevent such an action. Therefore, a reduced number of weather sequences representing the full spectrum of atmospheric conditions at the site under consideration have to be selected.

1.3.1 Meteorolological sampling scheme

The meteorological data base was the same as used for the selection of three weather sequences for the deterministic calculations. The meteorological record includes (against others) windspeed, wind direction, rainfall and atmospheric stability category in hourly values for a given period (in our example for the whole vegetation period, 4800 hours). For each of the 4800 possible weather sequences the trajectory of the plume will be calculated and evaluated according to the following criteria:

1. initial wind direction (12 classes)

   - twelve 30^0 sectors

2. travel time T up to the 20 km radius from the release point (3 classes)

   - $0 < T \leq 3$ h

- $3\ h < T \leq 6\ h$
- $T > 6\ h$

3. rain intensity I found during the travel time to reach 20 km (4 classes)

   - $I = 0$ mm/h;
   - $0\ mm/h < I \leq 1\ mm/h$
   - $1\ mm/h < I \leq 3\ mm/h$
   - $I > 3$ mm/h

In this way 144 different classes of weather conditions are obtained together with their probability of occurrence which was determined from the number of weather sequences sorted in each class divided by the total number of weather sequences. For the calculations one weather sequence of each class was chosen randomly. Thus 144 weather sequences with their probability of occurrence resulted which represent the spectrum of possible weather situations within the vegetation period. Additionally, a second set of 144 weather sequences representing the remaining periods of the year was sampled for the activation product calculations.

1.3.2 Results of the probabilistic calculations

A detailed overview of the model input parameters is given in Table 10 in Appendix A.

Three different sets of calculations were performed.

1. Puff release, 10 m release height and chemical form HTO with the standard deposition model. Input parameters are defined in accordance to set 2 (Table 7 in Appendix A) in the previous section.
   (Results are presented in Figure 6 to Figure 11 in Appendix C)

2. Puff release, 10 m release height and chemical form HTO with the resistance model. Input parameters are defined in accordance to set 3 (Table 8 in Appendix A) in the previous section.
   (Results are presented in Figure 12 to Figure 17 in Appendix C)

3. 1 hour release, 10 m release height and chemical form HTO with resistance model. Input parameters are defined in accordance to set 3 (Table 8 in Appendix A) in the previous section.
   (Results are presented in Figure 18 to Figure 23 in Appendix C)

Probabilistic assessments are performed to assess the possible impact of a release scenario due to changing environmental conditions. The results are presented in the form of CCFD's

(Cumulative Complementary Frequency Distributions). Therefrom percentile values (50%, 95% or 99%) are often used to quantify the possible impact on the population. CCFD's offer also the possibility to identify 'realistic worst case scenarios': they are those which give dose values with small cumulative probabilities in the CCFD curve. In case of the inhalation pathway, the highest doses obtained from the probabilistic calculations are nearly identical with those obtained from the deterministic night case. This is not surprising because the initial meteorological conditions are identical (Pasquill F, 0.5 m/s etc.). A different result was calculated for the ingestion pathways. Here, the CCFD's show higher doses (factor of 1.4) than obtained for the worst of the three deterministic weather sequences.

Another remarkable result from the evaluation of the probabilistic calculations is the small impact of the re-emitted HTO for the peak concentrations, also indicated by the deterministic calculations. The following is an attempt to explain the calculated results. The impact of re-emission on the dose strongly depends on meteorological conditions. Releases during hours with stable atmospheric stratification combined with low wind speed (low probability) result in a narrow plume geometry and high peak doses during plume passage. Thus the re-emission is negligible for the high contaminated grid points. In case of releases within neutral to unstable atmospheric stratification with moderate wind speed (higher probability) the radioactive material is highly spread by turbulent mixing. Therefore a more extended plume geometry with a more uniformly distributed concentration and thus lower peak doses may be expected. In this case the re-emission may play a more significant role for the peak doses. But the most important influence of the re-emission is the contamination of areas which were not reached by the primary plume. As an example: there exists a probability of more than 80% that areas (grid points) in 1 km distance will be not or only low contaminated - with doses less than 10^{-7} Sv (Figure 6 in Appendix C) -, if solely the plume passage is considered. The probability of non contaminated ($< 10^{-7}$ Sv) areas is much smaller (40%) (Figure 7 in Appendix C) if the re-emission is taken into account.

Another reason may be an underestimation of the doses due to re-emission in the case of stable atmospheric stratifications. The averaging procedure of UFOTRI may underestimate the peak concentrations for narrow plumes since the area source is too broad. This effect will have to be investigated in the future.

1.4 Summary of the main features resulting from an accidental tritium release in HTO form

Since the doses resulting from an HTO-release are considerably higher than those from a comparable HT-release, the following summary will be limited to results of the HTO calculations. Table 1 shows the effective dose equivalent (EDE), as a function of exposure time, subsequent to the plume passage up to 1 year, which represents the total chronic EDE in case of tritium releases.

dose in mSv / g-T	**Normalized Effective Dose Equivalent (EDE) to the most exposed individual (MEI) at 1 km from the release point due to a release of 1g tritium in HTO form, release height 10m, building wake considered, resistance model**				
weather sequence	**night**		**rain**	**morning**	
duration of release	*2 min*	*1 h*	*1 h*	*1 h*	*2 min*
i+s (plume passage)	1.46	0.447	0.039	0.305	1.02
i+s (7 days, early EDE)	1.46	0.450	0.047	0.308	1.03
i+s (1 year)	1.46	0.451	0.048	0.308	1.03
ingestion (1 day)	2.0	0.63	0.12	0.53	1.7
ingestion (7 days)	3.5	1.1	0.39	0.94	3.1
ingestion (1 year)	5.5	1.7	1.1	1.4	4.5
total 1 year chronic EDE	7.0	2.2	1.1	1.7	5.5
ITER reference early EDE, i+s (7 days)	0.5				

Table 1. Normalized Effective Dose Equivalent (EDE) to the most exposed individual (MEI) at 1 km: release height 10m, building wake considered, resistance model (**i+s = inhalation + skin absorption)**

Compared with the ITER reference value of 0.5 mSv/g-T for the early EDE, doses due to inhalation and skin absorption for a release time of 1 hour are smaller for all weather sequences; for puff release however, they will exceed the ITER value.

dose in man*Sv / g-T	**Normalized collective doses due to 1 year inhalation, skin absorption and ingestion, 250 persons/km²**				
weather sequence	**night**		**rain**	**morning**	
duration of release	*2 min*	*1 h*	*1 h*	*1 h*	*2 min*
radius 1 - 50 km	4.2	1.4	0.9	0.8	0.9
radius 50 - 100 km	1.2	0.4	0.2	0.4	0.5
radius 1 - 100 km	5.4	1.8	1.1	1.2	1.4

Table 2. Normalized collective doses due to 1 year inhalation, skin absorption and ingestion, due to a release of 1g tritium in HTO form: release height 10m, building wake considered, fixed deposition velocity of 0.5 cm/s

Collective doses are summarized in Table 2. The weather sequence 'night' shows the highest values.

The effect of the two methods of calculating the deposition velocity of HTO to soil (fixed value or resistance model) is shown in Table 3. Since the resistance model calculates a lower deposition velocity of HTO due to the atmospheric stratification, the early dose due to inhalation + skin absorption is higher and the ingestion dose is lower compared with the fixed model approach. However, the resistance model approach is nearer to the physics.

dose in mSv / g-T	**Normalized Effective Dose Equivalent (EDE) to the most exposed individual (MEI) at 1 km due to a release of 1g tritium in HTO form, release height 10m, building wake considered, fixed - resistance model**			
weather sequence	**night (1 h)**		**morning (1 h)**	
duration of release	*fixed*	*resistance*	*fixed*	*resistance*
i+s (plume passage)	0.40	0.447	0.27	0.305
i+s (1 year)	0.41	0.451	0.28	0.308
ingestion (1 year)	2.2	1.7	1.7	1.4

Table 3. Normalized Effective Dose Equivalent (EDE) to the most exposed individual (MEI) at 1 km for fixed and resistance deposition model: release height 10m, building wake considered, (**i+s = inhalation + skin absorption**)

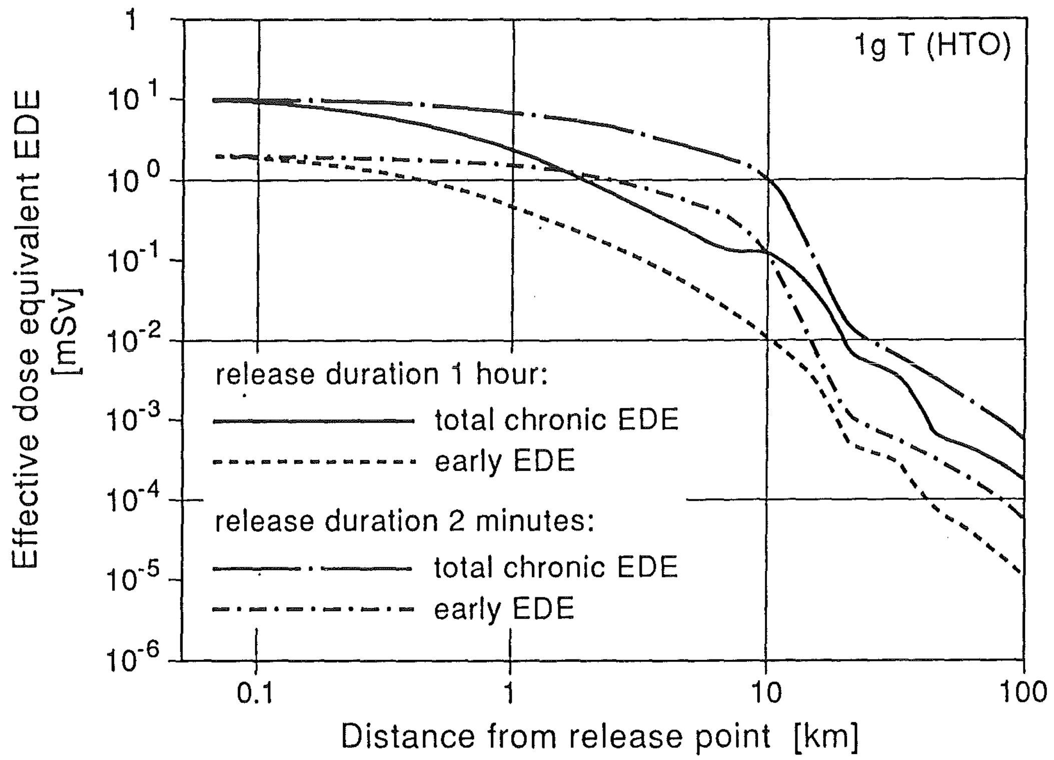

Figure 1. Impact of the release duration (1 hour and 2 minutes) on early and chronic effective dose equivalent (EDE) to the most exposed individual (MEI): weather sequence **'night'**, release of 1g tritium in HTO form, release height 10m, building wake considered, resistance model

Figure 1 to Figure 3 show normalized individual doses to the public as a function of distance from the release point up to 100 km. The highest doses in the vicinity of the plant for all exposure pathways are calculated for the 'night' case and the short release time of 2 minutes. This case is shown in Figure 1.

Figure 2 shows the chronic EDE due to inhalation and skin absorption for all three weather sequences and a release duration of 1 hour. Figure 3 shows the summed total chronic EDE due to inhalation, skin absorption and ingestion for all three weather sequences and a release duration of 1 hour.

For all the three considered weather sequences, the doses due to the ingestion of contaminated foodstuffs are considerably higher than doses due to inhalation and skin absorption.

Doses from the probabilistic calculations (release duration of 1 hour and doses at the fence of the tritium processing installation (1 km)) are summarized in Figure 4 and Figure 5.

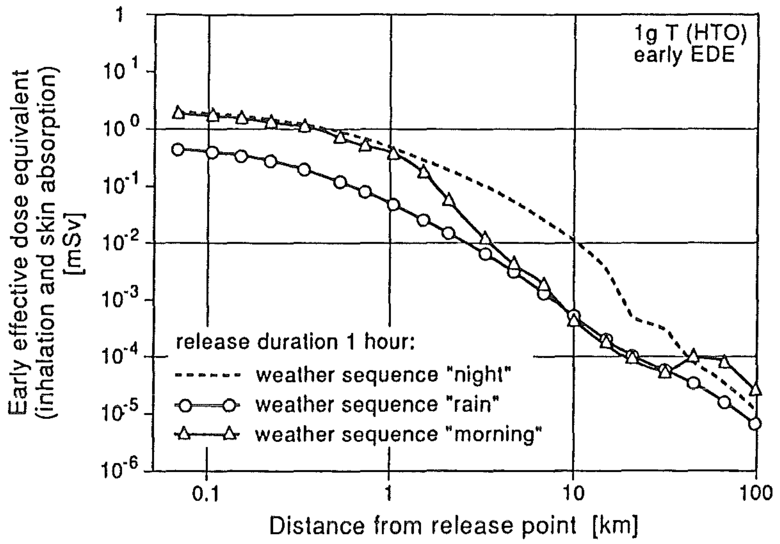

Figure 2. Impact of the meteorological conditions on the effective dose equivalent (EDE) to the most exposed individual (MEI) due to inhalation and skin absorption: release of 1g tritium in HTO form, release duration 1 hour, release height 10m, building wake considered, resistance model

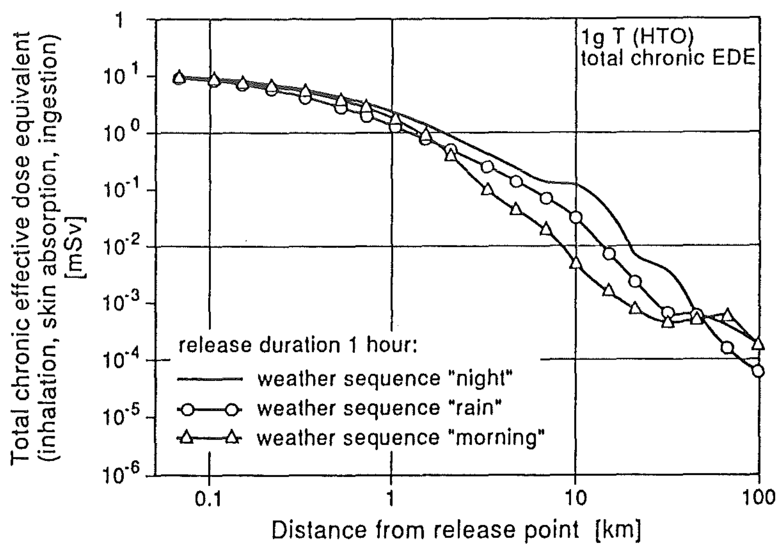

Figure 3. Impact of the meteorological conditions on the total effective dose equivalent (EDE) to the most exposed individual (MEI) due to inhalation, skin absorption and ingestion: release of 1g tritium in HTO form, release duration 1 hour, release height 10m, building wake considered, resistance model

Figure 4 shows the CCFD's (Cumulative Complementary Frequency Distributions) for doses to individuals located at a line of radius 1 km from the release point, following an accidental release of 1g tritium in HTO form (release duration 1 hour). Comparing the curves 'plume EDE' and 'early EDE' it is remarkable, that there exist differences only for high probabilities with low doses. The increase in this probability band shows the influence of the re-emission phase which results in contamination of areas which are not reached by the primary plume.

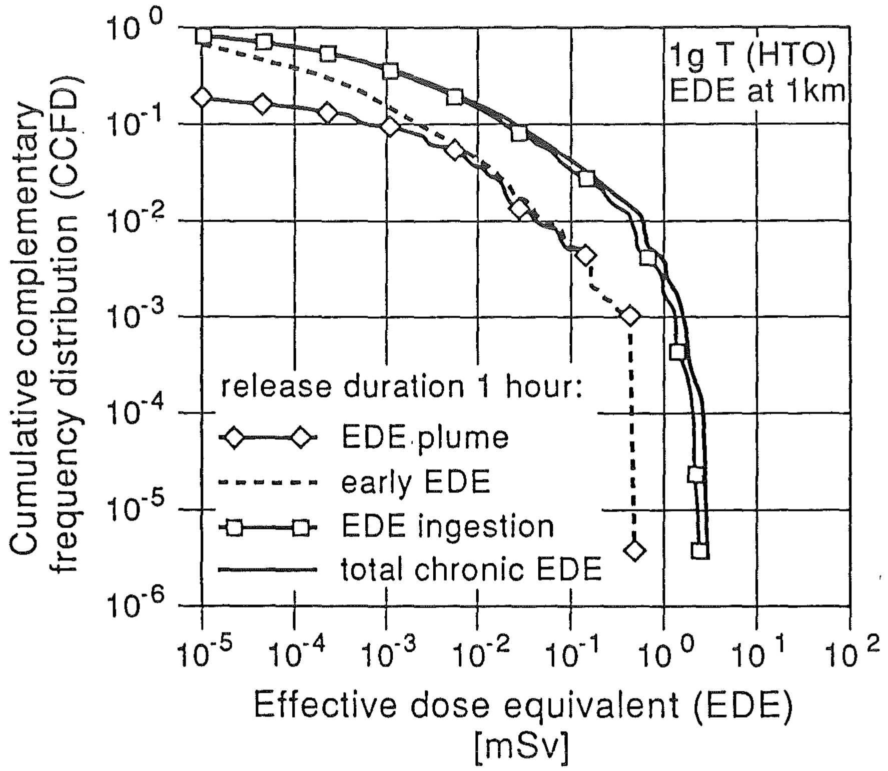

Figure 4. Cumulative complementary frequency distribution (CCFD) for the effective dose equivalent (EDE) to the public at 1 km from the release point: release of 1g tritium in HTO form, release duration 1 hour, release height 10m, building wake considered, resistance model

The CCFD's for doses to the most exposed individual (MEI) at 1 km are shown in Figure 5. An early EDE of 0.5 mSv / g-T (ITER reference value) is practically reached with a maximum probability of 0.05. The highest total chronic dose with the lowest probability (about 3 mSv/g T) exceeds that for the weather sequences 'night', 'rain' and 'morning' by at least 40%. This dose value is practically reached with a probability of about 10^{-3}.

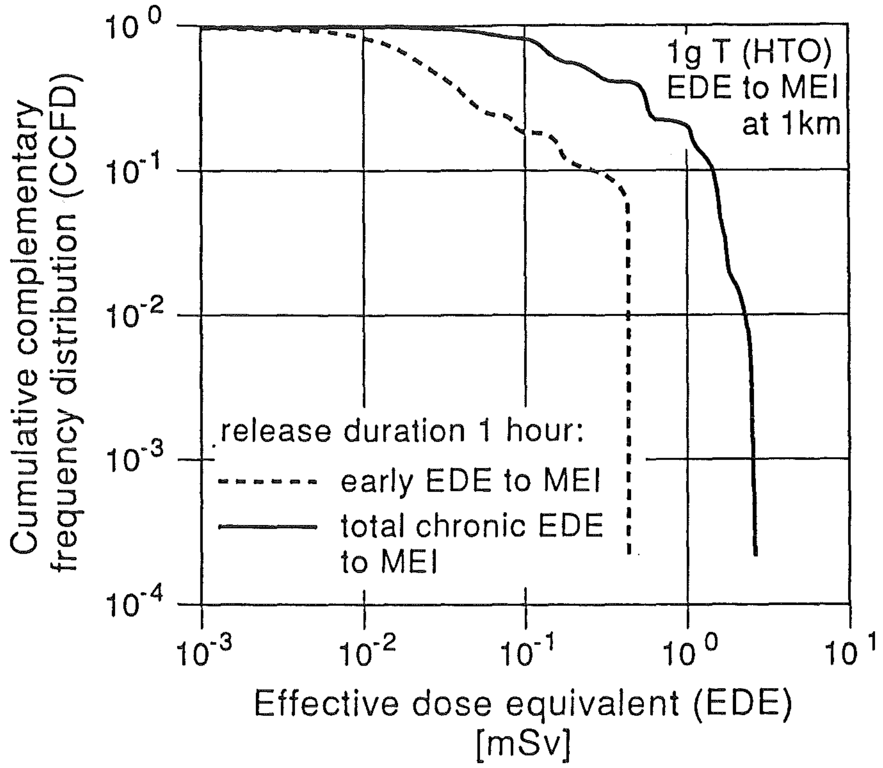

Figure 5. Cumulative complementary frequency distribution (CCFD) for the effective dose equivalent (EDE) to the most exposed individual (MEI) at 1 km from the release point: release of 1g tritium in HTO form, release duration 1 hour, release height 10m, building wake considered, resistance model

2. Dose calculations for accidental releases of activation products

2.1 Introduction

Deterministic and probabilistic calculations were performed with the program system COSYMA [4] (subsystem NL). For atmospheric dispersion and deposition (dry and wet) calculations the trajectory model MUSEMET [10] implemented in COSYMA was used. The calculations were performed for the activation products listed in Table 11 in Appendix A for each exposure pathway. For comparison, the deterministic calculations were also performed for four of the most important fission products and for four noble gases (including Rb-88 as important daughter product of Kr-88); they are also given in Table 11 in Appendix A. As realistic source terms are not yet defined, for each nuclide considered a release of 1.E9 Bq was assumed (but no release for Rb-88 which is daughter nuclide from Kr-88). It is assumed, that the nuclides (except the noble gases) are released in aerosol form with a mean diameter of 1 μm AMAD, and the corresponding dry deposition velocity is set to be 1.0 E-3 m/s. The specifications used in the calculations are shown in Table 12 in Appendix A.

The following terminology and abbreviations are used in the presentations of results:

exposure pathways :	cloudshine	CL
	groundshine	GR
	inhalation	IH
	inhalation after resuspension	IHR
	ingestion	IG

In the deterministic and probabilistic assessments three types of doses were calculated for the effective dose equivalent commitment :

- Individual doses

early dose : committed doses from short-term exposure with the following pathways and integration times :
CL, GR (7d), IH (50a), IHR (7d, 50a)[1]

chronic dose : committed doses from long-term exposure with the following pathways and integration times :

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1 For IHR and IG the times in brackets give
(1) the exposure time (either 7d or 50a) and
(2) the dose integration time (50a)

CL, GR (50a), IH (50a), IHR (50a, 50a)[1], IG (50a,50a)[1]

- Collective committed effective dose equivalent from short- / long-term exposure of the population within 100 km distance (population density 250 persons / km^2; no people up to 1 km)

The ingestion model uses data sets precalculated with the foodchain transport models ECOSYS [11], [12] for activation products and FARMLAND [13], [14] for fission products. A detailed description of the ingestion model implemented in COSYMA is given in [15]. Data sets with normalized activity concentrations are implemented for a release on 1st January and on 1st July, representative for the winter (1st November to 31st March) and summer season. The calculations were performed with the data set codes IG-91/B1 for activation products and IG-91/A1 for fission products (see Part III Section 3 in [16]). The following foodstuffs are considered with the specified average consumption rates (kg/a) [16] :

	ECOSYS	FARMLAND
milk, fresh	9.20E+01	9.20E+01
milk, processed	2.30E+01	2.30E+01
pork	5.00E+01	5.00E+01
beef	2.50E+01	
cow's meat		2.30E+01
cow's liver		2.00E+00
sheep's meat		1.30E+00
sheep's liver		2.00E - 01
grain products	9.50E+01	9.50E+01
potatoes	7.00E+01	7.00E+01
root vegetables	1.50E+01	1.50E+01
leafy vegetables	2.00E+01	
non-leafy vegetables	2.50E+01	
green vegetables		4.50E+01

The doses by ingestion of contaminated foodstuffs are calculated assuming the local production and consumption method; that means all foodstuffs are consumed in the grid element where they are harvested / produced.

In the dose assessments no shielding factors were applied. It is assumed that the individuals stay permanently outdoors throughout their life.

2.2 *Deterministic calculations*

Deterministic calculations were performed with the program system COSYMA [4] (subsystem NL) for two different weather situations (also used for the tritium calculations). The weather sequences (with hourly recorded meteorological data) can be characterized as follows :

- Release during **night** with very stable atmospheric stratification (Pasquill F) and very low wind speed (0.5 m/s)

- Release during heavy **rain** (5 mm/h) with neutral stable atmospheric stratification (Pasquill D) and moderate wind speed (2.0 m/s)

The individual doses reported are for the most exposed individual at four selected distances (0.5, 1.0, 2.0, 10.0 km) from the nuclear facility. For each nuclide the individual total dose is given assuming a release of 1.E9 Bq; additionally, this dose is broken down by exposure pathways. For the ingestion pathway the summer data were used in the calculations.

Similarly, the collective dose is presented for each nuclide separately, assuming a release of 1.E9 Bq. The results for each nuclide are summed up over all 72 azimuthal sectors and all distances up to 100 km. The results are presented in Table 48to Table 65 in Appendix B as follows:

Night release

individual dose	early	Table 48, Table 49, Table 50, Table 51
	chronic	Table 52, Table 53, Table 54, Table 55
collective dose	early	Table 56
	chronic	Table 56

Rain release

individual dose	early	Table 57, Table 58, Table 59, Table 60
	chronic	Table 61, Table 62, Table 63, Table 64
collective dose	early	Table 65
	chronic	Table 65

2.3 *Probabilistic calculations*

Two probabilistic calculations were performed with the program system COSYMA [4] (subsystem NL), one with a set of 144 weather sequences of the winter season, the other with 144 summer weather situations. The weather samples are the same as for the tritium calculations (see Section 1.3.1).

Because of the normalized release only relative results can be obtained from the individual and collective dose assessments. For each nuclide and five distances (0.5, 1.0, 2.0, 10.0, 100.0 km) the breakdown by exposure pathways to **mean** individual early and chronic doses is shown in Table 66 to Table 75 for the summer sample and in Table 81 to Table 90 for the winter sample (in Appendix C). For each distance, a single dose value is calculated for each of 144 weather sequences and for each of 72 azimuthal r-ϕ-grid elements by summing up over all exposure pathways; then the radius-dependent mean total individual dose is determined by adding all these single dose values, weighted with the probability for the weather sequence and the azimuthal sector. No shielding factors were applied in the calculations.

Additionally, for two selected single nuclides (Mn-54, Co-58) and one distance (2 km) the breakdown by exposure pathways to different organ doses are determined. Table 76 to Table 79 and Table 91 to Table 94 (in Appendix C) show the variation in the dose contributions of the different organs.

Assuming a uniform population distribution of 250 persons / km^2 (no people up to 1 km) the collective doses were estimated within 100 km distance. The breakdown by nuclides to **mean** (averaged over the weather sequences) collective doses (early and chronic) are given in Table 80 and Table 95 in Appendix C.

3. Dose calculations for radioactive effluents during normal operation

3.1 Tritium calculations

3.1.1 Introduction

According to the benchmark task described in [2], calculations were performed to assess the off site consequences from a tritium release during normal operations. The endpoints of this task are dose calculations for a most exposed individual and for the public. The tritium model of the German regulatory guidelines [17] was applied to this purpose. Additional calculations include the consumption of organically bound tritium (OBT), which is not considered in the regulatory model. Therefore at KfK, the development of an improved model for assessing the off site consequences from routine tritium releases (NORMTRI) is still under way. One part of this model was used to assess the influence of OBT via the ingestion pathway.

3.1.2 Model description

Concerning the most exposed individual, it is assumed in the regulatory model, that an individual lives at the most contaminated point at a certain distance from the nuclear installation and that it stays permanently outdoors for 24 hours. Furthermore, all the foodstuffs are produced locally at the point with the highest contamination, which is the same 'grid point' where the individual lives. From the intake the dose can be obtained with dose factors to convert the ingested activity into dose. The collective intake is also estimated under the assumption of local food production and under consideration of the spatial distribution of the population (homogenous) and tritium concentration (inhomogenous).

The regulatory model calculates the inhalation dose according to the time integrated air concentration near the surface at the point of interest. The absorption of tritium via the skin is neglected in the model; but a simple multiplication factor (one may use 0.5) will give the additional dose caused by skin absorption. Thus the inhalation dose in this report had to be multiplied by 1.5 to obtain the dose from inhalation + skin absorption.

The ingestion dose from the intake of contaminated foodstuffs is based on the tritium concentration in the foodstuffs. It is assumed that the tritium concentration in the plant is determined by two components, 30% of the concentration is caused by the air humidity and 70% originates from the soil water. The tritium concentration in the air humidity is calculated according to the tritium concentration in air and the specific water content averaged over the vegetation period in the air. The tritium concentration in the soil water is calculated according to the amount of rain fallen during the vegetation period and the amount of tritium deposited from wet deposition (washout). Transfer rates determine the tritium concentration in milk and meat, which are the main components of the human diet (Table 96, Appendix E) considered in the model.

Dry deposition as well as reemission of deposited tritium is not considered in the regulatory model. The basic idea might be that both effects will compensate each other. To investigate this in the future, the NORMTRI model - which is still under development - includes dry deposition as well as re-emission. Thus it will be applicable also to chronic releases of HT-gas, which can not be considered with the regulatory model.

The yearly release period starts at the first of January and ends at the 31th of December. To assess the dose from the ingestion pathway, the vegetation period from the first of April to the 17th of October was chosen according to the meteorological data set defined in the benchmark task [2]. The statistical atmospheric dispersion model ISOLA V [18] was applied (the statistics from [2] is the input) to calculate the actual and time integrated soil- and air concentrations, needed as input for the tritium model.

3.1.3 Results

Two different sets of calculations were performed with the model of the German regulatory guidelines. Some input specifications are listed in Table 96 in Appendix E.

1. Specifications according to the NET parameter list. No consideration of OBT (Table 97 in Appendix E)

2. Specifications according to the NET parameter list. Consideration of OBT (Table 97 in Appendix E)

The results for the most exposed individual for various distances and a release rate of $3.7\ 10^{11}$ (10 Ci) per day are shown in Table 97 in Appendix E. The doses in the vicinity of the plant are in the order of 1 μSv per year. They are dominated by the ingestion pathway. The air concentration in the vicinity of the source is relatively low due to the release height of 150 m. The release height has not such a big influence concerning the washout process, thus tritium concentration in soil dominates the tritium concentration in the foodstuffs. The doses from inhalation and ingestion (no OBT) differ by more than one order of magnitude (500 m and 1000 m). Far away from the source (100 km) the difference is reduced to a factor of about 5. There the initial release height plays no longer an important role. The consideration of OBT increases the ingestion dose by about 40%.

The collective dose for a uniform population distribution of 250 persons/km^2 up to a distance of 100 km are presented in Table 98 in Appendix E. Here again, the exposure pathway ingestion dominates the doses to the public.

3.2 Activation products

3.2.1 General comments

During normal operation radioactive material is released with a constant low rate into the atmosphere over a long time period. The appropriate atmospheric dispersion model is the statistical Gaussian model ISOLA V [18] which is also implemented in the susbsystem NL of COSYMA. For the dose assessments an annual release of 1.E9 Bq of those activation products indicated in Table 11 in Appendix A was assumed.

3.2.2 Results

The results of the dose assessments for normal operation are presented in the same way as mentioned in Section 2.1. The breakdown by exposure pathways is shown in Table 99 to Table 103 in Appendix E for **mean** annual individual chronic dose for five distances. "Mean" refers to the value averaged over all 72 azimuthal sectors of a distance band. For comparison, Table 104 and Table 105 (Appendix E) show for a single nuclide (Mn-54, Co 58) and distance (2 km) the variation in the contributions of exposure pathways to different organ doses. The **mean** annual collective effective doses are presented in Table 106 in Appendix E.

4. References

[1] Gulden, W.
Dose Calculations for NET Accidental Releases, S+E Subtask SEP2.2
NI/R/0262/2/A, 29 May 1991

[2] Gulden, W.
Normal Operation Release Calculations for NET, S+E subtask SEP2.2
N/R/0262/1/A, 1 March 1991

[3] Raskob, W.
UFOTRI: Program for Assessing the Off-Site Consequences from Accidental Tritium Releases
KfK-report 4605, Kernforschungszentrum Karlsruhe, June 1990

[4] COSYMA: A New Program Package for Accident Consequence Assessment.
Joint report by Kernforschungszentrum Karlsruhe GmbH and National Radiological Protection Board
Commission of the European Communities, Report EUR-13028 EN (1991)

[5] Raskob, W.
Modelling of the Tritium Behaviour in the Environment
in: Proceedings of the '4th Topical Meeting on Tritium Technology in Fission, Fusion, and Isotopic Applications'
Albuquerque, 29.9.91 - 4.10.91, (to be published) 1992

[6] Klug,
Ein Verfahren zur Bestimmung der Ausbreitungsbedingungen aus synoptischen Beobachtungen
Staub, Reinhaltung der Luft, Nr. 4, pp 143-147 (1969)

[7] Bultynck, H. and Malet, L.M.
Evaluation of Atmospheric Dilution Factors for Effluents Diffused from an Elevated Continuous Point Source.
Tellus, XXIV, 455-472 (1972)

[8] Raeder, j. and Piet, S.
ITER, Safety and Environmental Impact, Concepts and Technical Information
ITER-TN-SA-9-1, October 1989

[9] Gulden, W. and Raskob, W.
Accidental Tritium Doses Based on Realistic Modelling

in: Proceedings of the '4th Topical Meeting on Tritium Technology in Fission, Fusion, and Isotopic Applications'
Albuquerque, 29.9.91 - 4.10.91, (to be published) 1992

[10] Panitz, H.-J., Matzerath, C., Päsler-Sauer, J.
UFOMOD: Atmospheric dispersion and deposition,
Karlsruhe, Report KfK-4332 (October 1989)

[11] Jacobi, W., Paretzke, H.G., Friedland, W., Müller, H., Pröhl, G.
Transport von Radionukliden über Nahrungsketten
GSF-Report 12/89 (1989), Neuherberg

[12] Pröhl, G., Müller, H.
Calculation of normalized specific activity concentrations for activation products with ECOSYS
GSF Internal Report, Neuherberg, 1990

[13] Simmonds, J.R.
The influence of season of the year on the transfer of radionuclides to terrestrial foods following an accidental release to atmosphere. Report NRPB-M121 (1985)

[14] BfS, GSF, IPSN, RIVM and NRPB :
Post-Chernobyl Action 5, Underlying Data for Derived Intervention Levels, Luxembourg, CEC-Report EUR-12533 (1991)

[15] Steinhauer, C.
COSYMA : Ingestion pathways and foodbans
Report KfK-4334, Kernforschungszentrum Karlsruhe (1992)

[16] COSYMA : User Guide
compiled by I. Hasemann and J.A. Jones
CEC-Report EUR-13045EN, Luxembourg (1991)
Report KfK-4331B, Kernforschungszentrum Karlsruhe (1991)

[17] Der Bundesminister für Umwelt, Naturschutz und Reaktorsicherheit
Allgemeine Verwaltungsvorschrift zu § 45 StrlSchV: Ermittlung der Strahlenexposition durch die Ableitung radioaktiver Stoffe aus kerntechnischen Anlagen oder Einrichtungen.
Bundesanzeiger vom 31.03.1990, Bonn, (1990)

[18] Hübschmann, W. und Raskob, W.
ISOLA V - A FORTRAN 77-Code for the Calculation of the Long-Term Concentration Distribution in the Environment of Nuclear Installations
Report KfK-4606, Kernforschungszentrum Karlsruhe (1990)

5. APPENDIX A : Input Parameters

Stability Category	Diffusion Coefficients			
	p_y	q_y	p_z	q_z
A	0.946	0.796	1.321	0.711
B	0.826	0.796	0.950	0.711
C	0.586	0.796	0.700	0.711
D	0.418	0.796	0.520	0.711
E	0.297	0.796	0.382	0.711
F	0.235	0.796	0.311	0.711

Table 4. Diffusion coefficients of the S.C.K./C.E.N Mol, Belgium, as a function of stability classes

Stability Category	Diffusion Coefficients			
	p_y	q_y	p_z	q_z
A	0.469	0.903	0.017	1.380
B	0.306	0.885	0.072	1.021
C	0.230	0.885	0.076	0.879
D	0.219	0.764	0.140	0.727
E	0.237	0.691	0.217	0.610
F	0.273	0.594	0.262	0.500

Table 5. Diffusion coefficients of Klug as a function of stability classes

parameter	value
release duration	1 hour
deposition velocity HTO	0.5 cm/s
deposition velocity HT	0.05 cm/s
washout coefficient HTO	9.0E-5/s for 1 mm/h
release rate	10 g as HT or HTO
building wake	10 m release height
no building wake	150 m release height
sigma parameters	MOL
dose conversion factor HTO in Sv/Bq	1.7 E-11
dose conversion factor HT in Sv/Bq	6.8 E-16
dose conversion factor OBT **ingestion** in Sv/Bq	4.5 E-11
breathing rate in m^3 / s	2.66 E-4
skin absorption rate in m^3 / s	1.44 E-4
ingestion rate in kg per year: vegetables	610
ingestion rate in kg per year: meat	125
ingestion rate in kg per year: milk	320
population data	250 persons / km^2
minimum stomata resistance	2 s/cm

Table 6. Some reference parameters for the first release (release duration 1 hour)

parameter	**value**
release duration	2 minutes
deposition velocity HTO	0.5 cm/s
deposition velocity HT	0.05 cm/s
washout coefficient HTO	9.0E-5/s for 1 mm/h
release rate	10 g as HT or HTO
building wake	10 m release height
no building wake	150 m release height
sigma parameters	KLUG
dose conversion factor HTO in Sv/Bq	1.7 E-11
dose conversion factor HT in Sv/Bq	6.8 E-16
dose conversion factor OBT **ingestion** in Sv/Bq	4.5 E-11
breathing rate in m^3 / s	2.66 E-4
skin absorption rate in m^3 / s	1.44 E-4
ingestion rate in kg per year: vegetables	610
ingestion rate in kg per year: meat	125
ingestion rate in kg per year: milk	320
population data	250 persons / km^2
minimum stomata resistance	2 s/cm

Table 7. Some reference parameters for the second release (release duration 2 minutes)

parameter	value
release duration	2 minutes / 1 hour
deposition velocity HTO	resistance model
deposition velocity HT	0.05 cm/s
washout coefficient HTO	9.0E-5/s for 1 mm/h
release rate	10 g as HT or HTO
building wake	10 m release height
no building wake	150 m release height
sigma parameters	KLUG / MOL
dose conversion factor HTO in Sv/Bq	1.7 E-11
dose conversion factor HT in Sv/Bq	6.8 E-16
dose conversion factor OBT **ingestion** in Sv/Bq	4.5 E-11
breathing rate in m^3 / s	2.66 E-4
skin absorption rate in m^3 / s	1.44 E-4
ingestion rate in kg per year: vegetables	610
ingestion rate in kg per year: meat	125
ingestion rate in kg per year: milk	320
population data	250 persons / km^2
minimum stomata resistance	2 s/cm

Table 8. Some reference parameters for the third release (resistance model)

1. Emission

Release quantity	10 g
Chemical forms	HT / HTO
Release height	10 m / 150 m
Duration of release	1 hour / 2 minutes

2. Meteorology

Three weather sequences with hourly recorded meteorological data (see Appendix D)

Height dependence of wind speed $U = U_0 \ (h/h_0)^a$

(U_0 wind speed at reference height h_0; a is dependent on Pasquill class

a: 0.07 (A) 0.13 (B) 0.21 (C) 0.34 (D) 0.44 (E) 0.44 (F))

3. Building wake effects Building wake for 10 m release height,
Building dimensions : 100 m (width), 70 m (height).

4. Soil and vegetation

Type	sandy loam
Pore volume (contains 40 % water and 60 % air)	50 %
Vegetation density	1 kg wet matter per m^2
Leaf area index (LAI)	3 m^2/m^2
Minimum stomata resistance	2 s/cm / LAI

5. Site and population specification

Population density	250 people/km^2
Exclusion radius	1 km
Outer radius	100 km

6. Human diet

Food stuff	Ingestion rate fresh weight (kg/year)
Milk	180
Milk products	140
Green vegetables	180
Root vegetables	260
Grain	170
Cow's meat	80
Cow's liver	20
Sheep's meat	20
Sheep's liver	5

Table 9. Main parameters of the NET-Benchmark definition

RELEASE DURATION IN SEC.	:	3600 or 180
EXTENDED MODEL FOR SOIL WATER	:	1
INITIAL WATER CONT. SOIL %/100.	:	0.20000
SORT OF SOIL	:	4
WILTING POINT IN VOL %/100.	:	0.10000
MAX. WATER CONT. SOIL VOL %/100.	:	0.50000
RE-EMISSION RATE AT NIGHT %/h (initial)	:	1.00000
RE-EMISSION DURING RAIN %/h (initial)	:	0.30000
MULTIPLIC. FACTOR RE-EM. SOIL	:	1.00000
THRESH. VALUE FOR WATER STRESS	:	200
MINIMAL STOMATA RESIST. COMP 1	:	2.00000
PLANT WATER CONTENT COMP 1	:	900.00000
PLANT ORGANIC MATTER COMP 1	:	100.00000
LEAF AREA INDEX	:	3.00000
MINIMAL STOMATA RESIST. COMP 2	:	2.00000
PLANT WATER CONTENT COMP 2	:	800.00000
PLANT ORGANIC MATTER COMP 2	:	200.00000
LEAF AREA INDEX COMP 2	:	3.00000
PERCENTUAL FRACTION OF VEGET.	:	0.20000
PERCENTUAL FRACTION OF GRASS	:	0.80000
THE NEXT 8 LINES ARE INPUT FOR THE LONG TERM COMPARTMENT SUBMODEL		
NUMBER OF COWS PER SQUARE KIL.	:	250
WEIGHT OF THE ANORG. COWS PART KG	:	350.00000
WEIGHT OF THE ORGAN. COWS PART KG	:	150.00000
MASS OF WATER IN ATM. KG/KM**3	:	0.80000E+07
MASS OF RAIN IN KG/KM**2	:	0.19300E+07
CONSUMPTION RATE MEAT G/DAY	:	343
CONSUMPTION RATE VEGET. G/DAY	:	1671
CONSUMPTION RATE MILK G/DAY	:	877
DOSE CONVERSION FACTOR HTO SV/BQ	:	0.17000E-10
DOSE CONVERSION FACTOR HT SV/BQ	:	0.68000E-15
DOSE CONVERSION FACTOR OBT SV/BQ	:	0.45000E-10
BREATHING RATE IN M**3/S	:	0.26600E-03
RATE OF SKIN UPTAKE IN M**3/S	:	0.14000E-03

Table 10. Detailed printout of the UFOTRI model input

```
----------> HTO DSPOSITION VELOCITY : CALCULATED
            RESISTANCE OF SOIL      : 150.000  S/M

----------> HT DSPOSITION VELOCITY TO SOIL : FIXED

----------> PLANT MODEL
            EXTENDED MODEL FOR RESISTANCE CALCULATIONS

THE FOLLOWING ADDITIONAL PARAMETERS ARE USED FOR AGRICULTURAL PLANTS
  CONSTANT CONCERNING MINIMAL PAR FLUX:        2.00E+01
  CONSTANT CONCERNING WATER VAPOUR DEFICIT:    2.00E-01
  MINIMAL TEMPERATURE FOR STOMATA CLOSURE:     0.00E+00
  MAXIMAL TEMPERATURE FOR STOMATA CLOSURE:     4.50E+01
  OPTIMAL TEMPERATURE FOR STOMATA:             2.50E+01

THE FOLLOWING ADDITIONAL PARAMETERS ARE USED FOR GRASS
  CONSTANT CONCERNING MINIMAL PAR FLUX:        2.00E+01
  CONSTANT CONCERNING WATER VAPOUR DEFICIT:    2.00E-01
  MINIMAL TEMPERATURE FOR STOMATA CLOSURE:     0.00E+00
  MAXIMAL TEMPERATURE FOR STOMATA CLOSURE:     4.50E+01
  OPTIMAL TEMPERATURE FOR STOMATA:             2.50E+01

----------> SOIL MODEL
           EXTENDED MODEL FOR WATER TRANSPORT CALCULATIONS

THE FOLLOWING ADDITIONAL PARAMETERS ARE USED FOR SOIL SUCTION TENSION
  ACCORDING TO THE FOLLOWING FORMULA:
  SS = 1.5E5 * PSI1**(AP + BP*PSI1 + CP*PSI1**NP)
  CONSTANT   AP       1.65E+00
  CONSTANT   BP       7.30E+00
  CONSTANT   CP      -3.10E+00
  CONSTANT   NP       7.50E+00

THE FOLLOWING ADDITIONAL PARAMETERS ARE USED FOR SOIL CONDUCTIVITY
  ACCORDING TO THE FOLLOWING FORMULA:
  COND = AKP / (SS**MKP + BKP)
  CONSTANT   AKP      1.00E+03
  CONSTANT   BKP      6.00E+01
  CONSTANT   CKP      1.41E+00
```

Table 10. cont. : Detailed printout of the UFOTRI model input

nuclide	half-life (d)	CL	GR	IH	IG	
CR- 51	2.77E+01	*	*	*	*	
MN- 53	1.35E+09	*	*	*	*	
MN- 54	3.12E+02	*	*	*	*	
MN- 56	9.42E-02	*	*	*		
FE- 55	9.85E+02	*	*	*	*	
FE- 59	4.45E+01	*	*	*	*	
CO- 56	7.88E+01	*	*	*		
CO- 57	2.71E+02	*	*	*	*	
CO- 58M	3.72E-01	*	*	*		
CO- 58	7.08E+01	*	*	*	*	
CO- 60M	7.30E-03	*	*	*		
CO- 60	1.92E+03	*	*	*	*	
CO- 61	6.86E-02	*	*	*		
NI- 59	2.74E+07	*	*	*	*	
NI- 63	3.65E+04	*	*	*	*	
MO- 93	1.28E+06	*	*	*	*	
MO- 99	2.75E+00	*	*	*	*	
TC- 99M	2.51E-01	*	*	*		
W -181	1.21E+02	*	*	*	*	
SR- 90	1.06E+04	*	*	*	*	
I -131	8.03E+00	*	*	*	*	99 % aerosol-type 1 % organic
CS-137	1.10E+04	*	*	*	*	
PU-239	8.80E+06	*	*	*	*	
KR- 85	3.91E+03	*				
KR- 88	1.18E-01	*				
RB- 88	1.23E-02	*	*	*		no release, only daughter product
XE-133	5.26E+00	*				
XE-135	3.80E-01	*				

For the following radionuclides the radioactive decay during dispersion is considered:

daughter product	parent	yield
CO- 58	CO- 58M	1.000
CO- 60	CO- 60M	0.998
TC- 99M	MO- 99	0.868
RB- 88	KR- 88	1.000

Table 11. Nuclides considered for the calculations (activation and fission products)

parameter	value
release duration	1 h
dry deposition velocity	1.E-3 m/s
washout coefficient	A = 1.E-4/s for 1 mm/h B = 0.8
particle size	1 μm
building wake	10 m release height
building dimensions	width = 100 m height = 70 m
sigma parameters	Mol
breathing rate in m^3/s	2.66 E-4
integration time for organ doses	50 years
shielding factors for all exposure pathways	1.00
population data	250 persons / km^2

Table 12. Some reference parameters for the calculations (activation and fission products)

6. APPENDIX B-1 : Deterministic Results, Tritium

max. dose (Sv) in 500 m distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	6.4 E-3	8.4 E-3	1.0 E-3	1.2 E-7	9.2 E-10	2.3 E-6
inh. + skin ab. 1 day	6.5 E-3	8.5 E-3	1.2 E-3	3.4 E-7	1.4 E-7	7.9 E-6
inh. + skin ab. 7 days	6.5 E-3	8.6 E-3	1.2 E-3	6.1 E-7	7.8 E-7	2.3 E-5
inh. + skin ab. 30 days	6.5 E-3	8.6 E-3	1.2 E-3	6.1 E-7	7.9 E-7	2.4 E-5
inh. + skin ab. 1 year	6.5 E-3	8.6 E-3	1.2 E-3	6.1 E-7	7.9 E-7	2.4 E-5
ingestion 1 day	1.4 E-2	1.5 E-2	3.1 E-3	1.3 E-6	4.0 E-7	8.2 E-5
ingestion 7 days	2.7 E-2	2.5 E-2	8.7 E-3	3.8 E-6	6.2 E-6	1.4 E-3
ingestion 30 days	3.7 E-2	3.9 E-2	1.8 E-2	5.4 E-6	9.5 E-6	4.3 E-3
ingestion 1 year	4.1 E-2	4.7 E-2	2.4 E-2	6.2 E-6	1.1 E-5	6.1 E-3

Table 13. Dose in 500 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 500 m distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	2.9 E-7	3.7 E-7	4.6 E-8	4.9 E-12	3.7 E-14	9.4 E-11
inh. + skin ab. 1 day	8.2 E-6	5.8 E-6	5.7 E-7	1.1 E-8	6.8 E-9	4.1 E-10
inh. + skin ab. 7 days	1.5 E-5	1.3 E-5	2.3 E-6	4.3 E-8	5.9 E-8	1.6 E-9
inh. + skin ab. 30 days	1.5 E-5	1.3 E-5	2.3 E-6	4.3 E-8	6.0 E-8	1.6 E-9
inh. + skin ab. 1 year	1.5 E-5	1.3 E-5	2.4 E-6	4.3 E-8	6.0 E-8	1.6 E-9
ingestion 1 day	2.4 E-4	1.1 E-4	5.9 E-6	4.8 E-8	1.8 E-8	1.0 E-8
ingestion 7 days	9.5 E-4	1.0 E-3	1.2 E-4	2.8 E-7	4.6 E-7	3.1 E-7
ingestion 30 days	1.7 E-3	2.7 E-3	3.8 E-4	4.6 E-7	7.6 E-7	8.8 E-7
ingestion 1 year	2.2 E-3	3.7 E-3	5.3 E-4	5.5 E-7	9.2 E-7	1.2 E-6

Table 14. Dose in 500 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 1000 m distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	2.7 E-3	4.0 E-3	3.9 E-4	2.7 E-5	5.9 E-6	2.6 E-5
inh. + skin ab. 1 day	2.8 E-3	4.0 E-3	4.5 E-4	2.8 E-5	6.1 E-6	3.0 E-5
inh. + skin ab. 7 days	2.8 E-3	4.1 E-3	4.7 E-4	2.8 E-5	6.8 E-6	3.6 E-5
inh. + skin ab. 30 days	2.8 E-3	4.1 E-3	4.8 E-4	2.8 E-5	6.9 E-6	3.6 E-5
inh. + skin ab. 1 year	2.8 E-3	4.1 E-3	4.8 E-4	2.8 E-5	6.9 E-6	3.6 E-5
ingestion 1 day	6.1 E-3	6.0 E-3	1.2 E-3	6.2 E-5	9.3 E-6	1.1 E-4
ingestion 7 days	1.1 E-2	1.2 E-2	3.9 E-3	1.2 E-4	2.4 E-5	9.3 E-4
ingestion 30 days	1.5 E-2	1.9 E-2	8.6 E-3	1.6 E-4	3.8 E-5	2.6 E-3
ingestion 1 year	1.7 E-2	2.2 E-2	1.1 E-2	1.8 E-4	4.5 E-5	3.7 E-3

Table 15. Dose in 1000 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 1000 m distance from	HT release in the morn-ing, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morn-ing, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	1.4 E-7	1.9 E-7	2.0 E-8	1.1 E-9	2.4 E-10	1.1 E-9
inh. + skin ab. 1 day	3.9 E-6	2.9 E-6	3.0 E-7	3.2 E-8	1.1 E-8	6.5 E-9
inh. + skin ab. 7 days	7.1 E-6	6.0 E-6	1.1 E-6	8.6 E-8	8.0 E-8	4.4 E-8
inh. + skin ab. 30 days	7.1 E-6	6.0 E-6	1.1 E-6	8.6 E-8	8.0 E-8	4.5 E-8
inh. + skin ab. 1 year	7.1 E-6	6.0 E-6	1.1 E-6	8.8 E-8	8.0 E-8	4.5 E-8
ingestion 1 day	1.1 E-4	5.8 E-5	2.5 E-6	9.5 E-7	9.3 E-8	1.2 E-7
ingestion 7 days	4.4 E-4	5.3 E-4	5.0 E-5	3.8 E-6	1.1 E-6	2.8 E-6
ingestion 30 days	8.1 E-4	1.4 E-3	1.6 E-4	6.9 E-6	2.5 E-6	8.9 E-6
ingestion 1 year	1.0 E-3	1.9 E-3	2.3 E-4	8.6 E-6	3.3 E-6	1.3 E-5

Table 16. Dose in 1000 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 2000 m distance from	HTO release in the morn-ing, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morn-ing, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	4.4 E-4	1.4 E-3	1.2 E-4	1.1 E-4	8.1 E-5	3.3 E-5
inh. + skin ab. 1 day	4.5 E-4	1.5 E-3	1.4 E-4	1.1 E-4	8.1 E-5	3.5 E-5
inh. + skin ab. 7 days	4.6 E-4	1.5 E-3	1.5 E-4	1.1 E-4	8.2 E-5	3.9 E-5
inh. + skin ab. 30 days	4.6 E-4	1.5 E-3	1.5 E-4	1.1 E-4	8.2 E-5	4.0 E-5
inh. + skin ab. 1 year	4.6 E-4	1.5 E-3	1.6 E-4	1.1 E-4	8.2 E-5	4.0 E-5
ingestion 1 day	1.3 E-3	2.1 E-3	4.0 E-4	2.4 E-4	1.2 E-4	1.0 E-4
ingestion 7 days	2.3 E-3	4.3 E-3	1.5 E-3	4.5 E-4	2.9 E-4	6.0 E-4
ingestion 30 days	3.2 E-3	6.8 E-3	3.6 E-3	6.1 E-4	3.8 E-4	1.6 E-3
ingestion 1 year	3.5 E-3	8.2 E-3	4.8 E-3	6.8 E-4	4.5 E-4	2.2 E-3

Table 17. Dose in 2000 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 2000 m distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	2.6 E-8	8.0 E-8	7.5 E-9	4.4 E-9	3.3 E-9	1.5 E-9
inh. + skin ab. 1 day	1.9 E-6	1.3 E-6	1.4 E-7	8.6 E-8	3.7 E-8	1.4 E-8
inh. + skin ab. 7 days	3.5 E-6	2.6 E-6	4.8 E-7	1.9 E-7	1.3 E-7	6.5 E-8
inh. + skin ab. 30 days	3.5 E-6	2.6 E-6	4.8 E-7	1.9 E-7	1.3 E-7	6.6 E-8
inh. + skin ab. 1 year	3.5 E-6	2.6 E-6	4.8 E-7	1.9 E-7	1.3 E-7	6.6 E-8
ingestion 1 day	2.3 E-5	2.5 E-5	9.5 E-7	3.5 E-6	9.3 E-7	1.7 E-7
ingestion 7 days	9.3 E-5	2.2 E-4	1.9 E-5	1.4 E-5	9.1 E-6	3.6 E-6
ingestion 30 days	1.2 E-4	5.8 E-4	6.0 E-5	2.5 E-5	2.4 E-5	1.2 E-5
ingestion 1 year	2.1 E-4	8.0 E-4	8.6 E-5	3.2 E-5	3.3 E-5	1.7 E-5

Table 18. Dose in 2000 m distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 10 km distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	2.1 E-6	5.8 E-5	3.5 E-6	1.1 E-5	5.3 E-5	3.7 E-5
inh. + skin ab. 1 day	3.1 E-6	6.2 E-5	4.5 E-6	1.3 E-5	5.4 E-5	4.2 E-5
inh. + skin ab. 7 days	3.6 E-6	6.2 E-5	5.4 E-6	1.4 E-5	5.4 E-5	5.1 E-5
inh. + skin ab. 30 days	3.6 E-6	6.2 E-5	5.4 E-6	1.4 E-5	5.4 E-5	5.3 E-5
inh. + skin ab. 1 year	3.6 E-6	6.2 E-5	5.4 E-6	1.4 E-5	5.4 E-5	5.4 E-5
ingestion 1 day	1.3 E-5	3.9 E-4	1.4 E-5	5.3 E-5	7.3 E-5	1.4 E-5
ingestion 7 days	2.5 E-5	7.4 E-4	8.8 E-5	1.0 E-4	1.5 E-4	1.0 E-4
ingestion 30 days	3.4 E-5	1.0 E-3	2.4 E-4	1.3 E-4	2.4 E-4	2.7 E-4
ingestion 1 year	3.9 E-5	1.2 E-3	3.3 E-4	1.9 E-4	2.9 E-4	3.8 E-4

Table 19. Dose in 10 km distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 10 km distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	1.6 E-10	5.3 E-9	6.9 E-10	5.3 E-10	2.3 E-9	2.6 E-10
inh. + skin ab. 1 day	7.9 E-8	1.8 E-7	1.2 E-8	8.0 E-8	2.7 E-8	3.2 E-9
inh. + skin ab. 7 days	1.5 E-7	2.4 E-7	4.7 E-8	1.7 E-7	7.7 E-8	1.5 E-8
inh. + skin ab. 30 days	1.5 E-7	2.4 E-7	4.7 E-8	1.7 E-7	7.7 E-8	1.5 E-8
inh. + skin ab. 1 year	1.5 E-7	2.4 E-7	4.7 E-8	1.7 E-7	7.7 E-8	1.5 E-8
ingestion 1 day	2.7 E-7	2.0 E-6	8.4 E-8	6.7 E-7	6.7 E-7	3.0 E-8
ingestion 7 days	1.2 E-6	1.5 E-5	1.8 E-6	2.7 E-6	6.3 E-6	6.5 E-7
ingestion 30 days	2.2 E-6	4.0 E-5	5.6 E-6	4.8 E-6	1.7 E-5	2.1 E-6
ingestion 1 year	2.7 E-6	5.6 E-5	8.0 E-6	5.9 E-6	2.3 E-5	5.0 E-6

Table 20. Dose in 10 km distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 100 km distance from	HTO release in the morn-ing, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morn-ing, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	1.1 E-7	1.1 E-8	9.0 E-9	5.7 E-8	8.6 E-8	1.8 E-8
inh. + skin ab. 1 day	1.5 E-7	4.2 E-8	2.8 E-8	7.2 E-8	9.7 E-8	3.5 E-8
inh. + skin ab. 7 days	1.7 E-7	1.1 E-7	5.5 E-8	8.8 E-8	9.9 E-8	5.5 E-8
inh. + skin ab. 30 days	1.7 E-7	1.1 E-7	5.5 E-8	8.8 E-8	9.9 E-8	5.5 E-8
inh. + skin ab. 1 year	1.7 E-7	1.1 E-7	5.5 E-8	8.8 E-8	9.9 E-8	5.5 E-8
ingestion 1 day	2.5 E-7	1.8 E-7	5.7 E-8	1.1 E-7	2.4 E-7	2.9 E-7
ingestion 7 days	7.4 E-7	9.1 E-7	2.6 E-7	3.4 E-7	4.7 E-7	7.2 E-7
ingestion 30 days	1.1 E-6	1.4 E-6	4.5 E-7	4.9 E-7	6.6 E-7	1.5 E-6
ingestion 1 year	1.3 E-6	1.7 E-6	5.5 E-7	5.7 E-7	7.5 E-7	2.0 E-6

Table 21. Dose in 100 km distance for the most exposed individual (1 hour release; 10 g tritium)

max. dose (Sv) in 100 km distance from	HT release in the morn-ing, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morn-ing, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	1.3 E-11	2.6 E-12	2.4 E-11	3.3 E-12	7.5 E-12	1.2 E-12
inh. + skin ab. 1 day	2.2 E-9	1.7 E-9	6.6 E-10	6.2 E-10	7.6 E-10	4.1 E-10
inh. + skin ab. 7 days	5.8 E-9	8.7 E-9	4.1 E-9	2.0 E-9	2.5 E-9	1.6 E-9
inh. + skin ab. 30 days	5.8 E-9	8.8 E-9	4.3 E-9	2.0 E-9	2.6 E-9	1.7 E-9
inh. + skin ab. 1 year	5.8 E-9	8.8 E-9	4.3 E-9	2.0 E-9	2.6 E-9	1.7 E-9
ingestion 1 day	9.0 E-9	7.1 E-9	1.0 E-9	2.8 E-9	3.4 E-9	9.3 E-9
ingestion 7 days	4.3 E-8	7.4 E-8	7.2 E-8	1.6 E-8	2.2 E-8	3.4 E-8
ingestion 30 days	1.2 E-7	1.3 E-7	2.2 E-7	3.1 E-8	6.2 E-8	1.1 E-7
ingestion 1 year	1.6 E-7	1.6 E-7	3.1 E-7	4.0 E-8	8.6 E-8	1.5 E-7

Table 22. Dose in 100 km distance for the most exposed individual (1 hour release; 10 g tritium)

collective dose in man*Sv from	HTO release in the morn- ing, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morn- ing, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	0.3	0.6	0.07	0.25	0.5	0.05
inh. + skin ab. 1 day	0.6	0.9	0.19	0.4	0.6	0.11
inh. + skin ab. 7 days	0.8	1.2	0.5	0.5	0.8	0.37
inh. + skin ab. 30 days	0.8	1.2	0.5	0.5	0.8	0.38
inh. + skin ab. 1 year	0.8	1.2	0.5	0.5	0.8	0.38
ingestion 1 day	2.0	3.6	0.6	1.4	1.6	0.34
ingestion 7 days	4.6	7.2	3.4	3.1	4.6	2.6
ingestion 30 days	6.4	10.6	6.8	4.3	6.9	4.3
ingestion 1 year	7.2	12.4	8.6	4.8	8.0	8.0

Table 23. Collective dose between 1 km and 50 km distance (1 hour release; 10 g tritium)

collective dose in man*Sv from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	2.1 E-5	5.3 E-4	1.1 E-5	1.2 E-5	2.3 E-5	4.7 E-5
inh. + skin ab. 1 day	1.1 E-2	1.2 E-2	9.0 E-4	4.0 E-3	4.2 E-3	2.6 E-4
inh. + skin ab. 7 days	3.1 E-2	4.2 E-2	7.6 E-3	1.2 E-2	1.9 E-2	2.6 E-3
inh. + skin ab. 30 days	3.2 E-2	4.3 E-2	7.6 E-3	1.2 E-2	1.9 E-2	2.7 E-3
inh. + skin ab. 1 year	3.2 E-2	4.3 E-2	7.6 E-3	1.2 E-2	1.9 E-2	2.7 E-3
ingestion 1 day	5.6 E-2	5.6 E-2	3.3 E-3	2.2 E-2	2.3 E-2	1.1 E-3
ingestion 7 days	2.6 E-1	4.4 E-1	6.9 E-2	1.0 E-1	2.0 E-1	2.9 E-2
ingestion 30 days	4.3 E-1	9.0 E-1	1.6 E-1	2.0 E-1	4.0 E-1	6.7 E-2
ingestion 1 year	5.1 E-1	1.1	2.2 E-1	2.3 E-1	4.8 E-1	8.8 E-2

Table 24. Collective dose between 1 km and 50 km distance (1 hour release; 10 g tritium)

collective dose in man*Sv from	HTO release in the morn- ing, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morn- ing, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	0.09	0.03	4.6E-3	0.02	0.15	7.6 E-3
inh. + skin ab. 1 day	0.2	0.1	0.03	0.08	0.24	0.04
inh. + skin ab. 7 days	0.4	0.3	0.16	0.18	0.37	0.17
inh. + skin ab. 30 days	0.4	0.3	0.16	0.19	0.37	0.17
inh. + skin ab. 1 year	0.4	0.3	0.16	0.19	0.37	0.17
ingestion 1 day	0.6	0.8	0.07	0.3	1.0	0.1
ingestion 7 days	2.3	2.2	0.9	1.1	2.9	0.96
ingestion 30 days	3.3	2.2	1.6	1.4	4.3	1.7
ingestion 1 year	3.8	3.9	1.9	1.8	5.0	2.1

Table 25. Collective dose between 50 km and 100 km distance (1 hour release; 10 g tritium)

collective dose in man*Sv from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	9.3 E-6	5.1 E-6	8.4 E-6	1.1 E-6	1.0 E-5	3.4 E-6
inh. + skin ab. 1 day	5.3 E-3	3.6 E-3	5.0 E-4	1.9 E-3	2.8 E-3	2.7 E-4
inh. + skin ab. 7 days	2.1 E-2	2.1 E-2	5.9 E-3	7.4 E-3	1.2 E-2	2.4 E-3
inh. + skin ab. 30 days	2.1 E-2	2.1 E-2	6.1 E-3	7.4 E-3	1.3 E-2	2.5 E-3
inh. + skin ab. 1 year	2.1 E-2	2.1 E-2	6.1 E-3	7.4 E-3	1.3 E-2	2.5 E-3
ingestion 1 day	2.2 E-2	1.6 E-2	8.8 E-4	7.5 E-3	1.4 E-2	7.1 E-4
ingestion 7 days	1.4 E-1	1.6 E-1	5.1 E-2	5.0 E-2	1.0 E-1	2.0 E-2
ingestion 30 days	2.5 E-1	3.0 E-1	1.2 E-1	7.0 E-2	2.0 E-1	5.0 E-2
ingestion 1 year	3.1 E-1	3.6 E-1	1.7 E-1	9.0 E-2	3.8 E-1	7.0 E-2

Table 26. Collective dose between 50 km and 100 km distance (1 hour release; 10 g tritium)

max. dose (Sv) in 500 m distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	1.3 E-2	1.6 E-2	2.8 E-3	6.7 E-8	4.8 E-23	1.0 E-32
inh. + skin ab. 1 day	1.3 E-2	1.6 E-2	2.9 E-3	1.1 E-7	2.7 E-8	7.6 E-6
inh. + skin ab. 7 days	1.3 E-2	1.6 E-2	3.0 E-3	2.3 E-7	2.0 E-7	2.4 E-5
inh. + skin ab. 30 days	1.3 E-2	1.6 E-2	3.0 E-3	2.3 E-7	2.0 E-7	2.4 E-5
inh. + skin ab. 1 year	1.3 E-2	1.6 E-2	3.0 E-3	2.3 E-7	2.0 E-7	2.4 E-5
ingestion 1 day	3.0 E-2	2.4 E-2	7.4 E-3	5.6 E-7	1.2 E-7	1.6 E-4
ingestion 7 days	5.5 E-2	4.7 E-2	1.9 E-3	1.7 E-6	1.6 E-6	3.0 E-3
ingestion 30 days	7.5 E-2	7.4 E-2	3.9 E-2	2.4 E-6	2.5 E-6	9.5 E-3
ingestion 1 year	8.4 E-2	8.8 E-2	5.1 E-2	2.8 E-6	3.0 E-6	1.4 E-2

Table 27. Dose in 500 m distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 500 m distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	6.3 E-7	7.2 E-7	1.3 E-7	3.3 E-12	2.6 E-27	4.2 E-37
inh. + skin ab. 1 day	1.0 E-5	7.3 E-6	7.5 E-7	1.1 E-9	7.3 E-10	4.2 E-37
inh. + skin ab. 7 days	1.9 E-5	2.0 E-5	3.3 E-6	1.2 E-8	1.1 E-8	3.8 E-9
inh. + skin ab. 30 days	1.9 E-5	2.0 E-5	3.4 E-6	1.2 E-8	1.1 E-8	3.8 E-9
inh. + skin ab. 1 year	1.9 E-5	2.0 E-5	3.4 E-6	1.2 E-8	1.1 E-8	3.8 E-9
ingestion 1 day	5.1 E-4	2.1 E-4	1.5 E-5	6.4 E-9	3.1 E-9	4.4 E-35
ingestion 7 days	2.0 E-3	2.0 E-3	3.2 E-4	9.0 E-8	8.6 E-8	2.6 E-8
ingestion 30 days	3.7 E-3	5.2 E-3	1.0 E-3	1.6 E-7	1.4 E-7	4.3 E-8
ingestion 1 year	4.0 E-3	7.2 E-3	1.5 E-3	1.9 E-7	1.7 E-7	5.1 E-8

Table 28. Dose in 500 m distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 1000 m distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	8.7 E-3	1.3 E-2	1.6 E-3	8.1 E-8	9.1 E-23	2.5 E-14
inh. + skin ab. 1 day	8.8 E-3	1.3 E-2	1.6 E-3	1.3 E-7	2.9 E-8	6.0 E-6
inh. + skin ab. 7 days	8.8 E-3	1.3 E-2	1.7 E-3	2.8 E-7	2.2 E-7	1.9 E-5
inh. + skin ab. 30 days	8.8 E-3	1.3 E-2	1.7 E-3	2.8 E-7	2.2 E-7	1.9 E-5
inh. + skin ab. 1 year	8.8 E-3	1.3 E-2	1.7 E-3	2.8 E-7	2.2 E-7	1.9 E-5
ingestion 1 day	1.9 E-3	1.8 E-2	4.1 E-3	6.8 E-7	1.3 E-7	9.5 E-5
ingestion 7 days	3.6 E-2	3.7 E-2	1.1 E-2	2.0 E-6	1.8 E-6	1.8 E-3
ingestion 30 days	4.9 E-2	5.7 E-2	2.3 E-2	2.9 E-6	2.7 E-6	5.5 E-3
ingestion 1 year	5.5 E-2	6.9 E-2	3.0 E-2	3.3 E-6	3.2 E-6	7.8 E-3

Table 29. Dose in 1000 m distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 1000 m distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	4.7 E-7	6.4 E-7	8.3 E-8	3.9 E-12	5.0 E-27	1.0 E-18
inh. + skin ab. 1 day	6.1 E-6	5.0 E-6	4.8 E-7	1.4 E-9	7.8 E-10	1.0 E-18
inh. + skin ab. 7 days	1.1 E-5	1.4 E-5	1.9 E-6	1.4 E-8	1.2 E-8	4.2 E-9
inh. + skin ab. 30 days	1.1 E-5	1.4 E-5	2.0 E-6	1.4 E-8	1.2 E-8	4.2 E-9
inh. + skin ab. 1 year	1.1 E-5	1.4 E-5	2.0 E-6	1.4 E-8	1.2 E-8	4.2 E-9
ingestion 1 day	3.8 E-4	1.8 E-4	9.3 E-6	8.1 E-9	3.4 E-9	1.1 E-16
ingestion 7 days	1.5 E-3	1.8 E-3	2.0 E-4	1.1 E-7	9.0 E-8	2.9 E-8
ingestion 30 days	2.7 E-3	4.6 E-3	6.5 E-4	1.8 E-7	1.4 E-7	4.7 E-8
ingestion 1 year	3.4 E-3	6.3 E-3	9.3 E-4	2.2 E-7	1.8 E-7	5.6 E-8

Table 30. Dose in 1000 m distance for the most exposed individual (2 min. release; 10 g trtium)

max. dose (Sv) in 2000 m distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	7.3 E-4	8.0 E-3	6.6 E-4	1.1 E-7	3.1 E-22	6.4 E-8
inh. + skin ab. 1 day	7.6 E-4	8.0 E-3	6.9 E-4	2.3 E-7	3.1 E-8	4.6 E-6
inh. + skin ab. 7 days	7.7 E-4	8.0 E-3	7.0 E-4	4.0 E-7	2.4 E-7	1.4 E-5
inh. + skin ab. 30 days	7.7 E-4	8.0 E-3	7.0 E-4	4.0 E-7	2.4 E-7	1.4 E-5
inh. + skin ab. 1 year	7.7 E-4	8.0 E-3	7.1 E-4	4.0 E-7	2.4 E-7	1.4 E-5
ingestion 1 day	2.1 E-3	1.0 E-2	1.8 E-3	1.1 E-6	1.4 E-7	5.4 E-5
ingestion 7 days	3.9 E-3	2.3 E-2	4.9 E-3	2.9 E-6	1.9 E-6	1.0 E-3
ingestion 30 days	5.3 E-3	3.6 E-2	1.0 E-2	4.1 E-6	3.0 E-6	3.1 E-3
ingestion 1 year	5.9 E-3	4.3 E-2	1.4 E-2	4.7 E-6	3.5 E-6	4.4 E-3

Table 31. Dose in 2000 m distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 2000 m distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	5.1 E-8	5.1 E-7	4.3 E-8	5.6 E-12	1.7 E-26	2.8 E-12
inh. + skin ab. 1 day	3.5 E-6	4.6 E-6	2.9 E-7	3.0 E-9	8.4 E-8	1.0 E-10
inh. + skin ab. 7 days	6.3 E-6	1.2 E-5	1.1 E-6	2.0 E-8	1.3 E-7	5.2 E-9
inh. + skin ab. 30 days	6.3 E-6	1.2 E-5	1.1 E-6	2.0 E-8	1.3 E-7	5.2 E-9
inh. + skin ab. 1 year	6.3 E-6	1.2 E-5	1.1 E-6	2.0 E-8	1.3 E-7	5.2 E-9
ingestion 1 day	4.6 E-5	1.4 E-4	4.8 E-6	1.5 E-8	3.4 E-9	9.2 E-10
ingestion 7 days	1.8 E-5	1.4 E-3	1.1 E-4	1.4 E-7	1.0 E-7	3.8 E-8
ingestion 30 days	3.3 E-4	3.6 E-3	3.4 E-4	2.5 E-7	1.6 E-7	7.3 E-8
ingestion 1 year	4.0 E-4	5.0 E-3	4.9 E-4	3.0 E-7	1.9 E-7	9.2 E-8

Table 32. Dose in 2000 m distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 10 km distance from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	1.4 E-6	2.4 E-5	1.7 E-5	1.0 E-5	2.2 E-10	1.4 E-5
inh. + skin ab. 1 day	3.0 E-6	2.5 E-5	1.8 E-5	1.2 E-5	4.6 E-8	1.5 E-5
inh. + skin ab. 7 days	3.0 E-6	2.5 E-5	1.9 E-5	1.3 E-5	3.0 E-7	1.6 E-5
inh. + skin ab. 30 days	3.0 E-6	2.5 E-5	2.0 E-5	1.3 E-5	3.0 E-7	1.6 E-5
inh. + skin ab. 1 year	3.0 E-6	2.5 E-5	2.0 E-5	1.3 E-5	3.0 E-7	1.6 E-5
ingestion 1 day	1.1 E-5	1.6 E-3	4.8 E-5	4.8 E-5	1.8 E-7	4.4 E-5
ingestion 7 days	2.0 E-5	3.1 E-3	1.8 E-5	8.9 E-5	2.2 E-6	2.6 E-4
ingestion 30 days	2.8 E-5	4.2 E-3	4.5 E-4	1.2 E-4	3.5 E-6	7.1 E-4
ingestion 1 year	3.1 E-5	4.8 E-3	6.2 E-4	1.3 E-4	4.1 E-6	1.0 E-3

Table 33. Dose in 10 km distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 10 km distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	1.2 E-10	9.0 E-8	5.3 E-10	4.4 E-10	8.8 E-15	9.5 E-10
inh. + skin ab. 1 day	9.5 E-8	1.1 E-6	3.9 E-8	7.0 E-8	1.3 E-9	3.6 E-9
inh. + skin ab. 7 days	1.6 E-7	2.2 E-6	1.6 E-7	1.4 E-7	1.6 E-8	2.2 E-8
inh. + skin ab. 30 days	1.6 E-7	2.3 E-6	1.6 E-7	1.5 E-7	1.6 E-8	2.3 E-8
inh. + skin ab. 1 year	1.6 E-7	2.3 E-6	1.6 E-7	1.5 E-7	1.6 E-8	2.3 E-8
ingestion 1 day	3.4 E-7	2.7 E-5	6.0 E-7	5.8 E-7	4.4 E-9	1.0 E-7
ingestion 7 days	1.2 E-6	2.5 E-4	1.3 E-5	2.3 E-6	1.2 E-7	2.3 E-6
ingestion 30 days	2.0 E-6	6.6 E-4	4.2 E-5	4.0 E-6	2.0 E-7	7.5 E-6
ingestion 1 year	2.4 E-6	9.2 E-4	6.0 E-5	5.0 E-6	2.4 E-7	1.1 E-5

Table 34. Dose in 10 km distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 100 km distance from	HTO release in the morn- ing, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morn- ing, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	9.0 E-8	8.1 E-10	4.9 E-9	5.5 E-8	1.8 E-7	2.1 E-8
inh. + skin ab. 1 day	1.3 E-7	1.4 E-8	2.9 E-8	7.0 E-8	2.0 E-7	4.3 E-8
inh. + skin ab. 7 days	1.4 E-7	2.6 E-7	5.8 E-8	8.4 E-8	2.1 E-7	6.9 E-8
inh. + skin ab. 30 days	1.4 E-7	2.6 E-7	5.8 E-8	8.4 E-8	2.1 E-7	7.0 E-8
inh. + skin ab. 1 year	1.4 E-7	2.6 E-7	5.8 E-8	8.4 E-8	2.1 E-7	7.0 E-8
ingestion 1 day	3.1 E-7	6.3 E-7	6.7 E-8	1.0 E-7	3.5 E-7	3.4 E-7
ingestion 7 days	7.2 E-7	2.1 E-6	2.8 E-7	3.2 E-7	7.4 E-7	8.5 E-7
ingestion 30 days	1.0 E-6	3.3 E-6	4.8 E-7	4.6 E-7	1.2 E-6	1.8 E-6
ingestion 1 year	1.2 E-6	3.9 E-6	5.9 E-7	5.4 E-7	1.4 E-6	2.3 E-6

Table 35. Dose in 100 km distance for the most exposed individual (2 min. release; 10 g tritium)

max. dose (Sv) in 100 km distance from	HT release in the morning, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morning, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	1.1 E-11	1.6 E-12	2.8 E-11	3.0 E-12	1.0 E-11	1.7 E-11
inh. + skin ab. 1 day	3.0 E-9	1.2 E-8	7.6 E-10	4.7 E-10	1.1 E-10	5.1 E-10
inh. + skin ab. 7 days	7.6 E-9	4.8 E-8	4.3 E-9	1.5 E-9	2.3 E-9	2.0 E-9
inh. + skin ab. 30 days	7.7 E-9	4.8 E-8	4.5 E-9	1.5 E-9	2.4 E-9	2.1 E-9
inh. + skin ab. 1 year	7.7 E-9	4.8 E-8	4.6 E-9	1.5 E-9	2.4 E-9	2.1 E-9
ingestion 1 day	1.3 E-8	5.3 E-8	1.7 E-9	1.8 E-9	5.1 E-9	1.2 E-9
ingestion 7 days	4.2 E-8	3.7 E-7	5.5 E-8	1.4 E-8	3.3 E-8	4.5 E-8
ingestion 30 days	1.0 E-7	6.1 E-7	2.6 E-7	2.8 E-8	8.9 E-8	1.4 E-7
ingestion 1 year	1.4 E-7	7.4 E-7	3.7 E-7	3.5 E-8	1.2 E-7	2.0 E-7

Table 36. Dose in 100 km distance for the most exposed individual (2 min. release; 10 g tritium)

collective dose in man*Sv from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	0.35	2.4	0.16	0.2	0.45	0.07
inh. + skin ab. 1 day	0.67	3.1	0.33	0.3	0.54	0.16
inh. + skin ab. 7 days	0.9	4.0	0.67	0.42	0.8	0.53
inh. + skin ab. 30 days	0.9	4.0	0.67	0.42	0.8	0.34
inh. + skin ab. 1 year	0.9	4.0	0.67	0.42	0.8	0.54
ingestion 1 day	2.3	7.6	1.0	1.2	1.6	0.46
ingestion 7 days	5.3	21.4	4.4	2.6	5.2	4.1
ingestion 30 days	7.3	32.3	8.4	3.6	7.8	8.7
ingestion 1 year	8.2	37.8	10.5	4.1	9.1	11.3

Table 37. Collective dose between 1 km and 50 km distance (2 min. release; 10 g tritium)

collective dose in man*Sv from	HT release in the morn-ing, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morn-ing, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	2.6 E-5	3.4 E-4	2.7 E-5	1.0 E-5	1.9 E-5	9.1 E-5
inh. + skin ab. 1 day	1.6 E-2	8.0 E-2	3.4 E-3	2.7 E-3	2.4 E-3	4.6 E-4
inh. + skin ab. 7 days	4.1 E-2	2.7 E-1	1.8 E-2	9.4 E-3	1.7 E-2	4.5 E-3
inh. + skin ab. 30 days	4.1 E-2	2.8 E-1	1.8 E-2	9.5 E-3	1.7 E-2	4.6 E-3
inh. + skin ab. 1 year	4.1 E-2	2.8 E-1	1.8 E-2	9.5 E-3	1.7 E-2	4.6 E-3
ingestion 1 day	7.6 E-2	0.41	5.8 E-3	1.4 E-2	1.4 E-2	2.0 E-3
ingestion 7 days	3.3 E-1	2.9	1.7 E-1	8.4 E-2	1.8 E-1	4.7 E-2
ingestion 30 days	5.5 E-1	5.7	4.0 E-1	1.5 E-1	3.5 E-1	1.2 E-1
ingestion 1 year	6.6 E-1	7.4	5.3 E-1	1.8 E-1	4.4 E-1	1.6 E-1

Table 38. Collective dose between 1 km and 50 km distance (2 min. release; 10 g tritium)

collective dose in man*Sv from	HTO release in the morning, 10 m + wake effects	HTO release in the night, 10 m + wake effects	HTO release during rain, 10 m + wake effects	HTO release in the morning, 150 m	HTO release in the night, 150 m	HTO release during rain, 150 m
inh. + skin ab. pl. pass.	0.08	2.8E-3	1.8E-3	0.02	0.46	7.0 E-3
inh. + skin ab. 1 day	0.2	0.25	0.03	0.07	0.69	0.05
inh. + skin ab. 7 days	0.44	0.7	0.17	0.16	0.85	0.24
inh. + skin ab. 30 days	0.44	0.7	0.17	0.16	0.85	0.24
inh. + skin ab. 1 year	0.44	0.7	0.18	0.16	0.85	0.24
ingestion 1 day	0.7	1.2	0.07	0.24	2.2	0.1
ingestion 7 days	2.6	5.8	1.0	0.9	5.9	1.3
ingestion 30 days	3.7	8.7	1.7	1.3	8.7	2.4
ingestion 1 year	4.2	10.3	2.1	1.5	10.2	2.9

Table 39. Collective dose between 50 km and 100 km distance (2 min. release; 10 g tritium)

collective dose in man*Sv from	HT release in the morn-ing, 10 m + wake effects	HT release in the night, 10 m + wake effects	HT release during rain, 10 m + wake effects	HT release in the morn-ing, 150 m	HT release in the night, 150 m	HT release during rain, 150 m
inh. + skin ab. pl. pass.	8.9 E-6	4.5 E-6	6.9 E-6	1.0 E-6	2.0 E-5	3.5 E-6
inh. + skin ab. 1 day	7.3 E-3	2.5 E-2	8.8 E-4	1.3 E-3	3.8 E-3	4.5 E-4
inh. + skin ab. 7 days	2.6 E-2	1.2 E-1	1.0 E-2	5.8 E-3	1.6 E-2	3.7 E-3
inh. + skin ab. 30 days	2.6 E-2	1.2 E-1	1.0 E-2	5.9 E-3	1.6 E-2	3.8 E-3
inh. + skin ab. 1 year	2.6 E-2	1.2 E-1	1.0 E-2	5.9 E-3	1.6 E-2	3.8 E-3
ingestion 1 day	3.0 E-2	1.7 E-2	1.6 E-3	5.0 E-3	2.0 E-2	1.0 E-4
ingestion 7 days	1.7 E-1	0.9	7.0 E-2	3.6 E-2	1.6 E-1	2.8 E-2
ingestion 30 days	3.0 E-1	1.6	1.5 E-1	6.0 E-2	3.3 E-1	6.0 E-2
ingestion 1 year	3.6 E-1	1.8	1.9 E-1	7.0 E-2	4.3 E-1	8.0 E-2

Table 40. Collective dose between 50 km and 100 km distance (2 min. release; 10 g tritium)

max. dose (Sv) in 500 m distance from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	1.5 E-2	1.7 E-2	6.9 E-3	9.0 E-3
inh. + skin ab. 1 day	1.5 E-2	1.7 E-2	6.9 E-3	9.1 E-3
inh. + skin ab. 7 days	1.5 E-2	1.7 E-2	6.9 E-3	9.1 E-3
inh. + skin ab. 30 days	1.5 E-2	1.7 E-2	7.0 E-3	9.1 E-3
inh. + skin ab. 1 year	1.5 E-2	1.7 E-2	7.0 E-3	9.1 E-3
ingestion 1 day	2.5 E-2	2.4 E-2	1.2 E-2	1.3 E-2
ingestion 7 days	4.4 E-2	4.1 E-2	2.1 E-2	2.3 E-2
ingestion 30 days	5.8 E-2	5.8 E-2	2.8 E-2	3.0 E-2
ingestion 1 year	6.5 E-2	6.6 E-2	3.1 E-2	3.4 E-2

Table 41. Dose in 500 m distance for the most exposed individual (resistance model; 10 g tritium)

max. dose (Sv) in 1000 m distance from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	1.0 E-2	1.5 E-2	3.1 E-3	4.5 E-3
inh. + skin ab. 1 day	1.0 E-2	1.5 E-2	3.1 E-3	4.5 E-3
inh. + skin ab. 7 days	1.0 E-2	1.5 E-2	3.1 E-3	4.5 E-3
inh. + skin ab. 30 days	1.0 E-2	1.5 E-2	3.1 E-3	4.5 E-3
inh. + skin ab. 1 year	1.0 E-2	1.5 E-2	3.1 E-3	4.5 E-3
ingestion 1 day	1.7 E-2	2.0 E-2	5.3 E-3	6.3 E-3
ingestion 7 days	3.1 E-2	3.5 E-2	9.4 E-3	1.1 E-2
ingestion 30 days	4.1 E-2	4.8 E-2	1.2 E-2	1.5 E-2
ingestion 1 year	4.5 E-2	5.5 E-2	1.4 E-2	1.7 E-2

Table 42. Dose in 1000 m distance for the most exposed individual (resistance model; 10 g tritium)

max. dose (Sv) in 2000 m distance from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	1.0 E-3	1.1 E-2	5.3 E-4	1.8 E-3
inh. + skin ab. 1 day	1.0 E-3	1.1 E-2	5.4 E-4	1.8 E-3
inh. + skin ab. 7 days	1.0 E-3	1.1 E-2	5.5 E-4	1.8 E-3
inh. + skin ab. 30 days	1.0 E-3	1.1 E-2	5.5 E-4	1.8 E-3
inh. + skin ab. 1 year	1.0 E-3	1.1 E-2	5.5 E-4	1.8 E-3
ingestion 1 day	2.6 E-3	1.4 E-2	1.5 E-3	2.4 E-3
ingestion 7 days	4.7 E-3	2.5 E-2	2.6 E-3	4.2 E-3
ingestion 30 days	6.2 E-3	3.4 E-2	3.4 E-3	5.9 E-3
ingestion 1 year	7.0 E-3	3.9 E-2	3.8 E-3	6.7 E-3

Table 43. Dose in 2000 m distance for the most exposed individual (resistance model; 10 g tritium)

max. dose (Sv) in 10 km distance from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	1.9 E-6	1.0 E-3	2.6 E-6	1.0 E-4
inh. + skin ab. 1 day	2.8 E-6	1.0 E-3	3.5 E-6	1.0 E-4
inh. + skin ab. 7 days	3.2 E-6	1.0 E-3	4.1 E-6	1.0 E-4
inh. + skin ab. 30 days	3.2 E-6	1.0 E-3	4.1 E-6	1.0 E-4
inh. + skin ab. 1 year	3.2 E-6	1.0 E-3	4.1 E-6	1.0 E-4
ingestion 1 day	1.1 E-5	4.1 E-3	1.5 E-5	4.1 E-4
ingestion 7 days	2.1 E-5	7.8 E-3	2.8 E-5	7.6 E-4
ingestion 30 days	2.8 E-5	1.0 E-2	3.8 E-5	1.0 E-3
ingestion 1 year	3.1 E-5	1.2 E-2	4.2 E-5	1.2 E-3

Table 44. Dose in 10 km distance for the most exposed individual (resistance model; 10 g tritium)

max. dose (Sv) in 100 km distance from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	1.3 E-7	5.2 E-9	1.5 E-7	2.1 E-8
inh. + skin ab. 1 day	1.5 E-7	5.4 E-7	2.0 E-7	1.1 E-7
inh. + skin ab. 7 days	2.0 E-7	5.6 E-7	2.3 E-7	1.1 E-7
inh. + skin ab. 30 days	2.0 E-7	5.6 E-7	2.3 E-7	1.1 E-7
inh. + skin ab. 1 year	2.0 E-7	5.6 E-7	2.3 E-7	1.1 E-7
ingestion 1 day	2.8 E-7	1.7 E-6	2.2 E-7	3.1 E-7
ingestion 7 days	1.0 E-6	3.2 E-6	9.2 E-7	8.8 E-7
ingestion 30 days	1.4 E-6	4.3 E-6	1.3 E-6	1.4 E-6
ingestion 1 year	1.6 E-6	4.9 E-6	1.3 E-6	1.6 E-6

Table 45. Dose in 100 km distance for the most exposed individual (resistance model; 10 g tritium)

collective dose in man*Sv from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	0.46	5.1	0.4	0.94
inh. + skin ab. 1 day	0.73	6.2	0.6	1.1
inh. + skin ab. 7 days	0.9	7.1	0.74	1.4
inh. + skin ab. 30 days	0.9	7.1	0.74	1.4
inh. + skin ab. 1 year	0.9	7.1	0.74	1.4
ingestion 1 day	2.2	13.4	2.0	2.9
ingestion 7 days	4.8	32.1	4.2	7.4
ingestion 30 days	6.4	45.5	5.7	10.5
ingestion 1 year	7.2	52.1	6.4	12.0

Table 46. Collective dose between 1 km and 50 km distance (resistance model; 10 g tritium)

collective dose in man*Sv from	HTO release in the morning, 10 m + wake effects (2-min.)	HTO release in the night, 10 m + wake effects (2-min.)	HTO release in the morning, 10 m + wake effects (1-hour)	HTO release in the night, 10 m + wake effects (1-hour)
inh. + skin ab. pl. pass.	0.11	0.02	0.12	0.05
inh. + skin ab. 1 day	0.21	0.5	0.19	0.13
inh. + skin ab. 7 days	0.42	1.0	0.4	0.3
inh. + skin ab. 30 days	0.42	1.0	0.4	0.3
inh. + skin ab. 1 year	0.42	1.0	0.4	0.3
ingestion 1 day	0.66	2.0	0.55	0.43
ingestion 7 days	2.3	7.4	2.1	2.1
ingestion 30 days	3.2	11.0	3.0	3.2
ingestion 1 year	3.7	12.8	3.4	3.7

Table 47. Collective dose between 50 km and 100 km distance (resistance model; 10 g tritium)

7. APPENDIX B-2 : Deterministic Results, Activation Products

7.1 Release in the night

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	0.97	44.05	54.98	0.108E-07
MN- 53	0.00	100.00	0.00	0.439E-13
MN- 54	1.09	42.83	56.08	0.273E-06
MN- 56	33.78	26.34	39.88	0.170E-07
FE- 55	0.00	0.00	100.00	0.316E-07
FE- 59	0.98	34.23	64.78	0.441E-06
CO- 56	0.93	31.36	67.71	0.142E-05
CO- 57	0.15	9.39	90.46	0.252E-06
CO- 58M	0.00	0.00	100.00	0.197E-08
CO- 58	0.86	33.64	65.50	0.399E-06
CO- 60M	87.60	12.40	0.00	0.573E-11
CO- 60	0.16	5.74	94.10	0.576E-05
CO- 61	57.38	42.62	0.00	0.388E-09
NI- 59	0.00	0.00	100.00	0.229E-07
NI- 63	0.00	0.00	100.00	0.566E-07
MO- 93	0.00	0.01	99.99	0.735E-06
MO- 99	0.67	26.10	73.23	0.770E-07
TC- 99M	17.49	56.78	25.74	0.222E-08
W -181	1.04	58.23	40.73	0.791E-08
SR- 90	0.00	0.00	100.00	0.571E-05
I -131	0.16	5.40	94.45	0.831E-06
CS-137	0.22	9.01	90.77	0.900E-06
PU-239	0.00	0.00	100.00	0.710E-02
KR- 85	100.00	0.00	0.00	0.912E-11
KR- 88	100.00	0.00	0.00	0.690E-08
RB- 88	53.40	4.57	42.03	0.202E-08
XE-133	100.00	0.00	0.00	0.100E-09
XE-135	100.00	0.00	0.00	0.812E-09

Table 48. Contributions (in %) of exposure pathways to individual early dose (0.5 km distance; night release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	1.42	43.85	54.73	0.547E-08
MN- 53	0.00	100.00	0.00	0.222E-13
MN- 54	1.59	42.61	55.80	0.139E-06
MN- 56	42.85	22.73	34.41	0.915E-08
FE- 55	0.00	0.00	100.00	0.160E-07
FE- 59	1.44	34.08	64.48	0.224E-06
CO- 56	1.36	31.23	67.42	0.721E-06
CO- 57	0.22	9.39	90.40	0.127E-06
CO- 58M	0.00	0.00	100.00	0.977E-09
CO- 58	1.26	33.50	65.24	0.203E-06
CO- 60M	91.22	8.78	0.00	0.136E-11
CO- 60	0.23	5.74	94.03	0.291E-05
CO- 61	66.44	33.56	0.00	0.222E-09
NI- 59	0.00	0.00	100.00	0.116E-07
NI- 63	0.00	0.00	100.00	0.286E-07
MO- 93	0.00	0.01	99.99	0.371E-06
MO- 99	0.98	26.02	73.00	0.389E-07
TC- 99M	23.75	52.47	23.78	0.121E-08
W -181	1.53	57.95	40.53	0.402E-08
SR- 90	0.00	0.00	100.00	0.289E-05
I -131	0.23	5.39	94.38	0.420E-06
CS-137	0.32	9.00	90.68	0.455E-06
PU-239	0.00	0.00	100.00	0.359E-02
KR- 85	100.00	0.00	0.00	0.689E-11
KR- 88	100.00	0.00	0.00	0.488E-08
RB- 88	62.75	3.65	33.60	0.188E-08
XE-133	100.00	0.00	0.00	0.756E-10
XE-135	100.00	0.00	0.00	0.601E-09

Table 49. Contributions (in %) of exposure pathways to individual early dose (1.0 km distance; night release): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	2.04	43.57	54.39	0.229E-08
MN- 53	0.00	100.00	0.00	0.924E-14
MN- 54	2.29	42.31	55.40	0.582E-07
MN- 56	52.12	19.05	28.84	0.397E-08
FE- 55	0.00	0.00	100.00	0.666E-08
FE- 59	2.08	33.86	64.07	0.937E-07
CO- 56	1.96	31.04	67.01	0.302E-06
CO- 57	0.31	9.38	90.31	0.531E-07
CO- 58M	0.00	0.00	100.00	0.393E-09
CO- 58	1.82	33.31	64.87	0.848E-07
CO- 60M	93.78	6.22	0.00	0.138E-12
CO- 60	0.34	5.73	93.93	0.121E-05
CO- 61	74.18	25.82	0.00	0.995E-10
NI- 59	0.00	0.00	100.00	0.482E-08
NI- 63	0.00	0.00	100.00	0.119E-07
MO- 93	0.00	0.01	99.99	0.155E-06
MO- 99	1.41	25.91	72.68	0.162E-07
TC- 99M	31.14	47.38	21.48	0.553E-09
W -181	2.20	57.55	40.25	0.168E-08
SR- 90	0.00	0.00	100.00	0.120E-05
I -131	0.33	5.39	94.28	0.175E-06
CS-137	0.46	8.99	90.55	0.190E-06
PU-239	0.00	0.00	100.00	0.149E-02
KR- 85	100.00	0.00	0.00	0.426E-11
KR- 88	100.00	0.00	0.00	0.271E-08
RB- 88	70.97	2.85	26.18	0.117E-08
XE-133	100.00	0.00	0.00	0.466E-10
XE-135	100.00	0.00	0.00	0.359E-09

Table 50. Contributions (in %) of exposure pathways to individual early dose (2.0 km distance; night release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	3.67	42.85	53.48	0.145E-09
MN- 53	0.00	100.00	0.00	0.578E-15
MN- 54	4.11	41.52	54.37	0.371E-08
MN- 56	66.55	13.31	20.14	0.104E-09
FE- 55	0.00	0.00	100.00	0.416E-09
FE- 59	3.73	33.28	62.98	0.595E-08
CO- 56	3.52	30.54	65.94	0.191E-07
CO- 57	0.57	9.35	90.07	0.332E-08
CO- 58M	0.00	0.00	100.00	0.180E-10
CO- 58	3.27	32.82	63.91	0.538E-08
CO- 60M	96.50	3.50	0.00	0.206E-20
CO- 60	0.61	5.72	93.67	0.761E-07
CO- 61	84.01	15.99	0.00	0.187E-11
NI- 59	0.00	0.00	100.00	0.301E-09
NI- 63	0.00	0.00	100.00	0.745E-09
MO- 93	0.00	0.01	99.99	0.967E-08
MO- 99	2.55	25.61	71.84	0.982E-09
TC- 99M	45.25	37.67	17.08	0.411E-10
W -181	3.95	56.52	39.53	0.107E-09
SR- 90	0.00	0.00	100.00	0.751E-07
I -131	0.61	5.37	94.02	0.108E-07
CS-137	0.83	8.96	90.21	0.119E-07
PU-239	0.00	0.00	100.00	0.934E-04
KR- 85	100.00	0.00	0.00	0.533E-12
KR- 88	100.00	0.00	0.00	0.127E-09
RB- 88	81.72	1.79	16.49	0.548E-10
XE-133	100.00	0.00	0.00	0.571E-11
XE-135	100.00	0.00	0.00	0.332E-10

Table 51. Contributions (in %) of exposure pathways to individual early dose (10.0 km distance; night release): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.24	66.45	13.49	19.53	0.29	0.439E-07
MN- 53	0.00	100.00	0.00	0.00	0.00	0.946E-11
MN- 54	0.04	82.84	1.91	15.12	0.10	0.803E-05
MN- 56	33.78	26.34	39.88	0.00	0.00	0.170E-07
FE- 55	0.00	0.00	3.75	96.04	0.21	0.843E-06
FE- 59	0.18	58.32	11.63	29.54	0.33	0.245E-05
CO- 56	0.16	87.69	11.72	0.00	0.43	0.820E-05
CO- 57	0.01	45.19	8.66	45.70	0.43	0.263E-05
CO- 58M	0.00	0.00	99.95	0.00	0.05	0.197E-08
CO- 58	0.11	60.19	8.02	31.40	0.28	0.326E-05
CO- 60M	4.83	95.17	0.00	0.00	0.00	0.104E-09
CO- 60	0.01	59.93	4.13	35.69	0.24	0.131E-03
CO- 61	57.38	42.62	0.00	0.00	0.00	0.388E-09
NI- 59	0.00	0.00	6.88	92.71	0.41	0.333E-06
NI- 63	0.00	0.00	6.37	93.25	0.37	0.888E-06
MO- 93	0.00	0.52	28.57	69.23	1.68	0.257E-05
MO- 99	0.48	22.72	52.32	24.31	0.17	0.108E-06
TC- 99M	17.48	56.77	25.73	0.00	0.01	0.222E-08
W -181	0.03	42.47	1.25	56.19	0.05	0.258E-06
SR- 90	0.00	0.00	16.13	82.93	0.94	0.354E-04
I -131	0.07	5.22	41.53	52.83	0.35	0.189E-05
CS-137	0.00	28.82	0.54	70.61	0.03	0.152E-03
PU-239	0.00	0.00	93.93	0.54	5.53	0.756E-02
KR- 85	100.00	0.00	0.00	0.00	0.00	0.912E-11
KR- 88	100.00	0.00	0.00	0.00	0.00	0.690E-08
RB- 88	53.40	4.57	42.03	0.00	0.00	0.202E-08
XE-133	100.00	0.00	0.00	0.00	0.00	0.100E-09
XE-135	100.00	0.00	0.00	0.00	0.00	0.812E-09

Table 52. **Contributions (in %) of exposure pathways to individual chronic dose (0.5 km distance; night release):** 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.35	66.38	13.48	19.50	0.29	0.222E-07
MN- 53	0.00	100.00	0.00	0.00	0.00	0.479E-11
MN- 54	0.05	82.82	1.91	15.12	0.10	0.406E-05
MN- 56	42.85	22.73	34.41	0.00	0.00	0.915E-08
FE- 55	0.00	0.00	3.75	96.04	0.21	0.426E-06
FE- 59	0.26	58.28	11.62	29.51	0.33	0.124E-05
CO- 56	0.24	87.62	11.71	0.00	0.43	0.415E-05
CO- 57	0.02	45.19	8.66	45.70	0.43	0.133E-05
CO- 58M	0.00	0.00	99.95	0.00	0.05	0.977E-09
CO- 58	0.15	60.16	8.02	31.38	0.28	0.165E-05
CO- 60M	6.94	93.06	0.00	0.00	0.00	0.179E-10
CO- 60	0.01	59.93	4.13	35.69	0.24	0.663E-04
CO- 61	66.44	33.56	0.00	0.00	0.00	0.222E-09
NI- 59	0.00	0.00	6.88	92.71	0.41	0.168E-06
NI- 63	0.00	0.00	6.37	93.25	0.37	0.449E-06
MO- 93	0.00	0.52	28.57	69.23	1.68	0.130E-05
MO- 99	0.70	22.67	52.20	24.26	0.17	0.544E-07
TC- 99M	23.75	52.46	23.78	0.00	0.01	0.121E-08
W -181	0.05	42.46	1.25	56.18	0.05	0.130E-06
SR- 90	0.00	0.00	16.13	82.93	0.94	0.179E-04
I -131	0.10	5.22	41.51	52.81	0.35	0.956E-06
CS-137	0.00	28.82	0.54	70.61	0.03	0.771E-04
PU-239	0.00	0.00	93.93	0.54	5.53	0.382E-02
KR- 85	100.00	0.00	0.00	0.00	0.00	0.689E-11
KR- 88	100.00	0.00	0.00	0.00	0.00	0.488E-08
RB- 88	62.75	3.65	33.60	0.00	0.00	0.188E-08
XE-133	100.00	0.00	0.00	0.00	0.00	0.756E-10
XE-135	100.00	0.00	0.00	0.00	0.00	0.601E-09

Table 53. Contributions (in %) of exposure pathways to individual chronic dose (1.0 km distance; night release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.51	66.27	13.46	19.47	0.29	0.926E-08
MN- 53	0.00	100.00	0.00	0.00	0.00	0.199E-11
MN- 54	0.08	82.80	1.91	15.12	0.10	0.169E-05
MN- 56	52.11	19.05	28.83	0.00	0.00	0.397E-08
FE- 55	0.00	0.00	3.75	96.04	0.21	0.177E-06
FE- 59	0.38	58.21	11.61	29.48	0.33	0.517E-06
CO- 56	0.34	87.53	11.70	0.00	0.43	0.173E-05
CO- 57	0.03	45.19	8.66	45.69	0.43	0.553E-06
CO- 58M	0.00	0.00	99.95	0.00	0.05	0.393E-09
CO- 58	0.22	60.12	8.01	31.36	0.28	0.687E-06
CO- 60M	9.77	90.23	0.00	0.00	0.00	0.133E-11
CO- 60	0.01	59.93	4.13	35.69	0.24	0.276E-04
CO- 61	74.18	25.82	0.00	0.00	0.00	0.995E-10
NI- 59	0.00	0.00	6.88	92.71	0.41	0.701E-07
NI- 63	0.00	0.00	6.37	93.25	0.37	0.187E-06
MO- 93	0.00	0.52	28.57	69.23	1.68	0.541E-06
MO- 99	1.01	22.60	52.04	24.18	0.17	0.226E-07
TC- 99M	31.14	47.38	21.48	0.00	0.01	0.553E-09
W -181	0.07	42.46	1.25	56.17	0.05	0.542E-07
SR- 90	0.00	0.00	16.13	82.93	0.94	0.745E-05
I -131	0.15	5.22	41.50	52.79	0.35	0.397E-06
CS-137	0.00	28.82	0.54	70.61	0.03	0.321E-04
PU-239	0.00	0.00	93.93	0.54	5.53	0.159E-02
KR- 85	100.00	0.00	0.00	0.00	0.00	0.426E-11
KR- 88	100.00	0.00	0.00	0.00	0.00	0.271E-08
RB- 88	70.97	2.85	26.18	0.00	0.00	0.117E-08
XE-133	100.00	0.00	0.00	0.00	0.00	0.466E-10
XE-135	100.00	0.00	0.00	0.00	0.00	0.359E-09

Table 54. Contributions (in %) of exposure pathways to individual chronic dose (2.0 km distance; night release): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.92	66.00	13.40	19.39	0.29	0.579E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.125E-12
MN- 54	0.14	82.75	1.91	15.11	0.10	0.106E-06
MN- 56	66.55	13.31	20.14	0.00	0.00	0.104E-09
FE- 55	0.00	0.00	3.75	96.04	0.21	0.111E-07
FE- 59	0.69	58.03	11.57	29.39	0.33	0.324E-07
CO- 56	0.62	87.28	11.67	0.00	0.43	0.108E-06
CO- 57	0.05	45.17	8.66	45.68	0.43	0.346E-07
CO- 58M	0.00	0.00	99.95	0.00	0.05	0.180E-10
CO- 58	0.41	60.01	8.00	31.30	0.28	0.430E-07
CO- 60M	16.52	83.48	0.00	0.00	0.00	0.120E-19
CO- 60	0.03	59.92	4.13	35.69	0.24	0.173E-05
CO- 61	84.01	15.99	0.00	0.00	0.00	0.187E-11
NI- 59	0.00	0.00	6.88	92.71	0.41	0.438E-08
NI- 63	0.00	0.00	6.37	93.25	0.37	0.117E-07
MO- 93	0.00	0.52	28.57	69.23	1.68	0.338E-07
MO- 99	1.83	22.41	51.61	23.98	0.17	0.137E-08
TC- 99M	45.25	37.67	17.07	0.00	0.01	0.411E-10
W -181	0.12	42.43	1.25	56.14	0.05	0.339E-08
SR- 90	0.00	0.00	16.13	82.93	0.94	0.466E-06
I -131	0.27	5.21	41.45	52.72	0.35	0.245E-07
CS-137	0.00	28.82	0.54	70.61	0.03	0.201E-05
PU-239	0.00	0.00	93.93	0.54	5.53	0.995E-04
KR- 85	100.00	0.00	0.00	0.00	0.00	0.533E-12
KR- 88	100.00	0.00	0.00	0.00	0.00	0.127E-09
RB- 88	81.71	1.79	16.49	0.00	0.00	0.548E-10
XE-133	100.00	0.00	0.00	0.00	0.00	0.571E-11
XE-135	100.00	0.00	0.00	0.00	0.00	0.332E-10

Table 55. Contributions (in %) of exposure pathways to individual chronic dose (10.0 km distance; night release): 1.E + 9 Bq released from each nuclide

nuclide	collective dose (manSv/E9Bq) early	chronic
CR- 51	0.2844E-05	0.1686E-04
MN- 53	0.1884E-10	0.4059E-08
MN- 54	0.7204E-04	0.3396E-02
MN- 56	0.1767E-05	0.1767E-05
FE- 55	0.4118E-05	0.3521E-03
FE- 59	0.1041E-03	0.9606E-03
CO- 56	0.3236E-03	0.3217E-02
CO- 57	0.4000E-04	0.1058E-02
CO- 58M	0.1801E-06	0.1802E-06
CO- 58	0.9381E-04	0.1318E-02
CO- 60M	0.4281E-10	0.3621E-09
CO- 60	0.8530E-03	0.5462E-01
CO- 61	0.4233E-07	0.4233E-07
NI- 59	0.2979E-05	0.1360E-03
NI- 63	0.7366E-05	0.3641E-03
MO- 93	0.9563E-04	0.8834E-03
MO- 99	0.1477E-04	0.2626E-04
TC- 99M	0.7668E-06	0.7668E-06
W -181	0.2444E-05	0.1092E-03
SR- 90	0.7431E-03	0.1348E-01
I -131	0.1194E-03	0.5513E-03
CS-137	0.1424E-03	0.6513E-01
PU-239	0.9240E+00	0.1121E+01
KR- 85	0.6975E-08	0.6975E-08
KR- 88	0.1874E-05	0.1874E-05
RB- 88	0.7499E-06	0.7499E-06
XE-133	0.7400E-07	0.7400E-07
XE-135	0.4108E-06	0.4108E-06

Table 56. **Contributions (in %) of nuclides to early and chronic collective doses within 100 km distance, night release:** 1.E + 9 Bq released from each nuclide

7.2 Release during heavy rain

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	0.12	95.30	4.58	0.149E-07
MN- 53	0.00	100.00	0.00	0.131E-12
MN- 54	0.14	95.07	4.79	0.367E-06
MN- 56	6.52	88.33	5.15	0.161E-07
FE- 55	0.00	0.00	100.00	0.364E-08
FE- 59	0.15	93.07	6.78	0.484E-06
CO- 56	0.16	92.18	7.66	0.144E-05
CO- 57	0.07	72.91	27.03	0.968E-07
CO- 58M	0.00	0.03	99.97	0.231E-09
CO- 58	0.14	92.90	6.96	0.432E-06
CO- 60M	28.91	71.09	0.00	0.681E-11
CO- 60	0.10	61.27	38.64	0.161E-05
CO- 61	7.19	92.81	0.00	0.581E-09
NI- 59	0.00	0.01	99.99	0.263E-08
NI- 63	0.00	0.00	100.00	0.650E-08
MO- 93	0.00	0.21	99.79	0.846E-07
MO- 99	0.13	90.13	9.74	0.667E-07
TC- 99M	1.71	96.60	1.69	0.390E-08
W -181	0.10	97.28	2.62	0.141E-07
SR- 90	0.00	0.00	100.00	0.656E-06
I -131	0.10	59.55	40.35	0.224E-06
CS-137	0.10	71.98	27.92	0.336E-06
PU-239	0.00	0.00	100.00	0.816E-03
KR- 85	100.00	0.00	0.00	0.169E-11
KR- 88	100.00	0.00	0.00	0.135E-08
RB- 88	33.19	49.34	17.47	0.188E-09
XE-133	100.00	0.00	0.00	0.186E-10
XE-135	100.00	0.00	0.00	0.153E-09

Table 57. Contributions (in %) of exposure pathways to individual early dose (0.5 km distance; rain release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	0.13	96.58	3.29	0.798E-08
MN- 53	0.00	100.00	0.00	0.713E-13
MN- 54	0.14	96.41	3.45	0.197E-06
MN- 56	6.79	89.51	3.70	0.847E-08
FE- 55	0.00	0.01	99.99	0.140E-08
FE- 59	0.16	94.93	4.91	0.258E-06
CO- 56	0.16	94.28	5.56	0.766E-06
CO- 57	0.07	79.12	20.81	0.485E-07
CO- 58M	0.00	0.05	99.95	0.884E-10
CO- 58	0.14	94.81	5.04	0.230E-06
CO- 60M	29.49	70.51	0.00	0.283E-11
CO- 60	0.11	69.01	30.87	0.778E-06
CO- 61	7.38	92.62	0.00	0.307E-09
NI- 59	0.00	0.01	99.99	0.101E-08
NI- 63	0.00	0.00	100.00	0.251E-08
MO- 93	0.00	0.30	99.70	0.326E-07
MO- 99	0.14	92.75	7.11	0.352E-07
TC- 99M	1.77	97.03	1.20	0.211E-08
W -181	0.10	98.02	1.87	0.763E-08
SR- 90	0.00	0.00	100.00	0.253E-06
I -131	0.12	67.43	32.45	0.107E-06
CS-137	0.11	78.34	21.55	0.168E-06
PU-239	0.00	0.00	100.00	0.315E-03
KR- 85	100.00	0.00	0.00	0.104E-11
KR- 88	100.00	0.00	0.00	0.815E-09
RB- 88	35.61	51.47	12.93	0.189E-09
XE-133	100.00	0.00	0.00	0.114E-10
XE-135	100.00	0.00	0.00	0.937E-10

Table 58. Contributions (in %) of exposure pathways to individual early dose (1.0 km distance; rain release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	0.11	97.70	2.19	0.380E-08
MN- 53	0.00	100.00	0.00	0.344E-13
MN- 54	0.13	97.58	2.29	0.937E-07
MN- 56	6.24	91.28	2.48	0.384E-08
FE- 55	0.00	0.01	99.99	0.444E-09
FE- 59	0.15	96.57	3.28	0.122E-06
CO- 56	0.15	96.13	3.72	0.362E-06
CO- 57	0.07	85.21	14.72	0.217E-07
CO- 58M	0.00	0.07	99.93	0.277E-10
CO- 58	0.13	96.50	3.37	0.109E-06
CO- 60M	27.37	72.63	0.00	0.765E-12
CO- 60	0.11	77.20	22.69	0.335E-06
CO- 61	6.70	93.30	0.00	0.139E-09
NI- 59	0.00	0.02	99.98	0.321E-09
NI- 63	0.00	0.00	100.00	0.794E-09
MO- 93	0.00	0.45	99.54	0.104E-07
MO- 99	0.13	95.08	4.79	0.165E-07
TC- 99M	1.60	97.60	0.79	0.101E-08
W -181	0.09	98.67	1.24	0.365E-08
SR- 90	0.00	0.00	100.00	0.801E-07
I -131	0.12	75.85	24.03	0.460E-07
CS-137	0.11	84.60	15.29	0.749E-07
PU-239	0.00	0.00	100.00	0.996E-04
KR- 85	100.00	0.00	0.00	0.544E-12
KR- 88	100.00	0.00	0.00	0.411E-09
RB- 88	34.85	55.92	9.23	0.158E-09
XE-133	100.00	0.00	0.00	0.597E-11
XE-135	100.00	0.00	0.00	0.484E-10

Table 59. Contributions (in %) of exposure pathways to individual early dose (2.0 km distance; rain release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	specific dose (Sv/E9Bq)
CR- 51	0.06	99.20	0.74	0.239E-09
MN- 53	0.00	100.00	0.00	0.220E-14
MN- 54	0.07	99.15	0.78	0.590E-08
MN- 56	3.33	95.80	0.87	0.166E-09
FE- 55	0.00	0.03	99.97	0.950E-11
FE- 59	0.08	98.80	1.12	0.763E-08
CO- 56	0.08	98.64	1.28	0.226E-07
CO- 57	0.04	94.50	5.46	0.125E-08
CO- 58M	0.00	0.21	99.79	0.545E-12
CO- 58	0.07	98.78	1.15	0.680E-08
CO- 60M	16.06	83.94	0.00	0.522E-15
CO- 60	0.07	90.99	8.94	0.182E-07
CO- 61	3.52	96.48	0.00	0.537E-11
NI- 59	0.00	0.06	99.94	0.687E-11
NI- 63	0.00	0.00	100.00	0.170E-10
MO- 93	0.00	1.34	98.65	0.223E-09
MO- 99	0.07	98.28	1.65	0.101E-08
TC- 99M	0.82	98.91	0.27	0.626E-10
W -181	0.05	99.53	0.42	0.231E-09
SR- 90	0.00	0.00	100.00	0.171E-08
I -131	0.07	89.96	9.97	0.247E-08
CS-137	0.06	94.24	5.70	0.430E-08
PU-239	0.00	0.00	100.00	0.213E-05
KR- 85	100.00	0.00	0.00	0.763E-13
KR- 88	100.00	0.00	0.00	0.441E-10
RB- 88	23.07	72.91	4.02	0.414E-10
XE-133	100.00	0.00	0.00	0.833E-12
XE-135	100.00	0.00	0.00	0.625E-11

Table 60. Contributions (in %) of exposure pathways to individual early dose (10.0 km distance; rain release): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.02	76.55	0.60	22.49	0.34	0.114E-06
MN- 53	0.00	100.00	0.00	0.00	0.00	0.282E-10
MN- 54	0.00	84.41	0.07	15.41	0.10	0.235E-04
MN- 56	6.52	88.32	5.15	0.00	0.02	0.161E-07
FE- 55	0.00	0.00	0.15	99.63	0.22	0.243E-05
FE- 59	0.01	65.79	0.51	33.32	0.37	0.650E-05
CO- 56	0.01	99.00	0.51	0.00	0.48	0.217E-04
CO- 57	0.00	49.31	0.36	49.86	0.47	0.719E-05
CO- 58M	0.00	0.03	98.79	0.00	1.18	0.233E-09
CO- 58	0.01	65.30	0.34	34.06	0.31	0.897E-05
CO- 60M	0.29	99.71	0.00	0.00	0.00	0.676E-09
CO- 60	0.00	62.41	0.17	37.17	0.25	0.376E-03
CO- 61	7.19	92.81	0.00	0.00	0.00	0.581E-09
NI- 59	0.00	0.01	0.28	99.28	0.43	0.928E-06
NI- 63	0.00	0.00	0.26	99.34	0.40	0.249E-05
MO- 93	0.00	0.72	1.52	95.45	2.32	0.557E-05
MO- 99	0.06	46.14	4.09	49.37	0.34	0.159E-06
TC- 99M	1.71	96.59	1.69	0.00	0.01	0.390E-08
W -181	0.00	43.00	0.05	56.89	0.05	0.760E-06
SR- 90	0.00	0.00	0.73	98.15	1.12	0.893E-04
I -131	0.01	8.70	2.68	88.02	0.59	0.337E-05
CS-137	0.00	28.97	0.02	70.98	0.03	0.453E-03
PU-239	0.00	0.00	37.33	5.53	57.14	0.219E-02
KR- 85	100.00	0.00	0.00	0.00	0.00	0.169E-11
KR- 88	100.00	0.00	0.00	0.00	0.00	0.135E-08
RB- 88	33.19	49.34	17.47	0.00	0.01	0.188E-09
XE-133	100.00	0.00	0.00	0.00	0.00	0.186E-10
XE-135	100.00	0.00	0.00	0.00	0.00	0.153E-09

Table 61. **Contributions (in %) of exposure pathways to individual chronic dose (0.5 km distance; rain release):** 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.02	76.69	0.43	22.53	0.34	0.618E-07
MN- 53	0.00	100.00	0.00	0.00	0.00	0.154E-10
MN- 54	0.00	84.43	0.05	15.41	0.10	0.128E-04
MN- 56	6.79	89.49	3.70	0.00	0.02	0.848E-08
FE- 55	0.00	0.00	0.11	99.68	0.22	0.132E-05
FE- 59	0.01	65.89	0.36	33.37	0.37	0.353E-05
CO- 56	0.01	99.14	0.36	0.00	0.49	0.118E-04
CO- 57	0.00	49.36	0.26	49.91	0.47	0.391E-05
CO- 58M	0.00	0.05	98.30	0.00	1.66	0.899E-10
CO- 58	0.01	65.36	0.24	34.09	0.31	0.487E-05
CO- 60M	0.30	99.70	0.00	0.00	0.00	0.279E-09
CO- 60	0.00	62.44	0.12	37.19	0.25	0.204E-03
CO- 61	7.38	92.62	0.00	0.00	0.00	0.307E-09
NI- 59	0.00	0.01	0.20	99.36	0.43	0.504E-06
NI- 63	0.00	0.00	0.19	99.42	0.40	0.135E-05
MO- 93	0.00	0.72	1.08	95.87	2.33	0.301E-05
MO- 99	0.06	46.69	2.94	49.96	0.35	0.852E-07
TC- 99M	1.77	97.02	1.20	0.00	0.01	0.211E-08
W -181	0.00	43.01	0.03	56.90	0.05	0.413E-06
SR- 90	0.00	0.00	0.52	98.36	1.12	0.484E-04
I -131	0.01	8.77	1.92	88.71	0.59	0.182E-05
CS-137	0.00	28.97	0.01	70.98	0.03	0.246E-03
PU-239	0.00	0.00	29.70	6.20	64.09	0.106E-02
KR- 85	100.00	0.00	0.00	0.00	0.00	0.104E-11
KR- 88	100.00	0.00	0.00	0.00	0.00	0.815E-09
RB- 88	35.60	51.46	12.93	0.00	0.01	0.189E-09
XE-133	100.00	0.00	0.00	0.00	0.00	0.114E-10
XE-135	100.00	0.00	0.00	0.00	0.00	0.937E-10

Table 62. Contributions (in %) of exposure pathways to individual chronic dose (1.0 km distance; rain release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.01	76.80	0.28	22.57	0.34	0.297E-07
MN- 53	0.00	100.00	0.00	0.00	0.00	0.740E-11
MN- 54	0.00	84.45	0.03	15.42	0.10	0.616E-05
MN- 56	6.24	91.26	2.48	0.00	0.02	0.384E-08
FE- 55	0.00	0.00	0.07	99.71	0.22	0.635E-06
FE- 59	0.01	65.97	0.24	33.41	0.37	0.170E-05
CO- 56	0.01	99.27	0.24	0.00	0.49	0.566E-05
CO- 57	0.00	49.40	0.17	49.96	0.47	0.188E-05
CO- 58M	0.00	0.07	97.43	0.00	2.50	0.284E-10
CO- 58	0.01	65.41	0.16	34.12	0.31	0.235E-05
CO- 60M	0.27	99.73	0.00	0.00	0.00	0.776E-10
CO- 60	0.00	62.47	0.08	37.21	0.25	0.984E-04
CO- 61	6.70	93.30	0.00	0.00	0.00	0.139E-09
NI- 59	0.00	0.01	0.13	99.43	0.43	0.243E-06
NI- 63	0.00	0.00	0.12	99.48	0.40	0.651E-06
MO- 93	0.00	0.72	0.71	96.23	2.34	0.145E-05
MO- 99	0.05	47.17	1.95	50.48	0.35	0.406E-07
TC- 99M	1.60	97.59	0.79	0.00	0.01	0.101E-08
W -181	0.00	43.01	0.02	56.91	0.05	0.199E-06
SR- 90	0.00	0.00	0.34	98.54	1.12	0.233E-04
I -131	0.01	8.83	1.27	89.30	0.60	0.871E-06
CS-137	0.00	28.98	0.01	70.98	0.03	0.119E-03
PU-239	0.00	0.00	21.73	6.90	71.37	0.458E-03
KR- 85	100.00	0.00	0.00	0.00	0.00	0.544E-12
KR- 88	100.00	0.00	0.00	0.00	0.00	0.411E-09
RB- 88	34.85	55.92	9.23	0.00	0.01	0.158E-09
XE-133	100.00	0.00	0.00	0.00	0.00	0.597E-11
XE-135	100.00	0.00	0.00	0.00	0.00	0.484E-10

Table 63. Contributions (in %) of exposure pathways to individual chronic dose (2.0 km distance; rain release): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	specific dose (Sv/E9Bq)
CR- 51	0.01	76.95	0.09	22.61	0.34	0.189E-08
MN- 53	0.00	100.00	0.00	0.00	0.00	0.473E-12
MN- 54	0.00	84.47	0.01	15.42	0.10	0.394E-06
MN- 56	3.33	95.79	0.87	0.00	0.02	0.166E-09
FE- 55	0.00	0.00	0.02	99.76	0.22	0.406E-07
FE- 59	0.01	66.08	0.08	33.46	0.37	0.108E-06
CO- 56	0.00	99.43	0.08	0.00	0.49	0.361E-06
CO- 57	0.00	49.46	0.06	50.01	0.47	0.120E-06
CO- 58M	0.00	0.20	92.69	0.00	7.11	0.586E-12
CO- 58	0.00	65.48	0.05	34.15	0.31	0.150E-06
CO- 60M	0.14	99.86	0.00	0.00	0.00	0.611E-13
CO- 60	0.00	62.50	0.03	37.23	0.25	0.629E-05
CO- 61	3.52	96.48	0.00	0.00	0.00	0.537E-11
NI- 59	0.00	0.01	0.04	99.52	0.43	0.155E-07
NI- 63	0.00	0.00	0.04	99.56	0.40	0.416E-07
MO- 93	0.00	0.72	0.24	96.68	2.35	0.921E-07
MO- 99	0.03	47.80	0.66	51.15	0.36	0.253E-08
TC- 99M	0.82	98.89	0.27	0.00	0.01	0.626E-10
W -181	0.00	43.02	0.01	56.92	0.05	0.127E-07
SR- 90	0.00	0.00	0.12	98.76	1.12	0.149E-05
I -131	0.00	8.90	0.45	90.05	0.60	0.550E-07
CS-137	0.00	28.98	0.00	70.99	0.03	0.758E-05
PU-239	0.00	0.00	8.50	8.07	83.43	0.251E-04
KR- 85	100.00	0.00	0.00	0.00	0.00	0.763E-13
KR- 88	100.00	0.00	0.00	0.00	0.00	0.441E-10
RB- 88	23.07	72.90	4.02	0.00	0.01	0.414E-10
XE-133	100.00	0.00	0.00	0.00	0.00	0.833E-12
XE-135	100.00	0.00	0.00	0.00	0.00	0.625E-11

Table 64. Contributions (in %) of exposure pathways to individual chronic dose (10.0 km distance; rain release): 1.E+9 Bq released from each nuclide

nuclide	collective dose (manSv/E9Bq) early	chronic
CR- 51	0.2957E-05	0.2324E-04
MN- 53	0.2692E-10	0.5798E-08
MN- 54	0.7301E-04	0.4826E-02
MN- 56	0.2493E-05	0.2493E-05
FE- 55	0.2569E-06	0.4975E-03
FE- 59	0.9486E-04	0.1328E-02
CO- 56	0.2808E-03	0.4433E-02
CO- 57	0.1635E-04	0.1473E-02
CO- 58M	0.1509E-07	0.1562E-07
CO- 58	0.8453E-04	0.1837E-02
CO- 60M	0.2747E-09	0.2685E-07
CO- 60	0.2469E-03	0.7706E-01
CO- 61	0.8640E-07	0.8640E-07
NI- 59	0.1859E-06	0.1902E-03
NI- 63	0.4595E-06	0.5100E-03
MO- 93	0.6000E-05	0.1131E-02
MO- 99	0.1267E-04	0.3136E-04
TC- 99M	0.7795E-06	0.7796E-06
W -181	0.2851E-05	0.1558E-03
SR- 90	0.4635E-04	0.1824E-01
I -131	0.3401E-04	0.6786E-03
CS-137	0.5638E-04	0.9289E-01
PU-239	0.5763E-01	0.3388E+00
KR- 85	0.2280E-08	0.2280E-08
KR- 88	0.7502E-06	0.7502E-06
RB- 88	0.4076E-06	0.4076E-06
XE-133	0.2436E-07	0.2436E-07
XE-135	0.1453E-06	0.1453E-06

Table 65. Contributions (in %) of nuclides to early and chronic collective doses within 100 km distance, rain release: 1.E + 9 Bq released from each nuclide

8. APPENDIX C-1 : Probabilistic Results, Tritium

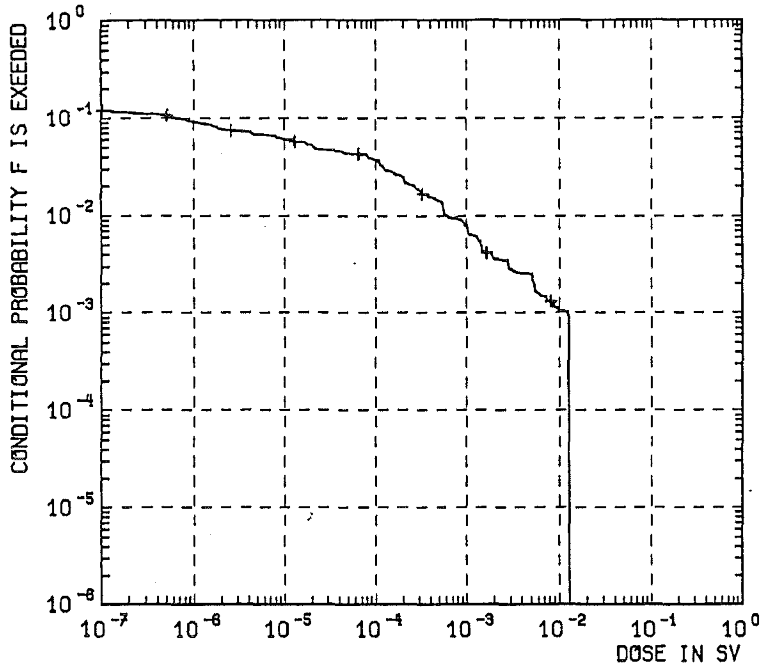

Figure 6. Puff release with fixed soil deposition model: dose at 1 km from inhalation + skin absorption (plume passage); 10 g T (HTO)

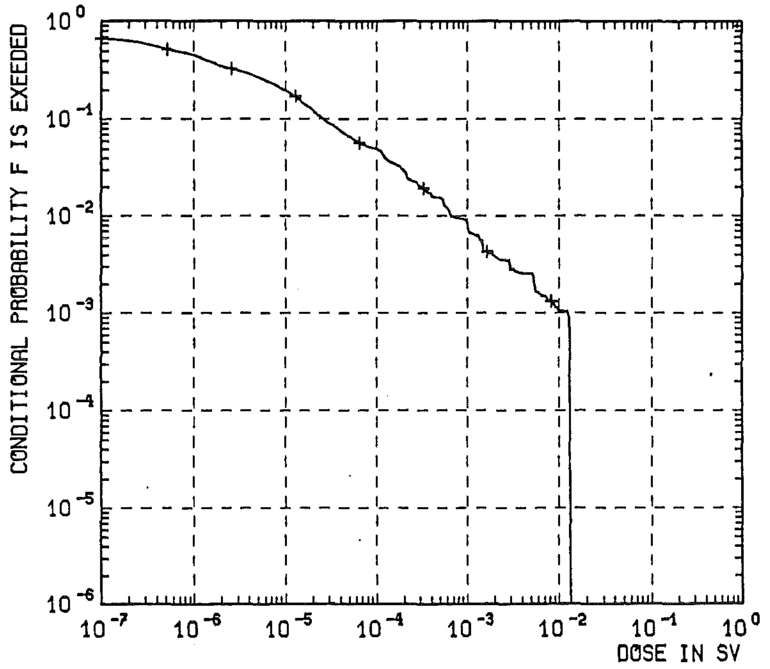

Figure 7. Puff release with fixed soil deposition model: dose at 1 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)

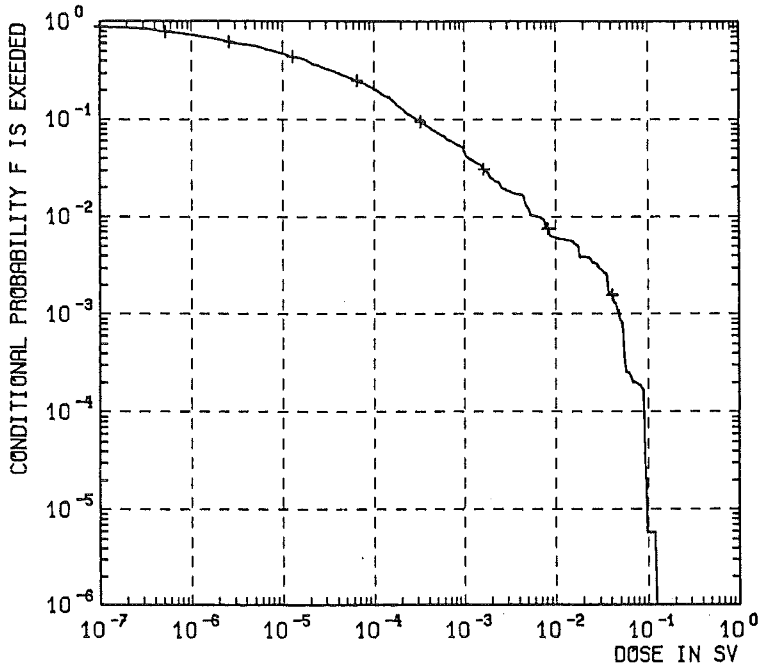

Figure 8. Puff release with fixed soil deposition model: dose at 1 km from long term ingestion; 10 g T (HTO)

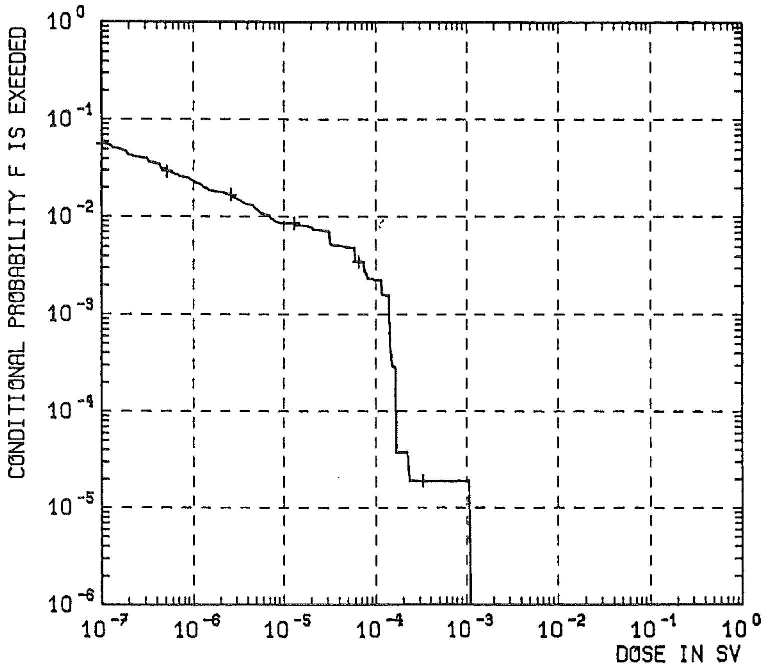

Figure 9. Puff release with fixed soil deposition model: dose at 10 km from inhalation + skin absorption (plume passage); 10 g T (HTO)

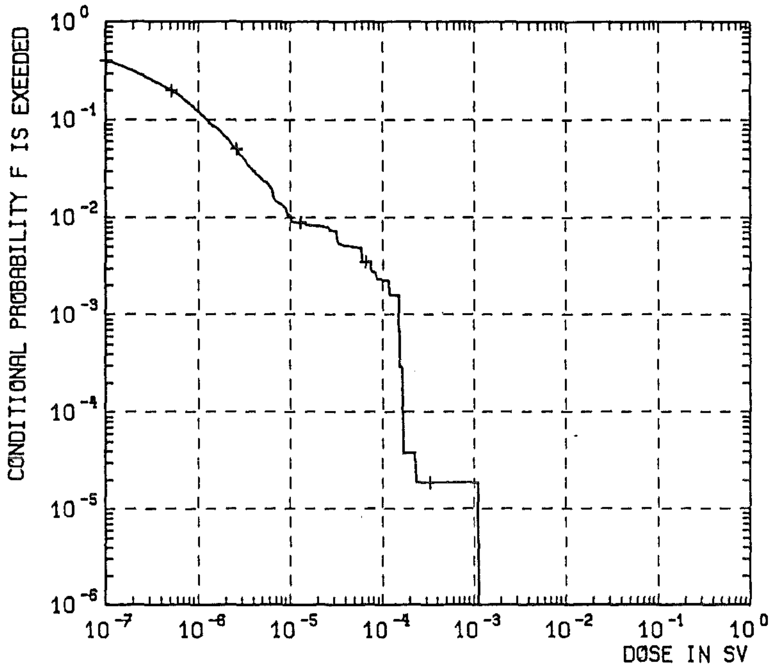

Figure 10. Puff release with fixed soil deposition model: dose at 10 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)

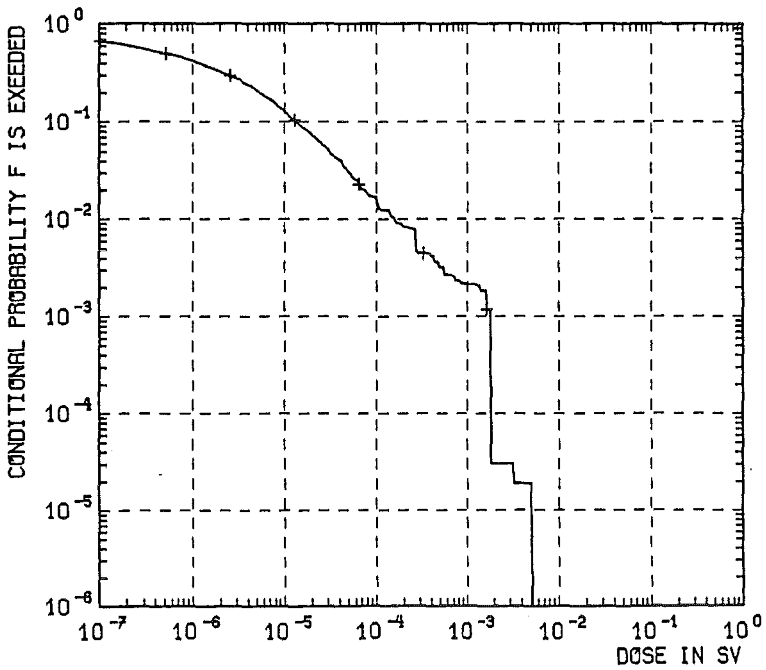

Figure 11. Puff release with fixed soil deposition model: dose at 10 km from long term ingestion; 10 g T (HTO)

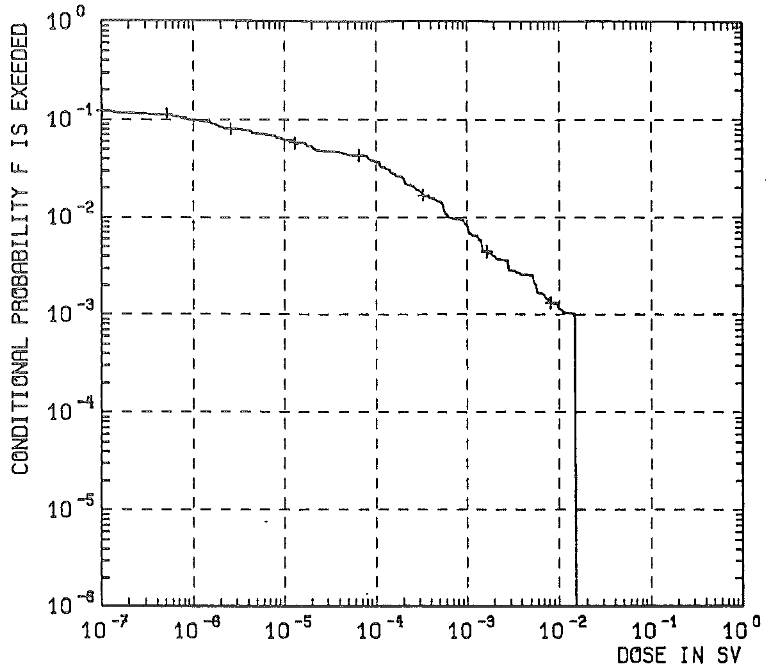

Figure 12. Puff release with variable soil deposition model: dose at 1 km from inhalation + skin absorption (plume passage); 10 g T (HTO)

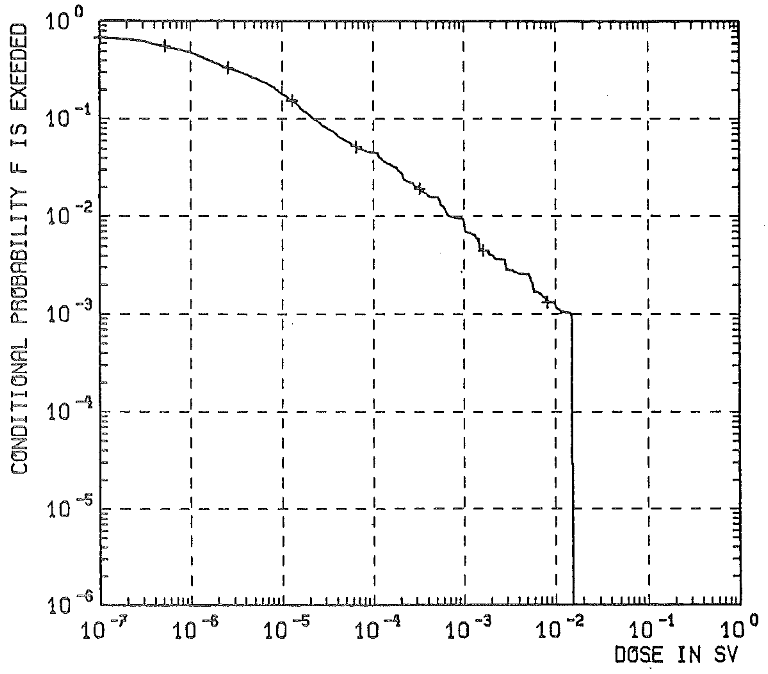

Figure 13. Puff release with variable soil deposition model: dose at 1 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)

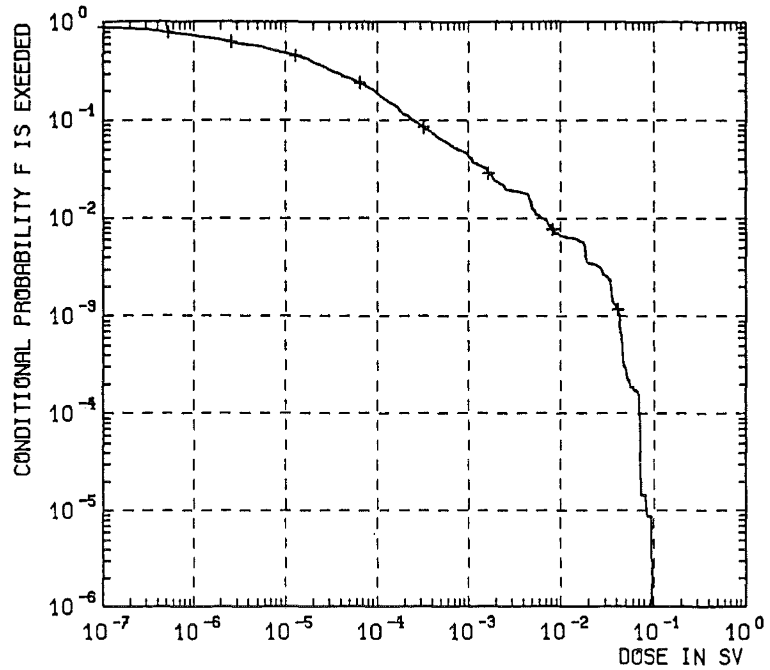

Figure 14. Puff release with variable soil deposition model: dose at 1 km from long term ingestion; 10 g T (HTO)

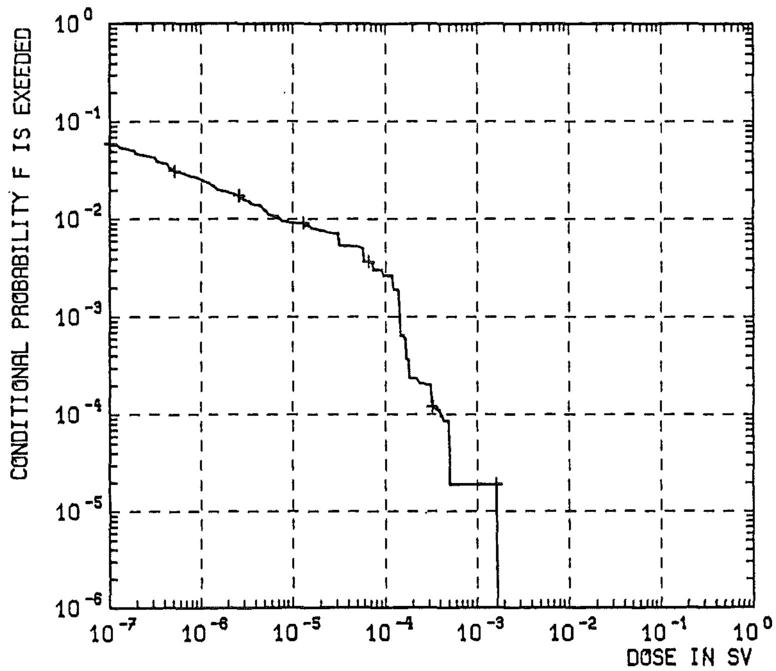

Figure 15. Puff release with variable soil deposition model: dose at 10 km from inhalation + skin absorption (plume passage); 10 g T (HTO)

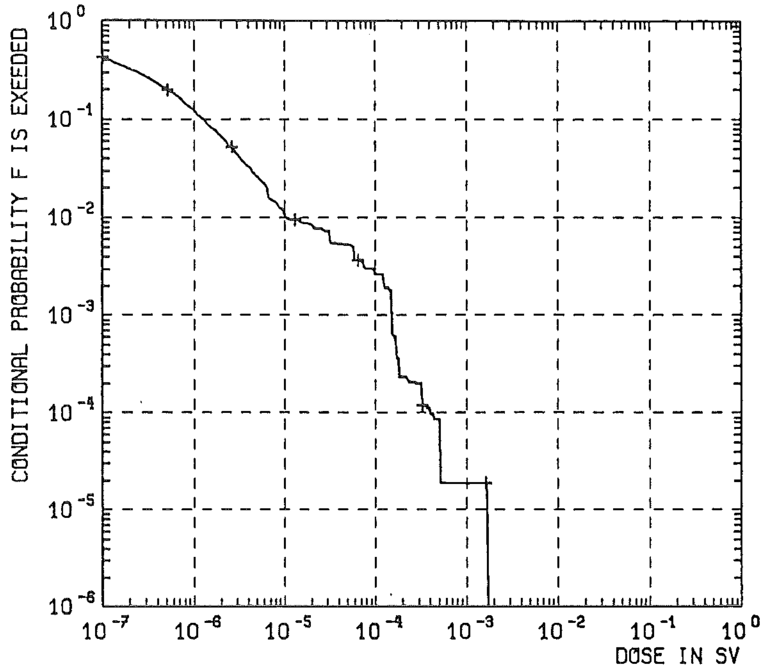

Figure 16. **Puff release with variable soil deposition model: dose at 10 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)**

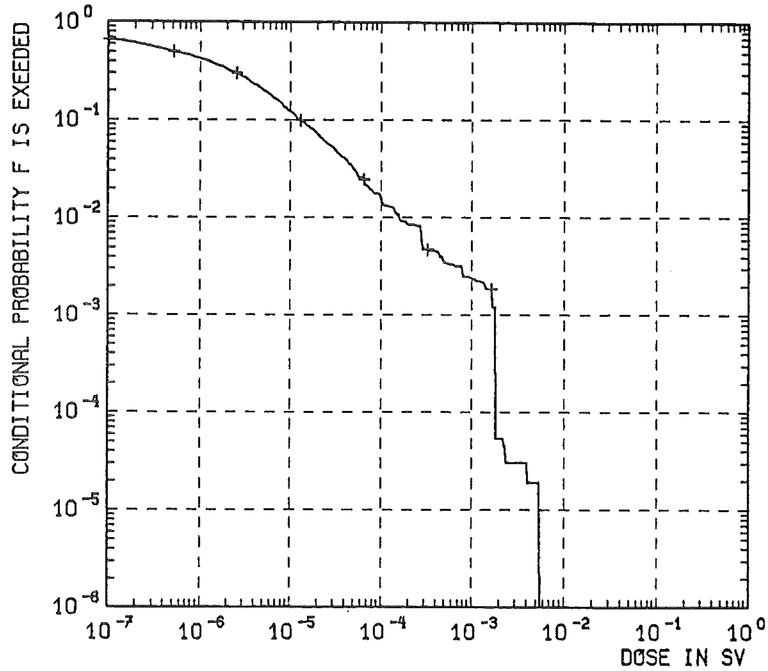

Figure 17. **Puff release with variable soil deposition model: dose at 10 km from long term ingestion; 10 g T (HTO)**

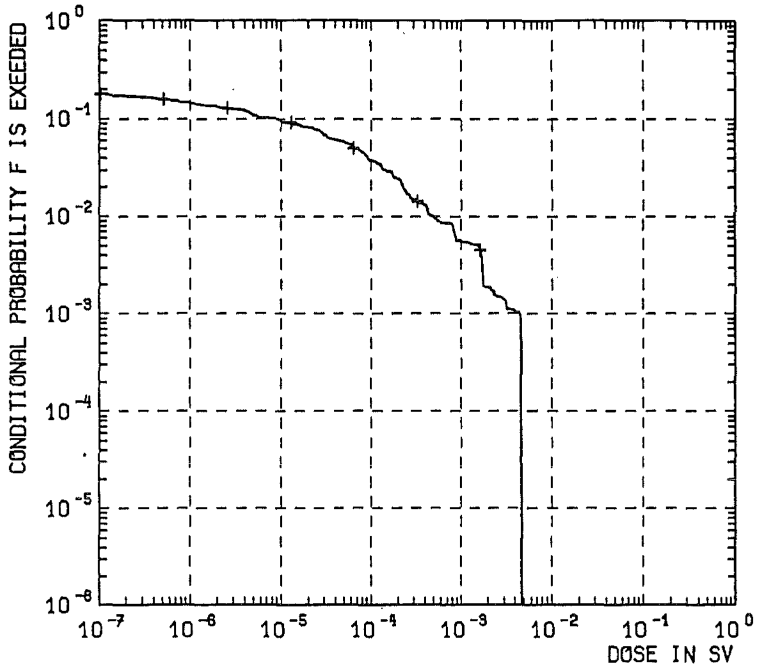

Figure 18. **1 hour release with variable soil deposition model: dose at 1 km from inhalation + skin absorption (plume passage); 10 g T (HTO)**

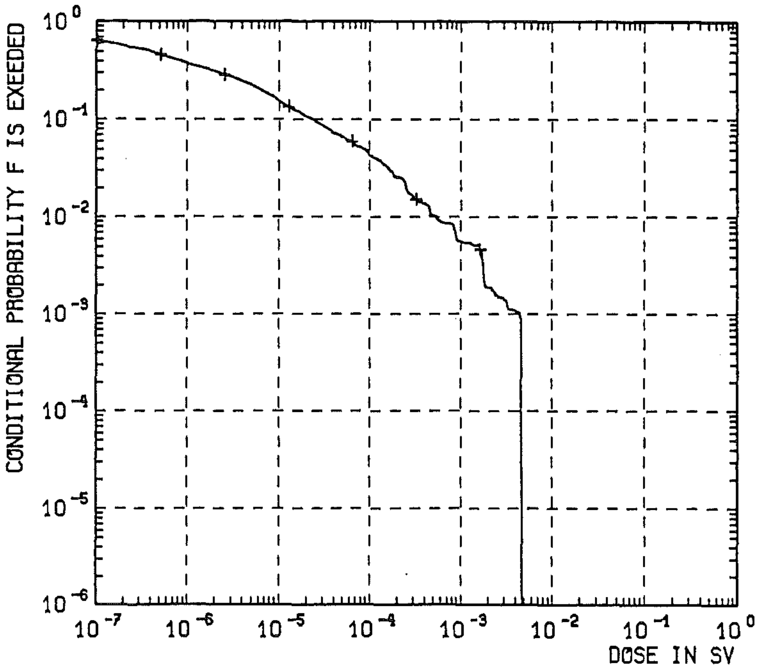

Figure 19. **1 hour release with variable soil deposition model: dose at 1 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)**

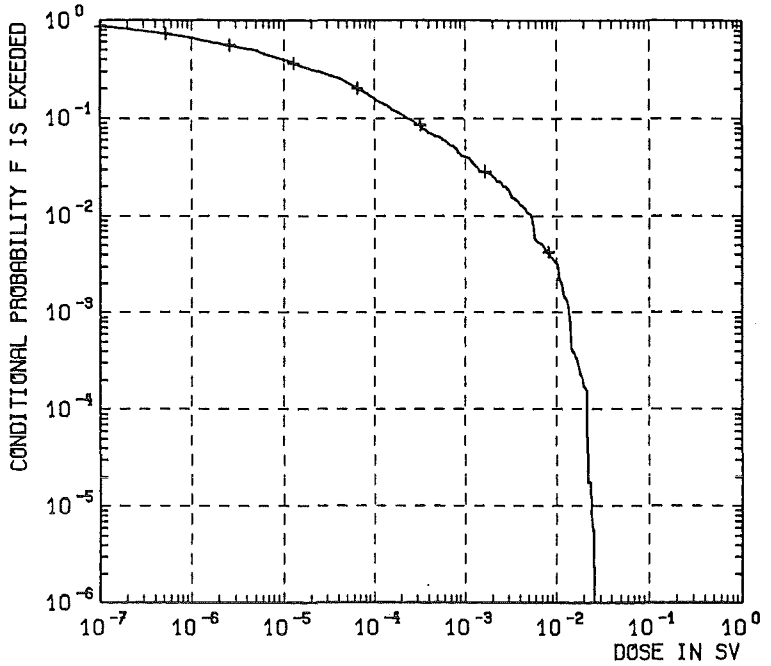

Figure 20. 1 hour release with variable soil deposition model: dose at 1 km from long term ingestion; 10 g T (HTO)

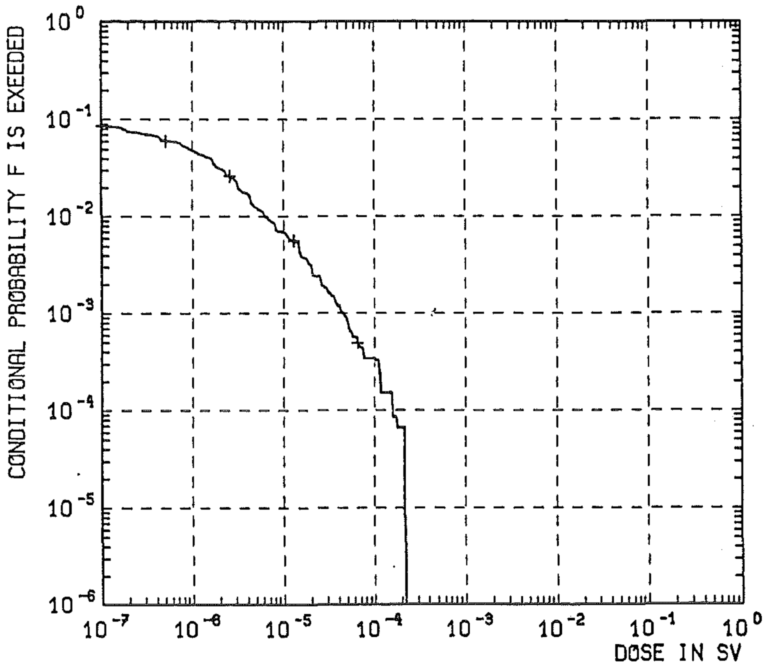

Figure 21. 1 hour release with variable soil deposition model: dose at 10 km from inhalation + skin absorption (plume passage); 10 g T (HTO)

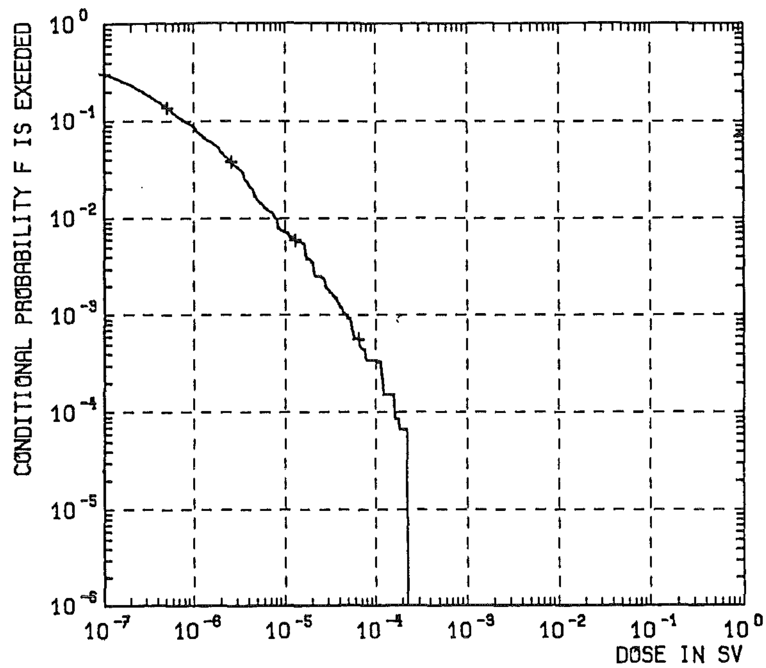

Figure 22. 1 hour release with variable soil deposition model: dose at 10 km from inhalation + skin absorption (plume + re-emission); 10 g T (HTO)

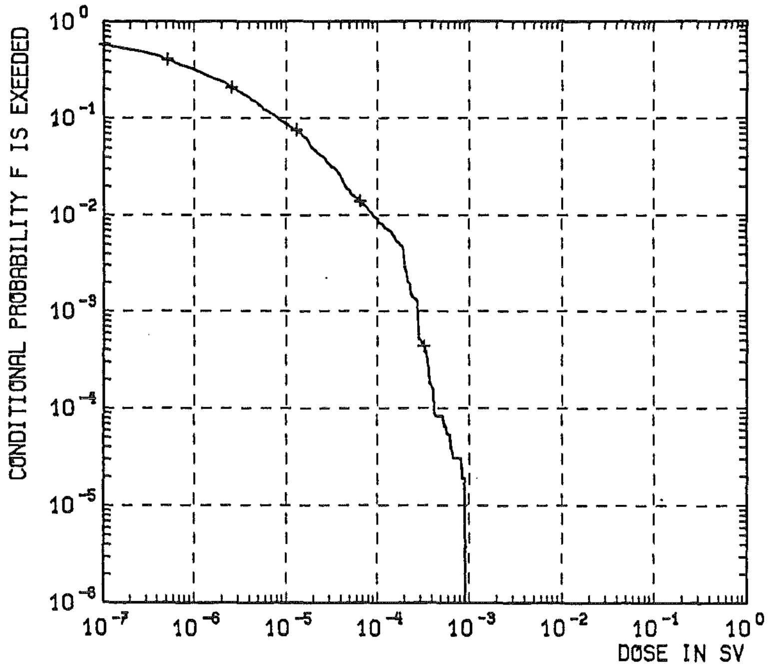

Figure 23. 1 hour release with variable soil deposition model: dose at 10 km from long term ingestion; 10 g T (HTO)

9. APPENDIX C-2 : Probabilistic Results, Activation Products

9.1 Summer Release

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	1.51	50.89	47.60	0.939E-10
MN- 53	0.00	100.00	0.00	0.442E-15
MN- 54	1.70	49.62	48.68	0.237E-08
MN- 56	44.44	26.08	29.48	0.178E-09
FE- 55	0.00	0.00	100.00	0.239E-09
FE- 59	1.58	40.70	57.72	0.373E-08
CO- 56	1.50	37.63	60.87	0.119E-07
CO- 57	0.26	12.14	87.60	0.196E-08
CO- 58M	0.00	0.00	100.00	0.150E-10
CO- 58	1.38	40.10	58.52	0.337E-08
CO- 60M	90.15	9.85	0.00	0.122E-12
CO- 60	0.28	7.51	92.21	0.443E-07
CO- 61	64.10	35.90	0.00	0.483E-11
NI- 59	0.00	0.00	100.00	0.173E-09
NI- 63	0.00	0.00	100.00	0.427E-09
MO- 93	0.00	0.01	99.99	0.554E-08
MO- 99	1.10	31.88	67.02	0.635E-09
TC- 99M	23.65	56.99	19.36	0.223E-10
W -181	1.56	64.59	33.85	0.718E-10

Table 66. Contributions (in %) of exposure pathways to mean individual early dose (0.5 km distance; summer weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	2.07	52.44	45.49	0.365E-10
MN- 53	0.00	100.00	0.00	0.177E-15
MN- 54	2.33	51.13	46.54	0.923E-09
MN- 56	52.30	23.37	24.33	0.752E-10
FE- 55	0.00	0.00	100.00	0.887E-10
FE- 59	2.18	42.25	55.57	0.144E-08
CO- 56	2.08	39.16	58.76	0.458E-08
CO- 57	0.36	12.95	86.68	0.737E-09
CO- 58M	0.00	0.00	100.00	0.547E-11
CO- 58	1.91	41.68	56.41	0.130E-08
CO- 60M	91.74	8.26	0.00	0.384E-13
CO- 60	0.40	8.04	91.56	0.166E-07
CO- 61	70.01	29.99	0.00	0.215E-11
NI- 59	0.00	0.00	100.00	0.642E-10
NI- 63	0.00	0.00	100.00	0.159E-09
MO- 93	0.00	0.01	99.99	0.206E-08
MO- 99	1.53	33.38	65.08	0.242E-09
TC- 99M	29.57	53.56	16.87	0.946E-11
W -181	2.12	65.86	32.02	0.282E-10

Table 67. Contributions (in %) of exposure pathways to mean individual early dose (1.0 km distance; summer weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	2.88	54.10	43.01	0.147E-10
MN- 53	0.00	100.00	0.00	0.738E-16
MN- 54	3.25	52.75	44.00	0.373E-09
MN- 56	59.73	20.93	19.33	0.307E-10
FE- 55	0.00	0.00	100.00	0.339E-10
FE- 59	3.07	43.95	52.98	0.577E-09
CO- 56	2.93	40.87	56.20	0.183E-08
CO- 57	0.53	13.94	85.53	0.285E-09
CO- 58M	0.00	0.00	100.00	0.199E-11
CO- 58	2.69	43.43	53.87	0.520E-09
CO- 60M	92.13	7.87	0.00	0.915E-14
CO- 60	0.58	8.69	90.73	0.639E-08
CO- 61	74.53	25.47	0.00	0.889E-12
NI- 59	0.00	0.00	100.00	0.245E-10
NI- 63	0.00	0.00	100.00	0.606E-10
MO- 93	0.00	0.01	99.99	0.787E-09
MO- 99	2.17	35.13	62.69	0.954E-10
TC- 99M	36.60	49.22	14.18	0.426E-11
W -181	2.92	67.16	29.92	0.115E-10

Table 68. **Contributions (in %) of exposure pathways to mean individual early dose (2.0 km distance; summer weather sequences):** 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	3.32	68.19	28.50	0.988E-12
MN- 53	0.00	100.00	0.00	0.625E-17
MN- 54	3.76	66.89	29.35	0.249E-10
MN- 56	61.16	27.15	11.69	0.134E-11
FE- 55	0.00	0.00	100.00	0.151E-11
FE- 59	3.75	58.91	37.34	0.364E-10
CO- 56	3.66	55.91	40.43	0.113E-09
CO- 57	0.81	23.47	75.72	0.143E-10
CO- 58M	0.00	0.00	99.99	0.740E-13
CO- 58	3.31	58.51	38.18	0.327E-10
CO- 60M	88.77	11.23	0.00	0.116E-15
CO- 60	0.93	15.27	83.81	0.308E-09
CO- 61	69.19	30.81	0.00	0.382E-13
NI- 59	0.00	0.00	100.00	0.109E-11
NI- 63	0.00	0.00	100.00	0.270E-11
MO- 93	0.00	0.02	99.97	0.351E-10
MO- 99	2.82	50.29	46.89	0.553E-11
TC- 99M	36.93	54.82	8.24	0.315E-12
W -181	3.11	78.49	18.39	0.835E-12

Table 69. **Contributions (in %) of exposure pathways to mean individual early dose (10.0 km distance; summer weather sequences):** 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	3.21	60.41	36.37	0.129E-13
MN- 53	0.00	100.00	0.00	0.728E-19
MN- 54	3.63	59.05	37.32	0.328E-12
MN- 56	59.47	26.55	13.98	0.530E-14
FE- 55	0.00	0.00	100.00	0.253E-13
FE- 59	3.51	50.44	46.05	0.492E-12
CO- 56	3.39	47.32	49.30	0.155E-11
CO- 57	0.67	17.59	81.74	0.223E-12
CO- 58M	0.00	0.00	100.00	0.776E-15
CO- 58	3.09	49.95	46.95	0.445E-12
CO- 60M	96.35	3.65	0.00	0.657E-22
CO- 60	0.74	11.14	88.12	0.492E-11
CO- 61	69.07	30.93	0.00	0.108E-15
NI- 59	0.00	0.00	100.00	0.183E-13
NI- 63	0.00	0.00	100.00	0.453E-13
MO- 93	0.00	0.02	99.98	0.588E-12
MO- 99	2.55	41.67	55.78	0.717E-13
TC- 99M	37.70	51.25	11.05	0.357E-14
W -181	3.14	72.41	24.44	0.105E-13

Table 70. Contributions (in %) of exposure pathways to mean individual early dose (100.0 km distance; summer weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.33	68.72	10.46	20.19	0.30	0.427E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.952E-13
MN- 54	0.05	83.22	1.44	15.19	0.10	0.804E-07
MN- 56	44.44	26.08	29.48	0.00	0.00	0.178E-09
FE- 55	0.00	0.00	2.84	96.95	0.21	0.840E-08
FE- 59	0.25	60.04	8.97	30.40	0.34	0.240E-07
CO- 56	0.22	90.29	9.04	0.00	0.44	0.801E-07
CO- 57	0.02	46.19	6.63	46.71	0.44	0.259E-07
CO- 58M	0.00	0.00	99.94	0.00	0.06	0.150E-10
CO- 58	0.14	61.41	6.13	32.03	0.29	0.322E-07
CO- 60M	6.17	93.83	0.00	0.00	0.00	0.179E-11
CO- 60	0.01	60.56	3.13	36.07	0.24	0.131E-05
CO- 61	64.10	35.90	0.00	0.00	0.00	0.483E-11
NI- 59	0.00	0.00	5.24	94.34	0.41	0.329E-08
NI- 63	0.00	0.00	4.85	94.77	0.38	0.879E-08
MO- 93	0.00	0.56	23.06	74.57	1.81	0.240E-07
MO- 99	0.74	26.10	45.04	27.93	0.19	0.944E-09
TC- 99M	23.65	56.99	19.35	0.00	0.01	0.223E-10
W -181	0.04	42.59	0.94	56.37	0.05	0.258E-08

Table 71. Contributions (in %) of exposure pathways to mean individual chronic dose (0.5 km distance; summer weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.44	69.17	9.76	20.33	0.30	0.170E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.382E-13
MN- 54	0.07	83.30	1.33	15.21	0.10	0.322E-07
MN- 56	52.30	23.37	24.33	0.00	0.00	0.752E-10
FE- 55	0.00	0.00	2.64	97.15	0.21	0.336E-08
FE- 59	0.33	60.38	8.37	30.58	0.34	0.957E-08
CO- 56	0.30	90.82	8.44	0.00	0.44	0.319E-07
CO- 57	0.03	46.41	6.18	46.93	0.44	0.103E-07
CO- 58M	0.00	0.00	99.93	0.00	0.07	0.547E-11
CO- 58	0.19	61.65	5.71	32.16	0.29	0.128E-07
CO- 60M	7.39	92.61	0.00	0.00	0.00	0.476E-12
CO- 60	0.01	60.69	2.91	36.15	0.24	0.522E-06
CO- 61	70.01	29.99	0.00	0.00	0.00	0.215E-11
NI- 59	0.00	0.01	4.88	94.70	0.41	0.132E-08
NI- 63	0.00	0.00	4.52	95.10	0.38	0.351E-08
MO- 93	0.00	0.57	21.75	75.83	1.84	0.947E-08
MO- 99	1.01	26.92	43.07	28.80	0.20	0.366E-09
TC- 99M	29.57	53.56	16.87	0.00	0.01	0.946E-11
W -181	0.06	42.61	0.87	56.40	0.05	0.104E-08

Table 72. **Contributions (in %) of exposure pathways to mean individual chronic dose (1.0 km distance; summer weather sequences):** 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.60	69.62	9.00	20.46	0.31	0.704E-10
MN- 53	0.00	100.00	0.00	0.00	0.00	0.159E-13
MN- 54	0.09	83.37	1.22	15.22	0.10	0.134E-07
MN- 56	59.73	20.93	19.33	0.00	0.00	0.307E-10
FE- 55	0.00	0.00	2.42	97.36	0.21	0.140E-08
FE- 59	0.45	60.74	7.72	30.76	0.34	0.396E-08
CO- 56	0.41	91.37	7.78	0.00	0.45	0.132E-07
CO- 57	0.04	46.65	5.70	47.17	0.45	0.428E-08
CO- 58M	0.00	0.00	99.92	0.00	0.07	0.199E-11
CO- 58	0.26	61.90	5.26	32.29	0.29	0.533E-08
CO- 60M	7.76	92.24	0.00	0.00	0.00	0.109E-12
CO- 60	0.02	60.84	2.67	36.23	0.24	0.217E-06
CO- 61	74.53	25.47	0.00	0.00	0.00	0.889E-12
NI- 59	0.00	0.01	4.49	95.09	0.42	0.546E-09
NI- 63	0.00	0.00	4.16	95.46	0.38	0.146E-08
MO- 93	0.00	0.58	20.31	77.24	1.88	0.387E-08
MO- 99	1.41	27.83	40.77	29.78	0.21	0.147E-09
TC- 99M	36.59	49.22	14.18	0.00	0.01	0.426E-11
W -181	0.08	42.64	0.80	56.43	0.05	0.431E-09

Table 73. **Contributions (in %) of exposure pathways to mean individual chronic dose (2.0 km distance; summer weather sequences):** 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.58	72.77	4.95	21.39	0.32	0.569E-11
MN- 53	0.00	100.00	0.00	0.00	0.00	0.135E-14
MN- 54	0.08	83.86	0.65	15.31	0.10	0.113E-08
MN- 56	61.16	27.15	11.69	0.00	0.00	0.134E-11
FE- 55	0.00	0.00	1.29	98.49	0.21	0.117E-09
FE- 59	0.42	63.07	4.21	31.94	0.36	0.323E-09
CO- 56	0.38	94.90	4.25	0.00	0.46	0.108E-08
CO- 57	0.03	47.95	3.08	48.48	0.46	0.353E-09
CO- 58M	0.00	0.00	99.85	0.00	0.14	0.741E-13
CO- 58	0.25	63.50	2.84	33.12	0.30	0.440E-09
CO- 60M	5.37	94.63	0.00	0.00	0.00	0.191E-14
CO- 60	0.02	61.62	1.42	36.70	0.24	0.182E-07
CO- 61	69.19	30.81	0.00	0.00	0.00	0.382E-13
NI- 59	0.00	0.01	2.41	97.16	0.42	0.452E-10
NI- 63	0.00	0.00	2.23	97.38	0.39	0.121E-09
MO- 93	0.00	0.64	11.82	85.46	2.08	0.296E-09
MO- 99	1.59	34.61	26.49	37.04	0.26	0.979E-11
TC- 99M	36.93	54.82	8.24	0.00	0.01	0.315E-12
W -181	0.07	42.80	0.42	56.65	0.05	0.364E-10

Table 74. **Contributions (in %) of exposure pathways to mean individual chronic dose (10.0 km distance; summer weather sequences):** 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.62	71.18	6.97	20.92	0.31	0.672E-13
MN- 53	0.00	100.00	0.00	0.00	0.00	0.157E-16
MN- 54	0.09	83.62	0.93	15.26	0.10	0.132E-10
MN- 56	59.46	26.55	13.98	0.00	0.00	0.530E-14
FE- 55	0.00	0.00	1.85	97.94	0.21	0.137E-11
FE- 59	0.45	61.89	5.96	31.35	0.35	0.381E-11
CO- 56	0.41	93.12	6.01	0.00	0.46	0.127E-10
CO- 57	0.04	47.30	4.38	47.83	0.45	0.416E-11
CO- 58M	0.00	0.00	99.89	0.00	0.11	0.776E-15
CO- 58	0.27	62.70	4.03	32.70	0.29	0.518E-11
CO- 60M	15.94	84.06	0.00	0.00	0.00	0.397E-21
CO- 60	0.02	61.23	2.04	36.47	0.24	0.213E-09
CO- 61	69.07	30.93	0.00	0.00	0.00	0.108E-15
NI- 59	0.00	0.01	3.44	96.13	0.42	0.532E-12
NI- 63	0.00	0.00	3.18	96.43	0.39	0.142E-11
MO- 93	0.00	0.61	16.18	81.23	1.98	0.363E-11
MO- 99	1.56	30.99	34.05	33.17	0.23	0.117E-12
TC- 99M	37.70	51.25	11.05	0.00	0.01	0.357E-14
W -181	0.08	42.72	0.61	56.54	0.05	0.423E-12

Table 75. **Contributions (in %) of exposure pathways to mean individual chronic dose (100.0 km distance; summer weather sequences):** 1.E+9 Bq released from each nuclide

organ	CL	GR	IH	mean specific dose (Sv/E9 Bq)
bone marrow	3.545	60.739	35.716	0.316E-09
bone surface	3.786	58.727	37.487	0.345E-09
breast	4.411	65.778	29.810	0.296E-09
lung	1.379	23.102	75.519	0.879E-09
stomach	3.509	59.194	37.297	0.319E-09
colon	3.336	56.274	40.390	0.335E-09
liver	2.480	41.829	55.691	0.451E-09
pancreas	3.099	53.467	43.434	0.331E-09
thyroid	4.421	71.354	24.225	0.316E-09
gonads	4.520	75.177	20.303	0.247E-09
remainder	3.691	58.080	38.229	0.338E-09
effect. dose	3.250	52.751	44.000	0.373E-09

Table 76. **Contributions (in %) of exposure pathways to mean individual early dose by Mn-54 for different organs (2.0 km distance; summer weather sequences):** 1.E + 9 Bq released

organ	CL	GR	IH	mean specific dose (Sv/E9 Bq)
bone marrow	3.982	67.153	28.865	0.828E-09
bone surface	4.965	72.846	22.190	0.319E-09
breast	4.724	66.614	28.662	0.335E-09
lung	0.743	12.398	86.858	0.188E-08
stomach	3.494	58.024	38.481	0.373E-09
colon	2.795	49.985	47.220	0.433E-09
liver	3.277	54.409	42.314	0.398E-09
pancreas	3.166	53.076	43.759	0.383E-09
thyroid	4.568	70.549	24.883	0.367E-09
gonads	4.612	81.320	14.068	0.263E-09
remainder	3.756	58.303	37.942	0.387E-09
effect. dose	2.692	43.434	53.873	0.520E-09

Table 77. **Contributions (in %) of exposure pathways to mean individual early dose by Co-58 for different organs (2.0 km distance; summer weather sequences):** 1.E + 9 Bq released

organ	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
bone marrow	0.089	86.858	0.898	12.083	0.072	0.125E-07
bone surface	0.097	85.449	0.959	13.419	0.076	0.135E-07
breast	0.108	91.906	0.732	7.195	0.058	0.120E-07
lung	0.093	88.882	5.109	5.509	0.407	0.130E-07
stomach	0.092	88.357	0.979	10.494	0.078	0.121E-07
colon	0.063	60.520	0.764	38.593	0.061	0.177E-07
liver	0.079	76.010	1.779	21.990	0.142	0.141E-07
pancreas	0.090	88.153	1.259	10.397	0.100	0.114E-07
thyroid	0.105	96.261	0.575	3.014	0.046	0.133E-07
gonads	0.090	85.063	0.404	14.411	0.032	0.124E-07
remainder	0.096	86.067	0.996	12.761	0.079	0.130E-07
effect. dose	0.090	83.370	1.223	15.219	0.098	0.134E-07

Table 78. **Contributions (in %) of exposure pathways to mean individual chronic dose by Mn-54 for different organs (2.0 km distance; summer weather sequences):** 1.E + 9 Bq released

organ	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
bone marrow	0.299	73.686	2.168	23.728	0.120	0.436E-08
bone surface	0.371	79.546	1.658	18.333	0.091	0.427E-08
breast	0.373	76.811	2.262	20.429	0.125	0.425E-08
lung	0.236	57.551	27.596	13.094	1.522	0.592E-08
stomach	0.279	67.722	3.074	28.755	0.170	0.467E-08
colon	0.124	32.290	2.088	65.383	0.115	0.980E-08
liver	0.246	59.741	3.180	36.657	0.175	0.530E-08
pancreas	0.286	69.955	3.948	25.594	0.218	0.424E-08
thyroid	0.364	82.122	1.982	15.422	0.109	0.461E-08
gonads	0.259	66.836	0.791	32.070	0.044	0.467E-08
remainder	0.293	66.425	2.959	30.160	0.163	0.496E-08
effect. dose	0.263	61.904	5.255	32.288	0.290	0.533E-08

Table 79. Contributions (in %) of exposure pathways to mean individual chronic dose by Co-58 for different organs (2.0 km distance; summer weather sequences): 1.E+9 Bq released

nuclide	mean collective dose (manSv) early	chronic
CR- 51	0.9613E-06	0.5695E-05
MN- 53	0.6316E-11	0.1360E-08
MN- 54	0.2413E-04	0.1138E-02
MN- 56	0.9143E-06	0.9143E-06
FE- 55	0.1387E-05	0.1181E-03
FE- 59	0.3500E-04	0.3227E-03
CO- 56	0.1089E-03	0.1081E-02
CO- 57	0.1350E-04	0.3540E-03
CO- 58M	0.6266E-07	0.6275E-07
CO- 58	0.3147E-04	0.4414E-03
CO- 60M	0.1246E-09	0.1632E-08
CO- 60	0.2874E-03	0.1830E-01
CO- 61	0.2499E-07	0.2499E-07
NI- 59	0.1007E-05	0.4552E-04
NI- 63	0.2484E-05	0.1221E-03
MO- 93	0.3222E-04	0.2959E-03
MO- 99	0.5174E-05	0.9351E-05
TC- 99M	0.2721E-06	0.2721E-06
W -181	0.8219E-06	0.3661E-04

Table 80. Contributions (in %) of nuclides to mean early and chronic collective doses within 100 km distance; summer release: 1.E+9 Bq released from each nuclide

9.2 Winter Release

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	1.44	51.20	47.36	0.107E-09
MN- 53	0.00	100.00	0.00	0.508E-15
MN- 54	1.63	49.93	48.44	0.271E-08
MN- 56	43.21	26.69	30.10	0.199E-09
FE- 55	0.00	0.00	100.00	0.271E-09
FE- 59	1.51	41.00	57.49	0.425E-08
CO- 56	1.44	37.91	60.65	0.136E-07
CO- 57	0.25	12.26	87.49	0.223E-08
CO- 58M	0.00	0.00	100.00	0.170E-10
CO- 58	1.33	40.39	58.28	0.384E-08
CO- 60M	89.63	10.37	0.00	0.138E-12
CO- 60	0.27	7.59	92.14	0.504E-07
CO- 61	62.89	37.11	0.00	0.535E-11
NI- 59	0.00	0.00	100.00	0.196E-09
NI- 63	0.00	0.00	100.00	0.485E-09
MO- 93	0.00	0.01	99.99	0.629E-08
MO- 99	1.05	32.11	66.83	0.723E-09
TC- 99M	22.81	57.77	19.43	0.252E-10
W -181	1.49	64.88	33.62	0.821E-10

Table 81. Contributions (in %) of exposure pathways to mean individual early dose (0.5 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	2.03	52.80	45.17	0.445E-10
MN- 53	0.00	100.00	0.00	0.217E-15
MN- 54	2.29	51.50	46.21	0.112E-08
MN- 56	51.77	23.58	24.65	0.899E-10
FE- 55	0.00	0.00	100.00	0.107E-09
FE- 59	2.14	42.60	55.25	0.175E-08
CO- 56	2.04	39.51	58.45	0.557E-08
CO- 57	0.36	13.11	86.53	0.892E-09
CO- 58M	0.00	0.00	100.00	0.660E-11
CO- 58	1.88	42.03	56.09	0.158E-08
CO- 60M	91.81	8.19	0.00	0.482E-13
CO- 60	0.39	8.15	91.46	0.201E-07
CO- 61	69.62	30.38	0.00	0.256E-11
NI- 59	0.00	0.00	100.00	0.776E-10
NI- 63	0.00	0.00	100.00	0.192E-09
MO- 93	0.00	0.01	99.99	0.249E-08
MO- 99	1.50	33.65	64.85	0.294E-09
TC- 99M	29.10	54.06	16.84	0.115E-10
W -181	2.07	66.20	31.73	0.344E-10

Table 82. Contributions (in %) of exposure pathways to mean individual early dose (1.0 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	2.62	56.35	41.03	0.162E-10
MN- 53	0.00	100.00	0.00	0.845E-16
MN- 54	2.96	55.04	42.00	0.409E-09
MN- 56	58.27	21.99	19.74	0.333E-10
FE- 55	0.00	0.00	100.00	0.355E-10
FE- 59	2.81	46.20	50.98	0.628E-09
CO- 56	2.70	43.08	54.22	0.199E-08
CO- 57	0.50	15.05	84.45	0.302E-09
CO- 58M	0.00	0.00	100.00	0.211E-11
CO- 58	2.47	45.68	51.85	0.566E-09
CO- 60M	92.66	7.34	0.00	0.121E-13
CO- 60	0.55	9.43	90.02	0.675E-08
CO- 61	73.35	26.65	0.00	0.979E-12
NI- 59	0.00	0.00	100.00	0.257E-10
NI- 63	0.00	0.00	100.00	0.635E-10
MO- 93	0.00	0.01	99.98	0.824E-09
MO- 99	2.01	37.04	60.95	0.103E-09
TC- 99M	34.08	52.07	13.85	0.457E-11
W -181	2.63	69.17	28.20	0.128E-10

Table 83. Contributions (in %) of exposure pathways to mean individual early dose (2.0 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	4.05	64.41	31.54	0.221E-11
MN- 53	0.00	100.00	0.00	0.133E-16
MN- 54	4.57	63.09	32.34	0.560E-10
MN- 56	70.49	18.46	11.05	0.325E-11
FE- 55	0.00	0.00	100.00	0.374E-11
FE- 59	4.50	54.83	40.67	0.828E-10
CO- 56	4.37	51.82	43.82	0.259E-09
CO- 57	0.93	20.77	78.30	0.344E-10
CO- 58M	0.00	0.00	99.99	0.181E-12
CO- 58	3.97	54.48	41.55	0.744E-10
CO- 60M	86.80	13.20	0.00	0.894E-16
CO- 60	1.04	13.35	85.61	0.749E-09
CO- 61	79.32	20.68	0.00	0.889E-13
NI- 59	0.00	0.00	100.00	0.271E-11
NI- 63	0.00	0.00	100.00	0.670E-11
MO- 93	0.00	0.02	99.98	0.869E-10
MO- 99	3.40	45.57	51.03	0.126E-10
TC- 99M	43.29	48.01	8.70	0.737E-12
W -181	3.86	75.47	20.67	0.184E-11

Table 84. Contributions (in %) of exposure pathways to mean individual early dose (10.0 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	mean specific dose (Sv/E9 Bq)
CR- 51	2.34	71.16	26.50	0.229E-13
MN- 53	0.00	100.00	0.00	0.152E-18
MN- 54	2.67	69.91	27.42	0.580E-12
MN- 56	47.97	40.76	11.27	0.712E-14
FE- 55	0.00	0.00	100.00	0.329E-13
FE- 59	2.68	62.17	35.15	0.837E-12
CO- 56	2.62	59.16	38.21	0.260E-11
CO- 57	0.60	25.59	73.81	0.320E-12
CO- 58M	0.00	0.01	99.99	0.952E-15
CO- 58	2.37	61.68	35.95	0.754E-12
CO- 60M	60.16	39.84	0.00	0.992E-22
CO- 60	0.69	16.81	82.50	0.682E-11
CO- 61	53.06	46.94	0.00	0.145E-15
NI- 59	0.00	0.00	100.00	0.238E-13
NI- 63	0.00	0.00	100.00	0.588E-13
MO- 93	0.00	0.03	99.97	0.764E-12
MO- 99	2.00	54.26	43.74	0.117E-12
TC- 99M	28.14	63.61	8.25	0.612E-14
W -181	2.18	80.89	16.93	0.197E-13

Table 85. Contributions (in %) of exposure pathways to mean individual early dose (100.0 km distance; winter weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.32	69.55	10.46	19.36	0.31	0.485E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.109E-12
MN- 54	0.05	91.78	1.57	6.50	0.11	0.838E-07
MN- 56	43.21	26.69	30.10	0.00	0.00	0.199E-09
FE- 55	0.00	0.00	6.63	92.87	0.50	0.409E-08
FE- 59	0.23	58.66	8.67	32.11	0.33	0.282E-07
CO- 56	0.21	90.39	8.95	0.00	0.44	0.919E-07
CO- 57	0.03	69.42	9.86	20.03	0.66	0.198E-07
CO- 58M	0.00	0.00	99.94	0.00	0.06	0.170E-10
CO- 58	0.17	75.41	7.45	16.62	0.35	0.301E-07
CO- 60M	5.84	94.16	0.00	0.00	0.00	0.212E-11
CO- 60	0.01	82.71	4.23	12.72	0.33	0.110E-05
CO- 61	62.89	37.11	0.00	0.00	0.00	0.535E-11
NI- 59	0.00	0.01	15.34	83.42	1.22	0.128E-08
NI- 63	0.00	0.00	14.47	84.39	1.15	0.335E-08
MO- 93	0.00	1.21	49.36	45.51	3.92	0.127E-07
MO- 99	0.70	25.87	44.20	29.04	0.19	0.109E-08
TC- 99M	22.80	57.76	19.43	0.00	0.01	0.252E-10
W -181	0.07	67.47	1.47	30.91	0.08	0.187E-08

Table 86. Contributions (in %) of exposure pathways to mean individual chronic dose (0.5 km distance; winter weather sequences): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.44	70.03	9.75	19.48	0.31	0.206E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.468E-13
MN- 54	0.07	91.99	1.45	6.38	0.11	0.358E-07
MN- 56	51.77	23.58	24.64	0.00	0.00	0.899E-10
FE- 55	0.00	0.00	6.27	93.22	0.51	0.171E-08
FE- 59	0.31	58.97	8.06	32.32	0.33	0.120E-07
CO- 56	0.29	90.93	8.33	0.00	0.45	0.391E-07
CO- 57	0.04	70.39	9.24	19.66	0.67	0.835E-08
CO- 58M	0.00	0.00	99.93	0.00	0.07	0.660E-11
CO- 58	0.23	76.00	6.94	16.47	0.36	0.128E-07
CO- 60M	7.45	92.55	0.00	0.00	0.00	0.593E-12
CO- 60	0.02	83.36	3.94	12.35	0.33	0.467E-06
CO- 61	69.62	30.38	0.00	0.00	0.00	0.256E-11
NI- 59	0.00	0.02	14.72	83.99	1.27	0.527E-09
NI- 63	0.00	0.00	13.88	84.92	1.19	0.138E-08
MO- 93	0.00	1.28	48.14	46.44	4.14	0.517E-08
MO- 99	0.98	26.67	42.19	29.96	0.20	0.452E-09
TC- 99M	29.10	54.06	16.84	0.00	0.01	0.115E-10
W -181	0.09	68.03	1.37	30.42	0.08	0.796E-09

Table 87. Contributions (in %) of exposure pathways to mean individual chronic dose (1.0 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.54	70.97	8.40	19.78	0.31	0.790E-10
MN- 53	0.00	100.00	0.00	0.00	0.00	0.182E-13
MN- 54	0.09	91.81	1.23	6.77	0.11	0.139E-07
MN- 56	58.26	21.99	19.74	0.00	0.00	0.333E-10
FE- 55	0.00	0.00	5.10	94.41	0.49	0.695E-09
FE- 59	0.38	59.71	6.94	32.63	0.34	0.461E-08
CO- 56	0.36	92.02	7.17	0.00	0.45	0.150E-07
CO- 57	0.05	69.97	7.82	21.50	0.67	0.327E-08
CO- 58M	0.00	0.00	99.92	0.00	0.08	0.211E-11
CO- 58	0.28	76.08	5.91	17.37	0.36	0.496E-08
CO- 60M	8.32	91.68	0.00	0.00	0.00	0.135E-12
CO- 60	0.02	82.67	3.32	13.67	0.33	0.183E-06
CO- 61	73.35	26.65	0.00	0.00	0.00	0.979E-12
NI- 59	0.00	0.01	11.85	86.94	1.20	0.217E-09
NI- 63	0.00	0.00	11.14	87.74	1.12	0.570E-09
MO- 93	0.00	1.31	41.98	52.47	4.24	0.196E-08
MO- 99	1.27	28.38	38.33	31.82	0.21	0.164E-09
TC- 99M	34.08	52.06	13.85	0.00	0.01	0.457E-11
W -181	0.11	66.64	1.14	32.03	0.08	0.316E-09

Table 88. Contributions (in %) of exposure pathways to mean individual chronic dose (2.0 km distance; winter weather sequences): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.74	72.57	5.78	20.59	0.32	0.121E-10
MN- 53	0.00	100.00	0.00	0.00	0.00	0.286E-14
MN- 54	0.11	89.22	0.80	9.76	0.10	0.225E-08
MN- 56	70.49	18.46	11.05	0.00	0.00	0.325E-11
FE- 55	0.00	0.00	2.43	97.22	0.35	0.154E-09
FE- 59	0.53	61.51	4.81	32.80	0.35	0.701E-09
CO- 56	0.49	94.12	4.93	0.00	0.46	0.230E-08
CO- 57	0.05	61.59	4.62	33.15	0.59	0.583E-09
CO- 58M	0.00	0.00	99.88	0.00	0.11	0.181E-12
CO- 58	0.36	72.14	3.77	23.40	0.34	0.821E-09
CO- 60M	4.51	95.49	0.00	0.00	0.00	0.172E-14
CO- 60	0.02	74.75	2.02	22.91	0.29	0.318E-07
CO- 61	79.32	20.68	0.00	0.00	0.00	0.889E-13
NI- 59	0.00	0.01	5.05	94.18	0.76	0.536E-10
NI- 63	0.00	0.00	4.70	94.60	0.71	0.143E-09
MO- 93	0.00	1.04	22.33	73.28	3.36	0.389E-09
MO- 99	1.98	32.33	29.72	35.73	0.24	0.216E-10
TC- 99M	43.29	48.01	8.70	0.00	0.01	0.737E-12
W -181	0.12	56.44	0.65	42.72	0.07	0.585E-10

Table 89. **Contributions (in %) of exposure pathways to mean individual chronic dose (10.0 km distance; winter weather sequences):** 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
CR- 51	0.40	73.88	4.47	20.93	0.33	0.136E-12
MN- 53	0.00	100.00	0.00	0.00	0.00	0.328E-16
MN- 54	0.06	89.68	0.62	9.53	0.10	0.257E-10
MN- 56	47.96	40.76	11.27	0.00	0.01	0.712E-14
FE- 55	0.00	0.00	1.92	97.72	0.36	0.171E-11
FE- 59	0.28	62.34	3.71	33.31	0.35	0.792E-11
CO- 56	0.26	95.45	3.82	0.00	0.47	0.260E-10
CO- 57	0.03	63.07	3.62	32.68	0.60	0.653E-11
CO- 58M	0.00	0.01	99.80	0.00	0.19	0.954E-15
CO- 58	0.19	73.35	2.93	23.19	0.34	0.926E-11
CO- 60M	1.07	98.93	0.00	0.00	0.00	0.556E-20
CO- 60	0.01	75.82	1.57	22.30	0.30	0.359E-09
CO- 61	53.06	46.94	0.00	0.00	0.00	0.145E-15
NI- 59	0.00	0.01	4.05	95.14	0.80	0.587E-12
NI- 63	0.00	0.00	3.77	95.49	0.74	0.156E-11
MO- 93	0.00	1.13	18.58	76.63	3.65	0.411E-11
MO- 99	1.08	35.66	23.59	39.40	0.27	0.217E-12
TC- 99M	28.14	63.61	8.25	0.00	0.01	0.612E-14
W -181	0.07	57.32	0.51	42.03	0.07	0.660E-12

Table 90. **Contributions (in %) of exposure pathways to mean individual chronic dose (100.0 km distance; winter weather sequences):** 1.E+9 Bq released from each nuclide

organ	CL	GR	IH	mean specific dose (Sv/E9 Bq)
bone marrow	3.207	62.933	33.860	0.349E-09
bone surface	3.431	60.963	35.607	0.380E-09
breast	3.974	67.878	28.147	0.328E-09
lung	1.289	24.733	73.978	0.940E-09
stomach	3.178	61.414	35.407	0.352E-09
colon	3.029	58.531	38.440	0.369E-09
liver	2.280	44.053	53.667	0.490E-09
pancreas	2.821	55.744	41.435	0.363E-09
thyroid	3.964	73.274	22.762	0.353E-09
gonads	4.039	76.946	19.015	0.277E-09
remainder	3.347	60.323	36.331	0.373E-09
effect. dose	2.960	55.036	42.004	0.409E-09

Table 91. **Contributions (in %) of exposure pathways to mean individual early dose by Mn-54 for different organs (2.0 km distance; winter weather sequences):** 1.E+9 Bq released

organ	CL	GR	IH	mean specific dose (Sv/E9 Bq)
bone marrow	3.583	69.195	27.222	0.364E-09
bone surface	4.447	74.721	20.832	0.356E-09
breast	4.254	68.694	27.052	0.372E-09
lung	0.702	13.397	85.902	0.199E-08
stomach	3.169	60.256	36.575	0.411E-09
colon	2.552	52.261	45.187	0.474E-09
liver	2.981	56.677	40.342	0.437E-09
pancreas	2.883	55.350	41.767	0.420E-09
thyroid	4.099	72.498	23.403	0.409E-09
gonads	4.100	82.791	13.109	0.295E-09
remainder	3.405	60.537	36.057	0.427E-09
effect. dose	2.472	45.676	51.852	0.565E-09

Table 92. **Contributions (in %) of exposure pathways to mean individual early dose by Co-58 for different organs (2.0 km distance; winter weather sequences):** 1.E+9 Bq released

organ	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
bone marrow	0.084	93.691	0.886	5.262	0.077	0.133E-07
bone surface	0.092	92.975	0.955	5.895	0.083	0.142E-07
breast	0.099	96.102	0.701	3.037	0.061	0.132E-07
lung	0.085	92.326	4.856	2.310	0.423	0.143E-07
stomach	0.086	94.351	0.956	4.524	0.083	0.130E-07
colon	0.072	78.684	0.909	20.257	0.079	0.156E-07
liver	0.080	87.643	1.877	10.236	0.164	0.140E-07
pancreas	0.084	94.099	1.230	4.481	0.107	0.122E-07
thyroid	0.093	98.084	0.536	1.240	0.047	0.150E-07
gonads	0.086	93.106	0.405	6.368	0.035	0.130E-07
remainder	0.091	93.253	0.988	5.582	0.086	0.137E-07
effect. dose	0.087	91.808	1.232	6.766	0.107	0.139E-07

Table 93. **Contributions (in %) of exposure pathways to mean individual chronic dose by Mn-54 for different organs (2.0 km distance; winter weather sequences):** 1.E+9 Bq released

organ	CL	GR	IH	IG	IHR	mean specific dose (Sv/E9 Bq)
bone marrow	0.302	85.251	2.296	12.013	0.138	0.432E-08
bone surface	0.362	88.876	1.696	8.964	0.102	0.437E-08
breast	0.369	87.017	2.345	10.127	0.141	0.429E-08
lung	0.228	63.757	27.981	6.348	1.686	0.611E-08
stomach	0.292	81.073	3.368	15.064	0.203	0.447E-08
colon	0.171	51.225	3.031	45.390	0.183	0.707E-08
liver	0.272	75.542	3.680	20.284	0.222	0.479E-08
pancreas	0.293	82.073	4.239	13.140	0.255	0.414E-08
thyroid	0.349	90.133	1.991	7.407	0.120	0.481E-08
gonads	0.277	81.643	0.885	17.143	0.053	0.437E-08
remainder	0.309	80.272	3.272	15.949	0.197	0.470E-08
effect. dose	0.282	76.085	5.912	17.366	0.356	0.496E-08

Table 94. Contributions (in %) of exposure pathways to mean individual chronic dose by Co-58 for different organs (2.0 km distance; winter weather sequences): 1.E+9 Bq released

nuclide	mean collective dose (manSv) early	chronic
CR- 51	0.1558E-05	0.9345E-05
MN- 53	0.1053E-10	0.2268E-08
MN- 54	0.3939E-04	0.1776E-02
MN- 56	0.1261E-05	0.1261E-05
FE- 55	0.2140E-05	0.1185E-03
FE- 59	0.5666E-04	0.5450E-03
CO- 56	0.1759E-03	0.1794E-02
CO- 57	0.2117E-04	0.4503E-03
CO- 58M	0.8821E-07	0.8834E-07
CO- 58	0.5099E-04	0.6387E-03
CO- 60M	0.1474E-09	0.1864E-08
CO- 60	0.4487E-03	0.2485E-01
CO- 61	0.3437E-07	0.3438E-07
NI- 59	0.1548E-05	0.4068E-04
NI- 63	0.3831E-05	0.1084E-03
MO- 93	0.4974E-04	0.2818E-03
MO- 99	0.8060E-05	0.1492E-04
TC- 99M	0.4291E-06	0.4292E-06
W -181	0.1346E-05	0.4566E-04

Table 95. Contributions (in %) of nuclides to mean early and chronic collective doses within 100 km distance; winter release: 1.E+9 Bq released from each nuclide

10. APPENDIX D : Meteorological Data for the Three Deterministic Cases

10.1 *Release in the night*

THE FIRST HOUR OF THIS DATASET IS THE HOUR OF THE RELEASE

ORDER OF PARAMETERS:

CODE NUMBER
TIME OF DAY (NUMBER OF HOUR)
STABILITY CLASS ACCORDING TO THE PASQUILL-GIFFORD NOTATION
(1 = VERY UNSTABLE, ..., 6 = VERY STABLE)
WIND DIRECTION (WIND COMES FROM...; N OVER O POSITIVE) <DEGREE>
WIND SPEED IN A HEIGTH OF 10 M ABOVE GROUND SURFACE <M/S>
RAIN INTENSITY <MM/H>
AIR TEMPERATURE IN A HEIGTH OF 2 M ABOVE GROUND SURFACE <DEGREE C>
NET RADIATION BALANCE TO A HORIZONTAL PLAIN SURFACE <WATT/M**2>
PRESSURE <HPA>
RELATIVE HUMIDITY (0.0 .... 1.0)

NR.	TIME	STAB.	DIR.	SPEED	RAIN	TEMP.	RAD.	PRESS.	REL.H.
1	2	6	60	0.50	0.00	3.19	-90	999.1	0.92
2	3	6	60	0.50	0.00	2.50	-95	998.9	0.92
3	4	6	60	0.50	0.00	2.10	-82	999.0	0.93
4	5	6	60	0.50	0.00	2.00	-59	999.1	0.97
5	6	6	60	0.50	0.00	2.39	45	999.3	1.00
6	7	6	60	1.00	0.00	3.50	103	999.5	0.99
7	8	5	60	0.50	0.00	5.39	227	999.7	0.91
8	9	3	60	1.00	0.00	7.60	207	999.6	0.80
9	10	3	60	2.60	0.00	9.60	129	999.4	0.71
10	11	3	30	3.60	0.00	10.80	141	999.0	0.66
11	12	3	165	3.10	0.00	11.39	148	998.8	0.63
12	13	2	300	1.00	0.00	11.60	150	998.7	0.62
13	14	2	270	0.50	0.00	11.60	144	998.8	0.63
14	15	3	320	2.00	0.00	11.39	133	999.0	0.65
15	16	3	250	3.10	0.00	11.30	116	999.1	0.67
16	17	3	290	1.50	0.00	11.30	91	999.1	0.67
17	18	3	330	3.10	0.00	11.30	61	999.0	0.67
18	19	4	330	2.60	0.00	11.19	30	998.8	0.67
19	20	4	340	2.00	0.00	10.89	0	998.6	0.68
20	21	5	10	1.00	0.00	10.30	-26	998.4	0.71
21	22	6	115	0.50	0.00	9.30	-37	998.2	0.76
22	23	6	220	1.00	0.00	7.89	-40	998.0	0.82
23	24	6	215	0.50	0.00	6.50	-35	997.7	0.88
24	1	6	210	2.00	0.00	5.39	-38	997.4	0.93
25	2	5	210	2.00	0.00	4.89	-29	997.2	0.95
26	3	4	210	2.60	0.00	4.69	-16	997.4	0.96
27	4	5	210	2.00	0.00	4.60	-8	998.2	0.97
28	5	5	210	3.10	0.00	4.39	-4	999.1	0.99
29	6	4	230	2.60	0.00	4.50	40	1000.0	0.99
30	7	4	210	2.60	0.00	5.60	102	1000.6	0.93
31	8	4	210	2.60	0.00	8.00	411	1000.8	0.81
32	9	2	250	2.60	0.00	11.00	477	1000.8	0.68
33	10	2	240	3.10	0.00	13.69	557	1000.5	0.58
34	11	2	240	2.60	0.00	15.30	616	1000.3	0.54
35	12	1	240	3.10	0.00	16.10	641	1000.1	0.52
36	13	1	220	4.60	0.00	16.80	781	1000.2	0.52
37	14	1	210	4.10	0.00	17.80	691	1000.5	0.51
38	15	1	220	3.10	0.00	19.00	668	1000.8	0.50
39	16	2	210	3.60	0.00	19.89	565	1001.0	0.49
40	17	2	250	2.60	0.00	20.19	392	1001.0	0.49
41	18	2	210	3.10	0.00	19.89	235	1001.0	0.49
42	19	4	180	1.00	0.00	18.80	139	1000.7	0.52

43	20	4	180	1.00	0.00	17.00	-3	1000.3	0.60
44	21	6	120	1.50	0.00	15.00	-78	999.9	0.72
45	22	6	80	1.00	0.00	13.50	-79	999.4	0.82
46	23	5	60	1.00	0.00	12.89	-50	999.0	0.87
47	24	5	50	1.00	0.00	12.80	-8	998.7	0.88
48	1	5	50	2.00	0.00	12.60	-8	998.6	0.88
49	2	5	60	1.50	0.00	11.80	-7	998.7	0.89
50	3	6	50	2.00	0.00	10.89	-26	999.0	0.91
51	4	5	50	1.00	0.00	10.30	-25	999.5	0.94
52	5	5	20	1.50	0.00	10.60	2	1000.1	0.94
53	6	4	10	2.00	0.00	11.50	29	1000.7	0.92
54	7	4	90	1.50	0.00	12.80	58	1001.3	0.88
55	8	4	170	0.50	0.00	14.19	133	1001.7	0.82
56	9	2	250	1.00	0.00	15.69	339	1002.0	0.76
57	10	2	240	1.00	0.00	17.39	239	1002.2	0.68
58	11	2	240	1.00	0.00	19.10	134	1002.4	0.61
59	12	2	270	1.00	0.00	20.60	136	1002.6	0.55
60	13	3	220	2.00	0.00	21.30	133	1003.1	0.53
61	14	3	240	3.60	0.00	21.00	127	1003.5	0.54
62	15	3	240	4.10	0.00	20.00	118	1004.0	0.59
63	16	3	270	4.10	0.00	19.10	106	1004.2	0.64
64	17	4	270	5.10	0.00	18.60	86	1004.2	0.68
65	18	4	250	6.10	0.00	18.10	62	1004.1	0.73
66	19	4	240	3.10	0.19	17.19	36	1004.0	0.77
67	20	4	220	6.10	0.40	15.50	10	1003.9	0.84
68	21	4	200	4.10	0.59	13.50	-6	1003.8	0.93
69	22	4	210	5.60	0.70	12.10	-2	1003.8	0.99
70	23	4	220	6.10	0.19	11.69	0	1003.8	0.99
71	24	4	220	6.10	0.69	12.00	-1	1003.9	0.96
72	1	4	220	6.10	0.59	12.10	-3	1004.1	0.94
73	2	4	220	6.10	0.69	11.60	-4	1004.3	0.93
74	3	4	220	7.69	1.10	10.80	-4	1004.7	0.94
75	4	4	230	8.19	0.50	10.00	-3	1005.1	0.96
76	5	4	230	8.19	0.70	9.60	5	1005.7	0.98
77	6	4	220	7.10	1.19	9.60	33	1006.3	0.99
78	7	4	230	7.69	1.10	9.89	64	1006.8	0.98
79	8	4	230	7.69	0.80	10.30	94	1007.1	0.97
80	9	4	240	7.10	1.10	10.69	122	1007.4	0.95
81	10	4	240	7.69	0.50	11.00	145	1007.4	0.94
82	11	4	230	7.10	0.50	11.19	162	1007.4	0.92
83	12	4	230	7.69	0.50	11.19	172	1007.5	0.93
84	13	4	230	8.19	0.80	11.19	176	1007.7	0.94
85	14	4	230	8.19	1.10	11.19	172	1007.8	0.95
86	15	4	230	7.69	0.69	11.30	161	1007.9	0.97
87	16	4	230	7.69	0.40	11.30	143	1007.9	0.99
88	17	4	230	6.60	0.89	11.30	118	1007.7	0.99
89	18	4	230	6.60	0.60	11.39	89	1007.5	0.97
90	19	4	220	7.10	0.19	11.30	57	1007.3	0.96
91	20	4	220	7.10	0.69	11.19	25	1007.0	0.95
92	21	4	210	7.10	0.60	11.00	-1	1006.7	0.94
93	22	4	210	6.60	0.50	11.00	-4	1006.2	0.94
94	23	4	220	6.60	0.60	11.10	-4	1005.6	0.93
95	24	4	220	7.10	0.60	11.19	-4	1005.0	0.93
96	1	4	230	4.10	0.69	11.19	-4	1004.4	0.94
97	2	4	230	3.60	0.00	10.89	-3	1003.9	0.95
98	3	4	250	2.60	0.00	10.50	-1	1003.5	0.98
99	4	4	240	3.10	0.00	10.19	0	1003.2	0.99
100	5	4	240	4.10	0.00	10.00	5	1002.9	0.98
101	6	4	240	3.10	0.00	10.10	32	1002.7	0.95
102	7	4	240	4.10	0.00	10.30	61	1002.3	0.94
103	8	4	250	4.10	0.00	10.69	91	1001.9	0.91
104	9	3	240	3.60	0.00	11.19	118	1001.5	0.90
105	10	3	230	3.60	0.00	11.80	141	1000.7	0.87
106	11	3	250	4.10	0.00	12.30	156	999.9	0.85
107	12	4	270	5.10	0.00	12.69	165	999.2	0.83
108	13	4	270	5.10	0.00	12.80	167	998.7	0.82
109	14	3	260	3.10	0.00	12.69	163	998.3	0.82

110	15	3	230	3.10	0.00	12.50	151	998.0	0.83
111	16	3	230	2.00	0.00	12.39	131	997.6	0.85
112	17	3	200	2.60	0.00	12.80	108	997.1	0.86
113	18	3	170	2.00	0.00	13.39	78	996.6	0.85
114	19	4	250	1.50	0.00	13.89	48	996.0	0.85
115	20	4	170	1.00	0.00	14.10	16	995.5	0.85
116	21	5	150	1.00	0.00	13.89	-7	995.1	0.88
117	22	5	140	0.50	0.00	13.50	-7	994.9	0.92
118	23	5	140	1.00	0.00	13.19	-4	994.9	0.95
119	24	5	210	1.50	0.10	13.10	-2	994.9	0.97
120	1	5	190	2.00	0.10	13.39	-1	995.0	0.96
121	2	4	220	3.10	0.00	13.69	-3	995.1	0.95
122	3	5	230	1.50	0.00	14.00	-10	995.3	0.94
123	4	4	260	2.60	0.00	14.30	-11	995.5	0.94
124	5	4	230	3.60	0.10	14.89	2	995.8	0.92
125	6	4	230	3.10	0.10	15.60	41	996.3	0.91
126	7	4	240	1.50	0.10	16.10	88	997.0	0.88
127	8	4	310	5.60	0.10	16.10	85	997.7	0.85
128	9	3	320	4.60	0.00	16.00	111	998.2	0.82
129	10	3	310	3.60	0.00	16.19	133	998.3	0.78
130	11	2	300	4.60	0.10	17.19	340	998.3	0.73
131	12	3	320	5.60	0.00	18.80	787	998.2	0.67
132	13	2	310	4.60	0.00	20.19	901	998.3	0.60
133	14	2	330	4.10	0.00	21.19	539	998.5	0.52
134	15	3	10	2.60	0.00	21.80	366	998.7	0.45
135	16	2	330	3.60	0.10	22.10	265	999.0	0.41
136	17	3	340	2.00	0.00	22.19	159	999.4	0.39
137	18	3	320	3.10	0.00	22.00	97	999.7	0.39
138	19	3	320	3.10	0.00	21.50	123	1000.1	0.40
139	20	3	340	2.00	0.00	20.69	-32	1000.5	0.42
140	21	4	330	3.60	0.00	19.50	-85	1000.7	0.46
141	22	4	330	3.10	0.00	17.60	-85	1000.8	0.52
142	23	6	39	1.50	0.00	15.10	-92	1000.8	0.62
143	24	6	55	0.50	0.00	12.30	-90	1000.8	0.75
144	1	6	21	0.50	0.00	9.89	-89	1000.6	0.87
145	2	6	60	1.00	0.00	8.30	-79	1000.6	0.92
146	3	6	50	1.00	0.00	7.60	-65	1000.7	0.91
147	4	6	60	1.00	0.00	7.69	-72	1001.1	0.87
148	5	6	60	1.00	0.00	8.69	-69	1001.6	0.83
149	6	6	60	1.00	0.00	10.30	37	1002.1	0.81
150	7	5	60	1.00	0.00	12.50	208	1002.3	0.76
151	8	5	60	2.60	0.00	14.89	142	1002.3	0.70
152	9	3	40	2.00	0.00	17.39	95	1002.2	0.63
153	10	3	120	3.10	0.00	19.60	194	1002.0	0.56
154	11	3	120	3.60	0.00	21.30	277	1001.8	0.50
155	12	3	140	3.10	0.00	22.39	347	1001.7	0.45
156	13	3	160	3.60	0.00	22.89	274	1001.8	0.44
157	14	3	170	3.10	0.00	22.80	240	1002.0	0.45
158	15	3	210	2.60	0.00	22.50	197	1002.0	0.48
159	16	3	200	2.60	0.00	22.60	171	1001.9	0.50
160	17	3	230	4.10	0.00	23.30	64	1001.7	0.48
161	18	3	170	3.10	0.00	23.89	93	1001.5	0.46
162	19	4	240	3.60	0.00	23.50	34	1001.5	0.47
163	20	4	190	2.60	0.00	21.50	-16	1001.5	0.53
164	21	6	160	2.00	0.00	18.80	-61	1001.4	0.64
165	22	6	155	0.50	0.00	16.60	-72	1000.9	0.77
166	23	6	157	0.50	0.19	15.69	-53	1000.2	0.86
167	24	5	150	1.00	0.60	15.69	-21	999.4	0.92
168	1	6	290	1.00	0.39	15.80	-19	998.8	0.94
169	2	5	150	1.50	0.00	15.39	-24	998.4	0.94
170	3	5	190	1.50	0.00	14.69	-10	998.1	0.94
171	4	6	190	2.00	0.00	14.39	-18	998.1	0.94
172	5	5	200	2.60	0.30	14.80	-25	998.1	0.93
173	6	4	210	2.60	0.19	15.60	24	998.0	0.91
174	7	4	190	3.60	0.19	16.50	174	997.6	0.88
175	8	4	230	5.60	0.00	17.10	204	997.1	0.82
176	9	4	230	5.10	0.00	17.69	173	996.4	0.74

177	10	4	220	6.10	0.00	18.60	120	995.7	0.64
178	11	4	230	7.10	0.00	19.89	127	995.0	0.53
179	12	4	230	8.69	0.00	21.10	124	994.5	0.45
180	13	4	230	9.69	0.00	21.69	120	994.2	0.43
181	14	4	240	10.19	0.00	21.10	118	994.1	0.49
182	15	4	220	7.10	0.00	19.89	118	994.1	0.61
183	16	4	220	6.60	0.30	18.69	114	994.1	0.72
184	17	4	250	8.69	0.00	18.00	97	994.2	0.77
185	18	4	240	7.69	0.00	17.69	117	994.1	0.75
186	19	4	240	7.10	0.00	17.50	67	993.8	0.72
187	20	4	250	6.10	0.00	17.19	16	993.5	0.72
188	21	4	230	4.10	0.00	16.89	-19	993.2	0.75
189	22	4	230	5.60	0.00	16.60	-19	993.1	0.77
190	23	4	240	5.60	0.00	16.39	-30	993.1	0.78
191	24	4	230	5.60	0.00	16.00	-29	993.1	0.80
192	1	4	230	4.10	0.00	15.39	-33	993.1	0.82
193	2	4	200	3.10	0.00	14.39	-38	993.2	0.85
194	3	5	200	2.00	0.00	13.30	-15	993.5	0.89
195	4	4	190	2.60	0.00	12.50	-6	994.1	0.94
196	5	5	190	2.00	0.00	12.30	4	994.7	0.97
197	6	4	200	3.60	0.00	12.69	34	995.1	1.00
198	7	4	200	4.60	0.00	13.50	65	995.2	0.99
199	8	4	200	5.10	0.00	14.60	95	995.0	0.94
200	9	4	200	5.10	0.00	15.89	117	994.8	0.85
201	10	4	210	5.60	0.00	16.89	133	994.7	0.77
202	11	4	230	8.69	0.00	17.50	144	994.7	0.69
203	12	4	240	7.10	0.00	17.80	148	994.7	0.63
204	13	4	240	7.69	0.00	17.69	146	994.6	0.59
205	14	4	250	6.10	0.00	17.30	138	994.5	0.58
206	15	4	250	8.19	0.00	16.89	219	994.4	0.59
207	16	4	250	5.10	1.50	16.39	190	994.4	0.63
208	17	4	210	5.10	0.00	15.89	90	994.4	0.71
209	18	3	230	4.60	0.10	15.30	70	994.2	0.80
210	19	4	250	3.60	0.19	14.50	47	993.9	0.87
211	20	4	320	5.60	0.00	13.50	30	993.5	0.87
212	21	4	310	4.60	0.00	12.30	-17	993.2	0.84
213	22	4	320	3.60	0.00	11.10	-19	993.0	0.81
214	23	4	230	3.10	0.00	9.89	-12	992.8	0.84
215	24	6	250	2.00	0.00	8.80	-35	992.7	0.89
216	1	5	200	2.60	0.00	8.10	-52	992.3	0.93
217	2	5	210	3.10	0.00	7.80	-50	991.9	0.95
218	3	5	195	2.60	0.00	7.69	-50	991.7	0.95
219	4	5	180	2.60	0.00	7.89	-37	991.6	0.93
220	5	5	180	3.10	0.00	8.19	-30	991.7	0.92
221	6	5	220	3.60	0.00	8.89	67	991.8	0.90
222	7	4	220	4.10	0.00	10.19	128	991.7	0.87
223	8	4	220	4.60	0.00	12.30	304	991.5	0.82
224	9	3	230	5.10	0.00	14.69	465	991.3	0.75
225	10	4	240	6.10	0.00	16.50	593	991.1	0.67
226	11	4	250	6.10	0.00	17.30	135	990.9	0.60
227	12	4	260	7.69	0.00	17.30	139	990.8	0.55
228	13	4	240	7.69	0.00	17.10	136	990.6	0.51
229	14	4	250	6.60	0.00	17.00	130	990.5	0.51
230	15	4	250	6.60	0.00	17.00	118	990.4	0.53
231	16	4	260	7.10	0.10	17.00	101	990.4	0.55
232	17	3	250	2.60	0.00	16.80	79	990.4	0.56
233	18	3	240	4.60	0.00	16.50	50	990.3	0.56
234	19	4	250	8.19	0.10	16.00	21	990.0	0.59
235	20	4	240	6.60	0.00	15.39	-4	989.7	0.65
236	21	4	230	6.60	0.00	14.69	-21	989.3	0.74
237	22	4	210	4.10	0.10	14.00	-17	988.9	0.82
238	23	4	190	3.10	0.00	13.39	-12	988.5	0.87
239	24	5	190	2.00	0.00	13.10	-8	988.2	0.88

10.2 Release during heavy rain

THE FIRST HOUR OF THIS DATASET IS THE HOUR OF THE RELEASE

ORDER OF PARAMETERS:

CODE NUMBER
TIME OF DAY (NUMBER OF HOUR)
STABILITY CLASS ACCORDING TO THE PASQUILL-GIFFORD NOTATION
(1 = VERY UNSTABLE, ..., 6 = VERY STABLE)
WIND DIRECTION (WIND COMES FROM...; N OVER O POSITIVE) <DEGREE>
WIND SPEED IN A HEIGTH OF 10 M ABOVE GROUND SURFACE <M/S>
RAIN INTENSITY <MM/H>
AIR TEMPERATURE IN A HEIGTH OF 2 M ABOVE GROUND SURFACE <DEGREE C>
NET RADIATION BALANCE TO A HORIZONTAL PLAIN SURFACE <WATT/M**2>
PRESSURE <HPA>
RELATIVE HUMIDITY (0.0 .... 1.0)

NR.	TIME	STAB.	DIR.	SPEED	RAIN	TEMP.	RAD.	PRESS.	REL.H.
1	11	4	270	2.00	5.00	18.89	220	996.8	0.92
2	12	4	270	2.00	5.00	19.39	366	996.8	0.92
3	13	3	270	2.00	0.80	19.39	247	996.9	0.93
4	14	3	290	2.00	0.19	18.80	152	997.2	0.93
5	15	3	280	2.60	0.00	17.80	139	997.6	0.92
6	16	3	330	2.60	0.00	16.89	119	998.1	0.92
7	17	3	330	3.10	1.19	16.39	144	998.4	0.92
8	18	3	310	0.50	1.19	16.10	102	998.6	0.95
9	19	4	330	1.50	1.19	16.10	44	998.9	0.92
10	20	5	280	1.00	0.00	16.10	-1	999.2	0.90
11	21	5	220	1.50	0.00	16.00	-8	999.6	0.88
12	22	5	200	2.00	0.00	15.89	-10	1000.0	0.87
13	23	4	270	4.10	0.00	15.60	-16	1000.3	0.88
14	24	5	250	2.00	0.00	15.30	-21	1000.6	0.90
15	1	4	290	3.60	0.00	14.89	-12	1000.7	0.92
16	2	4	300	2.60	0.00	14.60	-5	1000.7	0.93
17	3	5	290	1.50	0.00	14.39	-4	1000.6	0.92
18	4	4	290	3.10	0.19	14.10	-5	1000.6	0.92
19	5	4	240	4.10	0.19	13.80	-12	1000.7	0.92
20	6	4	270	3.10	0.19	13.50	-8	1000.9	0.93
21	7	4	300	3.10	0.19	13.60	45	1001.1	0.92
22	8	4	330	1.00	0.19	14.10	62	1001.4	0.90
23	9	4	220	2.00	0.10	14.80	91	1001.6	0.86
24	10	3	290	2.00	0.10	15.69	113	1001.7	0.81
25	11	3	280	2.60	0.00	16.50	207	1001.8	0.75
26	12	2	320	0.50	0.00	17.19	251	1001.7	0.70
27	13	3	10	2.00	0.00	17.60	297	1001.7	0.67
28	14	2	70	0.50	0.00	17.69	381	1001.8	0.66
29	15	2	110	0.50	0.00	17.50	242	1001.8	0.68
30	16	3	110	1.50	0.00	17.39	165	1001.8	0.71
31	17	2	120	1.00	0.00	17.30	126	1001.7	0.75
32	18	3	100	1.00	0.00	17.19	88	1001.7	0.79
33	19	4	100	2.00	0.00	16.89	31	1001.9	0.81
34	20	6	120	1.50	0.00	16.19	-26	1002.4	0.83
35	21	6	50	1.00	0.00	15.39	-38	1003.0	0.85
36	22	5	135	0.50	0.00	14.69	-30	1003.6	0.86
37	23	5	220	0.50	0.00	14.30	-22	1003.8	0.89
38	24	5	30	0.50	0.00	14.19	-20	1003.8	0.91
39	1	5	260	0.50	0.00	14.10	-13	1003.6	0.92
40	2	5	240	0.50	0.00	13.89	-5	1003.5	0.92
41	3	5	350	0.50	0.00	13.60	-5	1003.4	0.92
42	4	5	70	0.50	0.00	13.19	-5	1003.3	0.92

43	5	5	284	0.50	0.00	12.89	-11	1003.4	0.93
44	6	5	20	0.50	0.00	12.80	-7	1003.5	0.96
45	7	5	250	0.50	0.00	13.19	46	1003.8	0.92
46	8	4	310	1.50	0.00	14.19	101	1004.1	0.88
47	9	4	340	0.50	0.00	15.30	151	1004.4	0.81
48	10	2	340	1.00	0.00	16.30	175	1004.6	0.76
49	11	2	320	0.50	0.00	16.69	123	1004.6	0.72
50	12	2	340	0.50	0.00	16.89	131	1004.5	0.69
51	13	2	190	0.50	0.00	17.10	131	1004.2	0.66
52	14	2	40	0.50	0.00	17.69	212	1003.8	0.64
53	15	2	90	0.50	0.00	18.39	270	1003.4	0.63
54	16	3	160	2.00	0.00	18.89	180	1003.2	0.62
55	17	3	190	2.00	0.00	18.89	128	1003.0	0.64
56	18	4	130	2.00	0.00	18.50	75	1003.0	0.67
57	19	4	160	2.00	0.00	17.80	20	1003.1	0.71
58	20	6	140	1.50	0.00	16.89	-38	1003.3	0.76
59	21	6	170	0.50	0.00	15.89	-73	1003.6	0.82
60	22	6	200	0.50	0.00	14.69	-95	1003.8	0.86
61	23	6	190	0.50	0.00	13.19	-107	1003.9	0.90
62	24	6	220	1.00	0.00	11.80	-113	1003.9	0.92
63	1	6	150	0.50	0.00	11.00	-106	1003.8	0.92
64	2	6	200	0.50	0.00	11.00	-92	1003.6	0.92
65	3	6	200	0.50	0.00	11.39	-72	1003.3	0.92
66	4	6	80	0.50	0.00	11.80	-45	1003.1	0.92
67	5	5	150	0.50	0.00	11.89	-25	1003.0	0.92
68	6	5	350	1.00	0.00	11.80	-10	1003.0	0.92
69	7	5	80	1.00	0.00	11.89	42	1003.1	0.92
70	8	4	230	1.00	0.60	12.50	64	1003.3	0.95
71	9	4	350	1.00	0.60	13.60	94	1003.5	0.92
72	10	2	270	1.00	0.30	15.10	115	1003.6	0.86
73	11	2	230	0.50	0.10	17.00	207	1003.5	0.74
74	12	2	40	0.50	0.00	18.60	274	1003.3	0.64
75	13	3	270	2.00	0.00	19.30	213	1003.4	0.58
76	14	2	190	0.50	0.00	18.60	117	1003.7	0.62
77	15	3	40	1.50	0.10	17.19	112	1004.2	0.71
78	16	3	20	3.60	2.30	16.10	102	1004.5	0.81
79	17	3	185	3.10	0.39	15.80	145	1004.6	0.87
80	18	4	350	2.60	0.30	16.00	203	1004.6	0.87
81	19	4	330	1.00	0.30	16.00	18	1004.8	0.87
82	20	6	330	0.50	0.00	15.19	-89	1005.3	0.88
83	21	6	350	1.00	0.00	14.10	-100	1006.0	0.91
84	22	6	20	0.50	0.00	13.30	-93	1006.7	0.92
85	23	6	30	0.50	0.00	13.19	-78	1007.1	0.92
86	24	6	25	1.50	0.00	13.69	-66	1007.5	0.89
87	1	5	20	2.60	0.00	14.39	-48	1007.7	0.86
88	2	5	340	2.60	0.00	15.00	-36	1007.9	0.84
89	3	6	175	1.50	0.00	15.30	-38	1008.1	0.83
90	4	5	10	2.00	0.00	15.50	-33	1008.3	0.81
91	5	6	50	1.00	0.00	15.50	-34	1008.7	0.79
92	6	6	320	2.00	0.00	15.30	-33	1009.2	0.78
93	7	5	20	2.60	0.00	15.30	25	1009.7	0.76
94	8	5	20	5.10	0.00	15.50	165	1010.1	0.74
95	9	5	20	3.60	0.00	16.00	249	1010.5	0.71
96	10	4	10	6.60	0.00	17.00	516	1010.8	0.66
97	11	2	17	7.69	0.00	18.39	587	1011.1	0.61
98	12	3	14	8.69	0.00	20.00	441	1011.3	0.55
99	13	2	20	6.60	0.00	21.19	638	1011.4	0.52
100	14	2	10	7.10	0.00	21.80	622	1011.3	0.50
101	15	3	10	7.69	0.00	22.00	480	1011.0	0.49
102	16	3	20	5.10	0.00	22.19	325	1010.7	0.47
103	17	4	30	5.60	0.00	22.30	204	1010.5	0.46
104	18	4	10	4.60	0.00	22.19	113	1010.3	0.45
105	19	4	30	3.60	0.00	21.69	-17	1010.1	0.46
106	20	6	40	1.50	0.00	20.50	-101	1010.0	0.50
107	21	4	20	5.10	0.00	19.00	-107	1009.8	0.56
108	22	5	30	2.60	0.00	17.89	-97	1009.4	0.61
109	23	6	50	2.00	0.00	17.39	-94	1009.0	0.64

110	24	5	70	3.10	0.00	17.30	-98	1008.4	0.66
111	1	5	30	2.60	0.00	17.19	-98	1007.7	0.66
112	2	6	40	2.00	0.00	16.80	-98	1007.0	0.67
113	3	4	50	4.60	0.00	16.30	-92	1006.2	0.67
114	4	5	40	3.10	0.00	15.80	-79	1005.4	0.68
115	5	5	20	3.10	0.00	15.60	-73	1004.9	0.68
116	6	6	20	1.50	0.00	15.80	-66	1004.4	0.68
117	7	5	60	2.00	0.00	16.80	0	1004.0	0.65
118	8	5	80	2.60	0.00	18.30	105	1003.6	0.58
119	9	5	150	2.00	0.00	20.19	263	1003.2	0.51
120	10	3	80	2.00	0.00	22.19	319	1002.8	0.43
121	11	1	340	0.50	0.00	24.30	399	1002.3	0.36
122	12	1	110	0.50	0.00	26.10	517	1002.0	0.32
123	13	1	270	1.50	0.00	27.39	619	1001.7	0.29
124	14	1	330	1.00	0.00	27.89	405	1001.6	0.28
125	15	1	30	1.00	0.00	27.69	424	1001.4	0.30
126	16	2	270	1.50	0.00	27.00	403	1001.2	0.33
127	17	3	90	2.60	0.00	25.80	382	1001.1	0.39
128	18	3	180	0.50	0.00	24.60	138	1001.0	0.46
129	19	4	300	4.10	0.00	23.60	-21	1001.2	0.52
130	20	5	270	3.10	0.00	23.10	-62	1001.6	0.57
131	21	4	340	3.10	0.00	22.69	-58	1002.1	0.60
132	22	4	350	3.10	0.00	21.80	-49	1002.6	0.63
133	23	5	200	3.10	0.00	20.10	-49	1002.9	0.69
134	24	6	270	0.50	0.00	18.19	-54	1002.9	0.76
135	1	6	200	0.50	0.00	16.89	-54	1003.0	0.81
136	2	6	110	1.50	0.00	16.60	-51	1003.0	0.84
137	3	6	260	0.50	0.00	17.00	-44	1003.1	0.86
138	4	5	160	0.50	0.00	17.19	-30	1003.3	0.87
139	5	6	200	1.50	0.00	16.89	-35	1003.5	0.89
140	6	6	140	2.00	0.00	16.39	-54	1003.8	0.91
141	7	6	160	1.00	0.00	16.30	31	1004.0	0.92
142	8	5	200	0.50	0.00	17.10	221	1004.3	0.90
143	9	5	290	0.50	0.00	18.60	248	1004.4	0.84
144	10	2	270	1.00	0.00	20.19	262	1004.4	0.76
145	11	2	330	1.50	0.00	21.60	246	1004.3	0.68
146	12	1	160	2.00	0.00	22.69	592	1004.0	0.60
147	13	1	220	2.60	0.00	23.80	383	1003.6	0.52
148	14	1	260	4.10	0.00	24.89	593	1003.2	0.46
149	15	1	300	2.00	0.00	25.80	475	1002.8	0.42
150	16	1	280	2.60	0.00	26.19	375	1002.5	0.40
151	17	2	270	1.00	0.00	26.00	270	1002.3	0.43
152	18	3	280	2.00	0.00	25.30	88	1002.1	0.46
153	19	3	300	3.10	0.00	24.19	-27	1002.1	0.49
154	20	4	280	4.60	0.00	22.80	-70	1002.2	0.49
155	21	4	250	3.60	0.00	21.39	-73	1002.2	0.49
156	22	5	230	2.60	0.00	20.19	-71	1002.2	0.51
157	23	6	200	2.00	0.00	19.50	-64	1002.1	0.60
158	24	6	230	1.50	0.00	19.10	-53	1001.9	0.73
159	1	4	210	3.10	0.10	18.89	-36	1001.7	0.87
160	2	4	200	3.10	0.10	18.69	-20	1001.5	0.95
161	3	4	170	2.60	0.10	18.39	-17	1001.3	0.96
162	4	4	230	2.60	0.10	17.89	-11	1001.3	0.93
163	5	5	250	2.00	0.10	17.19	-5	1001.3	0.90
164	6	5	290	2.00	0.10	16.39	-5	1001.5	0.88
165	7	4	310	1.50	0.10	16.00	22	1001.7	0.87
166	8	4	260	1.50	1.60	16.10	84	1001.8	0.86
167	9	4	270	1.00	1.39	16.80	146	1001.9	0.84
168	10	3	250	2.00	0.89	17.89	172	1001.9	0.81
169	11	2	240	0.50	0.00	19.19	122	1001.8	0.76
170	12	3	290	2.60	0.00	20.19	130	1001.6	0.72
171	13	3	210	3.10	0.00	20.10	131	1001.4	0.72
172	14	3	200	2.60	1.00	18.60	129	1001.1	0.77
173	15	3	130	1.50	3.80	16.39	124	1000.8	0.88
174	16	2	140	1.00	7.50	14.80	113	1000.6	0.98
175	17	3	130	2.00	1.30	14.60	139	1000.5	1.00
176	18	3	220	0.50	1.30	15.19	95	1000.4	1.00

177	19	4	240	2.60	1.19	15.80	37	1000.5	0.98
178	20	5	260	2.00	0.00	15.80	1	1000.6	0.98
179	21	5	240	2.00	0.00	15.30	0	1000.8	1.00
180	22	4	220	2.60	0.00	14.80	1	1001.0	0.99
181	23	4	250	2.60	0.00	14.60	-7	1001.1	0.96
182	24	4	220	3.60	0.00	14.60	-18	1001.2	0.90
183	1	4	310	3.60	0.00	14.80	-21	1001.3	0.87
184	2	4	300	4.10	0.10	14.89	-23	1001.5	0.86
185	3	4	300	3.10	0.19	14.89	-22	1001.7	0.87
186	4	4	300	4.60	0.19	14.80	-16	1002.1	0.87
187	5	4	290	3.10	0.19	14.60	-10	1002.6	0.84
188	6	4	330	3.10	0.10	14.19	-10	1003.3	0.82
189	7	4	330	3.60	0.10	13.80	16	1004.0	0.81
190	8	4	310	1.50	0.10	13.30	80	1004.8	0.82
191	9	4	280	4.60	0.10	13.19	144	1005.6	0.84
192	10	3	300	4.60	0.10	13.89	199	1006.4	0.81
193	11	2	300	2.60	0.19	15.60	445	1007.0	0.73
194	12	3	310	5.60	0.00	17.69	554	1007.4	0.63
195	13	2	340	6.60	0.00	19.39	721	1007.6	0.55
196	14	1	320	4.60	0.00	20.00	566	1007.6	0.50
197	15	3	350	5.10	0.00	19.89	321	1007.6	0.48
198	16	3	350	3.60	0.30	19.50	177	1007.5	0.48
199	17	3	350	3.10	0.00	19.30	99	1007.5	0.48
200	18	4	290	3.10	0.00	19.10	37	1007.7	0.49
201	19	4	300	3.10	0.30	18.50	-13	1008.0	0.51
202	20	5	320	2.60	0.00	17.19	-68	1008.4	0.55
203	21	6	290	0.50	0.00	15.60	-92	1008.9	0.60
204	22	6	270	1.50	0.00	14.30	-104	1009.3	0.66
205	23	6	240	0.50	0.00	13.60	-101	1009.6	0.72
206	24	6	180	0.50	0.00	13.39	-81	1009.8	0.77
207	1	5	200	1.50	0.00	13.50	-47	1009.7	0.81
208	2	4	120	3.60	0.00	13.60	-19	1009.5	0.84
209	3	5	200	1.50	0.00	13.60	-11	1009.2	0.85
210	4	4	190	3.60	0.00	13.60	-10	1008.9	0.86
211	5	4	200	4.10	0.00	13.60	-16	1008.7	0.86
212	6	4	190	4.60	0.00	13.80	-20	1008.6	0.85
213	7	4	210	4.60	0.00	14.39	28	1008.6	0.81
214	8	4	210	6.10	0.00	15.50	77	1008.7	0.74
215	9	4	250	5.60	0.00	16.89	253	1008.8	0.67
216	10	4	260	7.69	0.00	18.10	412	1008.9	0.62
217	11	3	240	5.10	0.00	18.89	494	1008.9	0.61
218	12	2	240	8.19	0.00	19.39	530	1008.8	0.61
219	13	1	200	6.60	0.00	20.10	519	1008.5	0.59
220	14	1	200	7.10	0.00	21.19	591	1008.1	0.54
221	15	1	200	9.19	0.00	22.30	505	1007.6	0.48
222	16	2	210	7.69	0.00	22.89	383	1007.2	0.45
223	17	3	200	8.69	0.00	22.69	194	1006.9	0.47
224	18	3	200	6.10	0.00	21.89	134	1006.7	0.50
225	19	4	210	5.60	0.00	20.89	-41	1006.7	0.55
226	20	4	200	4.60	0.00	19.89	-98	1006.8	0.59
227	21	6	210	2.00	0.00	18.89	-107	1007.1	0.62
228	22	5	210	2.60	0.00	17.69	-110	1007.3	0.67
229	23	5	170	3.10	0.00	16.30	-108	1007.6	0.73
230	24	4	210	4.10	0.00	15.00	-105	1007.8	0.80

10.3 Release in the morning

THE FIRST HOUR OF THIS DATASET IS THE HOUR OF THE RELEASE

ORDER OF PARAMETERS:

CODE NUMBER
TIME OF DAY (NUMBER OF HOUR)
STABILITY CLASS ACCORDING TO THE PASQUILL-GIFFORD NOTATION
(1 = VERY UNSTABLE, ..., 6 = VERY STABLE)
WIND DIRECTION (WIND COMES FROM...; N OVER O POSITIVE) <DEGREE>
WIND SPEED IN A HEIGTH OF 10 M ABOVE GROUND SURFACE <M/S>
RAIN INTENSITY <MM/H>
AIR TEMPERATURE IN A HEIGTH OF 2 M ABOVE GROUND SURFACE <DEGREE C>
NET RADIATION BALANCE TO A HORIZONTAL PLAIN SURFACE <WATT/M**2>
PRESSURE <HPA>
RELATIVE HUMIDITY (0.0 .... 1.0)

NR.	TIME	STAB.	DIR.	SPEED	RAIN	TEMP.	RAD.	PRESS.	REL.H.
1	8	5	60	0.50	0.00	11.19	307	1007.5	0.82
2	9	2	20	0.50	0.00	13.69	371	1007.5	0.68
3	10	2	30	1.00	0.00	16.00	633	1007.4	0.58
4	11	1	190	1.00	0.00	17.89	684	1007.2	0.51
5	12	1	110	1.50	0.00	19.30	469	1006.9	0.47
6	13	1	270	0.50	0.00	20.19	722	1006.5	0.45
7	14	1	80	0.50	0.00	20.69	475	1006.0	0.45
8	15	1	30	1.50	0.00	21.00	609	1005.5	0.45
9	16	1	270	1.50	0.00	21.19	586	1005.1	0.45
10	17	2	330	0.50	0.00	21.39	277	1004.6	0.44
11	18	2	300	0.50	0.00	21.39	302	1004.3	0.44
12	19	4	60	0.50	0.00	21.00	63	1004.3	0.45
13	20	4	100	0.50	0.00	19.69	-9	1004.4	0.50
14	21	5	70	3.10	0.00	17.89	-54	1004.7	0.58
15	22	5	90	2.00	0.00	16.10	-56	1004.9	0.67
16	23	4	80	4.10	0.00	14.50	-59	1004.9	0.75
17	24	6	70	0.50	0.00	13.19	-78	1004.7	0.81
18	1	6	40	1.00	0.00	12.10	-102	1004.5	0.86
19	2	6	30	0.50	0.00	11.10	-113	1004.4	0.90
20	3	6	20	2.00	0.00	10.50	-112	1004.4	0.91
21	4	6	60	1.50	0.00	10.30	-105	1004.4	0.92
22	5	6	60	1.50	0.00	10.80	-86	1004.4	0.92
23	6	6	40	1.00	0.00	11.89	1	1004.4	0.89
24	7	5	50	2.00	0.00	13.60	184	1004.4	0.81
25	8	5	60	3.10	0.00	15.69	313	1004.5	0.69
26	9	2	120	0.50	0.00	18.00	394	1004.5	0.57
27	10	2	120	2.60	0.00	20.10	563	1004.4	0.48
28	11	1	210	2.00	0.00	21.80	545	1004.2	0.42
29	12	1	230	1.50	0.00	23.10	656	1003.8	0.39
30	13	1	270	1.00	0.00	24.19	708	1003.4	0.38
31	14	1	310	1.00	0.00	25.10	800	1003.0	0.37
32	15	1	160	0.50	0.00	25.80	585	1002.5	0.37
33	16	2	270	1.50	0.00	26.30	474	1002.1	0.38
34	17	2	130	1.00	0.00	26.50	228	1001.7	0.39
35	18	2	100	1.00	0.00	26.19	315	1001.4	0.40
36	19	4	120	1.00	0.00	25.10	33	1001.3	0.43
37	20	4	30	1.00	0.00	23.19	-15	1001.3	0.49
38	21	5	70	2.60	0.00	21.00	-68	1001.4	0.55
39	22	5	70	1.50	0.00	19.00	-82	1001.6	0.63
40	23	6	50	1.00	0.00	17.69	-76	1001.8	0.69
41	24	6	140	1.50	0.00	16.89	-66	1001.9	0.72
42	1	6	50	1.00	0.00	16.19	-52	1001.8	0.76

43	2	6	60	2.00	0.00	15.39	-42	1001.4	0.80
44	3	5	10	2.60	0.00	14.50	-46	1001.0	0.84
45	4	6	60	1.50	0.00	14.00	-49	1000.8	0.87
46	5	6	55	2.00	0.00	14.00	-44	1000.9	0.87
47	6	6	50	3.10	0.00	14.60	42	1001.1	0.83
48	7	5	40	2.00	0.00	15.89	160	1001.2	0.76
49	8	5	320	1.50	0.00	17.80	240	1001.0	0.66
50	9	2	320	1.50	0.00	20.00	490	1000.7	0.57
51	10	3	270	1.50	0.00	21.89	580	1000.3	0.49
52	11	2	100	1.50	0.00	23.30	564	999.9	0.42
53	12	1	40	1.00	0.00	24.19	731	999.5	0.38
54	13	2	270	1.00	0.00	24.89	315	999.1	0.35
55	14	1	40	0.50	0.00	25.60	295	998.6	0.33
56	15	1	190	1.50	0.00	26.39	764	998.0	0.32
57	16	1	270	1.50	0.00	27.00	578	997.4	0.31
58	17	2	240	0.50	0.00	27.39	469	996.9	0.31
59	18	2	120	1.50	0.00	27.30	298	996.5	0.32
60	19	4	70	2.60	0.00	26.30	145	996.4	0.36
61	20	4	10	2.00	0.00	24.30	-7	996.5	0.42
62	21	5	110	2.60	0.00	21.69	-99	996.8	0.52
63	22	5	60	0.50	0.00	19.10	-89	997.1	0.63
64	23	6	65	1.00	0.00	17.00	-74	997.2	0.73
65	24	6	70	0.50	0.00	15.60	-68	997.4	0.80
66	1	6	50	0.50	0.00	15.19	-66	997.6	0.81
67	2	6	80	1.50	0.00	15.60	-72	998.0	0.79
68	3	6	250	1.00	0.00	16.10	-86	998.5	0.75
69	4	5	230	2.60	0.00	16.19	-82	998.9	0.73
70	5	4	240	4.10	0.00	15.50	-53	999.0	0.75
71	6	4	210	3.10	0.00	14.60	15	998.9	0.78
72	7	4	220	3.10	0.10	13.69	81	998.5	0.81
73	8	4	220	5.10	0.10	13.00	130	997.9	0.84
74	9	4	220	5.10	0.10	12.60	113	997.0	0.86
75	10	4	210	6.10	0.10	12.39	137	996.0	0.86
76	11	4	200	6.60	0.10	12.60	155	995.0	0.83
77	12	4	190	5.60	0.00	13.00	164	994.2	0.79
78	13	4	200	7.69	0.00	13.39	165	993.7	0.76
79	14	4	210	7.69	0.00	13.69	159	993.4	0.75
80	15	4	210	6.60	0.00	13.80	148	993.1	0.78
81	16	4	210	6.10	0.00	14.00	131	992.9	0.81
82	17	3	210	4.10	0.00	14.30	109	992.7	0.84
83	18	4	220	6.60	0.00	14.80	131	992.5	0.86
84	19	4	210	5.60	0.00	15.10	89	992.4	0.87
85	20	4	210	5.10	0.89	15.19	34	992.2	0.84
86	21	4	200	5.60	0.80	15.19	-11	992.1	0.82
87	22	4	200	5.10	0.69	15.19	-14	992.1	0.81
88	23	4	200	6.10	0.50	15.10	-20	992.0	0.84
89	24	4	210	5.60	0.69	14.89	-30	992.1	0.89
90	1	4	230	4.60	1.19	14.10	-19	992.3	0.93
91	2	4	250	5.60	0.00	12.69	-18	992.8	0.92
92	3	4	260	5.60	0.00	11.30	-59	993.5	0.89
93	4	4	230	5.10	0.00	10.30	-80	994.1	0.86
94	5	4	230	6.10	0.00	10.30	-58	994.5	0.84
95	6	4	200	4.10	0.00	10.89	17	994.7	0.83
96	7	3	300	5.10	0.00	11.69	163	994.9	0.81
97	8	3	230	7.69	0.50	12.39	238	994.9	0.78
98	9	4	220	8.19	0.30	13.00	555	995.0	0.73
99	10	4	230	8.19	0.00	13.60	322	995.0	0.71
100	11	4	240	8.69	0.00	14.39	299	995.1	0.69
101	12	3	240	9.69	0.00	15.10	375	995.1	0.68
102	13	4	250	9.19	0.00	15.50	374	995.2	0.66
103	14	4	240	8.69	0.00	15.39	346	995.4	0.64
104	15	4	240	7.10	0.00	15.00	298	995.5	0.62
105	16	3	240	8.69	0.00	14.50	333	995.7	0.62
106	17	4	230	9.19	0.00	14.19	195	995.8	0.63
107	18	4	230	8.69	0.00	13.80	185	996.0	0.66
108	19	4	230	6.10	0.00	13.30	72	996.3	0.71
109	20	4	220	7.10	0.00	12.50	24	996.7	0.74

110	21	4	210	4.10	0.00	11.60	-22	997.2	0.78
111	22	4	210	6.60	0.00	10.89	-27	997.7	0.81
112	23	4	220	4.60	0.00	10.69	-26	998.0	0.81
113	24	4	210	6.10	0.00	10.80	-26	998.1	0.81
114	1	4	210	6.10	0.00	11.00	-26	998.1	0.81
115	2	4	220	6.60	0.00	11.10	-26	997.8	0.80
116	3	4	210	5.60	0.00	11.10	-26	997.6	0.81
117	4	4	230	6.60	0.00	11.19	-26	997.4	0.81
118	5	4	220	6.60	0.00	11.50	-17	997.4	0.80
119	6	4	210	6.60	0.00	11.89	30	997.7	0.80
120	7	4	220	6.60	0.00	12.30	85	998.0	0.81
121	8	4	230	7.10	0.00	12.60	142	998.4	0.82
122	9	4	220	7.69	0.00	12.80	211	998.8	0.84
123	10	4	220	7.69	0.00	13.39	262	999.1	0.81
124	11	4	230	7.69	0.00	14.30	275	999.3	0.75
125	12	4	240	9.19	0.00	15.19	304	999.4	0.69
126	13	4	240	6.10	0.00	15.60	331	999.7	0.66
127	14	4	240	7.10	0.00	15.10	366	1000.0	0.69
128	15	3	270	4.10	0.50	14.19	453	1000.4	0.76
129	16	4	270	5.10	1.39	13.39	260	1000.8	0.81
130	17	3	240	4.10	0.89	13.10	211	1001.0	0.82
131	18	3	260	3.60	0.69	13.19	142	1001.3	0.79
132	19	3	300	3.60	0.30	13.39	82	1001.7	0.76
133	20	3	300	3.60	0.00	13.50	25	1002.4	0.73
134	21	4	290	3.60	0.00	13.50	-30	1003.2	0.71
135	22	4	280	3.60	0.00	13.39	-40	1003.9	0.71
136	23	4	290	3.10	0.00	13.19	-35	1004.3	0.71
137	24	4	300	3.60	0.00	12.89	-34	1004.6	0.72
138	1	5	230	1.50	0.00	12.39	-33	1004.7	0.75
139	2	5	220	2.00	0.00	11.60	-28	1004.7	0.82
140	3	5	210	0.50	0.00	10.89	-23	1004.8	0.88
141	4	5	200	0.50	0.00	10.50	-19	1004.9	0.92
142	5	5	190	1.00	0.00	10.69	-4	1005.1	0.91
143	6	5	260	1.00	0.00	11.19	24	1005.3	0.86
144	7	4	300	2.00	0.00	11.69	81	1005.7	0.81
145	8	4	290	3.10	0.00	11.80	127	1006.1	0.77
146	9	3	300	2.00	0.00	11.89	103	1006.6	0.74
147	10	2	290	1.00	0.00	12.30	124	1006.9	0.70
148	11	3	250	2.00	0.00	13.30	233	1007.1	0.66
149	12	3	300	2.00	0.00	14.50	335	1007.2	0.62
150	13	2	270	1.50	0.00	15.60	326	1007.3	0.58
151	14	2	240	2.00	0.00	16.19	555	1007.2	0.56
152	15	3	270	3.60	0.00	16.50	403	1007.2	0.54
153	16	3	260	3.10	0.00	16.60	306	1007.2	0.54
154	17	3	240	4.60	0.00	16.80	180	1007.2	0.55
155	18	3	270	2.60	0.00	16.89	171	1007.3	0.56
156	19	3	230	2.60	0.00	16.69	58	1007.5	0.58
157	20	3	230	2.60	0.00	16.00	10	1007.8	0.62
158	21	4	250	2.60	0.00	15.19	-34	1008.1	0.66
159	22	4	180	1.50	0.00	14.30	-38	1008.3	0.71
160	23	5	190	2.00	0.00	13.69	-27	1008.4	0.75
161	24	4	190	3.10	0.00	13.30	-25	1008.5	0.78
162	1	4	200	2.60	0.10	13.00	-28	1008.4	0.81
163	2	5	190	2.00	0.00	12.60	-25	1008.3	0.85
164	3	4	200	3.10	0.00	12.30	-22	1008.2	0.90
165	4	4	210	4.10	0.00	12.19	-19	1008.2	0.92
166	5	4	200	4.60	0.00	12.30	-11	1008.3	0.92
167	6	4	200	4.60	0.00	12.69	36	1008.6	0.89
168	7	4	210	4.10	0.00	13.19	89	1008.8	0.86
169	8	4	210	5.60	0.00	13.80	143	1009.1	0.84
170	9	4	220	5.10	0.00	14.39	200	1009.3	0.82
171	10	3	210	4.10	0.00	14.89	214	1009.5	0.81
172	11	3	220	4.60	0.00	15.30	151	1009.7	0.81
173	12	4	240	6.10	0.00	15.69	163	1009.9	0.81
174	13	3	240	4.60	0.00	15.89	166	1010.0	0.81
175	14	3	210	4.10	0.30	16.00	162	1010.0	0.82
176	15	3	210	4.10	0.39	16.10	152	1010.0	0.84

177	16	3	200	2.60	0.60	16.00	135	1010.0	0.87
178	17	3	210	3.60	0.30	15.80	114	1010.0	0.91
179	18	3	190	1.50	0.50	15.60	89	1010.0	0.96
180	19	4	180	2.00	0.50	15.39	61	1010.2	0.97
181	20	4	170	1.50	0.00	15.30	30	1010.3	0.97
182	21	5	180	1.00	0.00	15.30	-1	1010.5	0.95
183	22	5	190	1.00	0.00	15.30	-17	1010.7	0.92
184	23	5	190	1.50	0.00	15.30	-17	1010.9	0.95
185	24	5	200	1.50	0.00	15.39	-16	1011.0	0.97
186	1	5	210	1.50	0.00	15.39	-8	1011.0	0.99
187	2	5	220	2.00	0.00	15.39	0	1010.9	0.99
188	3	5	240	0.50	0.00	15.39	0	1010.7	0.99
189	4	5	190	1.00	0.00	15.19	-7	1010.5	1.00
190	5	5	140	1.50	0.00	15.00	-6	1010.5	1.00
191	6	5	160	1.00	0.00	14.80	47	1010.6	1.00
192	7	4	220	2.00	0.00	15.00	97	1010.7	1.00
193	8	4	230	1.00	0.00	15.69	151	1010.7	0.96
194	9	2	238	1.00	0.00	16.80	216	1010.7	0.88
195	10	2	244	0.50	0.00	18.00	214	1010.8	0.81
196	11	2	235	0.50	0.00	19.19	146	1010.9	0.74
197	12	2	250	1.00	0.00	20.19	259	1010.9	0.69
198	13	2	230	1.00	0.00	21.19	303	1010.8	0.63
199	14	1	240	1.00	0.00	22.10	397	1010.4	0.59
200	15	1	240	1.00	0.00	22.80	750	1009.9	0.55
201	16	1	320	1.50	0.00	23.50	649	1009.3	0.52
202	17	2	350	1.00	0.00	24.00	422	1008.9	0.50
203	18	2	330	1.00	0.00	24.00	312	1008.5	0.50
204	19	4	170	0.50	0.00	23.19	113	1008.1	0.52
205	20	4	10	0.50	0.00	21.39	5	1007.7	0.60
206	21	6	70	1.00	0.00	19.19	-56	1007.4	0.70
207	22	6	50	1.00	0.00	17.19	-70	1007.2	0.81
208	23	6	40	1.00	0.00	16.00	-83	1007.1	0.88
209	24	6	30	1.00	0.00	15.39	-87	1007.0	0.91
210	1	6	40	2.00	0.00	14.89	-87	1006.8	0.92
211	2	6	40	0.50	0.00	14.19	-99	1006.3	0.96
212	3	6	60	2.00	0.00	13.50	-111	1005.8	0.98
213	4	5	30	2.60	0.00	13.19	-104	1005.4	0.99
214	5	6	40	2.00	0.00	13.50	-90	1005.3	0.98
215	6	6	40	2.60	0.00	14.50	0	1005.4	0.94
216	7	5	40	2.00	0.00	16.10	116	1005.4	0.87
217	8	5	60	3.10	0.00	18.10	298	1005.4	0.79
218	9	2	60	2.00	0.00	20.30	426	1005.1	0.71
219	10	2	90	2.00	0.00	22.30	514	1004.7	0.63
220	11	1	120	3.10	0.00	23.80	597	1004.3	0.58
221	12	1	100	2.60	0.00	24.80	560	1003.7	0.54
222	13	1	70	3.10	0.00	25.69	736	1003.1	0.49
223	14	1	100	2.00	0.00	26.50	709	1002.5	0.46
224	15	1	90	2.00	0.00	27.10	552	1001.8	0.43
225	16	1	110	2.00	0.00	27.60	556	1001.2	0.41
226	17	2	110	2.60	0.00	27.69	337	1000.6	0.41
227	18	2	120	2.00	0.00	27.39	215	1000.0	0.42
228	19	4	100	1.50	0.00	26.30	108	999.7	0.46
229	20	4	80	1.50	0.00	24.39	-15	999.6	0.54
230	21	6	80	2.00	0.00	22.19	-107	999.6	0.63
231	22	6	80	2.00	0.00	20.19	-110	999.6	0.72
232	23	6	50	2.00	0.00	18.80	-112	999.5	0.79
233	24	6	50	2.00	0.00	17.89	-117	999.4	0.84

11. APPENDIX E-1 : Normal Operation Results, Tritium

parameter	value
deposition velocity HTO	-
washout coefficient HTO	3.5E-5 s^{-1} for 1 mm/h
release rate	10 Ci HTO per day
no building wake	150 m rel. height
sigma parameters	Karlsruhe/Jülich
dose conversion factor HTO **inhalation** in Sv/Bq	1.7 E-11
dose conversion factor HTO **ingestion** in Sv/Bq	1.7 E-11
dose conversion factor OBT **ingestion** in Sv/Bq	4.5 E-11
breathing rate in m^3 / s	2.66 E-4
skin absorption rate in m^3 / s	-
ingestion rate in kg per year: vegetables	610
ingestion rate in kg per year: meat	125
ingestion rate in kg per year: milk	320
population data	250 persons / km^2

Table 96. Dose calculations for radioactive effluents during normal opperations, some reference input parameters

max. dose (Sv/a) in distance	dose from inhalation	dose from ingestion (no OBT)	dose from ingestion (with OBT)
500 m	9.0 E-8	1.8 E-6	2.5 E-6
1000 m	7.3 E-8	9.4 E-7	1.3 E-6
2000 m	5.1 E-8	5.0 E-7	7.0 E-7
10 km	1.3 E-8	1.0 E-7	1.4 E-7
100 km	1.9 E-9	1.1 E-8	1.5 E-8

Table 97. Anual dose to the most exposed individual from routine releases of 10 Ci HTO per day

	dose from inhalation	dose from ingestion (no OBT)	dose from ingestion (with OBT)
collective dose up to 100 km	1.8 E-2 man*Sv	7.2 E-2 man*Sv	9.7 E-2 man*Sv

Table 98. Annual collective dose from routine releases of 10 Ci HTO per day for a homogenous population distribution of 250 P/km^2

12. APPENDIX E-2 : Normal Operation Results, Activation Products

nuclide	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
CR- 51	0.95	68.80	10.80	19.14	0.30	0.574E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.128E-12
MN- 54	0.16	91.68	1.63	6.42	0.11	0.982E-07
MN- 56	69.64	13.98	16.37	0.00	0.00	0.466E-09
FE- 55	0.00	0.00	6.96	92.53	0.50	0.476E-08
FE- 59	0.68	58.16	8.97	31.86	0.33	0.333E-07
CO- 56	0.64	89.66	9.27	0.00	0.44	0.109E-06
CO- 57	0.08	69.33	10.27	19.65	0.66	0.232E-07
CO- 58M	0.00	0.00	99.94	0.00	0.06	0.210E-10
CO- 58	0.51	75.02	7.73	16.38	0.35	0.354E-07
CO- 60M	16.46	83.54	0.00	0.00	0.00	0.407E-11
CO- 60	0.04	82.75	4.41	12.47	0.33	0.129E-05
CO- 61	83.95	16.05	0.00	0.00	0.00	0.154E-10
NI- 59	0.00	0.01	16.12	82.63	1.23	0.149E-08
NI- 63	0.00	0.00	15.22	83.63	1.16	0.389E-08
MO- 93	0.00	1.19	50.82	44.11	3.87	0.151E-07
MO- 99	2.04	25.05	44.60	28.12	0.19	0.133E-08
TC- 99M	46.97	39.26	13.76	0.00	0.01	0.436E-10
W -181	0.20	67.61	1.54	30.57	0.08	0.219E-08

Table 99. Contributions (in %) of exposure pathways to mean annual organ dose (0.5 km distance; normal operation): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
CR- 51	0.85	69.76	9.67	19.40	0.31	0.197E-09
MN- 53	0.00	100.00	0.00	0.00	0.00	0.446E-13
MN- 54	0.14	91.93	1.44	6.38	0.11	0.341E-07
MN- 56	68.37	15.55	16.07	0.00	0.00	0.144E-09
FE- 55	0.00	0.00	6.24	93.24	0.51	0.163E-08
FE- 59	0.61	58.82	8.01	32.23	0.33	0.115E-07
CO- 56	0.57	90.71	8.28	0.00	0.44	0.373E-07
CO- 57	0.08	70.38	9.21	19.67	0.67	0.795E-08
CO- 58M	0.00	0.00	99.93	0.00	0.07	0.645E-11
CO- 58	0.45	75.85	6.90	16.44	0.36	0.122E-07
CO- 60M	14.82	85.18	0.00	0.00	0.00	0.117E-11
CO- 60	0.03	83.36	3.92	12.36	0.33	0.444E-06
CO- 61	82.20	17.80	0.00	0.00	0.00	0.475E-11
NI- 59	0.00	0.02	14.67	84.04	1.27	0.502E-09
NI- 63	0.00	0.00	13.84	84.97	1.19	0.132E-08
MO- 93	0.00	1.28	48.04	46.54	4.15	0.492E-08
MO- 99	1.91	26.49	41.65	29.75	0.20	0.436E-09
TC- 99M	44.64	42.27	13.08	0.00	0.01	0.141E-10
W -181	0.18	67.97	1.37	30.40	0.08	0.758E-09

Table 100. Contributions (in %) of exposure pathways to mean annual organ dose (1.0 km distance; normal operation): 1.E + 9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
CR- 51	0.74	70.91	8.33	19.72	0.31	0.696E-10
MN- 53	0.00	100.00	0.00	0.00	0.00	0.160E-13
MN- 54	0.12	92.20	1.23	6.35	0.11	0.122E-07
MN- 56	66.51	17.85	15.63	0.00	0.00	0.439E-10
FE- 55	0.00	0.00	5.38	94.10	0.52	0.575E-09
FE- 59	0.52	59.59	6.88	32.67	0.34	0.406E-08
CO- 56	0.49	91.95	7.11	0.00	0.45	0.132E-07
CO- 57	0.06	71.58	7.94	19.74	0.68	0.281E-08
CO- 58M	0.00	0.00	99.92	0.00	0.08	0.195E-11
CO- 58	0.39	76.80	5.92	16.53	0.36	0.432E-08
CO- 60M	12.85	87.15	0.00	0.00	0.00	0.295E-12
CO- 60	0.03	84.02	3.35	12.27	0.33	0.158E-06
CO- 61	79.64	20.36	0.00	0.00	0.00	0.144E-11
NI- 59	0.00	0.02	12.85	85.82	1.31	0.174E-09
NI- 63	0.00	0.00	12.11	86.66	1.23	0.457E-09
MO- 93	0.00	1.39	44.22	49.89	4.50	0.162E-08
MO- 99	1.73	28.38	37.80	31.88	0.21	0.146E-09
TC- 99M	41.48	46.36	12.16	0.00	0.01	0.460E-11
W -181	0.15	68.33	1.16	30.27	0.08	0.271E-09

Table 101. Contributions (in %) of exposure pathways to mean annual organ dose (2.0 km distance; normal operation): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
CR- 51	0.48	73.34	5.45	20.40	0.32	0.667E-11
MN- 53	0.00	100.00	0.00	0.00	0.00	0.159E-14
MN- 54	0.08	92.63	0.78	6.41	0.11	0.121E-08
MN- 56	60.26	25.58	14.16	0.00	0.00	0.247E-11
FE- 55	0.00	0.00	3.46	96.01	0.53	0.562E-10
FE- 59	0.34	61.26	4.47	33.58	0.35	0.392E-09
CO- 56	0.32	94.59	4.63	0.00	0.46	0.128E-08
CO- 57	0.04	73.62	5.17	20.46	0.70	0.271E-09
CO- 58M	0.00	0.00	99.87	0.00	0.13	0.116E-12
CO- 58	0.25	78.57	3.83	16.98	0.37	0.419E-09
CO- 60M	8.44	91.56	0.00	0.00	0.00	0.198E-14
CO- 60	0.02	84.98	2.15	12.52	0.33	0.155E-07
CO- 61	71.21	28.79	0.00	0.00	0.00	0.760E-13
NI- 59	0.00	0.02	8.48	90.13	1.37	0.166E-10
NI- 63	0.00	0.00	7.97	90.75	1.28	0.437E-10
MO- 93	0.00	1.65	33.26	59.74	5.35	0.136E-09
MO- 99	1.28	33.20	27.99	37.28	0.25	0.123E-10
TC- 99M	32.69	57.72	9.58	0.00	0.01	0.363E-12
W -181	0.10	68.54	0.74	30.54	0.09	0.268E-10

Table 102. Contributions (in %) of exposure pathways to mean annual organ dose (10.0 km distance; normal operation): 1.E+9 Bq released from each nuclide

nuclide	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
CR- 51	0.75	70.72	8.50	19.72	0.31	0.207E-12
MN- 53	0.00	100.00	0.00	0.00	0.00	0.478E-16
MN- 54	0.12	91.73	1.25	6.79	0.11	0.366E-10
MN- 56	66.54	17.81	15.64	0.00	0.00	0.107E-13
FE- 55	0.00	0.00	5.16	94.35	0.49	0.183E-11
FE- 59	0.54	59.56	7.04	32.53	0.34	0.121E-10
CO- 56	0.50	91.78	7.27	0.00	0.45	0.394E-10
CO- 57	0.06	69.75	7.92	21.60	0.67	0.859E-11
CO- 58M	0.00	0.00	99.92	0.00	0.08	0.313E-14
CO- 58	0.39	75.87	5.99	17.40	0.36	0.131E-10
CO- 60M	12.06	87.94	0.00	0.00	0.00	0.462E-28
CO- 60	0.03	82.52	3.37	13.76	0.32	0.481E-09
CO- 61	79.56	20.44	0.00	0.00	0.00	0.138E-15
NI- 59	0.00	0.01	11.95	86.85	1.19	0.573E-12
NI- 63	0.00	0.00	11.23	87.65	1.11	0.151E-11
MO- 93	0.00	1.29	42.21	52.30	4.20	0.521E-11
MO- 99	1.76	28.14	38.36	31.54	0.21	0.403E-12
TC- 99M	41.92	45.79	12.28	0.00	0.01	0.124E-13
W -181	0.15	66.47	1.16	32.14	0.08	0.830E-12

Table 103. Contributions (in %) of exposure pathways to mean annual organ dose (100.0 km distance; normal operation): 1.E+9 Bq released from each nuclide

organ	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
bone marrow	0.115	93.995	0.883	4.930	0.078	0.117E-07
bone surface	0.127	93.314	0.951	5.525	0.084	0.124E-07
breast	0.136	96.265	0.697	2.841	0.061	0.116E-07
lung	0.116	92.472	4.827	2.161	0.424	0.126E-07
stomach	0.118	94.610	0.952	4.236	0.084	0.114E-07
colon	0.099	79.736	0.914	19.170	0.080	0.135E-07
liver	0.110	88.227	1.876	9.623	0.165	0.122E-07
pancreas	0.115	94.358	1.224	4.196	0.107	0.107E-07
thyroid	0.128	98.135	0.532	1.158	0.047	0.132E-07
gonads	0.118	93.473	0.403	5.970	0.035	0.114E-07
remainder	0.125	93.574	0.983	5.231	0.086	0.120E-07
effect. dose	0.120	92.199	1.228	6.345	0.108	0.122E-07

Table 104. Contributions (in %) of exposure pathways to mean individual annual chronic dose by Mn-54 for different organs (2.0 km distance; normal operation): 1.E+9 Bq released

organ	CL	GR	IH	IG	IHR	mean total dose (Sv/a)
bone marrow	0.417	85.759	2.291	11.393	0.139	0.377E-08
bone surface	0.498	89.225	1.689	8.484	0.103	0.383E-08
breast	0.508	87.419	2.338	9.593	0.142	0.376E-08
lung	0.315	64.074	27.902	6.015	1.695	0.535E-08
stomach	0.403	81.710	3.368	14.314	0.205	0.390E-08
colon	0.241	52.569	3.087	43.916	0.188	0.606E-08
liver	0.377	76.373	3.692	19.334	0.224	0.417E-08
pancreas	0.404	82.631	4.235	12.473	0.257	0.361E-08
thyroid	0.480	90.413	1.982	7.005	0.120	0.421E-08
gonads	0.383	82.371	0.886	16.307	0.054	0.381E-08
remainder	0.427	80.938	3.274	15.162	0.199	0.410E-08
effect. dose	0.390	76.802	5.921	16.527	0.360	0.432E-08

Table 105. **Contributions (in %) of exposure pathways to mean individual annual chronic dose by Co-58 for different organs (2.0 km distance; normal operation):** 1.E+9 Bq released

nuclide	mean collective dose (manSv/a), chronic
CR- 51	0.6497E-05
MN- 53	0.1525E-08
MN- 54	0.1162E-02
MN- 56	0.1742E-05
FE- 55	0.5591E-04
FE- 59	0.3806E-03
CO- 56	0.1240E-02
CO- 57	0.2662E-03
CO- 58M	0.1188E-06
CO- 58	0.4086E-03
CO- 60M	0.3597E-08
CO- 60	0.1509E-01
CO- 61	0.4887E-07
NI- 59	0.1693E-04
NI- 63	0.4457E-04
MO- 93	0.1458E-03
MO- 99	0.1243E-04
TC- 99M	0.3757E-06
W -181	0.2604E-04

Table 106. **Contributions (in %) of nuclides to mean annual collective doses (within 100 km distance; normal operation):** 1.E+9 Bq released from each nuclide